

Trimble Survey Controller

Field Guide



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Field Guide



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About this Manual

Welcome to the *Trimble Survey Controller Field Guide*. This manual describes the operation of the Trimble Survey Controller™ software version 7.7 running on a TSC1™ data collector.

Scope and Audience

The aim of this manual is to have you surveying in the field as soon as possible. To get the most from the new system, read this manual from beginning to end. Even if familiar with the Trimble Survey Controller software running on a TSC1™ data collector, there will be features that are new to you.

This manual highlights some important features of the Trimble Survey Controller software and guides you through the concepts and steps of simple survey tasks. It shows how to:

- use the TSC1 data collector
- do a real-time kinematic (RTK) GPS survey
- use the Trimble Survey Controller software with a conventional instrument
- do a FastStatic™ survey
- download data
- charge the battery of the TSC1 data collector

The following sections provide a guide to this manual and to the other documentation that you received with this product.

Related Information

Other documentation for the Trimble Survey Controller software includes:

- *Trimble Survey Controller Reference Manual*

For detailed information on any topic covered in this manual, refer to the two-volume *Trimble Survey Controller Reference Manual*.

As well as being supplied in hardcopy, the manuals are also available in portable document format (PDF). These are available on the Trimble Survey Controller CD.

- Online help

The TSC1 data collector has an online Help system that makes it easy to find the information you need. To access the Help system, press the **(HELP)** button. For more information, see page 22.

- Release notes

The release notes describe new features of the product, information not included in the manuals, and any changes to the manuals. They are provided as a PDF file on the CD. Use Adobe Acrobat Reader to view the contents of the release notes.

Other sources of related information are:

- Update notes – contact your local Trimble dealer for more information about the support agreement contracts for software and firmware, and extended warranty programs for hardware.
- <ftp.trimble.com> – use the Trimble FTP site to send files or to receive files such as software patches, utilities, service bulletins, and FAQs. Alternatively, access the FTP site from the Trimble web site at www.trimble.com/support/support.htm.

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

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

Your Comments

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- Send an e-mail to ReaderFeedback@trimble.com.
- Complete the Reader Comment Form at the back of this manual and mail it according to the instructions at the bottom of the form.

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

Document Conventions

The document conventions are as follows:

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

Surveying with GPS

In this chapter:

- Introduction
- Kinematic surveying
- Differential surveying
- FastStatic surveying

Introduction

This chapter introduces you to the use of the Global Positioning System (GPS) as a survey tool. It provides an overview of some of the concepts involved, and lists the different survey techniques that the Trimble Survey Controller™ software supports. These concepts and techniques are covered in more detail in the two-volume *Trimble Survey Controller Reference Manual*.

High precision GPS surveying requires two or more GPS receivers. One receiver is located over a known control point for the duration of the survey. It is called the base receiver or base. The other receivers are called roving receivers or rovers. They are moved to the points that you are to survey or stake out.

It is possible to use more than two GPS receivers for some surveys, but this manual limits discussion to simple survey configurations that use two GPS receivers: the base receiver and one roving receiver.

Conduct GPS surveys in real time, or postprocess them:

- Real-time surveys use a radio system to transmit measurements from the base receiver to each rover, where they are processed. Results are available while surveying—‘in real time’.
- Postprocessed surveys use measurements that are stored in the receiver or in the TSC1™ data collector for processing at a later time. Use Trimble’s office computer software, such as Trimble Geomatics Office™, Trimble Survey Office™ or GPSurvey™ software, to process stored data.

Note – If you are using postprocessed techniques, make sure that you have the appropriate module of the Trimble Geomatics Office software to process the data.

The Trimble Survey Controller software controls three GPS survey techniques:

- Kinematic
- Differential
- FastStatic

The Kinematic and Differential techniques are suitable for real-time or postprocessed surveys. The FastStatic™ technique is suitable for postprocessed surveys only.

Note – Use real-time techniques for stakeout operations.

Kinematic Surveying

Kinematic (Stop and Go) surveying uses GPS phase measurements from four or more satellites common to both the base and rover receivers. To achieve centimeter-level precision the survey must first be initialized. There are different ways to achieve initialization:

- With single-frequency receivers, initialize real-time surveys by setting the rover over a known point or by using an initializer bar. Initialize postprocessed surveys over a new point or a known point.
- With dual-frequency receivers, initialize real-time surveys by setting the rover over a new or known point, or by using an initializer bar. Initialize postprocessed surveys over a new point or a known point.

With dual-frequency receivers that have the On-The-Fly (OTF) option installed, surveys are initialized automatically while the rover is moving. You cannot initialize on a new point if the receiver has OTF.

If the number of common satellites falls below four while you are surveying, reinitialize the survey when four (or more) satellites are again being tracked. If using OTF, wait until five satellites are being tracked.

Differential Surveying

Differential surveying calculates positions using GPS C/A-code measurements. Differential surveys do not require initialization or continuous tracking of satellites. Results typically achieve submeter precision.

FastStatic Surveying

FastStatic surveying is a centimeter-level precise, postprocessed method that uses GPS phase measurements to measure baselines in as little as eight minutes. The time required depends on the receiver type, the baseline length, the number of satellites (SVs) available, and the satellite geometry.

Static surveying is used for surveys of the highest precision, but it requires occupation times of one hour or longer. FastStatic surveying is derived from Static surveying, and is the result of advances in both hardware and software development.

Table 1.1 summarizes the different survey techniques.

Table 1.1 Characteristics of a GPS survey

Procedure	Minimum number of SVs	Minimum observation time	Typical horizontal precisions	Other characteristics
Static	4	1 hour	Single-frequency: ±5 mm + 1 ppm Dual-frequency: ±5 mm + 0.5 ppm	For single-frequency receivers, best precision is on baselines of ≤10 km. For dual-frequency receivers, there is no maximum baseline length.
FastStatic	4	8–30 minutes	Varies between static and kinematic precisions, depending on occupation time.	Procedure is the same as for Static, but observation times are shorter.
Postprocessed kinematic	4	2 epochs	±1 cm + 1 ppm	Baseline limit is approximately 50 km. Receiver needs five satellites to initialize on the fly. Rover must be initialized for centimeter-level precisions.

Table 1.1 Characteristics of a GPS survey

Procedure	Minimum number of SVs	Minimum observation time	Typical horizontal precisions	Other characteristics
Real-time kinematic (RTK)	4	1 epoch	$\pm 1 \text{ cm} + 1 \text{ ppm}$	Radio link is required. Baseline limit is approximately 10 km. Receiver needs five satellites to initialize on the fly. Rover must be initialized for centimeter-level precisions.
Postprocessed differential	4	2 epochs	Everest / Maxwell receivers: <0.5 m RMS with 5 SVs, PDOP <4 Other receivers: 1–3 m in same conditions.	Satellites do not have to be tracked continuously.
Real-time differential	4	1 epoch	Everest / Maxwell receivers: 0.2 m + 1 ppm RMS with 5 SVs, PDOP <4 Other receivers: 1–3 m in same conditions.	Radio link is required. Satellites do not have to be tracked continuously.

Values in this table assume a low multipath environment and low ionospheric activity. They are based on results obtained using the latest Trimble equipment.

The TSC1 Data Collector

In this chapter:

- Introduction
- Operating the TSC1 data collector
- Sample screen displays
- Trimble Survey Controller software menu structure
- Data entry/editing
- Reviewing data
- Online help
- Rebooting

Introduction

The Trimble Survey Controller software simplifies surveying by configuring and controlling receivers for GPS surveys, and by communicating with conventional instruments for conventional surveys. The Trimble Survey Controller software makes surveying a faster and more efficient process because it:

- stores points
- simplifies stakeout tasks
- performs numerous calculations, including calibration and coordinate geometry (Cogo) functions
- permits two-way data transfer operations

For GPS surveys, it also:

- configures the necessary receiver parameters
- monitors the receiver and radio status

This chapter introduces the TSC1 data collector, and shows how to use the keys and enter data. It gives an overview of the Trimble Survey Controller software menu structure and shows some sample screens.

A good way to learn how to use the software is to take the TSC1 data collector into the field. Become familiar with the keypad, press various keys, look through the menus, and use the online help.

Before going into the field, make sure you have everything you need.

Figure 2.1 and Figure 2.2 will help you to get started.

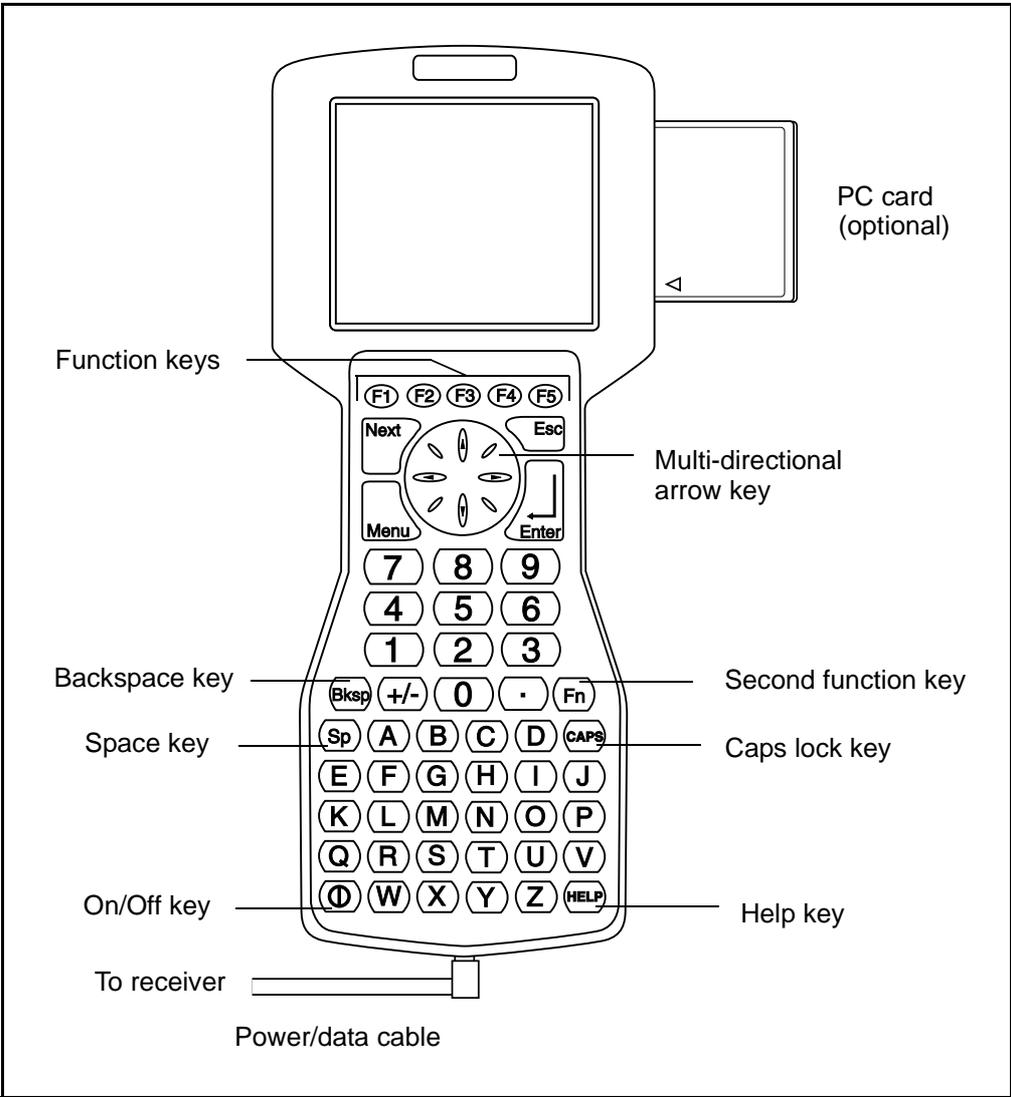


Figure 2.1 Front view of the TSC1 data collector

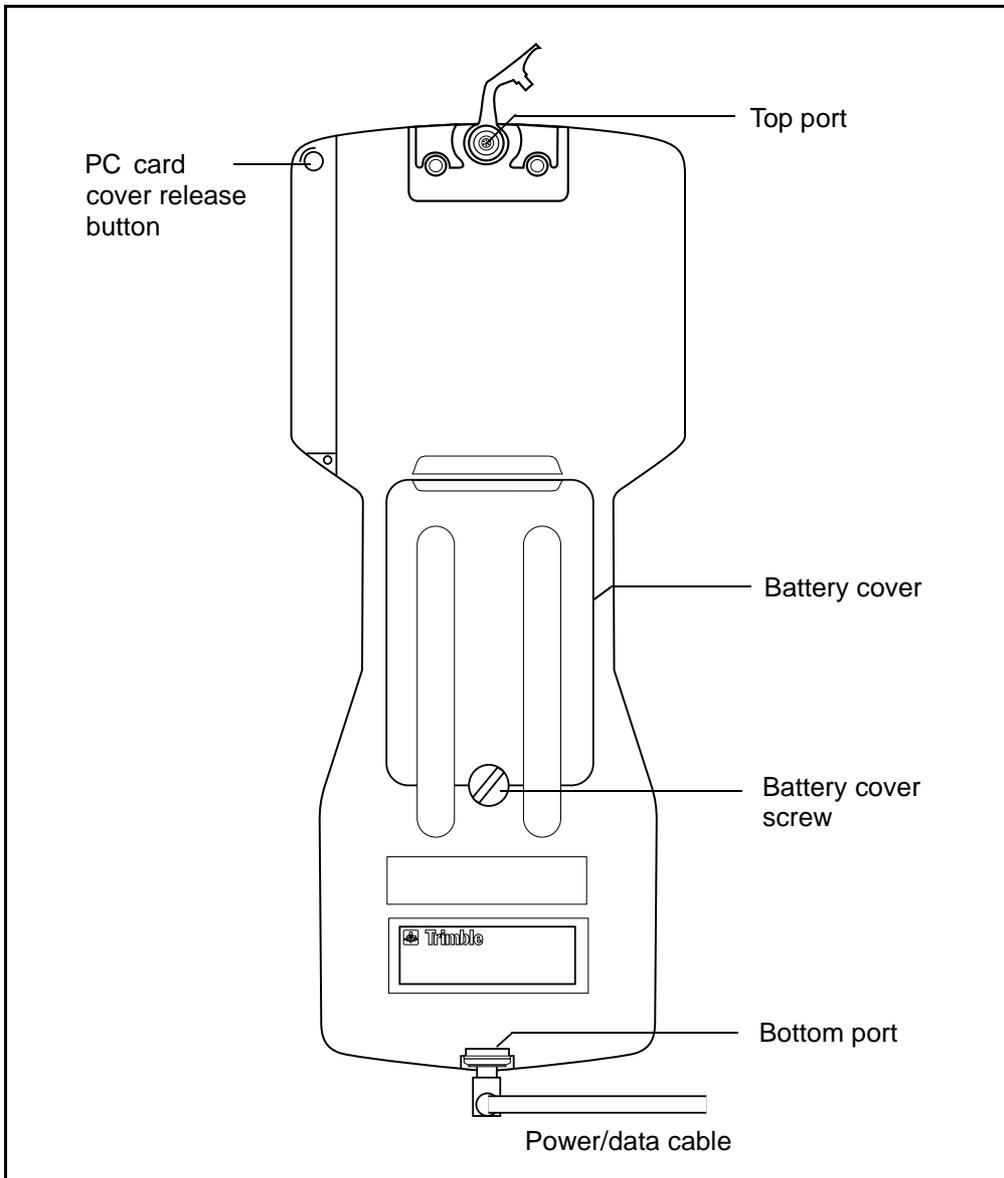


Figure 2.2 Back view of the TSC1 data collector

Operating the TSC1 Data Collector

Make sure the battery is inserted. Press the green  key to turn on the TSC1 data collector. Hold down the same key for one second to turn it off.

Keys

Hard keys are the physical keys on the TSC1 keypad. Examples of these are , , , , , , , , , , , and .

Use these keys to enter data and to access different screens.

