

# Trimble Survey Controller™

Help

**Version 11.40**

**Revision A**

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# General Operations

## Welcome

Welcome to the Trimble Survey Controller software version 11.4 Help.

This help system makes it easy to find the information you need to effectively use the full power and capabilities of the Trimble Survey Controller software.

For information that extends or updates this Help, refer to the Trimble Survey Controller Getting Started Guide and Release Notes. Alternatively, visit the Trimble website ([www.trimble.com](http://www.trimble.com)) or contact your local Trimble dealer.

## The Trimble Survey Controller Screen

For an explanation of the buttons and icons on the Trimble Survey Controller screen, see:

[Status Bar](#)

[Status Line](#)

[Trimble Survey Controller Buttons](#)

[Shortcut Keys \(ACU\)](#)

[About Trimble Survey Controller](#)

## Files Menu

Use this menu to view and manage jobs, and transfer data between the office computer and external devices.

For more information, see:

[New job](#)

[Open job](#)

[Review current job](#)

[Point manager](#)

[QC Graph](#)

[Map of current job](#)

[Properties of current job](#)

[Copy Between Jobs](#)

[Import/Export](#)

[Windows Explorer / File Explorer](#)



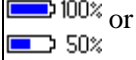







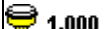



## Status Bar






















The status bar is located on the top right side of the Trimble Survey Controller screen. Which icons it displays depends on the equipment that is connected to the controller. Tap an icon to view more information about that equipment.

In a conventional survey, tap the instrument icon to access Trimble functions, or tap the target icon to change targets or target details.

In a GPS survey, tap the satellite icon to view the Sky plot.

The following table describes the status bar icons.

Icon	What it shows
	Controller is connected to and drawing power from an external supply.
	Controller is connected to an external power supply and is recharging the internal battery.
	Power level is 100% or 50%. If this icon is on the top, it refers to the controller battery. If the icon is below the controller battery, it refers to the power level of an external device.
	A 5800 receiver is in use.
	A Trimble R7 receiver is in use.
	A Trimble R8 receiver is in use.
	A Trimble R6 receiver is in use.
	A 5700 GPS receiver is in use.
	A 4800 GPS receiver is in use.
	A 4700 GPS receiver is in use.
	A 4800 GPS receiver is in use. The antenna height is shown to the right of the icon.
	An external antenna is in use. The antenna height is shown to the right of the icon.
	A conventional instrument is in use. If a station setup is completed, the instrument height is shown to the right of the icon.
	A conventional instrument is being used to measure a point.

	A conventional instrument is receiving an EDM signal back from the prism.
	A conventional instrument is locked on to the target (prism).
	A conventional instrument is locked and measuring to the target (prism).
	A conventional instrument in FastStandard (FSTD) mode averages the angles while a fast standard measurement is taken.
	A conventional instrument in Standard (STD) mode averages the angles while a standard distance measurement is taken.
	A conventional instrument in Tracking (TRK) mode constantly measures distances and updates in the status line. (TRK is commonly used in stakeout and continuous topo.)
	The laser pointer is on (DR mode only).
	The radio signals from the robotic instrument are no longer being received.
	The height of a conventional target is shown to the right of the icon. "1" indicates that target 1 is in use.
	The prism is locked by the robotic instrument. The prism constant (in millimeters) and target height are shown to the right of the icon. "1" indicates that target 1 is in use.
	The target icon changes to a DR icon to show that the instrument is in Direct Reflex mode.
	The target icon rotates to show that the conventional instrument has Autolock enabled but is not currently locked on to a target.
	A static point is being measured.
	Radio signals are being received.
	Cellular modem signals are being received. When the cellular modem hangs up, or stops receiving corrections, the icon appears with a cross through it.
	WAAS/EGNOS signals are being received.
	Continuous points are being measured.
	If no survey is running, the number of satellites being tracked is shown to the right of the icon. If a survey is running, the number of satellites in the solution is shown to the right of the icon.
	A real-time survey is running and base data from a network connection is being streamed to the rover.
	Real-time base data streaming from a network connection is paused. Base data streaming automatically restarts when required.
	A real-time survey with base data from a network connection is stopped. The base station network connection is maintained, but the real-time base data will not be streamed to the rover.

## Status Line

The status line is displayed on the bottom of the screen. It displays a message when an event or action occurs, and when the Trimble Survey Controller software cannot start or continue with its present function.

When the controller is connected to a receiver, the status line displays the current survey mode. The following table explains these modes.

<b>Survey mode</b>	<b>Explanation</b>
No Survey	The receiver is connected but a survey has not been started.
RTK:Fixed	The current RTK survey is initialized, and the solution type is L1 fixed–centimeter–level.
RTK:Float	The current RTK survey is not initialized, and the solution type is L1 float.
RTK:Check	The current RTK survey is verifying the initialization.
RTK:Auto	The radio link is down in the current RTK survey, and the solution is an autonomous position.
RTK:WAAS	The radio link is down in the current RTK survey, and the solution is a WAAS/EGNOS position
FastStatic	The current survey type is FastStatic.
PPK:Fixed	The current postprocessed kinematic survey is initialized and, when postprocessed, should yield an L1 fixed or an iono–free (centimeter–level) solution.
PPK:Float	The current postprocessed kinematic survey is not initialized and, when postprocessed, should yield an L1 float solution.
PP differential	The current survey type is postprocessed differential.
RT differential	The current survey type is real–time differential.
Infill:Fixed	The current kinematic infill survey is initialized and, when postprocessed, should yield an L1 fixed or an iono–free (centimeter–level) solution.
Infill:Float	The current kinematic infill survey is not initialized and, when postprocessed, should yield an L1 float solution.
Infill	The current survey type is differential, and you are doing an infill session.
WAAS	The current survey type is differential, and using signals from the WAAS/EGNOS satellites.

The root mean square (RMS) indicator is displayed when you are in Fine mode in a real–time kinematic survey. It shows the RMS of the current position, expressed in millicycles.

## Customizing the Startup Screen



















You can customize the Trimble Survey Controller software startup screen to display an image of your choice.





1. Create your image 320 pixels wide x 240 pixels high, in the bitmap file format (\*.bmp).
2. Save the file with the name [Startup\_image.bmp], to the same folder on the controller as Survey.exe .
  - ◆ On a ACU or TSCe controller: [\\Disk\\Program Files\\Survey Controller].

When the Trimble Survey Controller software detects the file [Startup\_image.bmp], it uses this file as the startup image, instead of the standard Trimble startup image.

## ACU Function Keys







The following table describes the Trimble Survey Controller functions that are associated with the ACU icons.


On this instrument or receiver...	tap...	to...
Conventional or GPS		access the main Trimble Survey Controller menu
Conventional (with Autolock)		access the <i>Trimble functions</i> screen
		switch on Autolock and start a search
		switch on Autolock or switch it off
		take a measurement
Conventional (with servos)		turn the instrument horizontally to the current point name or stakeout location
		turn the instrument vertically to the current point name or stakeout location
		turn the instrument horizontally and vertically to the current point name or stakeout location
		change face
		take a measurement
Conventional (3600)		activate the first softkey (F1)
		activate the second softkey (F2)
		activate the third softkey (F3)
		activate the fourth softkey (F4)
		take a measurement
GPS		access the <i>Position</i> dialog
		access the <i>Satellites</i> dialog
		activate the first softkey (F1)

	activate the second softkey (F2)
	activate the third softkey (F3)
	activate the fourth softkey (F4)
	activate the <b>Enter</b> button

## Trimble S Series Keys

The following table describes the Trimble Survey Controller functions that are associated with the Trimble S Series instrument keys when the controller is attached to the instrument and Trimble Survey Controller is running.

On the Trimble S Series instrument press...	to...
 (short press)	activate the <b>Enter</b> button
 (long press)	power the instrument and controller on and off
 (short press)	change face
 (short press)	scroll between the face 1 view displays
 (long press)	switch the face 2 backlight on or off
 (short press)	activate the <i>Enter</i> button

When taking measurements the face 2 display shows the same measurement information as the view display button on the *Measure topo* and *Station setup* forms on face 1. This is typically horizontal angle, vertical angle and, after a measurement, the slope distance. To scroll through the different views, press the  key. Information such as current measurement status appears in the face 2 status line at the bottom of the display.

When a duplicate observation is encountered the face 2 display shows delta Horizontal angle, delta horizontal distance and delta vertical distance.

**Note** – Before you store the point, confirm the *Store as* action in the face 1 display.

Use the face 2 keys to control the instrument's onboard applications when the controller is not attached to the instrument. For more information, refer to the documentation for your instrument.


## Controller Keyboard Functions

The controller provides several additional keyboard functions that you can access through the operating system.

- [Numeric and Alphanumeric modes](#) (Trimble ACU only)
- [Input panel](#)
- [Transcriber](#)
- [Keyboard properties](#) (Repeat, Sticky keys, Key preview (Trimble ACU only), Backlight)

For more information on these functions, refer to the help. Tap *Start / Help*.

## Numeric and Alphanumeric modes (Trimble ACU only)

Press the alpha key (  ) to switch between numeric and alphanumeric modes. The current mode appears on the Windows taskbar and on the top right of the Trimble Survey Controller screen.


On the ACU, when you press the alpha key, the controller toggles between 123 and abc. To key in uppercase alpha characters, use the **Shift** key.

The Trimble Survey Controller software automatically sets the mode to numeric for numeric fields. For fields that can be either alpha or numeric, the software inspects the field and then does one of the following.

If the fields contains the following character type...	the software sets the field to...
alpha	alpha
numeric	numeric
alpha and numeric	match the last character in the field

## Input panel

The input panel looks and functions like a PC keyboard. Use it as an alternative to the controller keyboard for entering characters.

To access the input panel through the taskbar icon (  ):

- ◆ ACU or TSCe controller: Double-tap the taskbar icon.  
To close, double-tap the icon again.


To open or close the input panel through a keyboard shortcut:

- ◆ ACU controller: Press and hold **Shift** + **Alt** and then press the  key.
- ◆ TSCe controller: Press and hold **Shift** + **Alt** and then press **Power**.

## Transcriber

Transcriber recognises characters that you write on the controller screen with the stylus.