When using hard keys to enter data, press the  key to access the beginning of a highlighted field,  to access the end of it.

Alternate keys give some hard keys a second function. Some second functions are displayed in yellow on the hard keys. To use a second function, press the  key and then press the key that has the second function you want.

For a complete list of second functions, refer to the *Trimble Survey Controller Reference Manual*.

Use second functions to move quickly around the TSC1 screen. Table 2.1 lists some of them.

Table 2.1 Second function keys

Press ...	To go ...	Also called ...
	down a page	Page down
	up a page	Page up
	to the beginning of a list	Home
	to the end of a list	End
	to the previous screen	Previous

Softkeys are displayed on the bottom line of the TSC1 screen. A softkey corresponds to the function key adjacent to it: , , , , or . To activate a softkey, press the relevant function key.

Note – The  softkey appears if there are more than five softkeys associated with a screen or field. Press it to see the others.

For some operations, pressing the  key has the same effect as pressing a softkey. When measuring a point, for example, press the  key or the  softkey to start measuring the point.

Some softkeys only appear when you access a particular field. In the *Antenna height* field, for example, the  softkey appears. It relates only to this field and is no longer visible when you move to the next field.

Menus

Menus list the Trimble Survey Controller software functions. When the TSC1 data collector is turned on, the Trimble logo screen appears. This is immediately followed by the main menu.

Note – To return to the main menu at any time, press the  key.

To select a menu item, use the arrow keys to move to the required field: press the  or  key to move up the list and press the  or  key to move down the list. Press  to select the highlighted item.



Tip – To select an item quickly, type the first letter of its name.

If only one item in the menu starts with that letter, typing the letter takes you to the field **and** displays the screen box for that field.

If more than one item starts with the same letter, type the letter once to go to the first of these items, then press  or  to move down the list. Alternatively, type the first letter twice to go directly to the second item.

See Table 2.1 on page 11 for more keypad shortcuts.

Sample Screen Displays

To turn on the TSC1 data collector, press the green  key. The Trimble logo screen appears, followed by the main menu.

The Trimble Survey Controller software is menu driven. This means that you select an item from a list to perform a function. The main menu consists of six icons. All other menus appear as lists.

Most of the details in the status line only appear when the TSC1 data collector is connected to either a GPS receiver or a conventional instrument.

Figure 2.3 shows the main menu screen that appears if the TSC1 is connected to a GPS receiver.

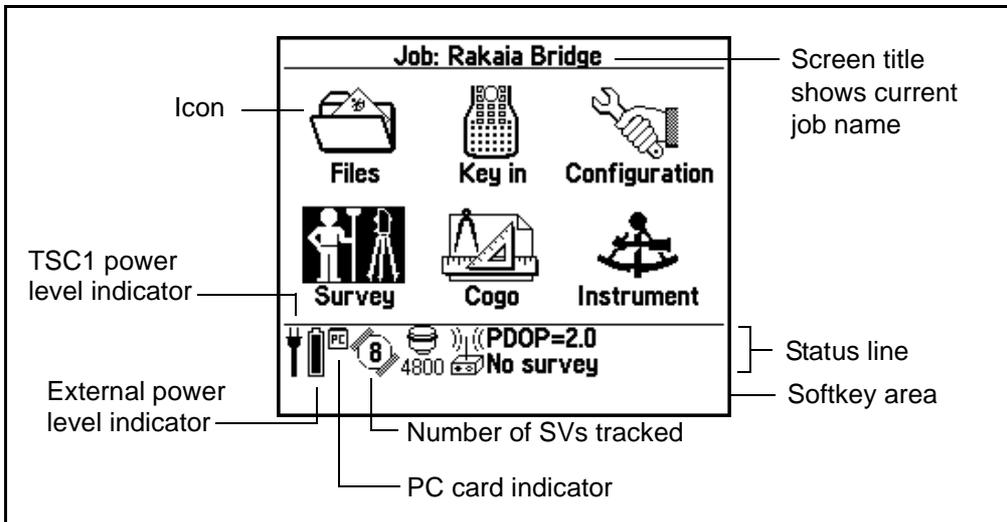


Figure 2.3 Main menu – TSC1 data collector connected to GPS receiver

Figure 2.4 shows the screen that appears if the TSC1 is connected to a conventional instrument.

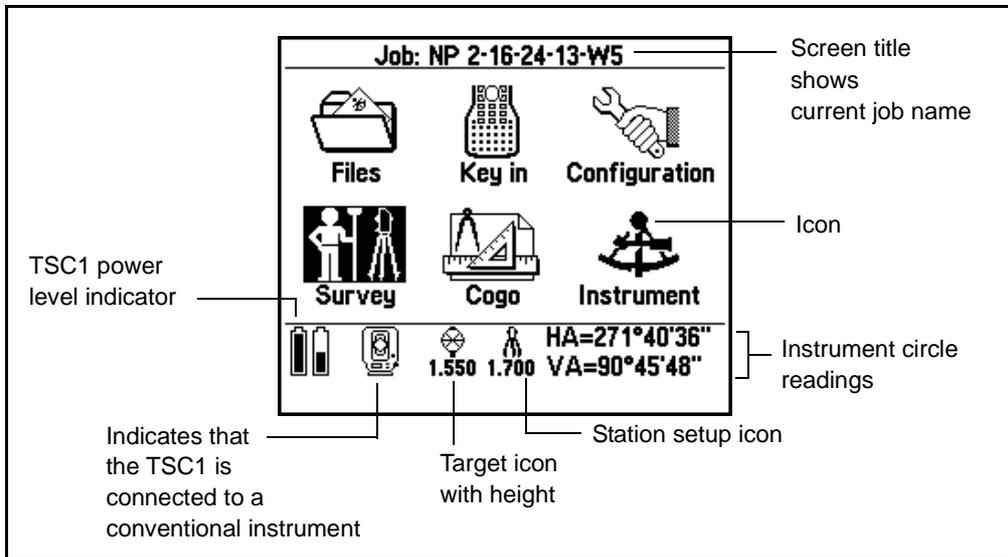


Figure 2.4 Main menu – TSC1 data collector connected to conventional instrument

Selecting a Menu Item

Use the arrow keys \leftarrow , \rightarrow , \uparrow , or \downarrow to move around a menu, then press the Enter key to complete the selection. The screen changes to display the menu for the chosen item. If a screen has softkeys, these appear in the area below the status line.

Practice

To practice using the Trimble Survey Controller software, follow these steps:

1. From the main menu, select *Files*, then *Job management*.

The *Select job* screen appears, as shown in Figure 2.5.

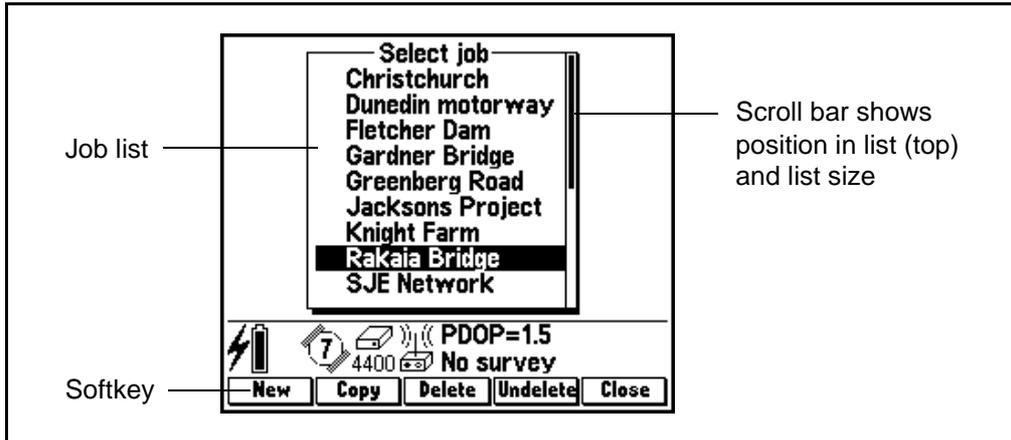


Figure 2.5 Job list and softkeys

2. To select a job, highlight the required job and press .

The first time you use the Trimble Survey Controller software, this list of jobs is empty. To create a new job, see *Creating a New Job*, page 26.

3. Press the key to return to the main menu.
4. Select *Survey*.

A list of Survey Styles appears.

5. Highlight *Trimble RTK* and press the key (this corresponds to the softkey).
6. Highlight *Rover options* and press .

The *Rover options* screen appears, see Figure 2.6.

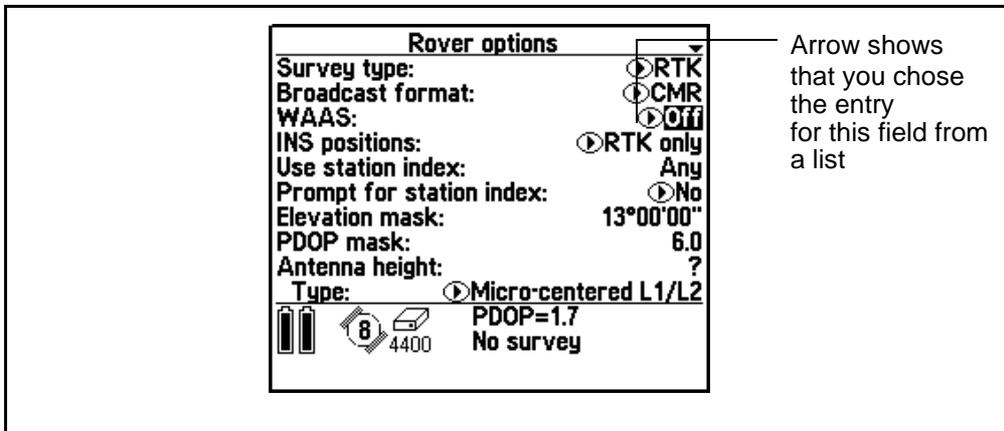


Figure 2.6 RTK Rover options screen

7. Press , then press the  softkey.
You return to the *Survey Style* menu for the chosen Style.
8. If the TSC1 data collector is connected to a receiver, press .
The *Survey* menu appears.
9. Select *Measure points* and press .
If this is the first time you have used this Survey Style, the Style wizard prompts you to select the type of antenna and the type of radio used.
10. From the list that appears on the screen, highlight the type of antenna you are using and press .
11. From the next list that appears, highlight the type of radio you are using and press .

The *Survey/Measure points* screen appears, see Figure 2.7.

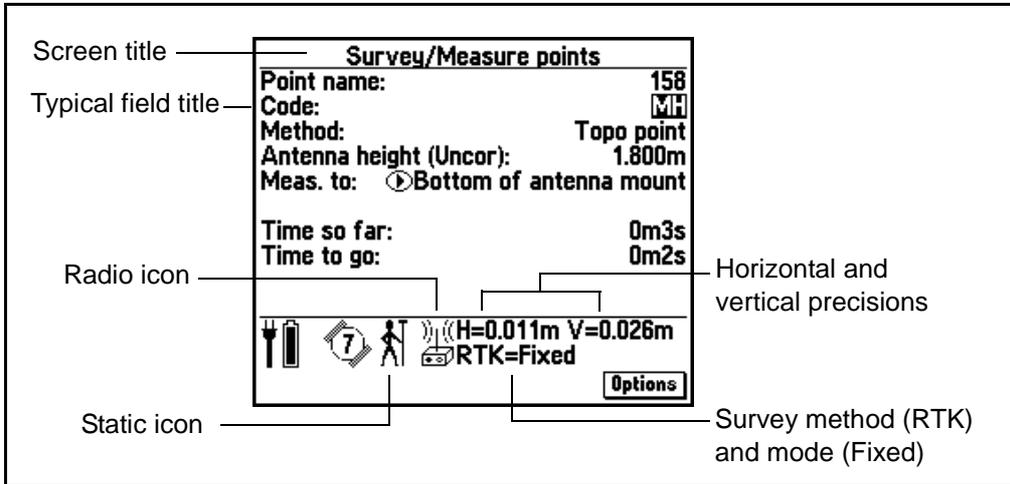


Figure 2.7 Survey/Measure points screen showing fields and status line

In a real-time kinematic survey, an RMS indicator appears as text above the **Options** softkey when the receiver is not static (when you are not measuring a point). It disappears when the receiver is in Coarse mode during stakeout.



Tip – If the TSC1 data collector is not connected to a receiver, use Figure 2.7 to familiarize yourself with the *Survey/Measure points* screen.

Trimble Survey Controller Software Menu Structure

For an overview of the entire Trimble Survey Controller software menu structure, see Figure 2.8. Keep this figure handy as a reference until you are familiar with the menu structure.