To enable the transcriber:

- ◇ On a Trimble ACU, or TSCe controller, tap [Start / Programs / Accessories / Transcriber].  
The Transcriber icon on the taskbar  appears with a grey background.

To stop using Transcriber, tap the icon on the task bar. The icon background colour changes. To start using again, tap the icon.

**Note** – When Transcriber is enabled, you need to tap and briefly hold screen buttons or icons to activate them. There is a slight delay while Transcriber determines if you are using the stylus to write with.

## Keyboard properties

To set the following:

- ◆ On a Trimble ACU, or TSCe controller, tap [Start / Settings / Control panel / Keyboard].

### Repeat

Repeat delay sets the time from when you first press a key to when the character starts repeating.

Repeat rate sets the speed at which the character repeats.

### Sticky keys

Use this to access a hotkey sequence without having to press and hold a modifier key (**Alt**, **Ctrl**, or **Shift**) while you press the hotkey.

If Sticky keys is enabled, when you press a modifier key, that key 'sticks' until you press it again. For example, on the ACU, use sticky keys to copy text (**Ctrl+C**) and paste text (**Ctrl+V**).

- ◇ Sticky keys enabled: Press **Ctrl**, and then press **8** three times (C). Press **Ctrl** and then press **2** three times (V).

- ◇ Sticky keys disabled: Press and hold **Ctrl** while you press **8** three times (C). Press and hold **Ctrl** while you press **2** three times (V).

### Simple caps lock (Trimble ACU and TSCe)

In the *Sticky Keys* dialog, select the *Enable simple caps lock* check box.

Then, to quickly set caps lock, press the **Shift** key twice.

To disable caps lock, press the **Shift** key twice again.

### Key preview (Trimble ACU)

When the controller is in alpha mode, a popup window shows the active character. For example, if you press **8** four times, the key preview shows, in succession, a, b, c, 8.

**Note** – You do not need to wait for the previewed character to be accepted before you press another key, for example **Enter** or another character. When you press another key, the controller accepts the character that is currently in the preview window. This function enables you to enter characters faster.

Alternatively, shorten the key preview to speed up alpha character entry.





## Backlight

- ◆ On a Trimble ACU, or TSCe controller, tap [Start / Settings / Control panel / Keyboard / Backlight] to enable or disable the keyboard backlight.


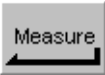


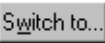
## Caps lock (Trimble ACU and TSCe)

As an alternative to the methods already mentioned, to enter text in upper case, do one of the following:

- ◇ To enter one character at a time, press and hold **Shift** (on the bottom right of the keyboard), while you tap the character.
- ◇ To enter all characters in upper case, press and hold **Shift+Alt** and the  key to open the input panel. Tap *Caps lock* on the panel. Press and hold **Shift+Alt** and the  key to close the panel. Caps lock is active.  
To turn off caps lock, open the input panel, then tap *Caps lock*. Close the input panel.

For more information on these functions, refer to the help. Tap *Start / Help*.

## Trimble Survey Controller Buttons

	Tapping the <i>Enter</i> button on the controller is the same as tapping the <b>Enter</b> key on the controller keypad. The actions of the <i>Enter</i> button depend on the current screen. In some screens, the caption on the button changes to describe the action for the screen. For example, the <i>Enter</i> button changes to the <i>Measure</i> button when you are in the <i>Measure points</i> screen.
	
	Tap <i>Map</i> to display a <a href="#">map of the current job</a> .
	Tap <i>Favorites</i> to access a list of commonly used screens. See the <i>Favorites</i> menu below.
	Tap this button to switch between active windows (screens).

**Note** – The up arrow softkey appears if there are more than four softkeys associated with a screen. Tap the arrow or press the **Shift** key to see the other softkeys.

**Tip** – To highlight a field without selecting it, tap and hold briefly with the stylus.

### Favorites menu

The *Favorites* menu provides quick access to commonly used screens and to various commands when connected to a conventional instrument or GPS receiver. Access a screen or command from the *Favorites* list, or use the *Switch to* button to access previously viewed screens.

To access a screen or command from the *Favorites* list, tap the *Favorites* button and then select the screen you want.

To add a screen to the Favorites list, view it and select *Favorites / Add to favorites*.

To add a command to the Favorites list:

1. Tap *Favorites / Customize / Add a command to Favorites menu*.
2. Tap the command you want to add.

To remove a command or form:

1. Tap *Favorites / Customize / Remove command from Favorites menu*.
2. Tap the item you want to remove.

**Note** – The commands that are available to be added to the *Favorites* menu vary depending on the Survey options you have set in *Configuration / Options*.

## Softkeys

Softkeys are displayed on the bottom line of the Trimble Survey Controller screen as on–screen buttons. They relate to particular screens and change when the screens change.

To access the softkeys using the keyboard:

- On a Trimble ACU, press **Ctrl** and then **1**, **2**, **3**, or **4** for softkeys *F1*, *F2*, *F3*, or *F4* respectively. To display the second row of softkeys, press **Shift**.
- On a TSCE, press **Ctrl** and then the symbols / (slash) , \* (star), – (minus), or + (plus) for softkeys *F1*, *F2*, *F3*, or *F4* respectively. To display the second row of softkeys, press **Shift**.

## Entering Quadrant Bearings

1. Make sure the system units are quadrant bearings.  
For more information, see [System Units](#).
2. Enter the bearing in any *Bearing* field.
3. Select NE, NW, SE, or SW from the popup list.  
The quadrant bearing is inserted in the field.

### Example

To enter the quadrant bearing N25° 30' 30"E in a bearing field:

- Key in **25.3030** .
- Select NE from the popup list.


## Calculator

To perform a calculation from within a dialog field:


1. Select Calculator from the pop–up menu.
2. Enter the numbers and functions.
3. Tap = to calculate the result.

4. Tap Accept to return the result to the field.

To use the calculator at any time, select Cogo / Calculator from the main Trimble Survey Controller menu.

Tap  (Options) to set the angle method, calculator mode (Reverse Polish Notation (RPN) or Standard), and decimal place display.

The calculator functions are shown below.

Calculator symbol	Function
<b>+</b>	Add
<b>-</b>	Subtract
<b>X</b>	Multiply
<b>÷</b>	Divide
<b>+/-</b>	Change sign of number being entered
<b>=</b>	Equals
<b>π</b>	Pi
<b>↵</b>	Enter
<b>▼</b>	Show all values on the stack
<b>↶</b>	Back space
	Options
<b><math>y^x</math></b>	Raise Y to the power of X
<b><math>x^2</math></b>	Square
<b><math>\sqrt{x}</math></b>	Square root
<b><math>10^x</math></b>	Raise 10 to the power of X
<b>E±</b>	Enter exponent or change exponent sign
<b><math>1/x</math></b>	Reciprocal
<b>X↔Y</b>	Swap X with Y
<b>SIN</b>	Sine
<b><math>\text{SIN}^{-1}</math></b>	Arc Sin
<b>COS</b>	Cosine
<b><math>\text{COS}^{-1}</math></b>	Arc Cosine
<b>TAN</b>	Tangent
<b><math>\text{TAN}^{-1}</math></b>	Arc Tangent
<b>LOG</b>	Log base 10

<b>SHIFT</b>	Switch SHIFT state
{	Open parenthesis
}	Close parenthesis
C	Clear all
CE	Clear entry
<b>Mem</b>	Memory functions
P→R	Polar to rectangular coordinate conversion
R→P	Rectangular to polar coordinate conversion
R↓	Rotate stack down
<b>R↑</b>	Rotate stack up
° ' "	Insert degrees, minutes, or seconds separator
<b>DMS-</b>	Subtract angles of the form DD.MMSSsss
<b>DMS+</b>	Add angles of the form DD.MMSSsss
→D.dd	Convert from DD°MM'SS.sss or DD.MMSSsss to angle units
→DMS	Convert from current angle units to DD°MM'SS.sss

## Time/Date

To set the time and date on a Trimble controller:

1. Double-tap the clock on the right of the taskbar.
2. Change the date and time as required. Press **Enter** to accept the new settings or **Esc** to cancel.

To configure the GPS time display setting:

1. From the main menu, select *Files / Properties of current job / Units*.
2. In the *Time format* field, select the required time display format.

A time stamp is stored with every record in the job and output to the DC file every 30 minutes.

## Sound Events

Sound events are prerecorded messages that notify you of an event or action that has occurred. They correspond with status line messages, and common error and warning messages.

Sound events are stored as .wav files. You can customize your own sound events by replacing or deleting the existing .wav files located in the [Program Files\Survey Controller\Languages\English\] folder.

**Tip** – Use the Recorder application provided in the ACU, and TSCe controller to record your own sound events. Alternatively, transfer .wav files from the office computer to the controller using Data Transfer or the Microsoft ActiveSync technology.

To turn all sound events on or off:

1. From the main menu, select *Configuration / Controller / Sound events*.
2. Select the *Play sound events* check box to turn on sound events, or clear it to turn them off.

## Language

To change the language of the Trimble Survey Controller software:

1. Use the Trimble Data Transfer utility to transfer a language file to the controller.
2. From the main menu of the Trimble Survey Controller software, select *Configuration / Controller / Language*.
3. Choose the required language from the list.
4. Restart the Trimble Survey Controller software.

## Windows Explorer / File Explorer

Use Microsoft Windows CE Explorer to view and manage files stored in a Trimble ACU, or TSCe controller.

To start Windows Explorer, tap [Start / Programs / Windows Explorer].

For more information, refer to the Windows Help provided on the controller.

### Deleting files

Use *Files / Open job* to copy and delete job files. If you delete job files, any associated GPS files are automatically deleted.

Use Microsoft Explorer to delete all other file types.

**Warning** – Files deleted in Explorer cannot be recovered.

## Trimble Controller – General Operation

Use the links below to find out how to operate the controller:

[Calibrate the Touch Screen](#)

[Disable the Touch Screen](#)

Use the keyboard to run programs

Perform a Soft Reset (Warm boot)

Perform a Hard Reset (Cold boot) – Trimble ACU and TSCe

File Storage on Trimble Controllers

Change the speaker volume

Get rid of Out of Memory errors


In addition, there are several [controller functions](#) that you can access through the keyboard.


## Calibrate the Touch Screen

Trimble ACU or TSCe controller:

Open the Control Panel ( **Ctrl, Esc, [Settings / Control Panel]** ) then select the [Stylus] icon. In the [Stylus Properties] dialog select the [Calibration] >tab. Tap [Recalibrate] and follow the prompts, using the stylus to tap the target as it moves from the center of the screen, to each corner. If the calibration is successful, you are prompted to press **Enter** to accept the new settings. If the calibration was not successful, the target returns to the center of the screen and the process must be repeated.

## Disable the Touch Screen

To disable the Trimble ACU touch screen, press [Ctrl]+  key.

This disables the screen, but not the keypad. The touch screen will remain disabled until [Ctrl]+  key is pressed again or the controller is reset.

To disable the TSCe touch screen, press [Ctrl]+[Power key].

This disables the screen, but not the keypad. The touch screen will remain disabled until [Ctrl]+[Power key] is pressed again or the controller is reset.

The touch panel disable notice can be disabled. To do this go to [Start / Settings / Control Panel], in the [Touch Pad Disable] tab of the [Stylus Properties] screen, clear the [Show notice each time touch is disabled] check box.

## Use the keypad to run programs

To do this...	Use this keyboard shortcut...
Access a pull-down menu	<b>Alt</b> – then the appropriate letter key of the menu item.
Move between fields	<b>Tab</b> , up and down <b>Arrow</b> keys
Move between buttons	<b>Arrow</b> keys
Click a check box	<b>Space</b> Key
Close a screen	<b>Alt</b> then <b>F</b> then <b>C</b>

Switch between programs	<b>Alt</b> then <b>Tab</b> or <b>Alt</b> then <b>Esc</b>
Select an item from a list	<b>Space</b> key
Select a radio button	<b>Space</b> key

**Note** – To use keyboard shortcuts on the ACU, you must switch the ACU to Alpha mode.

### Use the keyboard to run programs, as follows :

- To run a program from the desktop:

If no desktop icons are highlighted, press the **Tab** key until one is selected. Then use the arrow keys to navigate to the icon for the program that you want to run. Press **Enter** to run the program.

- To run a program from the [Start] menu:


Press **Ctrl** then **Esc** to display the [Start] menu, then use the arrow keys to select [Programs]. Press **Enter** to display a list of programs, then use the arrow keys to select the program that you want to run. Press **Enter** to run the program.

- If there is no icon or [Start] menu listing:

If there are no icons highlighted on the desktop, press the **Tab** key until one is selected, then use the arrow keys to select [My Computer]. In [My Computer], use the arrow keys to highlight the Disk folder, then press **Enter**. Use the arrow keys to locate the program you want to run (it may be located in a sub folder), then press **Enter** to run the program.

### Perform a Soft Reset (Warm boot)

You do not lose any data when you perform a soft reset.

- To reset the ACU, hold down the **Shift** key and the **Ctrl** key, then press and release the  key.
- To reset the TSCe, hold down the **Shift** key and the **Ctrl** key, then press and release the **Power** key.

### Perform a Hard Reset (Cold boot) on a Trimble ACU or TSCe controller

Perform a hard reset only if a soft reset fails to resolve an issue.

After a hard reset, the operating system is reloaded into RAM from the Flash memory. Some software programs may also store shortcuts or database information in RAM; this is erased during a hard reset.

When you use a Trimble ACU or TSCe, data is stored on "Disk", and is retained when you perform a hard reset.

To perform a hard reset, hold down the **Power** key. After about five seconds, a countdown timer appears, indicating that the controller will reset. Continue to hold down the **Power** key for a further five seconds, then release it. The controller briefly displays the boot screen and then resets to the default Microsoft Windows desktop view.

## File Storage on Trimble Controllers

Trimble controllers have similar RAM and Flash storage.

However, the file storage systems on the ACU and the TSCe controllers are different from that of the Trimble CU and TSC2 controllers.

In all controllers, the RAM storage is volatile and is shared between Storage memory and Program memory.

- Storage memory is required for such things as the Operating System, and installing programs.
- Program memory is required to run programs. When Program memory is low, programs may run slowly, become unresponsive, or even crash.

Flash memory is permanent, so data is not lost if the controller loses power or after a hard reset. However, as with a computer hard disk, this storage may occasionally fail.

- On the Trimble ACU and TSCe, folders and files that appear in the [Disk] folder are stored in Flash memory; the other folders are in RAM.

Trimble ACU or TSCe controller:

[RAM Backup] creates a copy of the files stored in volatile RAM memory and stores this backup in Flash memory when the controller is turned off.

## Get rid of Out of Memory errors

Trimble ACU or TSCe controller:

Open the Control Panel ( **Ctrl, Esc, S, C** ) then select the [System] icon. In the [System Properties] screen, select the [Memory] tab, then move the slider-bar to the left to increase the amount of RAM memory allocated to running programs.

## Change the speaker volume

Trimble ACU or TSCe controller:

Open the Windows CE Control Panel ( **Ctrl, Esc, S, C** ) then select the Volume and Sounds icon. Use the slider to increase or decrease the volume. You can also use this dialog to turn on or off individual sounds, such as tapping the screen.

## Power Indicators

The remaining battery power is displayed as a battery symbol in the status bar.

The symbol on the top represents the power remaining in the Trimble controller battery.

The symbol below the top battery symbol represents the remaining power in an external power supply, such as



from a GPS receiver or conventional instrument. (This symbol only appears when an external power supply is connected.)

The level of shading in the symbol reduces as the power reduces.

## Attaching and Detaching Trimble ACU Controller

### Attaching the ACU Controller to the ACU Holder or the Trimble 5600.

**Warning** – Switch off the ACU before attaching it to the holder or when changing the batteries in the holder with the ACU attached. Otherwise, the on/off status of the ACU and the holder may become unsynchronised.

To connect the ACU to the ACU holder or the Trimble Total Station 5600:

1. Hold the controller with both hands.
2. Fit the groove on the back of the controller over the lower lip on the front of the holder.
3. Press down and rest the back of the controller flat against the holder.
4. Gently release downward pressure and guide the controller so that the teeth on the front of the holder click into the notches on top of the controller.

**Warning** – If attaching to a Trimble Total Station 5600, ensure the instrument is well supported during each step.

### Detaching the ACU Controller from the ACU Holder or 5600.

To detach the ACU from the ACU holder or the Trimble Total Station 5600:

1. Hold the ACU with both hands.
2. Press down gently and pull the controller towards you to release it from the teeth on front of the holder.
3. Release the downward pressure and lift the controller off the holder.

**Warning** – If detaching from a Trimble Total Station 5600, ensure the instrument is well supported during each step.

## Registration

Please remember to register your Trimble Survey Controller software by selecting the Register Software option on the CD. Registration gives you access to:

- News about software updates and specials
- New product information

Registration gives Trimble information that is used to develop the product and improve customer support.

## Legal Notices

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The Trimble Survey Controller software is covered by the following U.S. patents: 6985104, 6035254, 6021376, 6016118, 5969708, 5986604, 5831573, 5614913 and other patents pending.

## About

To access the *About* dialog, tap *Configuration / About Trimble Survey Controller*.

The dialog contains the program version number, serial number, authorization key, software warranty expiry date, copyright, and patent information for the Trimble Survey Controller software.

Tap *Upgrade* to install a new option key for upgrading the software options.

## Troubleshooting

**The message "Connection failed" appears when you try to connect to a Bluetooth cellular modem.** Some cellular modems have different Bluetooth modes. If the mode is set to [Off] or [Automatic], a "Connection failed" message may appear. For a successful Bluetooth connection, set the mode to [On].

**The message "Hardware Error –1" appears when you tap [Scan] in the [Bluetooth Device Properties] applet.**

Clear, then re-select the [Enable Bluetooth] check box.

**Bluetooth controller does not always find all the Bluetooth devices within the specified range**

A Bluetooth scan cannot always find other Bluetooth devices during the scan if there is another Bluetooth device scanning in the same area. If the device you are looking for is not found during a scan, wait a minute, and then scan again.

**Bluetooth device not registered**

If this message appears when you start an internet RTK survey, you have selected *Internet connection* as your rover radio when you are using a Trimble Internal GPRS module. You must select *Trimble Internal* as your rover radio and set the method to *GPRS internet*.

**Bluetooth scan finds a [(null)] device**

Sometimes during a Bluetooth scan, a Bluetooth device within range is found, but not the device name. In this case, a [(null)] name is returned. Re-scan for the device until the correct name is returned.

**Bluetooth operating range difficulties**

Bluetooth has an operating range of 10 meters (~33 feet).

**Bluetooth [Scan] cannot find the Trimble 5800 receiver**

If the Bluetooth connection between the 5800 receiver and a Trimble ACU or a TSCe with a BlueCap, has been disrupted, or if the receiver is already connected to another Bluetooth device, [Scan] may fail to find the receiver.

Switch off the receiver, then switch it on again. Enable the [Enable Bluetooth] check box if it has been cleared and do another scan. If the [Scan] still cannot find the receiver, perform a warm boot on the receiver. Do another scan.

**Intermittent communication errors when using Bluetooth**

Make sure that your body does not block the line-of-sight between the two devices that are communicating with Bluetooth.

**Initialization lost because of high RMS**

The receiver has discarded the current initialization because the measurement RMS has stayed too long above an internal cut-off value. This may be caused by too much pole movement when static, by a very bad environment, or by incorrect initialization. Check two or three points measured with the initialization that was lost. To do this, reinitialize in a good environment and remeasure the points. If the remeasurements agree within RTK tolerances, you can be confident that the initialization was correct and that a bad environment caused the loss of initialization.

**"Cannot start streamed corrections" message in internet survey**

Make sure that the Internet connection you are using works outside of Trimble Survey Controller. Connect to the Internet, browse one or two websites, and use Google.com or similar. Leave that connection open and start a survey with Trimble Survey Controller. If the survey still fails to start correctly, there may be a problem with the IP addresses or port numbers in the style, or the base station providing the data may not be operational.

**Conventional instrument behaving erratically**

Set the *HA VA status rate* to Never if the instrument screen blinks erratically or has problems maintaining communication with the Trimble Survey Controller software. Some instruments cannot support a high status update rate.