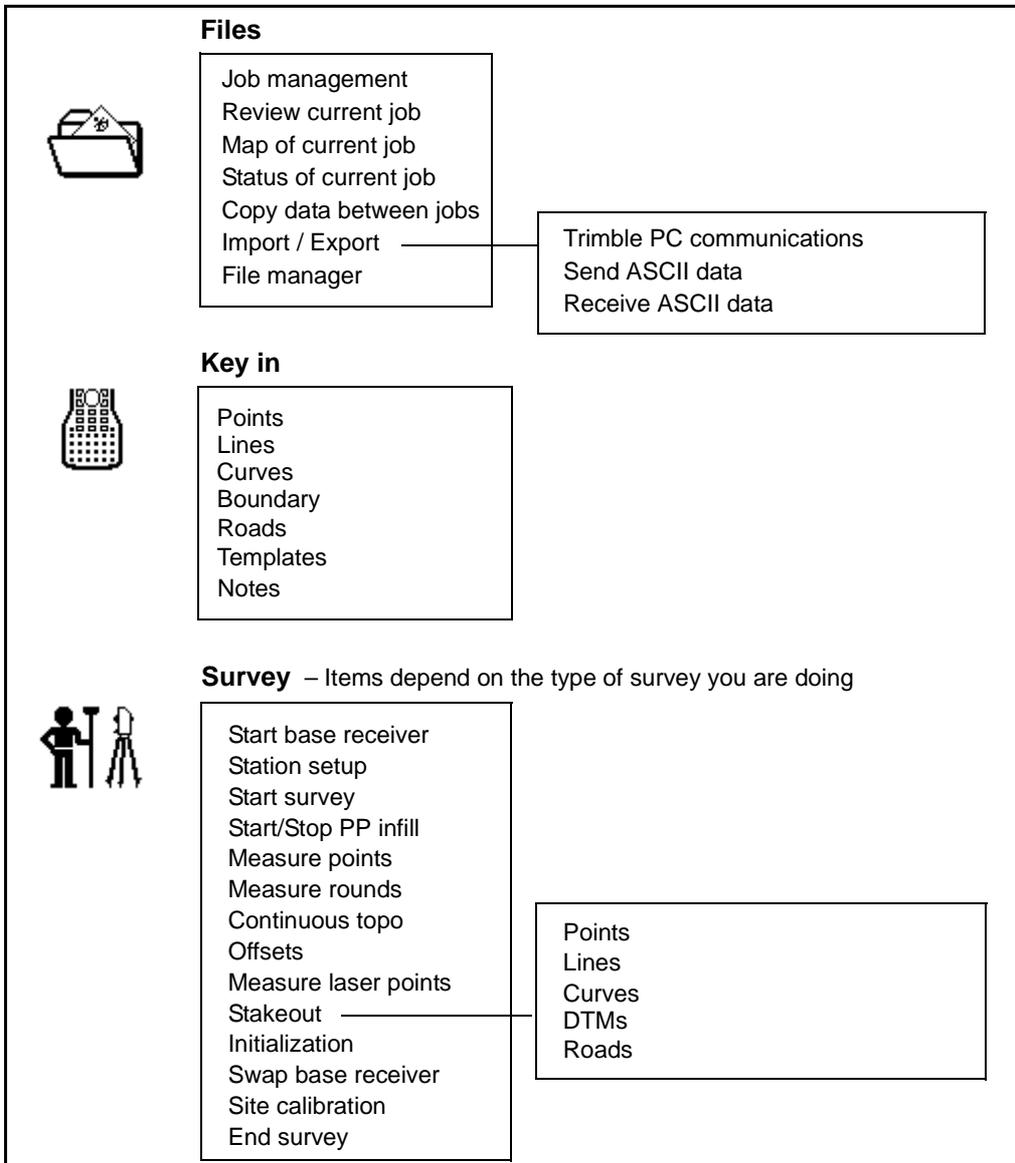
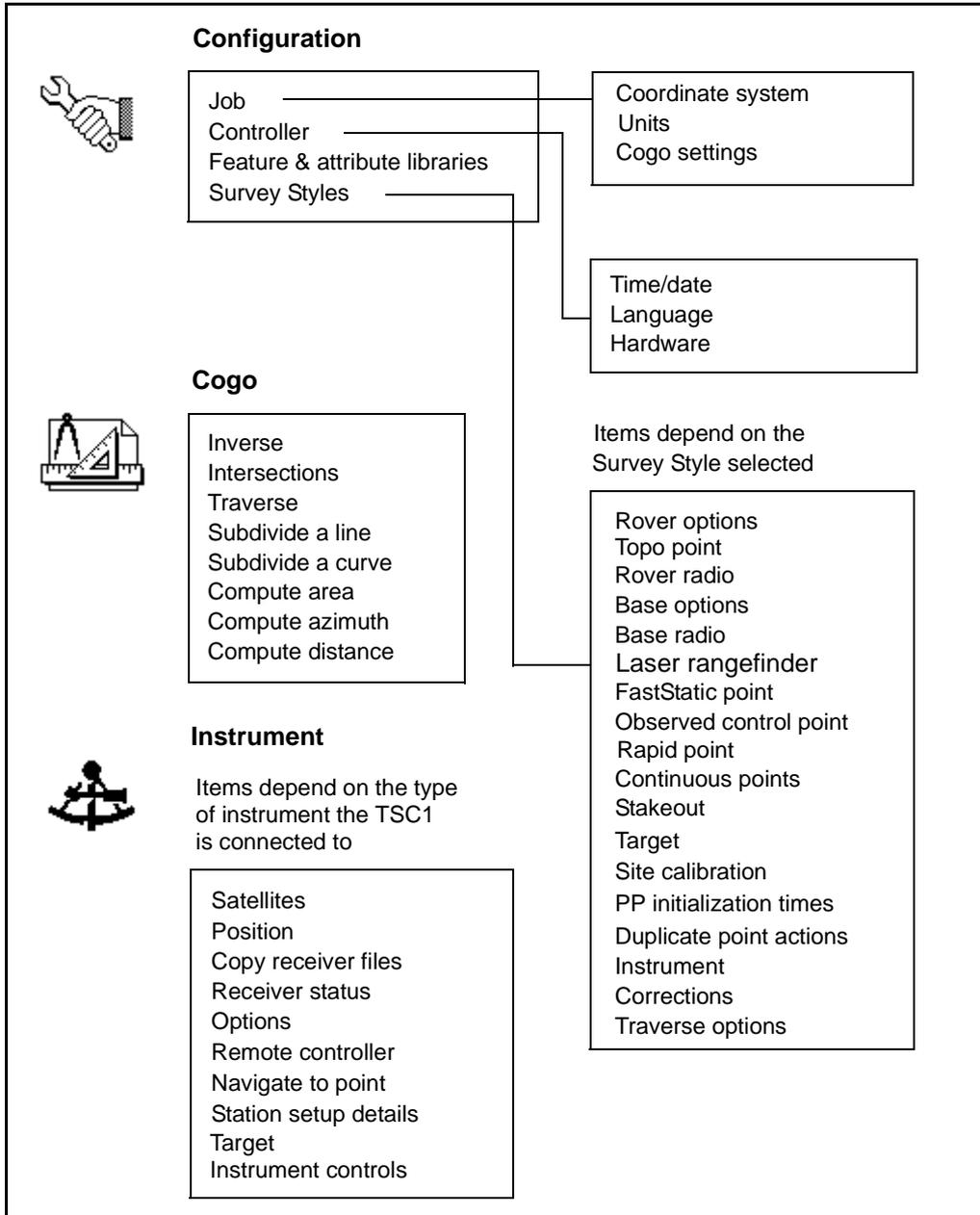


Figure 2.8 Trimble Survey Controller software menu structure

This figure continues on page 19.



Data Entry/Editing

Data must be entered before the Trimble Survey Controller software can perform most of its functions. A typical screen has several fields into which you can enter data. For some fields you select an option from a list, while for others you key in alphanumeric details.

Choosing an Option

For some fields, you select a parameter setting from a list of options. These fields have a  symbol on the left (see Figure 2.6 on page 16).

There are two ways to select an option:

- Press the  key when the field is highlighted. The options appear in a pop-up list box. Use the  or  key to move to the required setting and then press . This accepts the setting and moves the cursor to the next field.
- Press the  key when the field is highlighted. The pop-up list box does not appear. Instead, a value is displayed in the field. To change this value, press  again. Press it repeatedly until you reach the option that you want. (When you use this method, the Trimble Survey Controller software cycles through the options for the current field, starting at the bottom of the list.) When you reach the required option, press  to move to the next field, or  to move to the previous field.

Keying In Data

To enter data, highlight the field and press the  key. This takes you to the beginning of the field. Key in the details. When the details are complete, press  or the  key to move to the next field. Press  again to accept the screen.

Editing Data

To edit details in a field, highlight the field and press the \Rightarrow key. Then use the left and right arrow keys to move around inside the field. If necessary, press Fn Bksp to delete a character, and Fn Sp to create a space.

Reviewing Data

You can review the data in the Trimble Survey Controller software database at any time.

To review data, select *Files* from the main menu. Then select *Review current job*.

Records are stored in chronological order. The last (most recent) page of the database appears first when you access the database.

Press the $\text{Page}\uparrow$ and $\text{Page}\downarrow$ softkeys to move up and down in the database one page at a time. Press the \uparrow and \downarrow keys to move up and down one record at a time. Alternatively, use the second function keys. For a list of these, see Table 2.1 on page 11.

Use the $\text{Search}\uparrow$ softkey to find records elsewhere in the database. For example, it is possible to search for points surveyed several hours ago. To access the *Search* menu, press Search . Select a type of search. You can choose to repeat a previous search, or to search by name, code, or current record type. If required, enter the point name or the code then press the $\text{Search}\uparrow$ softkey to search up the database or $\text{Search}\downarrow$ to search down the database.

For more information about a record, highlight it and press Enter . To return to the database list, press Esc .

It is possible to edit some of the fields, such as *Code* and *Antenna height*.

Note – If point coordinates appear as ‘?’, see the Note on the next page.

Coordinate View Setting

The setting in the *Coordinate view* field (WGS-84, Local, Grid, or HA VA SD, for example) determines which values appear in the point record. You can change the coordinate view setting for an entire job, or just when viewing a point.

To change the *Coordinate view* setting for a point that you want to view:

1. When reviewing the database, highlight the point record and press .
2. Press  and set the *Coordinate view* field as required.

Note – *If no datum transformation and no projection are defined and the Coordinate view field is set to Local or Grid, the coordinate values for GPS points will be ‘?’.* Change the *Coordinate view* setting to WGS-84.

Online Help

To get more information about a topic, press the  key at any time. An alphabetic list of topics appears.

Press the  or  keys to move to a topic, or use the  or  softkeys. The structure of the Help list of topics reflects the structure of the Trimble Survey Controller software menus. Information about staking out a point, for example, is under *Stakeout / Point*.



Tip – To move quickly to a Help topic, type the first few letters of the topic. Then use the arrow keys if necessary.

Press  to access the information on the selected topic. A screen of text appears. For some topics there is also a graphics screen. Press  to see it. See Figure 2.9.

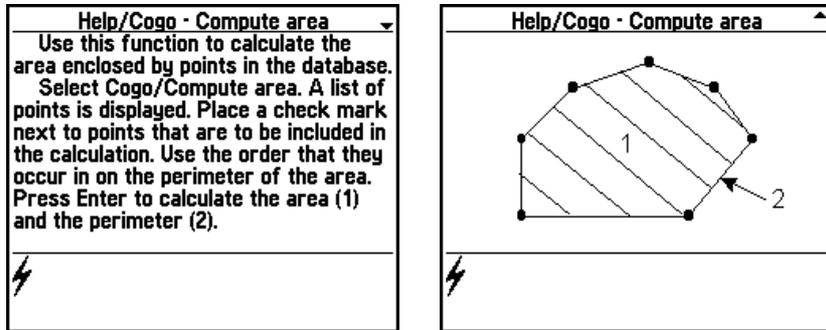


Figure 2.9 Online help screens

Some topics have more than one screen of information. This is indicated by a small arrow in the top right corner of the screen. For these topics, press  or  to see the next screen. Press  to return to the Help list of topics.

To exit the online help system, return to the Help list of topics and press .

Rebooting

If the Trimble Survey Controller software fails to respond to keystrokes, it may be necessary to reboot the system. Turn off the TSC1 data collector and turn it back on again.

If this does not work, hold down  for five seconds, then release it. Press it again to turn on the TSC1 data collector.

If this does not work, perform a warm boot.

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

Warm Boot

A warm boot shuts down the hardware and restarts the Trimble Survey Controller software.

Note – No data is lost during a warm boot.

To perform a warm boot:

1. Turn off the TSC1 data collector. It may be necessary to hold down the  key for five seconds.
2. Hold down  while pressing and releasing the  key. This turns on the TSC1 data collector.
3. When you hear three beeps, release . The TSC1 restarts and, a few seconds later, runs the Trimble Survey Controller software.

Note – A warm boot restores the Trimble default settings.

If the warm boot fails, perform a cold boot.

Cold Boot

A cold boot *erases* the internal memory and restarts the Trimble Survey Controller software. It does not affect the PCMCIA (PC) card.



Warning – A cold boot loses all data in the internal memory. Only perform one if a warm boot fails.

To perform a cold boot:

1. Turn off the TSC1 data collector. It may be necessary to hold down the  key for five seconds.
2. Hold down the  and  keys together while pressing and releasing . This turns on the TSC1 data collector.

After a few seconds a message appears:

Force Reformat Internal Media Please Wait.....

3. Release the  and  keys.
After a few minutes, the Trimble Survey Controller software starts.

RTK Field Procedures

In this chapter:

- Introduction
- Creating a new job
- Configuring the job
- Setting up the base station
- Setting up the rover using the internal radio
- Auto calibrate
- Stakeout
- Ending the survey

Introduction

This chapter guides you through a basic real-time kinematic (RTK) field survey using the TSC1 data collector with a GPS Total® Station 4800 or 4700 receiver. For information about using a Site Surveyor™ 4400 receiver, a Series 4000 receiver, or a 4600LS™ receiver refer to the *Trimble Survey Controller Reference Manual*.

This chapter shows how to:

- create a new job
- configure the job
- set up the base receiver
- set up a rover receiver (select a Survey Style, and initialize a kinematic survey)
- measure a point
- use the Auto calibrate function
- stake out a point
- end the survey
- review the data in the TSC1 data collector

To set up a survey using a conventional instrument, see Chapter 4, Conventional Instrument Field Procedures.



Tip – For more information on any topic covered in this manual, refer to the *Trimble Survey Controller Reference Manual*.

Creating a New Job

To create a job:

1. Turn on the TSC1 data collector.
2. From the main menu, select *Files*.

3. Select *Job management* then press the softkey.
4. Type the job name. Press to accept the job name. If a PCMCIA (PC) card is inserted and you want to record data on it, change the *File location* field to PC card. Press again to create the job.
5. The *Select coordinate system* screen appears. Do one of the following:
 - Select a system from the list.
To do this, choose *Select from library* and select a system from the list. Select the zone for the system. Set the *Use geoid model* field to No.
 - Key in the datum transformation and projection parameters for the site.
To do this, select *Key in parameters* then *Datum transformation* and enter the details for the site. Press then select *Projection* and enter the details. Press again to accept the details.
 - Copy a coordinate system from another job in the database.
To do this, select *Copy from other job* and select the job name to copy from.
 - Select no projection and no datum transformation.
To do this, select *No projection/no datum*.

Set the *Coordinates* field to Ground and enter a value in the *Reference elevation* field to use ground coordinates after a site calibration. Alternatively, set the *Coordinate* field to Grid.

Set the *Use geoid model* field to Yes and select a geoid model to calculate a Geoid/Inclined plane vertical adjustment after a site calibration.

For a survey where GPS measurements are to be combined with conventional observations later, choose a coordinate system now. For more information, refer to the *Trimble Survey Controller Reference Manual*.

Note – *If you are not sure of the coordinate system, select No projection/no datum. Set the Coordinates field to Ground and enter the average site elevation in the Reference elevation field. Define these parameters later in the job and all points will be updated. (To do this, select Configuration / Job / Coordinate system. Press the  or  softkey and enter the parameters or select a coordinate system.)*

If no datum transformation and no projection are defined, any points measured using GPS are only displayed as WGS-84 coordinates. Any points measured using a conventional instrument are displayed with null (?) coordinates.

6. After selecting or keying in a coordinate system, press the  softkey to create the job.

Configuring the Job

To configure the job that you just created:

1. Select the job if it is not already selected.

To do this, select *Files* from the main menu, then select *Job management*. Use the arrow keys to highlight the required job, and press .

2. From the main menu, select *Configuration / Job*.

Setting the System Units

To set the units for the system:

1. Select *Units*.

The *Units* screen appears.

2. Highlight a field, for example *Angles*, and press .

A list of formats for angle display appears.

3. To select one, highlight it and press . Alternatively, press  to cycle through the list of possible formats.
4. Change the other fields as required.
The setting selected for the *Coordinate view* field (WGS-84, Local, or Grid, for example) determines what coordinates are displayed. If no datum transformation and no projection are defined and the *Coordinate view* field is set to Local or Grid, the coordinate values for GPS points will be ‘?’.
5. Press  to accept the settings and return to the *Job* menu.
6. Press  to return to the *Configuration* menu.

Setting the System Time and Date

To set the time and date for the system:

1. From the *Configuration* menu, select *Controller* then *Time/date*.
2. Highlight the *Local time offset* field and press the  key. Enter the local offset from UTC/GMT and press . This updates the local time and the local date.
3. Press  again to accept the settings and return to the *Controller* menu.

Note – The UTC value is updated by the GPS system every time you connect the TSC1 data collector to a receiver and start a survey.

Setting up the Base Station

Locate the base station where there is a clear and uninterrupted view of the sky, for example on top of a hill or building. You should be able to see the sky all around at an elevation angle of 13° above the horizon.

The WGS-84 coordinates for the base station should be known. Every 10 m error in these coordinates can cause an error of 1 ppm in the length of the RTK baseline. Define the coordinates in one of the following ways (the most accurate methods are listed first):

- Key in published WGS-84 coordinates.
- Key in WGS-84 coordinates derived from a previous control survey.
- Key in known grid coordinates, if a projection and datum transformation are known.
- Key in local geodetic coordinates, if a datum transformation is known.
- Record GPS data at the base station over a number of hours. Use Trimble's GPSurvey software to postprocess the data as a point position. This yields approximate WGS-84 coordinates. Key in or upload these WGS-84 coordinates to the TSC1 data collector.
- Use the  softkey to obtain a WAAS position generated by the receiver—use this method if no control exists for the location and you have a receiver that tracks WAAS satellites.
- Use the  softkey to obtain the current approximate (autonomous) position calculated by the receiver. This position can be in error by up to 100 m, so you should perform a calibration to reduce the effect of this process.



Warning – Only use an autonomous position once for each job—to start the *first* base receiver. (An autonomous position is equivalent to an assumed coordinate in conventional surveying.) This ensures that all surveys in the same job are in terms of each other.

To set up the base station for an RTK survey:

1. Set up the GPS antenna over the base station survey point. Use a tripod, tribrach, and tribrach adaptor.
2. Set up the radio antenna on a separate tripod next to the base station.
3. Connect the radio hardware as shown in Figure 3.1.
4. Connect the receiver as shown in Figure 3.2 (or Figure 3.3, depending on the receiver type).

Figure 3.1 shows how to connect a radio at the base station.