**Conventional instrument will not connect**

Always select the correct survey style in the Trimble Survey Controller software before connecting the controller to a conventional instrument. Otherwise, they may fail to connect. If this occurs, reset the

conventional instrument by switching it off and then on, and then try to connect again.

### **Modem is not responding**

This message may appear after a *Connecting to modem* dialog has to be cancelled because it goes on indefinitely. If this happens, power cycle the modem.

If you see the "Modem is not responding" message when connecting to an Enfora GSM/GPRS card, you may need to set the baud rate. To do this:

1. On the controller, tap [Start / Settings / Connections].
2. Tap the [Connections] icon and then select [Manage existing connections] under [My ISP].
3. Select the connection name for the Enfora card that you created earlier, and tap [Edit].
4. Tap [Next] twice and then tap [Advanced].
5. Set the [Baud rate] to 115200.
6. Tap [Ok] and [Finish] as required to exit the Enfora configuration.

### **"No Base Data" when Internet Surveying**

If you start an internet RTK survey and the *No base data* message appears, check the broadcast format, the initialization string for your modem, the IP address, and the port number of the base.

### **"No Carrier" message when dialling up an RTK base**

This message means that the base is not answering, or that the rover cannot get a dial tone. Call the base manually to make sure that it answers, and is not going to a voicemail system. Check that the rover has enough money on its account.

### **No communication between instrument and the Trimble Survey Controller software**

Check the cables, connections and switches. Also check the power source to the receiver or conventional instrument.

**Note** – Make sure that you have selected an appropriate survey style.

### **No coordinates in Review**

Check the *Coordinate view* setting. Tap *Options* to change the coordinate view.

To see grid coordinates in review, this setting must be grid. Also, to display grid coordinates, a projection and datum transformation must be defined.

In conventional surveys, check that the instrument and/or backsight point has been coordinated.

In conventional surveys, an observation is displayed with null coordinates until the observation to the backsight is stored.

### **No data recorded in receiver**

Check the Base and Rover options in the survey style. Is the logging device set to Receiver? Is the antenna connected? Is power connected?

### **No grid coordinates**

Check that a projection and datum transformation have been defined. Also check that the *Coordinate view* setting is Grid. To do this, select *Files / Properties of current job / Units*.

**Not receiving radio**

Check that all radio cables are connected to the correct ports and that the radio is switched on.

Check that the radios are configured correctly in the Survey Style.

Check that there are no obstructions (for example, trees or buildings). If there are, move to a place where the radio signals will not be obstructed.

Check that the base radio is switched on.

**Receiver does not turn on**

Check the cables, connections, and switches. Also check the power source.

**RTK survey will not work**

Check that you have selected an RTK Survey Style. Check that it is configured for RTK in the *Type* field in both the Base and Rover options. Check that the antenna is configured correctly in the *Antenna Type* field in Base and Rover options. Check that the radio is working and that it has been configured correctly.

**RTK precisions are too high**

Is RTK mode Fixed? If it is not, initialize the survey.

If the mode is Fixed, remain stationary on the point for a while and wait for the precisions to decrease. If you are in stakeout, tap *Fine* to go into fine mode.

**Satellite/s not being tracked**

Check that there are no obstructions – look at the azimuth and elevation of the SV in the *GPS / Satellites* screen. Check the GPS antenna connections. Check the elevation mask setting. Check that the satellite is not disabled – tap *Info* in the *Satellites* screen. Are there any transmitting antennas nearby? If there are, reposition the GPS antenna.

## Job Repair Wizard

The Job repair wizard runs when Trimble Survey Controller detects damage in the job file. You can cancel the wizard at any point or go back to any previous step.

The wizard retrieves job data up to the point of the damage, discards anything beyond this point, and informs you of the time and date of the last good item in the job.

As a safety measure, the wizard can make a copy of the job before anything is discarded. Before proceeding with the copy, check that the file system has enough space for a copy of the entire job.

Once the repair is completed, use *Files / Review current job* to check what (if anything) has been discarded from the end of the job. Because the job is stored in chronological order, anything discarded is timed later than the last good record reported by the wizard.

Be aware that discarded data may include changes made to the job such as deletions (the item may no longer

be deleted), changes to antenna or target heights, coordinate systems, and new items such as points, observations, and lines.

Damage to Job files may be caused by a hardware problem, a failure to properly shut down the Trimble Survey Controller program, or an unexpected power failure due to a flat battery. When the Job wizard reports a problem, review the controller's operating procedure, and/or check the hardware. If you repeatedly experience corruption problems, there may be a fault in your controller hardware. For more information, contact your local Trimble dealer.

# Job Operations

## Job

A job can contain several different surveys. Select a job before you measure any points or make any calculations.

To create a new job:

1. From the main menu, select *Files / New job*.
2. Enter a name for the new job.
3. Tap the *Coord. sys.* button and choose a [coordinate system](#) for the job. Tap *Next*.
4. Configure the coordinate system settings required for the job and tap *Store*.
5. Tap the [Units](#) button to specify the units and various other settings for the job. Tap *Accept*.
6. Tap the [Linked files](#) button to select a linked file(s) for the job. Tap *Accept*.
7. Tap the [Active map](#) button to select an active map file(s) for the job. Tap *Accept*.
8. Tap the [Feature library](#) button to associate a feature library with the job. Tap *Accept*.
9. Tap the [Cogo settings](#) button to set the cogo settings for the job. Tap *Accept*.
10. Optionally, tap the *Page down* button to enter *Reference*, *Description* and *Operator* details, and any *Notes*.
11. Tap *Accept* to save the job.

To open a job:

1. From the main menu, select *Files / Open job*.
2. Highlight the job name and tap *Select*.  
The job name appears in the title area of the main menu.

To delete a job:

1. From the main menu, select *Files / Open job*.

If the job you want to delete is not highlighted, use the arrow keys to highlight it, or tap and hold it with the stylus.

**Note** – If you tap with the stylus without holding, the job that you highlight opens automatically.

2. Tap *Delete*.
3. Tap *Yes* to confirm deletion, or *No* to cancel.

To copy a job:

1. From the main menu, select *Files / Open job*.
2. Highlight the name of the job to be copied and tap *Copy*.
3. Enter a name for the new job in the *To name* field and tap *Copy*. The complete job is copied.

**Tip** – You can also use *Windows/File Explorer* to copy, rename, or delete a file.

To create a new job with all the defaults (including Coordinate System settings) from another job:

1. From the main menu, select *Files / Open job*.
2. Select and open the job that contains the settings to use as the defaults for the new job.

**Note** – To use the settings in the **current** job as defaults for the new job, omit steps 1 and 2. New jobs always use the settings from the previous job as defaults.

3. From the main menu, select *Files / New job*.
4. Enter a name for the new job.
5. Tap the appropriate button to change job settings as required.
6. To save the job, tap *Accept*.

## Properties of Current Job

Use this menu to configure settings for the current job.

For more information, see:

[Coordinate system](#)

[Units](#)

[Linked files](#)

[Active map files](#)

[Feature library](#)

[Cogo settings](#)

[Descriptions](#)

Each button displays the current settings. When you create a new job, settings from the previous job are used as the defaults. Tap a button to change the settings.

Tap *Accept* to save any changes.

## Review Current Job

To see the records stored in the job database:

1. From the main menu, select *Files / Review current job*.



2. Use the arrow keys, stylus, or softkeys to navigate the database.

**Tip** – To move to the end of the database quickly, highlight the first record and press the up arrow key.

**Tip** – To highlight a field without selecting it, tap and hold briefly with the stylus.

3. To see more information about an item, tap the record. Certain fields, for example, *Code* and *Antenna height*, can be edited.

**Note** – Offset points that are stored as coordinates are not updated when you change an antenna or target height record in the database. In addition, a change in antenna height does not affect any postprocessed points that will be processed using the Trimble Geomatics Office software.

Verify the antenna or target height information when you transfer the data to the office computer or transfer postprocessed points directly from the receiver to the office software.

When you change an antenna or target height record in the database, stakeout deltas, Cogo points, averaged points, calibrations, resections, and traverse results are not automatically updated.

Re-observe staked out points, and re-calculate Cogo points, averaged points, calibrations, resections, and traverses.

To search for a particular item, tap *Search* and select an option.

**Tip** – To review features from the *Map of current job* screen, select the required feature(s), tap and hold on the screen and choose *Review* from the shortcut menu.

## Inserting notes

To store a note in the database:

1. Highlight a record.

**Tip** – To highlight a field without selecting it, tap and hold briefly with the stylus.

2. Tap *Note*. The *Note* screen that appears displays the date and time that the current record was created.
3. Enter the note and then tap *Accept*. The note is stored with the current record. In *Review current job*, the note appears below the record with the note icon.

## Editing target/antenna records using *Review current job*

Select *Review current job* to edit existing antenna or target height records. These edits change the antenna or target height for all observations using that antenna or target height.

To edit a target/antenna record:

1. Tap the target/antenna record. The current target (conventional survey) or antenna (GPS survey) details appear.
2. Enter the new details and then tap *Accept*.

The current record is updated with the new details, which apply to all subsequent observations using that record.

A note with a timestamp is attached to the record. This note documents the old details, including when the changes were made.

### **Editing target/antenna records using Point manager**

Use [Point manager](#) to easily change the target or antenna height of a single observation or any number of observations.

### **Editing codes using Review current job**

If you have only a single code to edit, you can use *Review current job*.

To edit a code:

1. From the main menu, select *Files / Review current job*.
2. Tap the observation record that contains the code you want to edit.
3. Change the code and then tap *Accept* to store the changes.

The Note stored with the observation is a record of the old code and the date and time it was modified.

### **Editing codes using Point Manager**

You can use *Point manager* to edit single or multiple codes.

When you edit multiple codes, the *Point manager* is easier to use than *Review current job*.

For more information, see [Point manager](#).

### **Deleted points, lines, and arcs**

A deleted point, line, or arc is not used in calculations, but it is still in the database. Deleting points, lines, or arcs does not make a job file smaller.



When you transfer a file that contains deleted points, the deleted points are not transferred to the office software. If you transfer a file using the Trimble Data Transfer utility, however, the deleted points are recorded in the Data Collector (.dc) file. They have a classification of Deleted.

Some points, such as continuous offset points and some intersection and offset points, are stored as vectors from a source point. If you delete a source point, any point stored as a vector from that point has null (?) coordinates when you review the database point record.

To delete a point, line, or arc in the Trimble Survey Controller database:

1. From the main menu, select *Files / Review current job*.
2. Highlight the point, line, or arc to be deleted and tap *Details*.

3. Tap *Delete*. For points, the search class changes to Deleted (normal), Deleted (control), Deleted (staked), Deleted (backsight), or Deleted (check), depending on the original search classification.
4. Tap *Accept*. The Trimble Survey Controller software records a note with the original point, line, or arc record, showing the time it was deleted.

When you delete a point, line, or arc, the point symbol changes. For example, for a topo point, the  symbol replaces the  symbol.

When you delete an observation that has been recorded during a [Station setup plus](#), a [Resection](#), or [Measure rounds](#) operation, the mean turned angle records and station or round residuals records will not be updated. Deleting an observation that has been used to compute an average does not automatically update the average. Use *COGO / Compute average* to recompute the average.

**Tip** – To delete features from the *Map of current job* screen, select the required feature(s), tap and hold on the screen and choose *Delete* from the shortcut menu. Select the feature(s) to delete and then tap *Enter*. You cannot delete points from a linked file.

**Note** – You cannot delete points, lines or arcs from a linked map file (for example, a DXF or SHP file).

To restore a point, line, or arc in the Trimble Survey Controller database:

1. From the main menu select *Files / Review current job*.
2. Tap the point, line, or arc record to be restored.
3. Tap *Undelete*.
4. Tap *Accept*.

## Point Manager

As an alternative to *Review current job*, use the *Point manager* to manage your data.

You can easily review:

- Point coordinates
- Observations
- The [best point](#) and all duplicate points
- Target and antenna heights
- Codes and notes
- Descriptions
- Notes

You can easily edit:

- Target and antenna heights (single or [multiple](#))
- Codes (single or [multiple](#))
- Descriptions (single or multiple)
- Notes

## Using Point manager

To open *Point manager*, select *Files / Point manager* from the main menu. The screen that appears shows a tabulated tree structure of all points and observations in the job database and linked files.

### Viewing the data

When there are duplicate points of the same name, the best point always appears first. All occurrences of points of the same name, including the best point, appear in a list below the best point. However, when the data is in the *Target height* view, all observations in the database appear in the order that they occur in the database.

To change the view of the data, select *Display*. For example, to view coordinates, set *Display* to Grid; to view or edit target heights, set *Display* to Target height.

**Note** – In *Point manager*, the *Target height* setting refers to both antenna height and target height.

To sort the data, tap the column heading.

To change the width of the column, or to hide the column, tap and drag the separator between headings.

Use the scroll bars to scroll horizontally or vertically through the data.

To filter the displayed point information, tap *Filter*. Select the column to filter point information from and then enter the filter details. The points are filtered so that only those in the selected column, and that contain the filter details, appear.

**Note** – To see a complete list of the icons and their descriptions used in the Trimble Survey Controller software see the [filter table](#).

**Tip** – If there are too many matches, enter a more restrictive filter string or use the *Match whole word only* check box to narrow the search parameters.

To disable the filter, clear the *Filter* field.

To view more information on a point do one of the following:

- To reveal all associated points and observations, tap + to expand the point tree list. Expand the subtree to view individual point information. These records can include the point coordinates, observations, antenna or target details, and quality control records.
- To open the same point form as seen in *Review current job*, tap a point, or highlight a point and tap *Details*. This allows you to edit information such as the point code and attributes.

To change the format of the indented coordinates or the observations that appear when you expand the point tree, tap the coordinates or observations displayed, or highlight them and press the space key. In the list that appears, select the new data view.

This allows you to review the raw conventional observations (or WGS–84 observations) and the Grid coordinates at the same time.

## Reviewing and editing antenna and target heights

**Note** – In *Point manager*, the *Target height* setting refers to conventional target heights and the GPS antenna heights.

To change a target height record and update **all** observations using that target height record, edit the target height in [Review current job](#).

To change an individual target height, or group of target heights, in *Point manager*:

1. From the main menu, select *Files / Point manager*.
2. Tap *Display* and then select *Target height*. In the screen that appears, the point name, from point, target height, code, and note are listed in the order they exist in the database.

- To change the record order, tap the appropriate column heading.
- To filter the list, tap *Filter*, select the appropriate column and then enter the filter details.

**Tip** – If you enter a filter value of 2 for a point name, the system will show all points with 2 in their name, including 2, 1002, 2099, or 2day. To filter for a point name "2", select the Match whole word check box.

3. To select a target or multiple targets for editing, do one of the following:

- Tap the *Target* field.
- Use the arrow keys to highlight the record to edit and then tap *Edit*.
- To select multiple fields, press and hold *Ctrl* and then tap the required fields. Then tap *Edit*.
- To select a range of fields, tap the first required field, press and hold *Shift* and then tap the last required field. Then tap *Edit*.

4. In the *Target details* form enter the new *Target height* and/or *Prism constant*. To store the changes, tap *OK*.

When measuring to the bottom notch on a [Trimble prism base](#), tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

Point manager now displays the corrected target details. In *Review current job*, view the inserted target records with notes that record the old target details.

## Group editing Target heights (conventional) and Antenna heights (GPS)

You can use the *Point manager* to edit details of antenna heights or target heights for multiple–selected points. This function is available when the *Display* softkey setting in the *Point manager* is set to *Target height*. Use the standard Windows selection methods of *Ctrl–click* and *Shift–click* to choose the points to apply the target or antenna height edits to.

- When you edit antenna heights, you can edit the measured heights and the measurement method.

- When you edit target heights, you can edit the measured target height value, the measurement method (when applicable), and the prism constant.
- When you select points to edit, you can include points with target heights and points with antenna heights. When you tap *Edit*, two dialogs appear – one to edit antenna heights and one to edit target heights.
- You do not need to select contiguous target and/or antenna heights to edit.
- You cannot edit a selection of antenna heights that includes more than one type of antenna. In this case, select and edit the points in separate groups, according to the type of antenna used.
- You can edit a selection of different targets. In such a case, the new target heights are applied to each of the different targets but the target numbers remain unchanged.
- Some conventional measurements use calculated (system) targets, which have a zero height and zero prism constants, for example, Dual-prism offset. You cannot edit the target heights for system targets.
- You can sort *Point manager* columns to help you find and select groups of target or antenna heights to edit. Tap the column heading to sort that column.
- The *Point manager* automatically inserts the appropriate target and antenna equipment records into the job database to ensure that the correct heights and measurement methods are assigned to each point.
- When you edit points, the *Point manager* automatically inserts notes into the job database to record what was edited, the original measurement data, and the time of the edit.

### **Adding or editing codes using Point manager**

To enter a code or change an existing code, tap the *Code* field. Enter the code details, and the attributes, if required. Tap *Accept* to store the changes.

### **Group editing codes using Point Manager**

You can use the *Point manager* to edit code details for more than one point at a time.

1. Use the standard Windows selection methods; press **Ctrl** or **Shift** and tap the records for which you want to change the code.
2. Tap *Edit* and then select *Codes*.
3. Enter the new code and then tap *Enter*.

If the code has attributes, you are prompted to enter them.

The new codes are updated and displayed in the *Point manager*. A note with the old code value is stored for each modified record.

**Tip** – You can edit Descriptions in the same way.

### **Adding or editing notes using Point manager**

To enter a note or change an existing note, tap the *Note* field. Enter the note details and then tap *Accept* to store the changes.

## QC Graph

The *QC Graph* screen displays a graph of quality indicators that are available from data in a job. To change the type of data to display, tap *Display*. To scroll along the graph, use the arrow buttons. To view basic details of a point, tap the graph. For more information, double tap the graph to access *Review*.

You can view a graph of:

- Horizontal precision
- Vertical precision
- Satellites
- PDOP
- RMS
- HA standard error
- VA standard error
- SD standard error
- Elevation
- Target height

## Storing Points

How you record a point determines how it is stored in the Trimble Survey Controller software. Points are stored either as vectors or as positions. For example, RTK points and conventionally observed points are stored as vectors, while keyed-in points, real-time differential points, and postprocessed points are stored as positions.

To review details about a stored point, from the main menu, select *Files / Review current job*. A point record contains information about the point, such as the point name, the code, the method, the coordinates, and the GPS data file name. The *Method* field describes how the point was created.

The coordinates are expressed as WGS-84, local, or grid coordinates, depending on the setting in the *Coordinate view* field. To change a *Coordinate view* setting, do one of the following:

- Select *Files / Properties of current job / Units*.
- Select *Files / Review current job*. Access the point record and then tap *Options*.

**Note** – Define a datum transformation and/or a projection if you want to display local or grid coordinates for a GPS point. Alternatively, calibrate the job.

Each point record uses the antenna height given in the previous antenna height record. From this, the Trimble Survey Controller software generates a ground height (elevation) for the point.

The following table shows how the point is stored in the *Stored as* field.

Value	What the point is stored as
Grid	Grid coordinates

Local	Local geodetic coordinates
WGS-84	WGS-84 geodetic coordinates
ECEF	WGS-84 Earth-Centered-EarthFixed X , Y , Z coordinates
ECEF deltas	WGS-84 Earth-Centered-EarthFixed X , Y , Z vector
Polar	Azimuth, horizontal distance, and vertical distance. This is a vector.
HA VA SD	A horizontal circle reading, vertical circle reading (a zenith angle), and slope distance. This is a vector.
HA VA SD (raw)	A horizontal circle reading, vertical circle reading (a zenith angle), and slope distance with no corrections applied. This is a vector.
Mag.Az VA SD	A magnetic azimuth, vertical (zenith) angle, and slope distance vector.
MHA MVA MSD	A meaned horizontal angle from the backsight, meaned vertical angle (a zenith angle), and meaned slope distance. This is a vector.

Read the *Stored as* field in conjunction with the *Method* field.

For points calculated using *Cogo/Compute point*, you can choose how to store that point. The available options depend on the selected coordinate system and the type of observation used in computing the point.

**Note** – Points stored as vectors are updated if the calibration or coordinate system of the job changes, or the antenna height of one of the source points is changed. Points stored as WGS-84 coordinates (for example, an offset point calculated using the *From a baseline* method) are not updated.