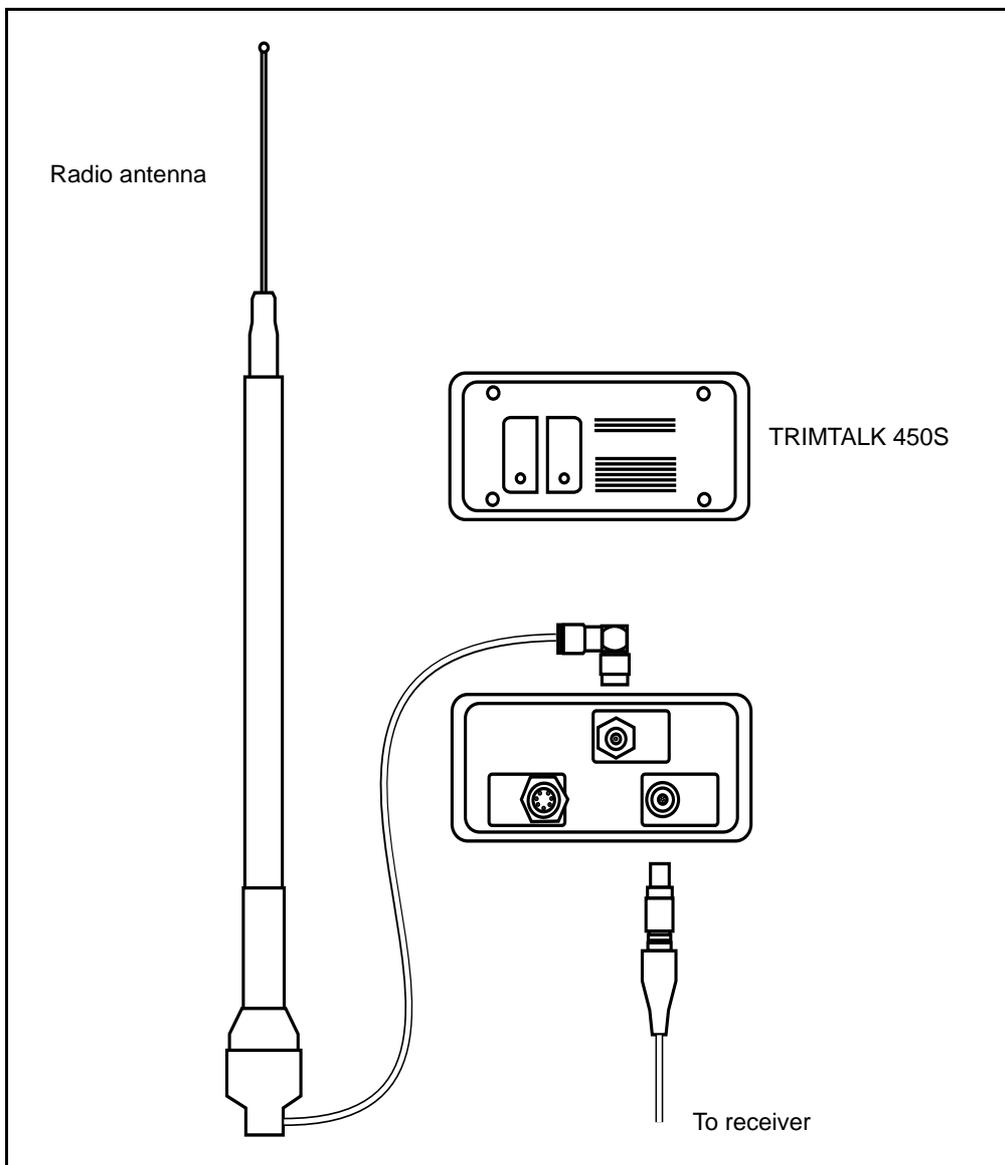


Figure 3.1 Radio connections (RTK survey)

Figure 3.2 shows how to connect the base receiver for an RTK survey using a GPS Total Station 4800 receiver.

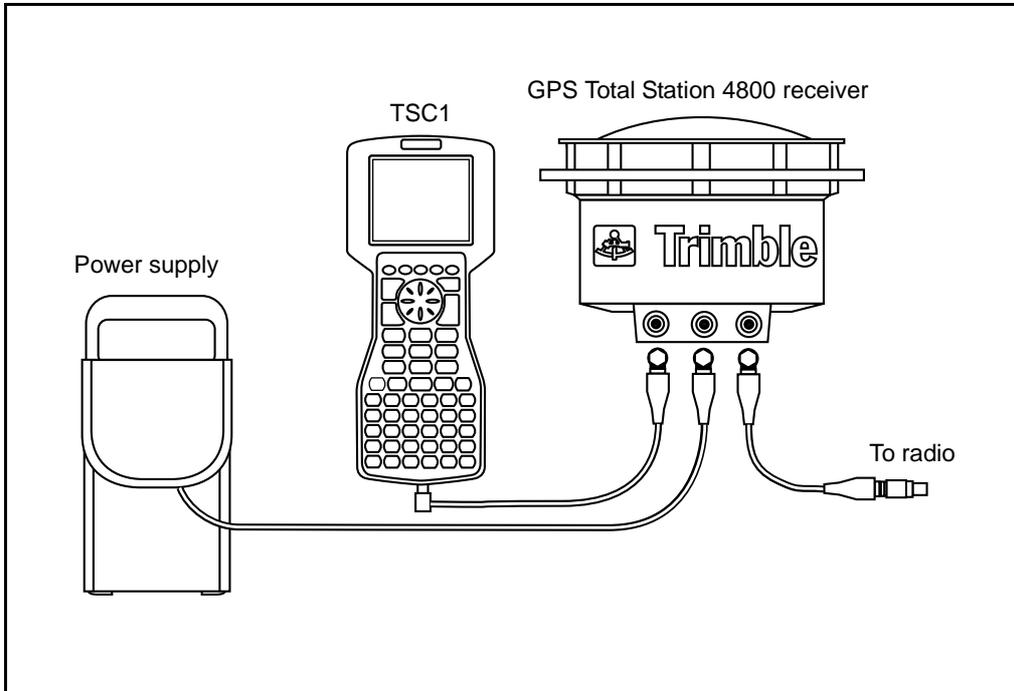


Figure 3.2 Base receiver configuration using a GPS Total Station 4800 receiver

Figure 3.3 shows how to connect the base receiver for an RTK survey using a GPS Total Station 4700 receiver.

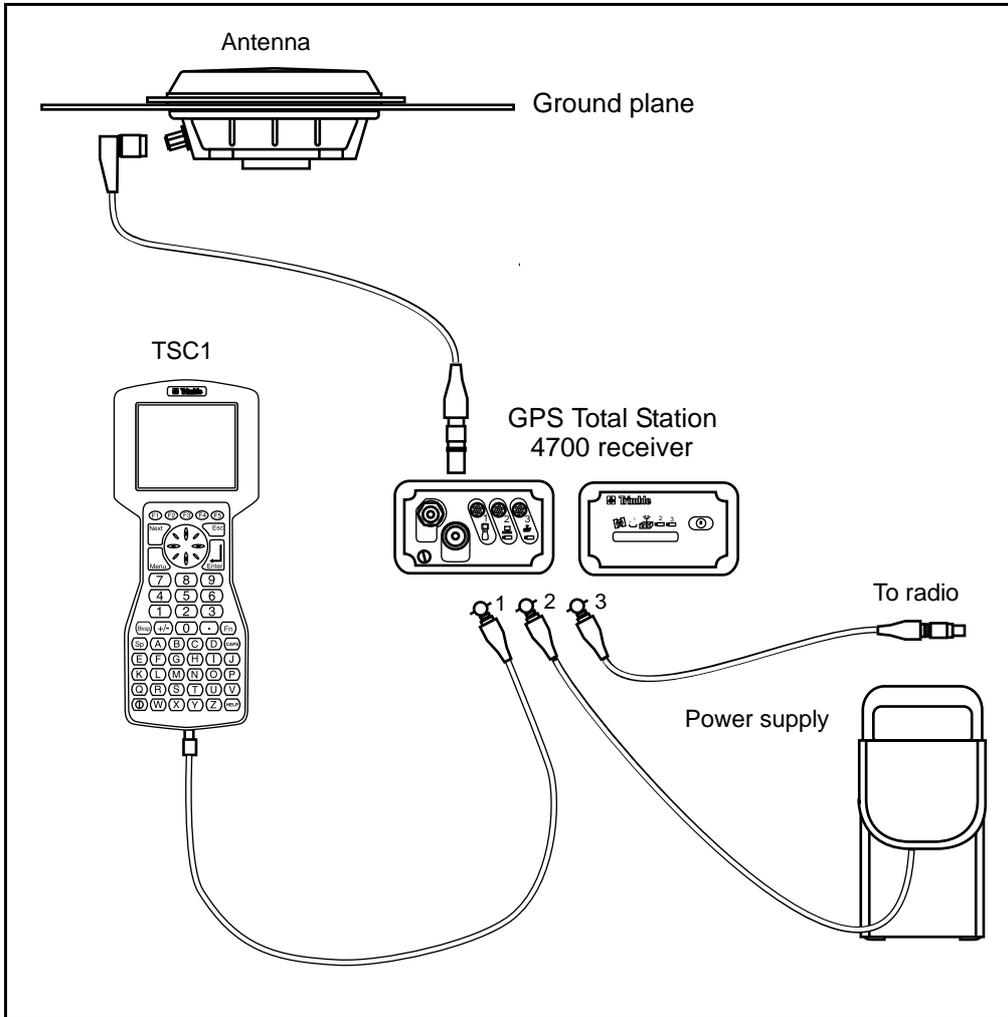


Figure 3.3 Base receiver configuration using a GPS Total Station 4700 receiver

Starting the Base Survey

If you have not yet created and configured a job, do so now. See *Creating a New Job*, page 26.

Then do the following:

1. From the main menu, select *Survey*. The *Select Survey Style* menu appears.

Note – A *Survey Style* is a set of configurations that apply to one particular type of survey. Each *Survey Style* provides a template that you can use when you perform a survey of that type. A *GPS Survey Style* instructs the base and rover receivers to perform compatible types of measurements. It also defines the parameters needed for measuring and storing points.

2. Highlight *Trimble RTK* and press the **Copy** softkey. In the *Style name* field, type a name for the new *Survey Style* you are about to create (for example, *Test RTK*). If a PC card is inserted, you can choose to store the new *Survey Style* on the PC card or in the main memory. Press **Enter** to add the new *Style* to the menu of *Survey Styles*. Press **Enter** again to return to the *Select Survey Style* menu.
3. Highlight the name of the new *Survey Style* and press **Enter**. The *Survey* menu appears.
4. Select *Start base receiver*. Then do the following:
 - a. Because this is the first time you have used this *Survey Style*, the *Style wizard* prompts you to select the type of antenna you are using. Select one from the list—*Micro-centered L1/L2 w Ground* (with *Ground plane*), for example—and press **Enter**.



Warning – Select the correct antenna type. The antenna selected here determines which antenna phase center model the *Trimble Survey Controller* software uses to process height information.

- b. The wizard prompts you to select a radio type. Select one from the list and press .

The *Survey/Start base* screen appears.

5. Highlight the *Point name* field and press the  key. Enter the point name and press the  softkey to access the *Key in/Point* screen. The current position is displayed. Press  to accept and store it.

Note – When you press  as instructed above, the base receiver starts using an autonomous position generated by the receiver. This is the least accurate method of establishing the base station WGS-84 coordinates, but it does let you start surveying immediately.

If you have a receiver that tracks WAAS satellites, press the  softkey to return a WAAS position generated by the receiver. A WAAS position is better than an autonomous position.

6. Highlight the *Antenna height* field and enter the base station antenna height. Make sure the value in the *Meas. to* field is correct.



Warning – Measuring the height of the antenna is an important step in any survey. There will be serious consequences if it is not measured correctly.

7. Make sure the radio antenna is connected to the radio then press the  softkey. A message appears:
Base started. Disconnect data collector from receiver.
8. Disconnect the TSC1 data collector but **do not** turn off the receiver.

Setting up the Rover Using the Internal Radio

To set up the rover receiver for an RTK survey:

1. Set up the GPS antenna on a range pole. The antenna must have a clear view of the sky.
2. Connect the receiver hardware as shown in Figure 3.4 (or Figure 3.5, depending on the receiver type).
3. Turn on the receiver and the TSC1 data collector. From the main menu, select *Files*, then select *Job management*. A list of jobs appears. Highlight the required job and press  to open it. Press  to return to the main menu.
4. To start the rover survey see Starting the Rover Survey, page 40.

Figure 3.4 shows how to connect the rover receiver for an RTK survey using a GPS Total Station 4800 receiver with an internal radio.

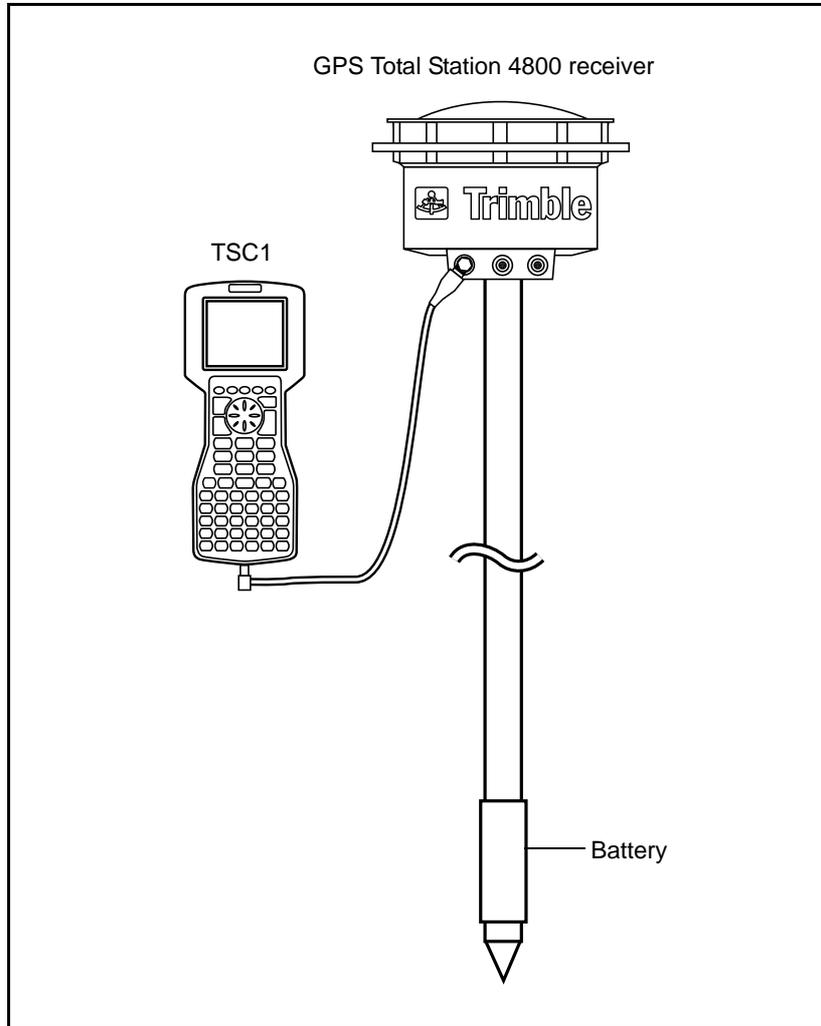


Figure 3.4 Rover receiver configuration using a GPS Total Station 4800 receiver – internal radio

Figure 3.5 shows how to connect the rover receiver for an RTK survey using a GPS Total Station 4700 receiver and an internal radio.

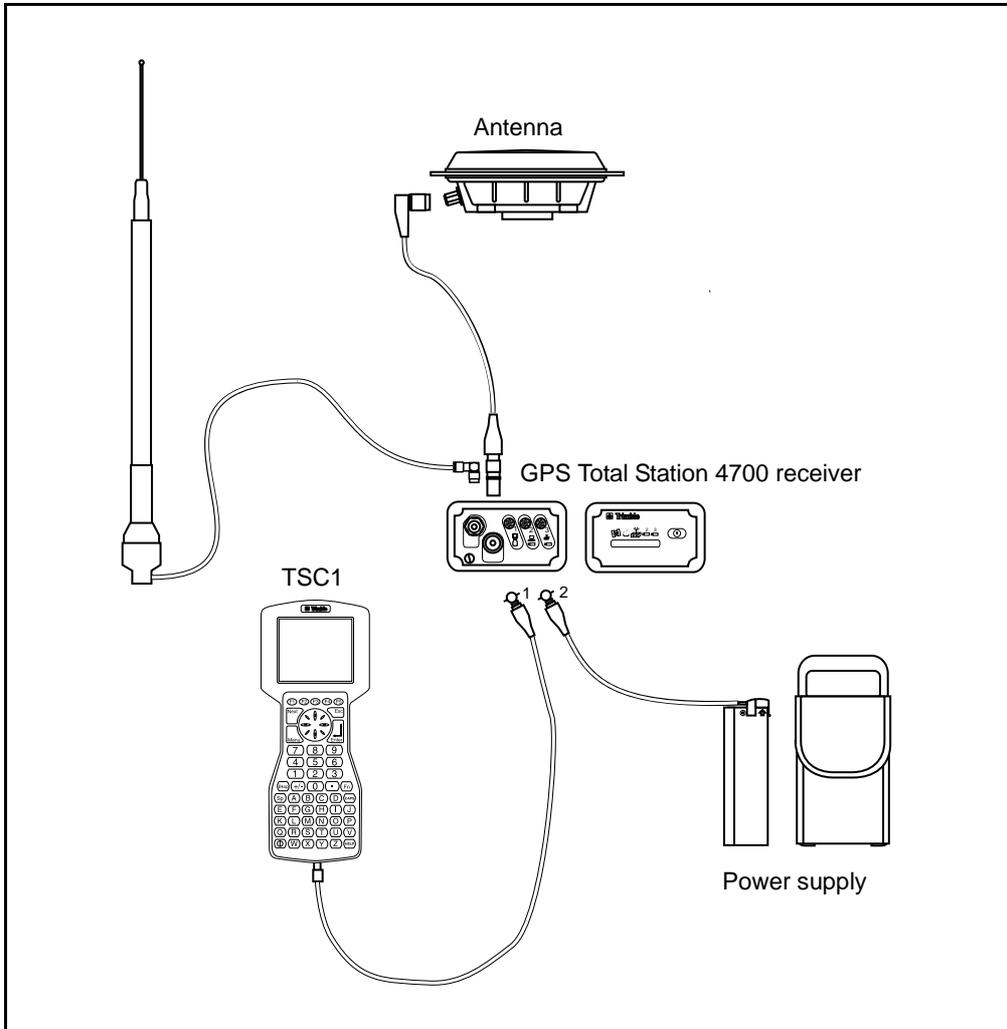


Figure 3.5 Rover receiver configuration using a GPS Total Station 4700 receiver – internal radio

Starting the Rover Survey

To start the survey:

1. From the main menu, select *Survey*. The *Select Survey Style* menu appears.
2. Select your new RTK Survey Style and press . For more information, see Step 2 on page 35.
3. Select *Start survey*.

If this is the first time you have used this Survey Style, the Style wizard prompts you to select the type of antenna. From the list, select the one you are using—4800 Internal or Micro-centered L1/L2, for example—and press .

The wizard then prompts you to select the type of radio in use. From the list, select the one you are using—Trimble internal, for example—and press .

4. Initialize the survey as described below.

Initializing the Survey

All RTK surveys must be initialized to obtain centimeter-level positioning. Table 3.1 summarizes different ways to initialize a survey using a dual-frequency receiver.

Table 3.1 Initializing an RTK survey

Initialization method	Time required for initialization	Range
Known point	~15 s (5+ SVs)	<10 km
	~30 s (4 SVs)	
OTF	~60 s (5+ SVs)	

Note – Initialization must be maintained throughout the survey by continuously tracking a minimum of four satellites. If initialization is lost at any time, reinitialize and then continue the survey.

If the system has On-The-Fly (OTF) capability, initialization is automatic. Wait for the system to initialize (this can happen faster if you move around). When the status line shows RTK=Fixed, the survey is initialized and you can start to measure points. See *Measuring a Point*, page 42.

For information about Trimble's recommended RTK initialization procedure and details of how to check an OTF initialization, refer to the *Trimble Survey Controller Reference Manual*.



Tip – If there is a previously-measured point nearby and it is stored in the Trimble Survey Controller software database, it is possible to do a Known Point initialization. A Known Point initialization is quicker and more reliable.

Known Point initialization (No OTF)

To perform a Known Point initialization:

1. Position the rover antenna over a known point.
2. From the *Survey* menu, select *Initialization*.
3. Set the *Method* field to Known point and press .
4. Enter a value in the *Point name* field. This must be the name of a known point in the Trimble Survey Controller software database. Alternatively, access the *Point name* field and press the  softkey. Select the point from the list of known points.
5. Enter a value in the *Antenna height* field.
6. When the antenna is centered and vertical over the point, press the  softkey or .

The data collector starts to record data, and the static icon () appears in the status line. Keep the antenna vertical and stationary while data is recorded.

7. When the survey is initialized, the softkey appears. Press it to accept the initialization.
8. If the initialization fails, the results are displayed and you are asked if you want to retry. Press or .
If you press , make sure you are on the correct point before initializing again.

The survey is now initialized. Measure a point as described below.

Measuring a Point

To measure a point:

1. Position the antenna on a range pole over the point.
Remember that results will be poor if the antenna's view of the sky is obstructed (by buildings or trees, for example).
2. From the main menu on the TSC1 data collector, select *Survey*.
3. From the *Select Survey Style* menu, select your new RTK Survey Style and press . For more information, see Step 2 on page 35.
Note – If a survey is running, the *Select Survey Style* menu does not appear. If the current survey is not using the new RTK Survey Style, end it (see page 54) and return to Step 1.
4. From the *Survey* menu, select *Measure points*.
5. Set the *Type* field to Topo point. Enter values in the *Point name*, *Code*, and *Antenna height* fields. When entering the antenna height, make sure the value in the *Meas. to* field is correct.
6. Press the softkey and set *Auto end point* to No. This lets you store the point manually.

7. When the antenna is centered and vertical over the point, wait until the status line shows RTK=Fixed. This indicates that the survey is initialized. Press the **Measure** softkey or **Enter**. The data collector starts to record data, and the static icon () appears in the status line.

Keep the antenna vertical and stationary while data is recorded.

8. The Trimble Survey Controller software has preset times for recording a certain type of point. These times are related to the number of satellites tracked, the Dilution of Precision (DOP), and the precisions required. When the preset time has elapsed, the **Store** softkey appears. Inspect the precisions:
 - If they are satisfactory, press the **Store** softkey to store the point.
 - If they are not satisfactory, wait a while for the precisions to reduce. Otherwise press **Esc** to abort the measurement. Press the **Yes** softkey when the Abandon point? message appears.
9. Move to another point. Measure it. Keep doing this until you have measured the required points. End the survey (see page 54).

Auto Calibrate

A calibration calculates the parameters needed to convert the GPS measured coordinates to local grid coordinates.

Trimble recommends you use a minimum of four three-dimensional local grid coordinates (N, E, E) and four observed WGS-84 coordinates, combined with the local projection and datum transformation parameters (the coordinate system). This should provide adequate redundancy. If you do not specify a coordinate system, the Trimble Survey Controller software calculates a transverse mercator projection and a three-parameter datum transformation between the WGS-84 system and the grid system.

When surveying in real time, you can use the Auto calibrate function. When you do this, the Trimble Survey Controller software automatically computes and stores a calibration every time a calibration point is measured.

To use automatic calibration you need to:

- key in or upload the grid coordinates of the local control points
- set the *Auto calibrate* field in the *Site calibration* option to Yes
- use GPS to measure the calibration points



Warning – Perform a calibration at any time, but always complete the calibration **before** staking out any points, or computing some types of offset or intersection points.

Keying In the Grid Coordinates

To key in the grid coordinates:

1. From the main menu, select *Key in / Points*. The *Key in/Point* screen appears.
2. Move the highlight to the *Point name* field and press the  key.
3. Type the point name and enter a code if required.
4. Set the *Method* field to Keyed in coordinates.

Make sure the coordinate fields are *North*, *East*, and *Elevation*. If they are not, press the  softkey and change the coordinate view to Grid. Key in the known grid coordinates, then press .

5. Set the *Control point* field to Yes. This ensures that the point is not overwritten by a measured point of the same name.
6. Press  to store the point.
7. Repeat Step 3 through Step 6 for each of the grid coordinate points, then press  to return to the *Key in* screen.

8. Press  again to return to the main menu.

Note – To upload grid coordinates using the Trimble Geomatics Office, Trimble Survey Office or TRIMMAP™ software, refer to the Trimble Survey Controller Reference Manual.

Setting Auto Calibrate to Yes

To set the *Auto calibrate* field to Yes:

1. End the current survey and return to the main menu. For more information, see Ending the Survey, page 54.
2. From the main menu, Select *Survey*. The *Select Survey Style* menu appears.
3. Highlight your new RTK Survey Style and press the  softkey. For more information, see Step 2 on page 35.

The menu that appears has the same name as the RTK Survey Style that you added and contains all the options for an RTK survey.

4. Highlight *Site calibration* and press . The *Site calibration* screen appears.
5. Press  to move to the *Auto calibrate* field. Press  to toggle the setting to Yes, then press .
6. Press  again to accept the screen. This takes you back to the menu of Survey Styles.
7. Press the  softkey or  to return to the *Select Survey Style* menu.
8. Press  to return to the *Survey* menu.

Using GPS to Measure Calibration Points

You have keyed in grid coordinates for the control points. For more information see *Keying In the Grid Coordinates*, page 44. Now use GPS to measure these control points as calibration points. The Trimble Survey Controller software automatically matches the keyed-in grid points to the measured WGS-84 values, calculates and stores the calibration.

When you have calibrated one point or defined a projection and datum transformation, the  softkey appears. Use it to navigate to the next control point.

As you measure another calibration point, the new calibration is calculated and stored.

To measure calibration points:

1. From the main menu, Select *Survey*.
2. From the *Select Survey Style* menu, select your new RTK Survey Style. For more information, see page 35.
3. Select *Measure points*. Press the  key to move to the *Method* field. Change the setting to Calibration point.
4. Access the *Grid point name* field by pressing . Then press the  softkey. A list of keyed in grid coordinates appears.
5. Highlight the point to be measured and press . The point name is inserted in the *Grid point name* field and the *GPS point name* field is automatically filled.



Tip – If you have not yet keyed in the grid coordinates for this point, press the  softkey in the *Grid point name* field. The *Key in/Point* screen appears. Enter the coordinates and press .

6. Enter values for the *Code* and *Antenna height* fields. Press  to accept the screen.

7. When the antenna is centered and vertical over the control point, press the **Measure** softkey or . The TSC1 data collector starts to record data and the static icon () appears.

Keep the antenna vertical and stationary while data is recorded.

8. When the preset required time has elapsed, the **Store** softkey appears. Inspect the precisions. If they are satisfactory, press **Store** to store the point.

The Trimble Survey Controller software automatically does the calculations and stores the results. While this is happening, the following messages appear:

Please wait. Storing point
Calculating calibration
Storing calibration

***Note** – If a calibration exceeds the tolerances set in the Site calibration option for the Survey Style, the residuals are displayed. Select which points to use. For more information, refer to the section on Auto calibrate in the Calibration chapter of the Trimble Survey Controller Reference Manual.*

9. Enter the next calibration point name in the *Grid point name* field and press the **Find** softkey. The navigation screen appears. The azimuth and distance to the next point appear on the right of the screen.

To navigate using the arrow in the graphical display screen, move forwards with the TSC1 data collector held in front of you. The arrow points in the direction of the next calibration point. Walk towards the point. When you are about 3 meters or 10 feet from the point, the display changes. Two concentric circles (resembling a bull's-eye) show the position of the point, and a cross shows your position. Walk towards the point until the cross is over the circles. Find the physical control point, and place the range pole over it. Press  to return to Step 7.

10. Repeat these steps until all calibration points are measured.

Stakeout

This section shows how to stake out a point. To do this, set up the base receiver (see page 29), then use the rover receiver to locate and stake out points.

Always use a real-time survey for stakeout operations.

Trimble recommends that you carry out a complete calibration before staking out any points.

Note – Before staking out grid coordinates, define a projection and datum transformation.

General Procedure

To stake out a point:

1. Define the point and store it in the Trimble Survey Controller software database.

To define the point, do one of the following:

- key in data
 - upload a job from the Trimble Geomatics Office or Trimble Survey Office software
 - calculate coordinates using one of the Cogo functions
2. Initialize the survey.
 3. Navigate to a point.
 4. Stake/mark the point.
 5. Measure the as-staked point (this is optional).
 6. Repeat Step 3 through Step 5 until all points are staked out.
 7. End the survey.



Warning – Do not stake out points and *then* change the coordinate system or perform a calibration. If you do, any points staked out after the changes will not be in the same terms as the points already staked out.

The rest of this section shows how to key in a point using the *Key in* option, and then stake it out. For information on other methods, refer to the *Trimble Survey Controller Reference Manual* and the online Help.

Keying In a Point

To key in a point:

1. From the main menu, select *Key in / Points*. The *Key in/Point* screen appears. Move the highlight to the *Point name* field and press .
2. Type the point name and enter a code if required.
3. Set the *Method* field to Keyed in coordinates.

You can key in grid, local, or WGS-84 coordinates. To change the coordinate fields, press the  softkey and change the coordinate view.

4. Key in the coordinates and press .
5. Press  again to store the point.
6. Repeat Step 2 through Step 5 for each point, then press  to return to the *Key in* menu.
7. Press  again to return to the main menu.

Staking Out a Point

To stake out a point:

1. From the main menu, select *Survey*. From the *Select Survey Style* menu, select your new RTK Survey Style. For more information, see Step 2 on page 35.

Note – If a survey is already running, the *Select Survey Style* menu does not appear. If the current survey is not using your new RTK Survey Style, end it (see page 54) and return to Step 1.

2. Select *Stakeout / Points*. A screen similar to Figure 3.6 appears.

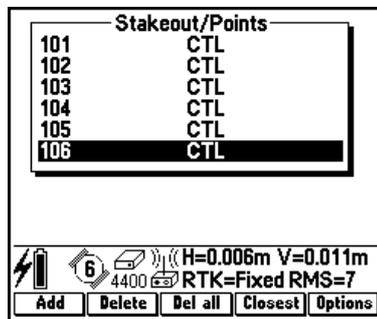


Figure 3.6 Stakeout/Points screen

If this is the first time you have used the Stakeout function in this job, this list is empty.

3. Transfer points from the Trimble Survey Controller software database to the *Stakeout/Points* list. To do this:
 - a. Press the softkey. The *Select point* screen appears, see Figure 3.7.

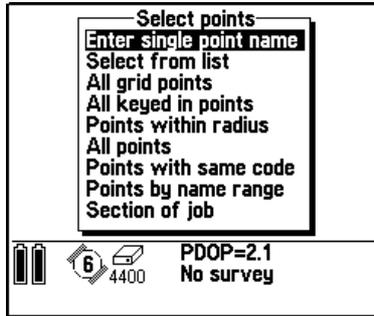


Figure 3.7 Select points screen – Trimble Survey Controller software database

- b. From this list, choose how points are to be selected. Choose *Select from list*. The *Select points* screen appears, see Figure 3.8. This time, it displays a list of points in the Trimble Survey Controller software database.

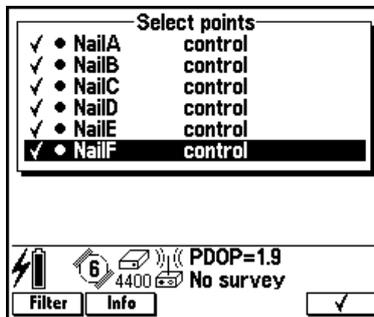


Figure 3.8 Select points screen – Trimble Survey Controller software database

- c. To select a point from the list, highlight it and press the softkey. A check mark appears next to the selected point name. Do this for each point to be staked out.