For GPS points, Quality Control (QC) records are stored at the end of the point record.

## Point Classification

When points are stored they have either one or two classifications:

- Points that have been measured using GPS have an observation class and a search class.
- Points that have been keyed in, computed, or measured with a conventional instrument or laser rangefinder have only a search class.

## Observation class

For real-time surveys, the observation class is L1 Fixed, L1 Float, WA Fixed, WA Float, or L1 Code, and precisions are recorded. For postprocessed surveys, the observation class is autonomous and no precisions are recorded.

The following table lists the observation classes and resulting solutions.

Observation class	Result
L1 Fixed	An L1 fixed real-time kinematic solution.
L1 Float	An L1 float real-time kinematic solution.
L1 Code	An L1 code real-time differential solution.



Autonomous	A postprocessed solution.
WAAS	A position that has been differentially corrected using WAAS/EGNOS signals.
WA Fixed	A fixed solution using Wide Area processing.
WA Float	A float solution using Wide Area processing.

## Search class

A search class is applied to a point when it is measured, keyed in, or computed. The search class is used by the Trimble Survey Controller software when details of a point are required for stakeout or calculations (for example, for Cogo calculations).

For more information, see [Database search rules](#).

## Map of Current Job

The *Map of current job* screen is a graphical representation of features from multiple sources:

- points, lines, and arcs from the current job database
- points, lines, and arcs from linked jobs and linked CSV files
- points, lines, arcs, and other map entities from [map files](#) (for example DXF and SHP files)
- Trimble roads defined as .rxl files and stored in the Trimble data folder

You can move around the map and select features for [common tasks](#) such as Cogo and stakeout.

To access the *Map of current job* screen:

1. Tap *Map*. The current position of the GPS antenna is displayed as a vertical/horizontal cross. The current orientation of a conventional instrument is shown by a dotted line extending from the instrument to the end of the screen. The location of the prism is shown as a cross when a distance is measured.
2. Tap *Map*. The current position of the GPS antenna is displayed as a vertical/horizontal cross.
3. Use the [map softkeys](#) to navigate around the map.

**Note** – Only grid coordinates are displayed. If you have not defined a projection, only points stored as grid coordinates appear.

If there is a point with the same name as another point in the database, the point with the higher search class is displayed. For more information about how the Trimble Survey Controller software uses search classes, see [Database search rules](#).

**Note** – If the *Grid coords* field in the [Cogo settings](#) screen is set to Increase South–West or Increase South–East, this screen is rotated by 180°. The letter N on the north arrow denotes Grid 0°.

## Map Softkeys


Use the map softkeys to:



- navigate around the map
- change the map display options

Some softkeys can operate in an "active" mode. The effect of tapping on the map depends on the active softkey selected.

The functions are described in the following table:

Softkey	Function
+	Tap this softkey to zoom in. Tap and hold the softkey to make it active. Tap the area of the map to zoom in on, or drag to create a box around the area of interest.
–	Tap this softkey to zoom out. Tap and hold the softkey to make it active. Tap the area of the map to zoom out from.
<i>Pan</i>	Tap this softkey to shift the center of the map area to another part of the map. Tap the softkey to make it active. Tap an area of the map to center on, or tap and drag the map area to where you want to pan.
	Tap this softkey to show all features on the screen. Tap the softkey to make it active.

Click the up arrow to access more softkey functions. The additional functions are described in the following table.

<i>Filter</i>	Shows a legend for the feature symbols and lets you choose which features are displayed.
<i>Pan to</i>	Displays the <i>Pan to point</i> screen. Enter a point name and scale value.
<i>Options</i>	Controls how name or code labels appear next to points in the map.
	Controls the options to display the points symbols and coded features for each point. If the <i>Display coded features</i> check box is selected, Trimble Survey Controller software draws lines between points that have feature codes with certain display properties. When you create or edit a feature code, use the <i>Display</i> softkey to specify the display features of the feature code.
	Controls the option to display points from the stakeout list in the map. To do this, set the <i>Display stakeout list</i> points field to Yes.
	Controls the <a href="#">Automatic pan to your current position</a> option.
	Tap the automeasure option to automatically start a measurement when you press the measure key.
	Controls the option to display elevations in the map.
	Controls the option to display the map in <a href="#">Widescreen mode</a> .
<i>Layers</i>	Controls the display of one or more active map files or layers.
	Controls the selectability of one or more active map files or layers.

## Zoom Previous and Zoom Default

In the map view, tap and hold the map softkey to display more navigation options:

- Zoom to the previous view
- Zoom to a default scale and location
- Set a default scale and location

## Widescreen mode

The map appears in widescreen mode across the entire width of the screen.

To access the status bar while the map is in widescreen mode, tap the mini status bar icon in the upper right corner of the map. The status bar appears for approximately three seconds, after which time the map returns to widescreen.

To change the widescreen mode, do one of the following:

- Tap and hold in the map window and then select *Widescreen*
- Tap *Options* within the map screen and then select the *Widescreen* setting
- Press the '.' key on the controller

## Filter

Use the *Filter* softkey to control:

- points to select. For example, tap *Stakeout / Points / Add / Select from list / Filter*.
- features to display. For example, tap *Map / Filter*.

Tap an item to select it. Tap it again to clear it. A check mark beside an item shows that it is selected.

Use the *All* and *None* softkeys to aid selection.

The icons that appear in many parts of the Trimble Survey Controller software are shown below. For example, point lists, map graphics, point manager, and job review.

Icon	Description	Icon	Description
×	Topo points (GPS)	田	Rapid points
⌕	F1 Topo points (Conv.)	*	Laser points
✕	F2 Topo points (Conv.)	✕	Resection points
∇	Mean turned angle	▪	Continuous points
†	As-staked points	⊕	Copied control points
●	Keyed in points (normal)	⊕	Copied construction points
▲	Keyed in points (control)	⊕	Copied normal points
⊗	Calibration points	⊕	Copied as staked points
□	Cogo points (computed)	↻	Adjusted points

▪	Construction points	Ⓢ	Copied adjusted points
⊙	Observed control points	↗	Lines
△	FastStatic points	↪	Arcs
⋈	Base points	◆	Active map points
✓	Check points	⚡	Linked file points
○	Offset points	///	Roads
⊕	Intersection points		

**Note** – Face 1 and Face 2 Topo points may be suffixed by a number 1 to 5, for example  $\text{K}^3$ . The number represents the target number used with that observation.

## Using the Map for Common Tasks

The *Map of current job* screen is a graphical representation of features from multiple sources:

- points, lines, and arcs from the current job database
- points, lines, and arcs from linked jobs and linked CSV files
- points, lines, arcs, and other map entities from [map files](#) (for example DXF and SHP files)
- Trimble roads defined as .rxl files and stored in the Trimble data folder

You can move around the map and select features for [common tasks](#) such as Cogo and stakeout.

To select a feature from the map, do one of the following:

- Tap the required feature(s) from the map area. If there is more than one feature in the highlighted area, a list of features in this area appears. Select the features as required. To return to the map, tap *OK* or tap off the list.
- Drag a box around the features you want to select.

To select a feature from a map file, the map file or layers must be made selectable.

To deselect a feature from the map, do one of the following:

- Tap the selected feature to deselect it. If there is more than one feature within the highlighted area, a list of features within this area appears. Deselect the features as required. Tap *OK* or tap off the list to return to the map.
- Tap and hold on the map and select *List selection* from the shortcut menu. A list of the selected features appears. Deselect the features as required.
- To clear the entire selection, double-tap off the selected features. Alternatively, tap and hold on the map and select *Clear selection* from the shortcut menu.

To carry out a task using the selected feature(s), do one of the following:

- Measure

- ◆ If there are no features selected, tap *Measure* to measure the current position.

**Tip** – To change the code when using *Measure* from the map, make sure that there are no features selected, then tap and hold on the map and select *Set point code*.

- Stakeout

- ◆ If one or more features are selected, tap *Stakeout* to stake out the selected feature(s).  
If more than one point is selected, the points are added to the *Stake out points* list, from where you can select them for stakeout.
- ◆ If more than one line or arc is selected, the first item selected is the one used for stakeout.
- ◆ Double-tap a feature to stake out.  
If there is more than one feature within the highlighted area, a list of features within this area appears. Select the feature to stake out.

**Tip** – If two points are selected, tap and hold on the map and then select *Stake out line* to stake a line defined by the two selected points.

If the selection contains different feature types (points, lines, arcs), only features of the first type selected can be staked out from the map. To stake out other feature types, clear the selection then reselect the other features.

## Shortcut menu

Tap and hold on the map area to access a shortcut menu. The shortcut menu provides quick access to common tasks. The tasks depend on the number and type of features selected.

In the following table, the \* symbol against a task shows that you can access it through the shortcut menu for the feature at the top of that column.

Task	Feature					
	No Features	One point	Two points	Three or more points	Line	Arc
Review	—	*	*	*	*	*
List section	—	*	*	*	*	*
Clear section	—	*	*	*	*	*
Widescreen	*	*	*	*	*	*
Delete	—	*	*	*	*	*
Stakeout point	—	*	*	*	—	—
Stakeout line	—	—	*	—	*	—
Stakeout arc	—	—	—	—	—	*
Measure calibration point	—	*	—	—	—	—
Navigate to point	—	*	—	—	—	—
Turn to point	—	*	—	—	—	—
Compute inverse	—	—	*	*	—	—
Compute area	—	—	—	*	—	—

Subdivide a line	—	—	—	—	*	—
Subdivide an arc	—	—	—	—	—	*
Key in point	*	—	—	—	—	—
Key in line	—	—	*	—	—	—
Set point code	*	—	—	—	—	—

The menu items that are available for features in a linked file or active map file are shown below.