- d. After selecting the points, press  to return to the *Stakeout/Points* screen. Select the next point to be staked out. To do this, highlight the point and press .



Tip – To practice before there are points in the database, measure a point and move away from it. Follow Step 1 through Step 3, using the point you measured as the stakeout point. For more information see *Measuring a Point*, page 42.

4. Make sure the survey is initialized (For more information, see *Initializing the Survey*, page 40).
5. In the *Survey/Stakeout/Point* screen, enter a value in the *Antenna height* field and press the  softkey or . The azimuth and horizontal distance from the present position to the point to be staked out appear, together with a graphical representation of these values, as shown in Figure 3.9.

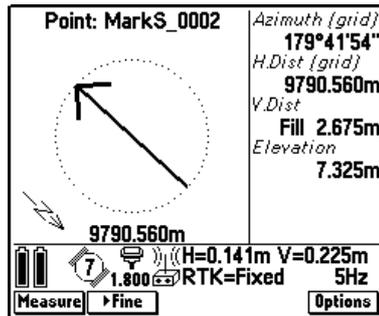


Figure 3.9 Stakeout/Point graphical display screen – arrow

6. The azimuth and distance to the next point appear on the right of the screen.

To navigate using the arrow in the graphical display screen, move forwards with the TSC1 data collector held in front of you. The arrow points in the direction of the point to be staked out. Walk towards the point. When you are about three meters or 10 feet from the point, the display changes. Two concentric circles (resembling a bull's-eye) show the position of the point, and a cross shows your position, as shown in Figure 3.10.

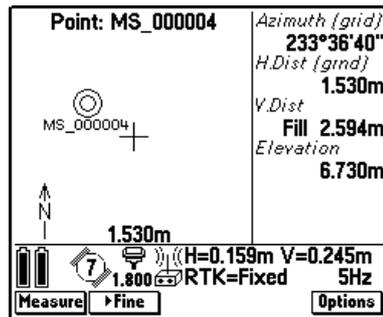


Figure 3.10 Stakeout/Point graphical display screen – concentric circles (bull's-eye)

When you get closer to the point, press **Fine** to go into Fine mode. The graphical display screen zooms in and magnifies the display. Walk towards the point until the cross on the screen is over the two concentric circles. Remember to keep the pole vertical. Mark the point with a stake or nail as required, and press **Esc** to return to the *Stakeout/Points* screen.

7. Do one of the following:
 - To record the as-staked point, place the range pole over it. When the range pole is centered and vertical, press **Measure** to measure the point (see page 42). Press **Store** to store the point, then **Esc** to return to the *Select/Points* screen.
 - If you do not want to measure the as-staked point, press **Esc** to return to the list. Stake out more points.

Ending the Survey

When you have measured or staked out all the points you need, end the survey:

1. From the *Survey* menu, select *End survey*.
2. Press **Yes** to confirm the instruction. The Trimble Survey Controller software asks if you want to power down (turn off) the receiver. Press **Yes** again.

*Note – Turn off the TSC1 data collector **before** disconnecting the equipment.*

3. Return to the base station and connect the TSC1 data collector to the receiver. Once again, select *Survey / End survey*.
4. Press **Yes** to confirm the instruction.

The Trimble Survey Controller software asks if you want to power down (turn off) the receiver.

5. Press **Yes** again.

Conventional Instrument Field Procedures

In this chapter:

- Introduction
- Creating a new job
- Configuring the job
- Connecting to a conventional instrument
- Selecting a survey style
- Performing a station setup
- Measuring a Point
- Measuring rounds of observations
- Stakeout
- Ending the survey

Introduction

This chapter guides you through a basic field survey using the Trimble Survey Controller software with a conventional instrument. It shows how to:

- create a job
- configure the job
- connect the equipment
- select a Survey Style
- do a station setup
- measure a point
- measure rounds of observations
- stake out a point
- end the survey



Tip – For more information on any topic covered in this manual, refer to the *Trimble Survey Controller Reference Manual*.

Creating a New Job

To create a job:

1. Turn on the TSC1 data collector.
2. From the main menu, select *Files / Job management*.
3. Press the **New** softkey.
4. Type the job name and press  to accept it.
5. If a PCMCIA (PC) card is inserted and you want to record data on it, set the *File location* field to PC card.
6. Press the **OK** softkey.

7. The *Select coordinate system* screen appears.

Do one of the following:

- Choose a coordinate system from the list.

To do this, choose *Select from library* and select a system from the list. Select the zone for the system. Set the *Use geoid model* field to No.

- Key in the datum transformation and projection parameters for the site.

To do this, select *Key in parameters* then *Datum transformation* and enter the details for the site. Press , then select *Projection* and enter the details. Press  again to accept the details.

- Select *Scale factor only*. Select this option if you are doing a survey that will contain only conventional instrument observations.

Note – *If you intend to combine the GPS measurements with conventional observations later, choose a coordinate system now. Do not select Scale factor only.*

- Copy a coordinate system from another job in the database. To do this, select *Copy from other job* and select the job name to copy from.

8. Press  to create the job.

Configuring the Job

Configure the job just created to display the correct units, and the correct time and date. For more information, see *Configuring the Job*, page 28.

Connecting to a Conventional Instrument

This section shows how to assemble the equipment to do a survey with a conventional instrument.

The Trimble Survey Controller software interfaces with the following brands of conventional instruments:

- Trimble
- Leica
- Geotronics (Spectra Precision)
- Nikon
- Pentax
- Sokkia SET
- Topcon
- Zeiss

To assemble the equipment, see Figure 4.1 (or Figure 4.2, depending on the equipment) then do the following:

1. Set up the conventional instrument on a tripod.
2. Connect the TSC1 data collector to the instrument using the 0-shell Lemo to 0-shell Lemo cable. If using a third-party conventional instrument, connect the TSC1 data collector to the instrument using the 0-shell Lemo to DB9 cable connected to the instrument download cable.



Warning – Do not force plugs into the ports. Align the red dot on the plug with the red line on the socket and insert the plug carefully.



Warning – Before connecting the TSC1 data collector to a Leica or Geodimeter instrument, select the appropriate Survey Style. This Survey Style must specify the correct type of instrument. If you do not do this, the Trimble Survey Controller will not connect to the instrument and the instrument will have to be reset.

3. Turn on the TSC1 data collector and go to [Selecting a Survey Style](#), page 61.

Figure 4.1 shows the TSC1 data collector connected to a Trimble conventional instrument.

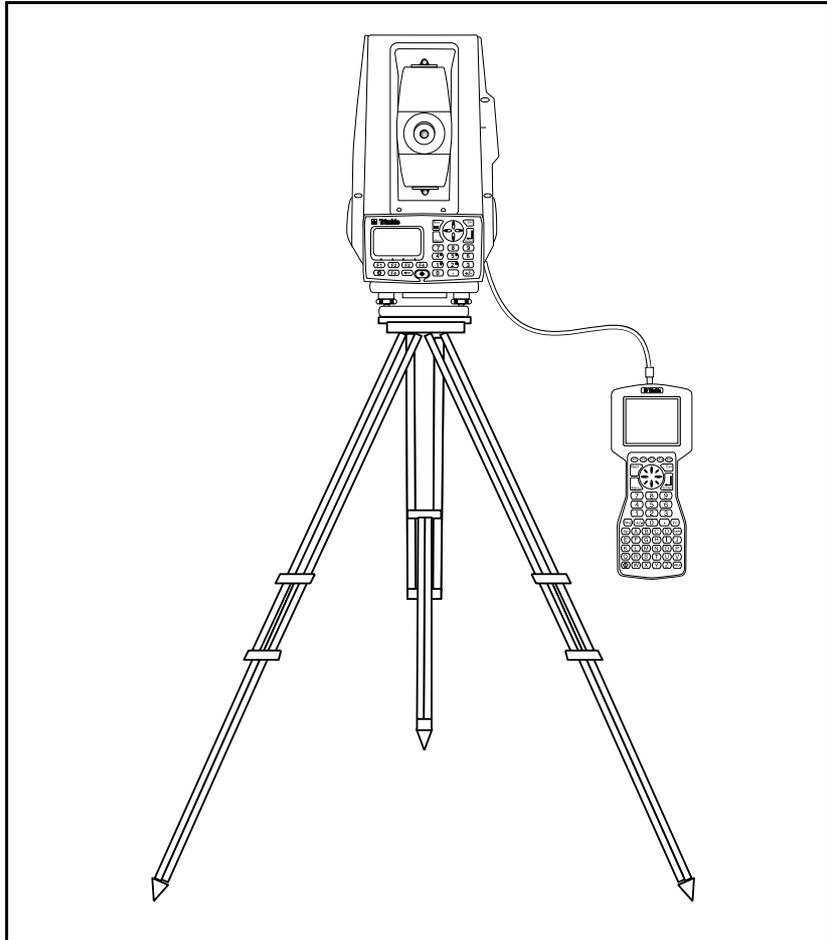


Figure 4.1 TSC1 connected to a Trimble conventional instrument

Figure 4.2 shows the standard connection to a third-party conventional instrument.

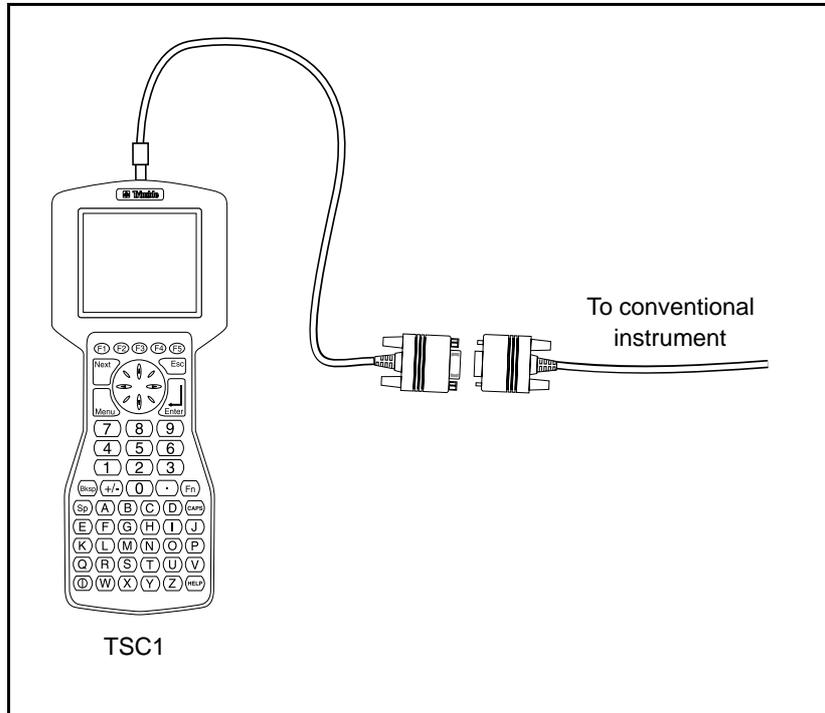


Figure 4.2 Standard connection to a third-party conventional instrument

Selecting a Survey Style

To select a conventional Survey Style, do the following:

1. From the main menu, select *Survey*. The *Select Survey Style* menu appears.

Note – A Survey Style is a set of configurations that apply to one particular type of survey. Each Survey Style provides a pattern or template that you can use when performing a survey of that type. For a conventional survey, the Survey Style defines the type of instrument used and the parameters needed for measuring and storing points.

2. Highlight *Trimble Conventional* and press the softkey.
3. In the *To name* field, type a name for the new Survey Style (for example, Test conventional).
4. If a PCMCIA (PC) card is inserted, choose whether to store the new Survey Style on the PC card or in the main memory.
5. Press to add the new Style to the menu of Survey Styles.

If you are using a third party instrument, press and select the *Instrument* option in the Survey Style. From the *Manufacturer* and *Model* (optional) fields, select the instrument you are using. Press then to return to the *Select Survey Style* menu.

For more information on configuring a conventional Survey Style and your conventional instrument see Appendix E Conventional Instrument Settings.

6. Highlight the name of your new Survey Style and press .
7. Turn on the instrument.
8. Perform a station setup. For more information see the next section.

Performing a Station Setup

Before making any measurements or staking out any points, perform a station setup.

Set up the equipment. If you have not yet created and configured a job, do so now. See *Creating a New Job*, page 56, and *Configuring the Job*, page 57. Select your new Survey Style, (for more information, see *Selecting a Survey Style*, page 61), then do the following:

1. From the *Survey* menu, select *Station setup*. The *Survey/Station setup* screen appears.
2. Enter the station point name in the *Instrument point name* field.

Note – If you have not already keyed in or uploaded the coordinates of the instrument point, press the softkey and key them in now. If you do not know the coordinates of the instrument point, press and key them in later.

3. Enter the height of the instrument in the *Instrument height* field.

Note – For a two-dimensional or planimetric survey, the *Instrument height* field can be left as null (?). No elevations will be calculated.

4. Enter the backsight point name in the *Backsight point name* field.

Note – If the backsight point is not in the Trimble Survey Controller software database, a message appears, asking if you want to key in the point. Press or as required.

If the backsight coordinates are stored in the Trimble Survey Controller software, the azimuth is automatically calculated and inserted in the *Azimuth* field. The field name changes to *Azimuth (Computed)*.

If the backsight coordinates are not stored in the database, you can key in a value in the *Azimuth* field. The field name changes to *Azimuth (Keyed in)*.

5. Enter the height of the backsight target in the *Backsight height* field.

Note – To enter a prism constant, press the **Options** softkey. Enter a value in the *Prism constant* field.

It is also possible to enter values for various corrections in the Options screen.

6. Choose one of the following options from the *Method* field, :
 - Angles only – measures the horizontal and vertical angles
 - Angles and distance – measures the horizontal and vertical angles and slope distance

Note – If you choose *Angles only* and the backsight point is not yet stored in the database, no coordinates are calculated for it.

A screen similar to the one shown in Figure 4.3 appears.

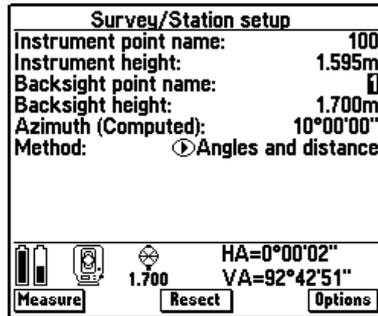


Figure 4.3 Survey/Station setup screen

7. Sight the center of the backsight target and press **Measure**.

8. The distance deltas are displayed on the screen, as shown in Figure 4.4.

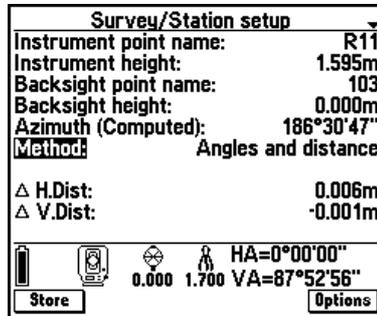


Figure 4.4 Survey/Station setup screen – after measurement taken

9. A small arrow in the top right corner of the screen indicates that there is more information than can be shown in one screen. Press the \odot key repeatedly to see the measurement information in the next screen.
10. Do one of the following:
- If the measurement information is correct, press the softkey to accept the station setup. The station setup is finished.
 - If you do not want to use the measurement, press then the softkey to abandon it. Repeat Step 7 and Step 8 to take another measurement.

Measuring a Point

Before measuring points, do a station setup.

To measure a point:

1. From the *Survey* menu, select *Measure points*. The *Survey/Measure points* screen appears, as shown in Figure 4.5.

Survey/Measure points	
Point name:	Topo300
Code:	Nail
Method:	Angles and distance
Target height:	1.700m
HA=0°00'02" VA=92°42'51"	
Measure	Check Options

Figure 4.5 Survey/Measure points screen

2. Press **Options**.
3. Make sure that the *View before storage* field is set to Yes. Change any other fields as required.
4. Enter a value in the *Point name* field.
5. If applicable, enter a feature code in the *Code* field.
6. Set the measurement method to Angles and distance in the *Method* field.
7. Enter a value in the *Target height* field.
8. Sight the center of the target and press **Measure**.
The measurement information appears on the screen.
9. Press **Store** to store the point.
The Trimble Survey Controller software stores the raw observations (HA, VA, and SD).
10. Repeat Step 4 through Step 9 until all points are measured.

Measuring Rounds of Observations

To measure multiple sets (rounds) of observations, complete a station setup and do the following:

1. From the *Survey* menu, select *Measure rounds*. The *Survey/Measure rounds* screen appears, as shown in Figure 4.6.

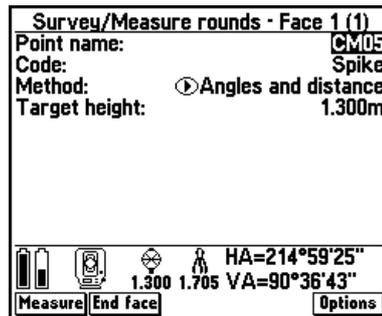


Figure 4.6 Survey/Measure rounds screen

2. To change the settings for the survey, press **Options**. Change the fields as required.
3. Enter a value in the *Point name* field.
4. If applicable, enter a feature code in the *Code* field.
5. Choose one of the following options from the *Method* field, :
 - Angles only—measures the horizontal and vertical angles
 - Angles and distance—measures the horizontal and vertical angles and slope distance
6. Enter a value in the *Target height* field.

Note – Press **Options** to enter a prism constant for the target.
7. Sight the center of the target and press **Measure**.
The measurement information appears on the screen.
8. Press **Store** to store the point.

9. Repeat Step 4 through Step 8 until all points to be included in the rounds of observations are measured.

10. Press **End face**.

For subsequent observations, the Trimble Survey Controller software guides you through the specified number of rounds by:

- directing you to change face when required
- defaulting to the correct point details for each observed station

11. Repeat Step 7 and Step 8 until all observations are completed in the current round.

At the end of each round the Trimble Survey Controller software displays the results for the survey in the *Rounds summary* screen.

12. Do one of the following:

- To continue and observe more rounds, press **Continue**.
- To end the rounds survey, press **End**.

Stakeout

This section shows how to stake out a point using a conventional instrument. For information about staking out lines, curves, and surfaces refer to the *Trimble Survey Controller Reference Manual*.



Warning – Do not stake out points and then change the coordinate system or perform a calibration. If you do, these points will not be in terms of the new coordinate system. They will also be inconsistent with points staked out after the change.

General Procedure

To stake out a point, set up the conventional instrument and do the following:

1. Define the point and store it in the Trimble Survey Controller software database.

To define the point do one of the following:

- key in data
 - upload a job from the Trimble Geomatics Office or Trimble Survey Office software, or upload coordinates from another device
 - calculate coordinates using a Cogo function
2. Complete a station setup.
 3. Start a survey.
 4. Select the point to stake out.
 5. Direct the person with the target to the point.
 6. Store the as-staked point (this step is optional).
 7. Repeat Step 4 through Step 6 until all points are staked out.
 8. End the survey.

The rest of this section shows how to key in a point using the *Key in* option, and then stake it out. For information on other methods, refer to the *Trimble Survey Controller Reference Manual* or the online help.

Keying in a Point

To key in a point:

1. From the main menu, select *Key in / Points*. The *Key in/Point* screen appears.
2. Enter the point name, and a code if required.
3. Set the *Method* field to *Keyed in coordinates*.

Make sure the coordinate fields are *North*, *East*, and *Elevation*. If not, press the **Options** softkey and change the coordinate view to Grid.

4. Key in the coordinates.
5. Press **Enter** to store the point.
6. Repeat Step 2 through Step 5 for each point, then press **Esc** to return to the *Key in* menu.
7. Press **Esc** again to return to the main menu.

Staking Out a Point

To stake out a point:

1. From the main menu, select *Survey*. From the *Select Survey Style* menu, select your Conventional Survey Style.
2. Select *Station setup* and perform a station setup.
3. Select *Stakeout / Points*. The *Stakeout/Points* list appears.
4. Press the **Add** softkey to transfer points in the Trimble Survey Controller software database to the *Stakeout/Points* list. The *Select points* screen appears, as shown in Figure 4.7.

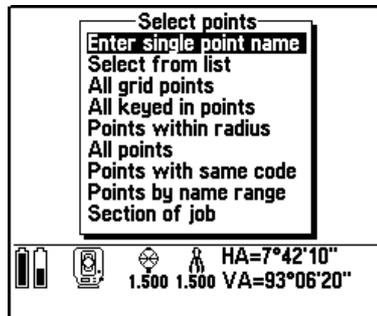


Figure 4.7 Screen showing selection methods

5. From the list, choose the method by which points are to be selected.

If you choose Select from list, for example, a list of points in the Trimble Survey Controller software database appears as shown in Figure 4.8.

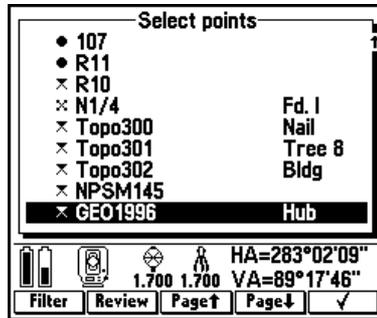


Figure 4.8 Select points screen showing list of points

To select a point from the list, highlight it and press the softkey. A check mark appears beside the selected point name. Do this for each point that is to be added to the stakeout list.

6. Press to return to the *Stakeout/Points* screen.
7. Select the point to be staked out. (To do this, highlight the point and press .)

The stakeout graphical display screen appears. It displays the horizontal angle to which you should turn the instrument and the distance from the instrument to the point, together with a graphical representation of this, as shown in Figure 4.9.

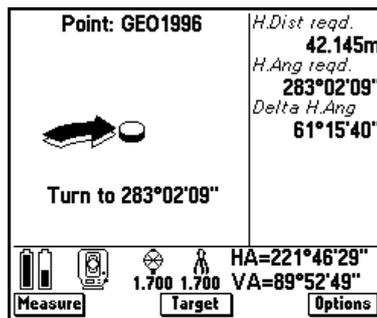


Figure 4.9 Graphical display screen – initial screen

8. Use the graphical display or the text display to navigate the target to the point.

A solid/filled arrow in the graphical display usually means that you must perform some action. Use the arrows to locate the point. In Figure 4.9, the large arrow indicates the direction in which the instrument must be turned. The value below the arrow indicates the circle reading that the instrument must display.



Tip – Press **Options** to edit the tolerances used when locating a point.

The graphical display operates in two modes: Distances, and Angles and Distances. Both modes are shown in the following figures. To choose a mode, press **Options** and set the *Display/Deltas* field.

9. When the instrument is within the angular tolerance, the graphical display shows two hollow/outline arrows.
10. Press **Measure**. When the distance measurement has been made, a screen similar to those shown in Figure 4.10 appears.

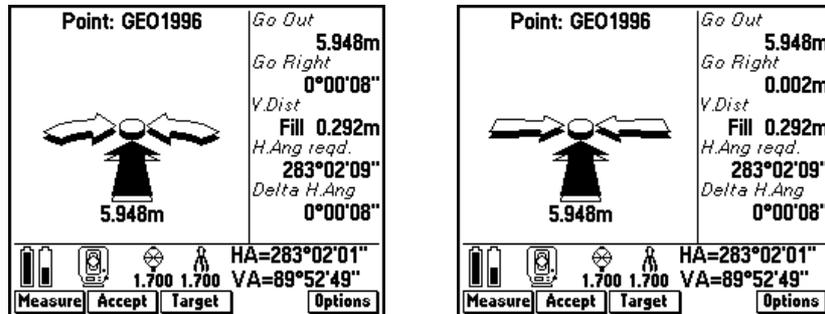


Figure 4.10 Graphical display screen – distance measurement made

In the left screen, the *Display/Deltas* field is set to Angles and distances. The arrows are curved. In the right screen, the *Display/Deltas* field is set to Distances. The arrows are straight.

The left and right arrows are hollow because the instrument is still on line. The up/down arrow is solid because the target must move away from the instrument.

11. Instruct the person with the target to move.
12. Press **Measure** again. If the instrument has turned off line, the two outline arrows disappear and a solid one appears, as shown in Figure 4.11.

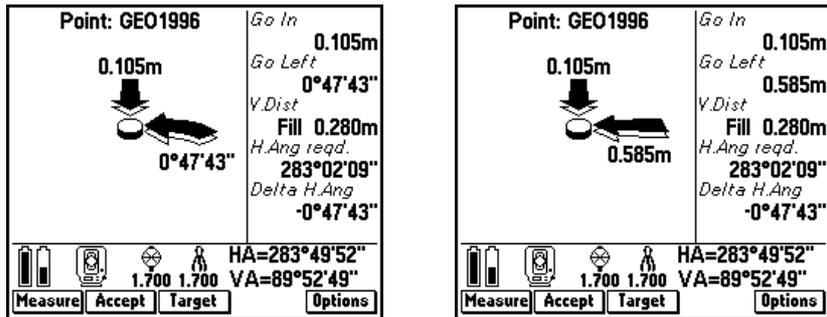


Figure 4.11 Graphical display screen – measurement made, instrument off line

In the left screen, the instrument must be turned to the left by the amount shown and the target must follow to stay on-line. The down arrow indicates that the target must also move towards the conventional instrument.

In the right screen, the target must move to the left. The instrument must be turned to follow the target. When the instrument is on-line, the two outline arrows reappear. The down arrow indicates that the target must also move towards the conventional instrument.

13. When the target has moved, press **Measure** again.

If the instrument is on-line, two left/right outline arrows appear. If the distance is not yet correct, a solid up/down arrow shows the direction and amount that the target must move towards or away from the instrument, as shown in Figure 4.10.

14. Instruct the person with the target to move.

15. Press **Measure** again.

If the measurement is within the set angular and distance tolerances, four hollow/outline arrows appear and the center point is filled in, as shown in Figure 4.12.

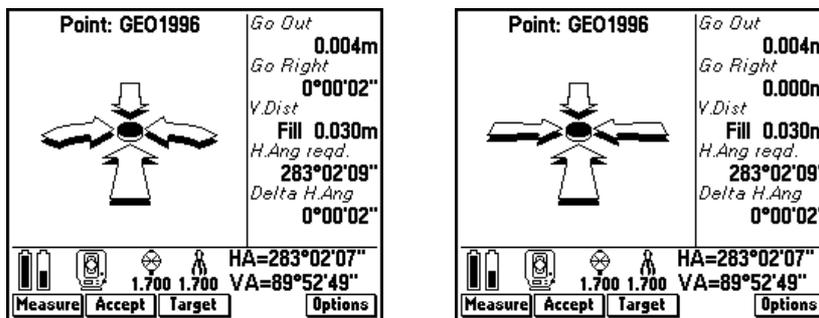


Figure 4.12 Graphical display screen – point located within tolerance

16. When all arrows are hollow, mark the point. Then do one of the following:
- To record the as-staked point, press the **Store** softkey.
If the *View deltas before storage* option is set to Yes, press **Accept** then **Store**.
 - If you do not want to record the as-staked point, press **Esc** then **Yes**. You return to the list and can stake out more points.
17. Repeat Step 7 through Step 16 until all points are staked out.

Ending the Survey

End the survey when you have finished measuring and staking out points at the current station setup.

To end the survey:

1. From the *Survey* menu, select *End survey*.
2. Press **Yes** to confirm the action.

FastStatic Surveying

In this chapter:

- Introduction
- Creating a new job
- Configuring the job
- Setting up the base station
- Setting up the rover
- Reviewing data

Introduction

Use a Trimble FastStatic survey to obtain results that are more precise than those obtained from a real-time survey. As FastStatic surveying is always a postprocessed operation, no radios are required.

Note – If you are using postprocessed techniques, make sure that you have the appropriate module of the Trimble Geomatics Office software to process the data.

To complete a FastStatic survey you need to:

- create a new job (see page 26)
- configure the job (see page 28)
- set up the base receiver
- set up a rover receiver and measure points
- end the survey (see page 54)
- review the data in the TSC1 data collector (see page 21)

Most of these operations are common to all Survey Styles. For more information see Chapter 3, RTK Field Procedures.



Tip – For more information on any topic covered in this chapter, refer to the *Trimble Survey Controller Reference Manual*.

Creating a New Job

To create a new job, see page 26.

Configuring the Job

To configure the job, see page 28.

Setting up the Base Station

Locate the base station where there is a clear and uninterrupted view of the sky, for example on top of a hill or building. You should be able to see the sky all around at an elevation angle of 13° above the horizon.

To set up the base station for a FastStatic survey:

1. Set up the antenna over the base station survey point using a tripod, tribrach, and tribrach adaptor.
2. Connect the receiver as shown in Figure 5.1 (or Figure 5.2, depending on the receiver type).

Note – You do not need a radio connection for a FastStatic survey.

Figure 5.1 shows how to connect a GPS Total Station 4800 receiver for a FastStatic survey.

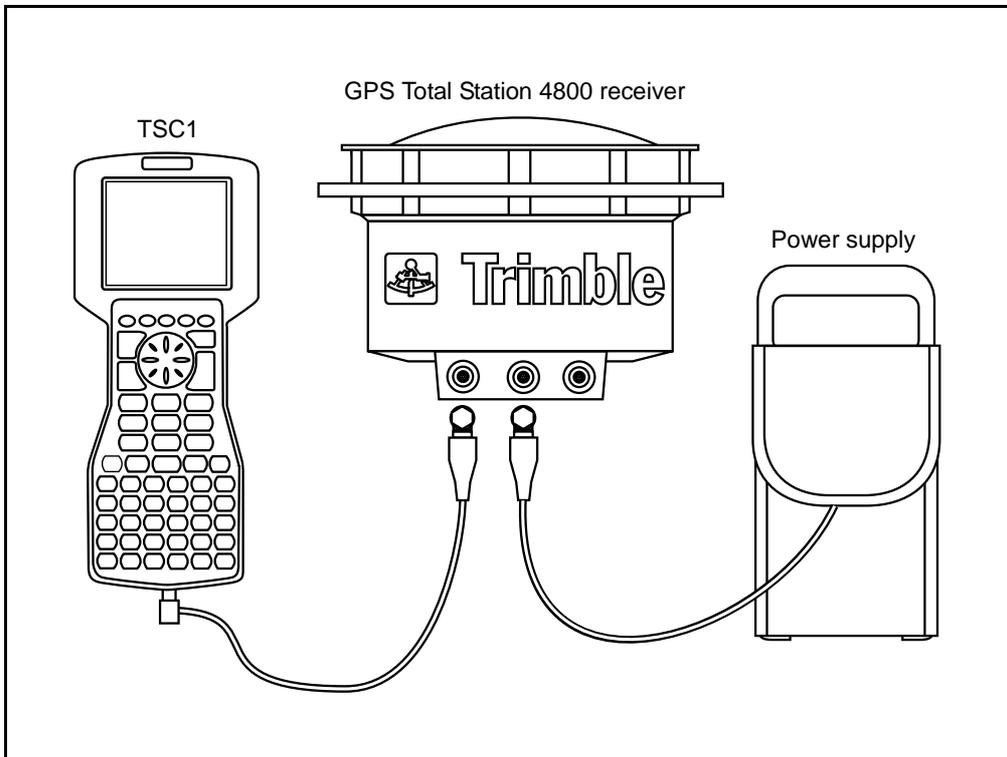


Figure 5.1 TSC1 connected to a GPS Total Station 4800 receiver (FastStatic survey)

Figure 5.2 shows how to connect a GPS Total Station 4700 receiver for a FastStatic survey.