Task	Feature				
	One active map or linked file point	Two active map or linked file points	Three or more active map or linked file points	Active map line	Active map arc
Review	*	*	*	*	*
List section	*	*	*	*	*
Clear section	*	*	*	*	*
Widescreen	*	*	*	*	*
Delete	—	—	—	—	—
Stakeout point	*	*	*	—	—
Stakeout line	—	*	—	*	—
Stakeout arc	—	—	—	—	*
Measure calibration point	*	—	—	—	—
Navigate to point	*	—	—	—	—
Turn to point	*	—	—	—	—
Compute inverse	—	*	*	—	—
Compute area	—	—	*	—	—
Subdivide a line	—	—	—	—	—
Subdivide an arc	—	—	—	—	—
Key in point	—	—	—	—	—
Key in line	—	*	—	—	—
Set point code	—	—	—	—	—

**Note** – If you select a point with the same name as another point in the database, then select the *Review* or *Delete* option from the shortcut menu, a list of the duplicate points appears. Select the point you want to review or delete.

- Field fill-in. Enter feature names into fields by selecting from the map. Select the feature(s) from the map then select a survey function, such as Cogo or Stakeout. The selected feature(s) are automatically entered into the appropriate fields.
- Map selection list. The *Map selections option* is available on the right side of the feature name field when you have selected features from the map. Tap it to access the list of the selected features. Only features that are specific to the field are shown.

You cannot use Trimble Survey Controller to delete points from linked files. Points from linked files do not appear in the *Review* screen list of deleteable points.

## Autopan

The Autopan function automatically centers the map using the current position. Autopan only operates when the current position appears within the selected map view.

To automatically view your current position:

1. In the Map of current job screen, tap the Up arrow.
2. Tap *Options*.
3. Select the *Automatic pan to current position* check box.
4. Tap *Accept*.

## Units

You can specify the units, such as degrees and meters, used by the Trimble Survey Controller software.

You can also specify the order of the displayed coordinates, the type of coordinates, the way a slope grade is displayed, and how stationing values are displayed.

To configure the units display, select *Files / Properties of current job / Units* and change the fields as required.

The order for the displayed coordinates can be set to:

- North–East–Elev
- East–North–Elev
- Y–X–Z
- X–Y–Z

For the Y–X–Z and X–Y–Z options the convention used defines that the Y axis is the East axis and the X axis is the North axis.

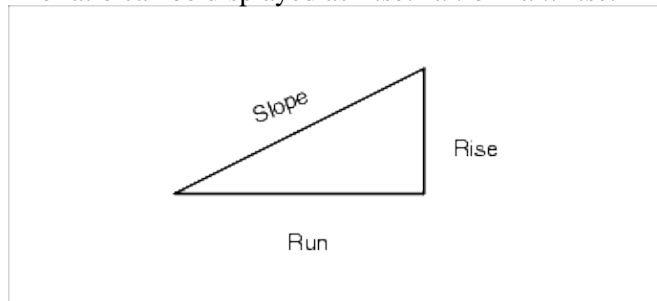
The following table describes the coordinate view options.

Option	Description
WGS–84	View as WGS–84 Latitude, Longitude, and Height
Local	View as local ellipsoidal Latitude, Longitude, and Height
Grid	View as Northing, Easting, and Elevation
Station and Offset	View as station, offset, vertical distance relative to a line, arc or road
ECEF (WGS–84)	View as Earth–Centered–Earth–Fixed WGS–84 X, Y, Z coordinates
Az VA SD	View as azimuth, vertical angle, and slope distance

HA VA SD (raw)	View as horizontal angle, vertical angle, and slope distance
Az HD VD	View as azimuth, horizontal distance, and vertical distance
HA HD VD	View as horizontal angle, horizontal distance, and vertical distance
Delta Grid	View as differences in Northing, Easting, and Elevation from the instrument point

In some fields (for example, *Azimuth*), you can enter a value in units other than the system units. The *Units* softkey appears in these fields. When you tap *Enter* to accept the field, the value is converted to the system units.

The grade of a slope can be displayed in one of the following formats: angle, percent, or ratio. The ratio can be displayed as *Rise:Run* or *Run:Rise*.



The setting in the *Laser VA display* field determines whether the laser measurements are displayed as vertical angles measured from the zenith, or inclinations measured from horizontal.

## Linked Files

You can link files (\*.csv, \*.txt, or \*.job) to your current job to provide easy access to additional data.

**Note** – In a linked job, you cannot access roads, lines, or arcs.

Use a linked file to access points that do not exist in the current job, or that you do not want to import into the current job. Linked CSV points appear as a comma ( , ). Linked points from another job appear with their original point symbol. All linked points appear blue. You can use points from a linked file to:

- stake out without having the design points in the job
- enter values into *Point name* fields, such as for Cogo functions
- navigate to control or check shots from previous surveys

### Notes

- You can only review points in a linked file from the map. Once you select a linked point and copy it into the current job, it appears as a "c" in the map.
- You can link multiple files (\*.csv \*.txt \*.job). When the point does not exist in the current job, but does exist in multiple linked files, the point in the first linked file is used. If multiple points of the same name exist in a linked job, the [search rules](#) work within that job to find the best point.

### Transferring linked files



You can transfer linked CSV files from the office computer, transfer files between controllers, or export points to a CSV file from a previous job.

Before you transfer a CSV file, make sure the data in the file is in the format: Point name, First ordinate (Northing or Easting), Second ordinate (Northing or Easting), Elevation, Point code.

**Note** – The coordinate order (Northing and Easting ordinates) in the comma delimited file must be the same as the setting in the *Coordinate order* field in the *Units* screen.

To transfer a CSV file from the office computer to the \Trimble Data folder on the Trimble controller, use the Data Transfer utility or the Microsoft ActiveSync technology. For more information, see [Transferring Files between the Controller and the Office Computer](#).

To transfer files between controllers, use the controller's *File Transfer Application*. Select *Files / Import/Export / File Transfer Application*.

For more information, see [File Transfer Application](#).

Use the Data Transfer utility or the Microsoft ActiveSync technology to transfer the file from the office computer to the \Trimble Data folder on the Trimble controller. For more information, see [Transferring Files between the Controller and the Office Computer](#).

To select linked files:

1. From the Trimble Survey Controller main menu, select *Files / Properties of current job* and tap the *Linked files* button. The *Linked files* screen appears.
2. Tap the file(s) that you want to use for the current job or tap *All* to select all files.

To import points from a linked file to the current job, select *Files / [Import/Export](#) / Receive data from another device*.

When using points from linked files, make sure that they use the same coordinate system as the job that they are being brought into.

### Staking out points from a linked file

To stake out a point from a linked file, do one of the following:

- From the [map](#), select a point to stake out.
- Add a point to the *Stake out points* list using the *Select from file* option.

**Note** – When you add points to the stakeout list using the *Select from file* option, if the point already exists in the current job, points in linked files are not displayed.

### Entering point name fields

To enter a point from a linked file into a *Point name* field, access the field and key in the point name. A linked point entered into a point name field is copied into the current job database.

## Active Map

Trimble Survey Controller software supports the display of AutoCAD (ASCII) files (\*.dxf) and ESRI Shape files (\*.shp).

You can control the visibility and selectability of active map files. Selectable features in map files can be used in the following operations:

- Navigate to a point
- Stakeout – points, lines, arcs
- Active map lines and arcs can be selected for stakeout only from the map.
- Cogo calculations – points only
- Active map lines and arcs cannot be used in Cogo calculations
- Review from the map

Files that support layers enable you to control visibility and selectability in each layer. If there are no layers, you can control the visibility and selectability of the entire file.

- Autocad DXF files support layers
- ESRI Shape files do not support layers

Points, lines, and arcs in the current job database appear in black.

Active points in map files appear in blue.

Lines and arcs appear in the colours defined in the map file.

### Using Maps:

1. To transfer the files to the controller, use the Trimble Data Transfer utility or Microsoft ActiveSync technology.
2. To select a map to view in the [Map of current job](#) screen, do one of the following:
  - ◆ Select *Files / Properties of current job / Active map*.
  - ◆ Tap the *Map* button, tap the Up softkey to access additional softkey functions and then tap *Layers*.

All map files appear in a tree list view.



3. The following table shows how to display, make selectable, and disable active map files and layers:

Tap...	
+	to expand the file to display all layers
–	to minimize the file and hide all layers
the file name	once to display all layers within the map file
	again to make all layers within the map file selectable
	again to disable all layers within the map file
the layer name	once to display all layers within the map file
	again to make all layers within the map file selectable
	again to disable all layers within the map file

<i>All</i>	once to display all layers within the map file
	again to make all layers within the map file selectable
<i>None</i>	to deselect all files and layers

Once the file is loaded, you can switch between the map view and the select map file screen and then select or deselect the layers you want to view.

The following table explains the icons that appear beside the file names.

<b>File icon</b>	<b>Layer icon</b>	<b>indicates...</b>
No icon	No icon	the file is not selected
✓	–	all layers within the map file are visible in the map
–	✓	the current layer is visible in the map
	–	all layers within the map file are visible and selectable in the map
–		the current layer is visible and selectable in the map
✓	–	some layers are visible in the map
–	×	there are no supported entities in the layer to display

## Notes

- If the selectable icon does not appear beside the layer name, the layer does not contain any features that can be selected.
- A name is generated for every selectable feature within the map file. The first five characters are derived from the map file name, followed by a space and an autogenerated number.
- A code can be generated for every selectable feature within a map file. This is derived from the attributes stored in the DXF file; often, it is the name, code, and attributes of features in the original file.
- You can review a selectable feature in the map to find the file and layer name.
- Map files are loaded into the job when the map is opened or when the map selection screen is opened.
- You can display more than one map at a time.
- Map features can be made visible and selectable but they can not be edited or deleted.
- Supported DXF entities are 3D FACE, ARC, CIRCLE, INSERT, LINE, LWPOLYLINE, POINT, POLYLINE, and TEXT.
- Supported Shape entities are Null shape, Point, PolyLine, Polygon, MultiPoint, PointZ, PolyLineZ, PolygonZ, MultiPointZ, PointM, PolyLineM, PolygonM, MultiPointM, and MultiPatch.

## Using a Feature and Attribute Library

To select a code in a survey, first select the library that you want to use:

1. From the main menu, select *Files / Properties of current job*.
2. Tap the *Feature library* button and select the library that you want to use.