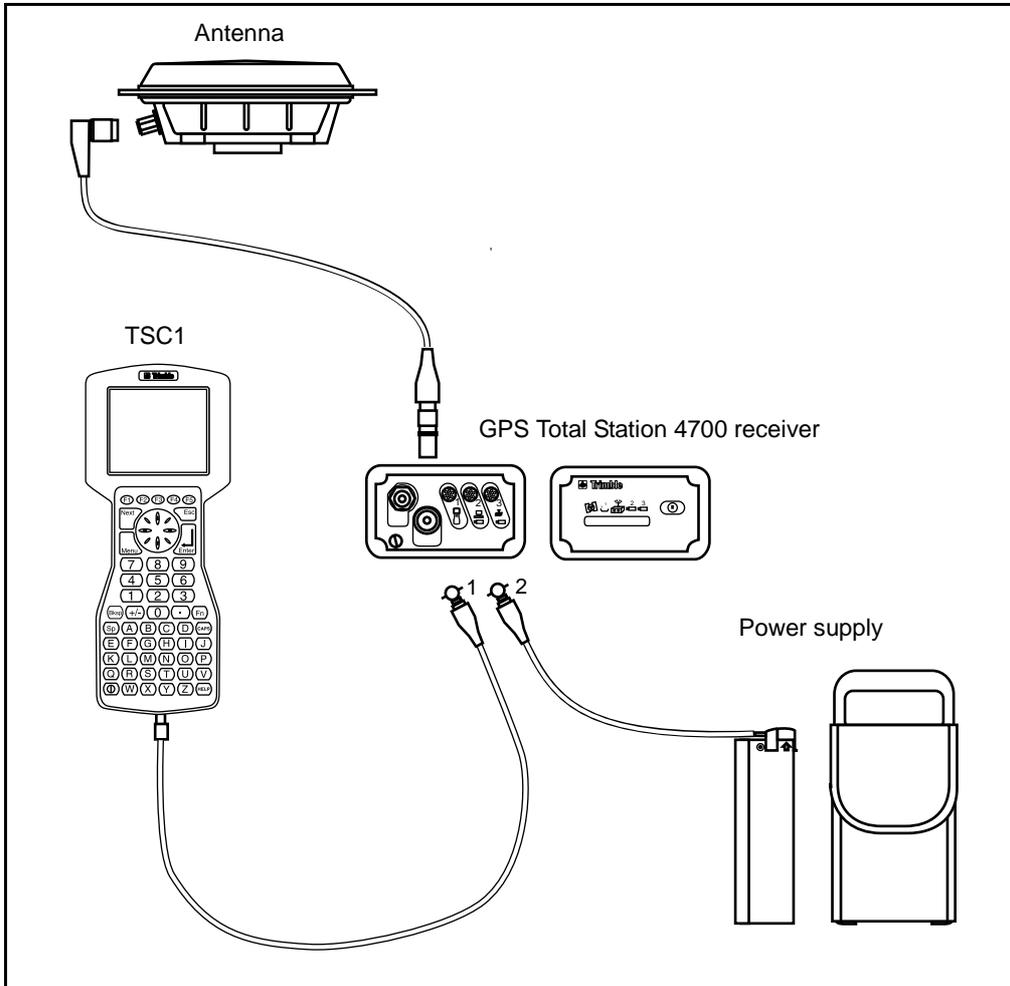


Figure 5.2 TSC1 Connected to a GPS Total Station 4700 receiver (FastStatic Survey)

Starting the Base Survey

To start the survey:

1. From the main menu, select Survey. The *Select Survey Style* menu appears.

Note – If a survey is running, the *Select Survey Style* menu does not appear. If the current survey is not FastStatic, end it (see page 54) and return to Step 1.

2. Do one of the following:
 - If this is the first FastStatic survey with the current equipment:

Highlight *Trimble FastStatic* and press the softkey. In the *Style name* field, type a name for the new FastStatic Survey Style to be created (for example, Test FastStatic) and press . Press again to return to the *Select Survey Style* menu.

With the new FastStatic Survey Style still highlighted, press the softkey. Select *Rover options* and change the *Logging device* field to Receiver or Handheld as required. Select a value in the *Logging interval* field and set the *Antenna type* field to the type of antenna you are using. Press and do the same for *Base options*.

Press the softkey, then . The *Survey* menu appears.

- If this is not the first FastStatic survey with the current equipment, highlight your FastStatic Survey Style and press .
3. From the *Survey* menu, select *Start base receiver*.
 4. Enter the point name and press .

If the point does not yet exist in the database, a message appears:

Point does not exist. Provide coordinates at processing time

With FastStatic surveys you can use known, published, or measured values to enter WGS-84 coordinates for the base station into the TSC1 data collector. Alternatively, enter coordinates for the base station when you postprocess the data.

5. Enter values in the *Code* and *Antenna height* fields.
6. Make sure the antenna is centered and vertical over the control point, then press the **Measure** softkey or . The TSC1 data collector starts to record data. Do one of the following:
 - If you are logging data in the receiver a message appears:
Base started. Disconnect data collector from receiver.

Disconnect the TSC1 data collector but **do not** turn off the receiver.
 - If you are logging data in the TSC1 data collector, the *Base* screen appears. It shows what point is being surveyed and the time elapsed since data logging started. Leave the TSC1 connected to the base receiver, and set up the rover using another TSC1.

Setting up the Rover

To set up the rover receiver for a FastStatic survey:

1. Set up the antenna using a tripod, tribrach, and tribrach adaptor. The antenna must have a clear view of the sky.
2. Connect the hardware as shown in Figure 5.1 (see page 78) or Figure 5.2 (see page 79), depending on the receiver type.

Note – *You do not need a radio connection for a FastStatic survey.*

Starting the Rover Survey

To start the survey:

1. From the main menu, select Survey. From the *Select Survey Style menu*, select your new FastStatic Survey Style. Press . For more information, see page 80.

Note – If a survey is running, the *Select Survey Style menu* does not appear. If the current survey is not FastStatic, end it (see page 54) and return to Step 1.

2. Select *Measure points*.
3. Enter values in the *Point name*, *Code*, and *Antenna height* fields.
4. Make sure the antenna is centered and vertical over the control point, then press the  softkey or . The data collector starts to record data.

Note – The antenna should be on a tripod to keep it vertical and stationary while data is recorded.

5. The Trimble Survey Controller software has preset times for recording a FastStatic point. These times are related to the number of satellites tracked. When the preset time has elapsed, the  softkey appears. Press it to store the point.
6. Move to another point. Repeat Step 3 through Step 5 until all the points are measured.

Note – There is no need to maintain lock on satellites when moving between points.

7. End the survey (see page 54).

Reviewing Data

To review the data in the Trimble Survey Controller software database, see page 21.

In the Office

In this chapter:

- Introduction
- Recharging the TSC1 battery
- Data transfer

Introduction

This chapter describes operations normally performed in the office. There is a section on charging batteries and a section on transferring files to and from the office computer.



Tip – For more information on any topic covered in this chapter, refer to the *Trimble Survey Controller Reference Manual*.

Recharging the TSC1 Battery

To recharge the Lithium-ion battery of the TSC1 data collector, do one of the following:

- Connect the TSC1 to the AC adaptor (the power supply for the PowerLiTE™ battery charger).
- Connect the TSC1 to an Office Support Module II™ (OSM II) charger.
- Remove the battery and charge it in the (optional) battery charger.
- Connect the TSC1 to a receiver that has an external power source, or to a camcorder battery. Change the *Low voltage charging enabled* setting to Yes.

The battery recharges fully in approximately three hours.

Using the AC Adaptor

To recharge the TSC1 battery using the AC adaptor:

1. Connect the TSC1 data collector to the AC adaptor using the TSC1 to DB9/power supply Y-cable (part number 32345).
2. Insert the jack plug on the AC adaptor into the socket on the Y-cable, and the Lemo connector into the TSC1 data collector.

3. Plug the AC adaptor into the main power.

Note – The AC adaptor can power the PowerLiTE battery charger while recharging the TSC1 battery.

Using the Office Support Module II (OSM II) Charger

To recharge the TSC1 battery using the OSM II:

1. Connect the TSC1 data collector to the OSM II charger using the TSC1 to 5-pin Lemo adaptor cable (part number 32959). Connect this cable to the TSC1 and to the 5-pin Lemo cable from the OSM II.
2. Plug the OSM II charger into the main power.

Using the Battery Charger

To recharge the TSC1 battery using the optional battery charger:

1. Remove the battery from the TSC1 data collector.
2. Connect the battery charger to the main power using the AC adaptor (part number 30413).
3. Insert the TSC1 battery in the battery charger. The orange (Contact) status light indicates that a battery is correctly inserted. When the green (Charge) status light is on continuously, the battery is fully charged.

Using a Low Voltage Power Supply

To recharge the TSC1 battery using a power source of less than 15 V:

1. Connect the TSC1 data collector to a receiver that has an external power source, or directly to a camcorder battery.
2. Make sure the TSC1 cannot turn itself off while the battery is being charged. To do this:
 - a. Select *Configuration / Controller / Time/date*.
 - b. Access the *Timeout* field and press the softkey.
3. Select *Configuration / Controller / Hardware* and set the *Low voltage charging enabled* field to Yes. This field defaults back to No when the TSC1 data collector is turned off.

A Charge icon appears in the status line until the battery is fully charged.

Note – Do not start a survey while charging the TSC1 battery in this way.

Data Transfer

You can transfer various types of files between the TSC1 data collector and the office computer, including .dc files, feature and attribute libraries, DTMs, and language files. The data transfer process on the TSC1 data collector is controlled by the office software when you connect the TSC1 and select the appropriate options.

Use one of the following software packages to transfer data to and from the TSC1 data collector:

- Trimble Geomatics Office
- Data Transfer
- Trimble Survey Office
- TRIMMAP
- GPSurvey

For more information about the data transfer process, refer to the documentation for the software you use.

Connecting the TSC1 Data Collector

To transfer data between the TSC1 data collector and the office computer, connect the equipment as shown in Figure 6.1 (or Figure 6.2, depending on the equipment).

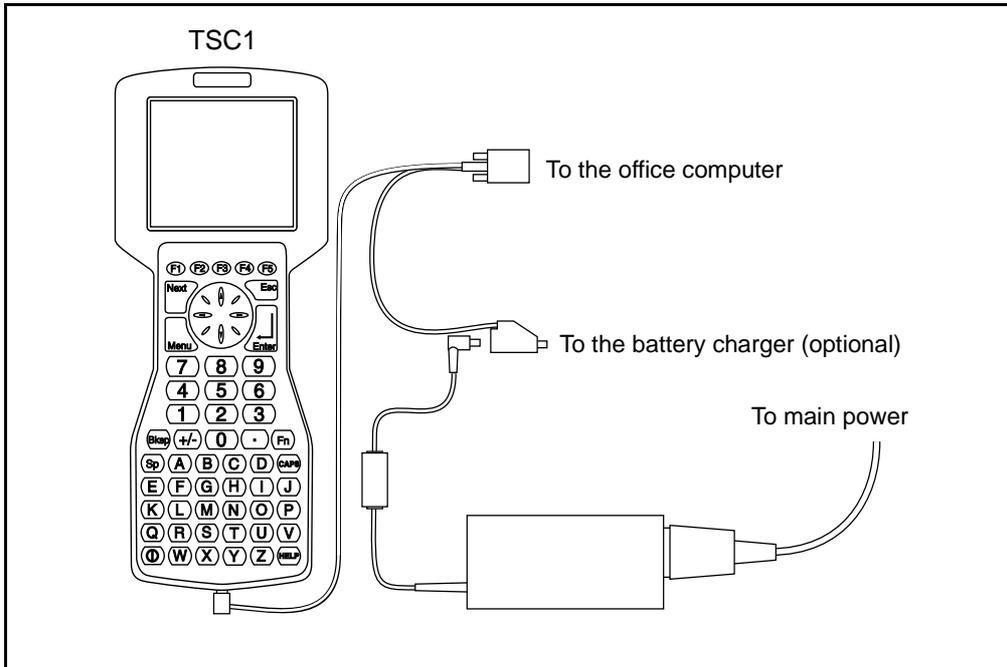


Figure 6.1 Download connection

Connect the TSC1 data collector to the office computer, the battery charger, and the AC adaptor using the TSC1 to DB9/power supply Y-cable (part number 32345).

Alternative connection

If using an Office Support Module (OSM, part number 20669-40), connect the TSC1 data collector to the office computer using the cable attached to the OSM II charger. With some equipment, you may need to use the adaptor cable, part number 32959, to do this:

1. Connect the TSC1 data collector to the OSM II using the cable attached to the OSM.
2. Connect the OSM II to the office computer using the RS232 cable. Insert one end in the OSM II DATA I/O port, the other in the office computer.

Figure 6.2 shows how to connect the equipment using this method.

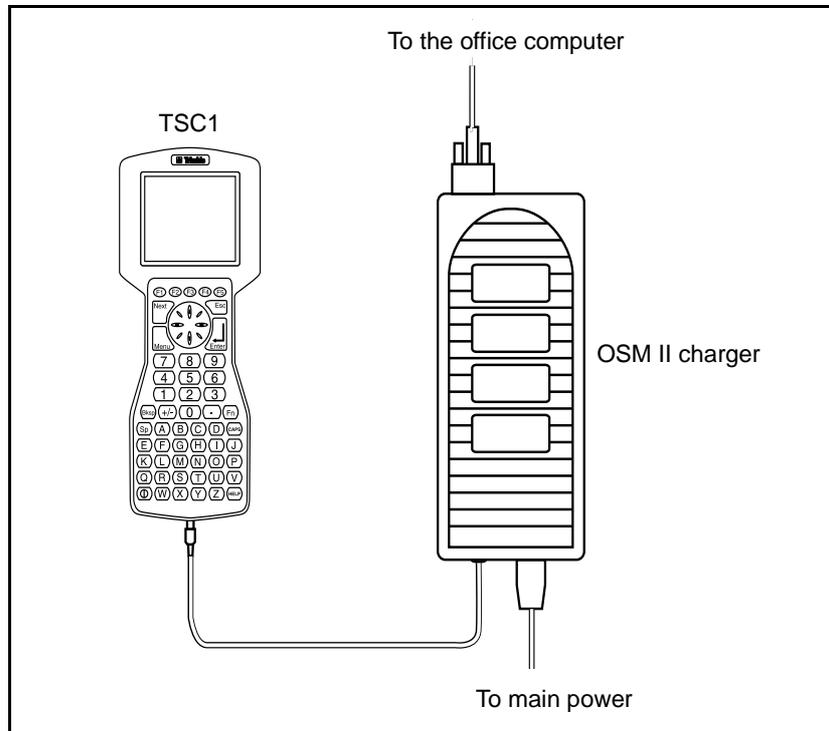


Figure 6.2 Alternative download connection

Transferring the Data

You can download files from the TSC1 data collector to the office computer or upload files from the office computer to the TSC1:

- On the TSC1 data collector select *Files / Import/Export*. Then select *Trimble PC communications*.

The following message appears:

Data transfer. Waiting for PC connection.

The rest of the procedure is controlled by the office computer. To continue, refer to the documentation for the software you use.

Note – There are no communication parameters to set up, as the Trimble Survey Controller software and the office software negotiate the maximum speed at which they can work together.

To abandon the data transfer at any time, press the  key on the TSC1 data collector or the  key on the office computer.

When a .dc file is transferred to Trimble Geomatics Office, Trimble Survey Office, TRIMMAP, or GPSurvey software, any GPS data files associated with that file are also transferred. You cannot transfer these GPS data files separately.

Note – If you use a geoid model in a Trimble Geomatics Office or Trimble Survey Office project and you upload the job into the Trimble Survey Controller software, remember to upload the geoid file (or the relevant part of the geoid file) as well.

A

Serial Number Form

Introduction

This appendix provides a serial number form that you can use to record the part numbers, serial numbers, and version numbers of the Trimble Survey Controller equipment.

Use Table A.1 to record these details.

Table A.1 **Equipment Details**

	Type	Part number	Serial number	Software version	Firmware version
Receiver					
Antenna (optional)					
TSC1					



Tip – There is a copy of this form in Appendix A of the *Trimble Survey Controller Reference Manual*. Store one of them in a safe place. You will need it if the equipment is ever lost, stolen, or damaged.

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