**Note** – Feature and attribute libraries cannot be used in Description fields.

To choose a code from the library:

1. In the *Code* field, enter the first character of the required feature code. The feature code list is filtered according to the type of controller that you are using and the Auto-complete setting:

Trimble controller	Auto-complete on	Auto-complete off
TSCe	The feature code list is always filtered according to the characters that you enter. When you type a character, the first available code that starts with that character appears.	The feature code list is always filtered according to the characters that you enter. Only the character that you enter appears and is used to filter the feature code list.
ACU	You do not need to put the controller into alpha mode to select an alpha code. The feature code list is filtered according to the characters available on the controller key that you pressed. For example, if you press "2", the list is filtered on a "2", and the associated keypad characters "T", "U", and "V". The first available code that starts with one of these characters appears.	The Trimble Survey Controller software maintains the alpha or numeric setting. Only the character that you enter appears and is used to filter the feature code list.

2. To further filter the feature code list, enter additional characters. Use the arrow keys to scroll to the required code, or if the required code is already displayed, tap *Enter* to accept this code and move to the next field.

When you select a code from the list, filtering is disabled and the entire feature code list appears, which allows you to select another code.

To enter multiple codes, select each code in turn from the list.

As you select multiple codes from the list, the system automatically enters a space to separate the codes. If you enter codes through the controller keypad, you must enter a space after each code to display the entire code list again before you enter the next code.

The maximum number of characters in a code field is 42.

**Note** – If a feature code list is already selected for the job, you can use codes from the list when keying in a note. From the *Note* screen, press *Space* to display the feature code list. Select a code from the list or type the first few letters of the code.

### How to use the Code field when using feature code libraries

Feature code entry has been improved to make selection faster and more flexible.

If you use a feature and attribute library, when you access the code field on forms in the Trimble Survey Controller software, a *Code list* dialog appears with special controls to help you select codes from the feature

code list.

Selection improvements in the code field:

- To select the entire code in the code list window, click anywhere in the code field, or press the controller left or right arrow when on a code field.
- A partial selection made in the code field is retained in the *Code list* dialog.

When the *Code list* dialog is active:

- To replace the code:
  - ◆ Select a code from the list when the entire code is highlighted (with an unfiltered list)
  - ◆ Select a code from the list when the highlight or cursor is within a code (with a filtered list).
- To add a code:
  - ◆ Select a code from the list when the cursor is at the start or end of a code (with an unfiltered list).

**Note** – Spaces are automatically entered to separate multiple codes.

Filtering improvements in the *Code list* dialog:

- The code list is filtered according to the characters to the left of the cursor or highlight.
- If the cursor is at the beginning or end of the code field and editing is not in progress, the code list is not filtered.

Using a touch screen to replace a code:

1. Tap in the code field. The code field is highlighted.
2. Use the scroll bar to scroll to the new code and then tap to select the new code you want to replace the old code.
3. To exit the *Code selection* dialog, tap *Enter*.

Using a touch screen to add to an existing code:

1. To open the *Code list* dialog, tap in the code field.
2. To remove the highlight on the code field before you select the new code, tap at the beginning or end of the code field.

The Trimble Survey Controller software automatically inserts spaces to separate multiple codes.

Using a keyboard to replace code:

1. Tab or arrow to the code field.
2. Press the key representing the first character of the code. The code list is filtered on that first character.
3. Depending on the size of your code library, do one of the following:

- ◆ If the required code is not visible, press the key(s) representing the next character(s) of your code to further filter the list.
- ◆ If the required code is visible, arrow down to the code, press *Enter* to select the code and then press *Enter* again to exit the dialog.

Using a keyboard to add to an existing code:

1. To open the *Code list* dialog, press the right arrow.
2. To remove the highlight on the code field before you select the new code, press the right arrow again.

The Trimble Survey Controller software automatically inserts spaces to separate multiple codes.


### Tips

- To edit an existing code, use the arrow keys to navigate to the correct position and then use the backspace key to remove unwanted characters. As the code is modified, the code list filters accordingly.
- When auto-complete is turned off, recently used codes appear at the top of the code list. Multiple entry codes are remembered as a single entry in the recently used list. This allows you to quickly select recently used codes, especially multiple code entries.
- To enter a code that is not in the library, but which has a similar entry in the library, press the space key to accept the code that you enter not the similar code from the library. Alternatively, turn off auto-complete.

**Note** – You cannot select a different feature and attribute library for the current job once a point with attributes is stored, or when a point with attributes is copied from another job.

When you use a feature code that has attributes, the Trimble Survey Controller software prompts you to enter the attribute data.

### Using Feature Codes with Predefined Attributes

You can use feature and attribute libraries that were created using the Trimble Geomatics Office software, the Feature and Attribute Editor or Data Dictionary Editor utilities, to store additional attribute information for feature codes. In the Trimble Survey Controller software, these feature codes have an attribute icon (  ) next to the feature code in the library.

**Note** – Feature codes created using the Trimble Survey Controller software do not have attributes associated with them.

**Note** – Feature classifications defined in feature and attribute libraries as Point, Line, or Area in the office software all appear as *Point features* in the Trimble Survey Controller software.

**Tip** – To capture attribute data more efficiently, use the office software to predefine default values, minimum and maximum ranges, auto-generated times and dates, and well-structured menu options. If you use auto-generated times, make sure that the time is set correctly on your Trimble controller. For information on setting the Trimble controller time and date, refer to [Time and date](#).

**Note** – If you specify in the office software that field entry is not permitted for an attribute, you cannot use the Trimble Survey Controller software to enter that attribute data.

To enter attributes before measuring a point:

1. Enter the feature code and tap the *Attrib* softkey. A screen with the feature code and attribute fields appears.
2. Enter values in the attribute fields.

The maximum number of characters in text attribute fields is usually 100. Your definition of a feature and attribute library can specify fewer.

**Tip** – If the feature has been used in the current job, the last stored set of attributes for the current feature are the defaults. Tap *Default* to set the defaults from the library.

The *Prev* and *Next* softkeys appear when there are multiple feature codes with attributes in the *Code* field. Use them to swap between attributes.

To enter attributes while measuring a point:

1. Enter the feature code. The *Attrib* softkey appears.
2. Tap *Measure* to start measuring the point.

A screen with the feature code and attribute fields is displayed.

3. Enter values in the attribute fields. Tap *Store* to accept the attributes.

**Tip** – The Trimble Survey Controller software can automatically store the point while you are still entering attribute data. To enable this, select the *Auto store point* check box in the survey style.

### Prompt for attributes option

When you store points with attributes in *Measure topo*, you can disable the *Prompt for Attributes* checkbox in the *Options* screen. This stops the Trimble Survey Controller software from prompting you to enter the attributes on every point that you store in the *Measure topo* screen (and when you measure a topo point from the map). The software completes the attributes with the default values or the previously used attributes for a particular feature code. To change the attributes, use the *Attrib* softkey. Subsequent points that have the same feature code will use the newly entered attributes. If there are any feature codes that have required attribute fields without default values or previously defined values, the software prompts you for attributes the first time that you store a point with that particular feature code.

### Notes

- During normal operation, the Trimble Survey Controller software always prompts you to enter point attributes. The option to turn off *Prompt for Attributes* is available when you measure conventional topo points from *Measure topo* or from the map, or measure GPS points from *Measure points*, or from the map.
- In *Continuous topo*, when you measure points using a code that has attributes, and *Prompt for Attributes* is switched ON, you are only prompted for attributes once, when you enter the code.

## Entering attributes for a point using feature codes without predefined attributes

You can enter several attributes for one point. For a point that has a feature code of Tree, for example, you can enter its type, height, girth, and spread as attributes.

To enter attributes for a point using the colon (:) key:

1. Measure, key in, or compute the point.
2. Tap *Favorites* and select *Key in note*.
3. Enter the first attribute and press the colon key (:). Enter the data and press : again.  
If a feature code and attribute library is selected for the job, the code list appears when you press the space key.
4. Enter the next attribute and press the colon (:) key. The attributes for a tree, for example, could be:  
**Type:Oak:Girth:1.0:Height:15:Spread:12**
5. Repeat step 4 until all attributes are entered and then tap *Enter*.

**Tip** – Use the *Switch to* softkey to return to the screen where you stored the point without closing this window.

**Note** – Attributes collected using note records with ":" separators are processed as note records in the Trimble Geomatics Office software. For more flexibility in the office software, collect attributes using attribute subrecords or features from the feature and attribute libraries created in the office software.

To edit a Code once a point has been measured:

1. Select *Files / Review current job* or *Files / Point manager*.
2. Edit the code field for the point.

## Resurveying points that already have attributes

To stake out and re-measure points for which you already have attribute data:

1. If the job is not yet in the Trimble Survey Controller software, transfer it from the Trimble Geomatics Office software.

**Note** – Transfer relevant features and attributes as well as the points.

2. From the main menu, select *Survey / Survey style / Stakeout*.
3. Tap *Options* and set the as-staked point details:
  - ◆ Set the *As-staked* name field to *Design name*.
  - ◆ Set the *As-staked* code field to *Design code*.
4. Stake out the point.
5. Measure the as-staked point.

The attribute data displayed for the point is the attribute data that you entered previously. The defaults in the feature and attribute library are not used. Update the values as required.



## Using Description Fields

You can choose to display two additional description fields in many functions within the Trimble Survey Controller software.

The description fields are similar to code fields because they enable you to add additional information to data. They do not use feature code libraries, and they do not support attributes.

The description field data is available in Trimble DC files as Note records.

You can also export the data stored in the description fields using [Export Custom Format Files](#).

To enable and customize the description fields:

1. From the main menu, select *Files / Properties of current job*.
2. Tap the *Page down* button and then tap the *Descriptions* button.
3. Select the *Use descriptions* check box.
4. If required, enter a new name for *Description 1 label* and *Description 2 label*.
5. Tap *Accept*.

Once the additional descriptions fields are enabled, they are available in the following features of the Trimble Survey Controller software:

- Station setup
- Measure topo
- Measure codes
- Continuous topo
- Stakeout
- Point manager
- Review current job
- Key in point, line, and arc
- Compute point
- Compute average
- Transformations
- Traverse

Each of the two description fields remembers the descriptions that are entered. To view the stack of previously used descriptions, tap the arrow on the description field.

The description stack is unique for each description field. The description stack is stored to the [descriptions.xml] file in the Trimble data folder on the controller. You can edit it with a text editor, and copy it to another controller.

## Copy Between Jobs

To copy a calibration, control points, or points from one job to another job on the controller:

1. Select *Files / Copy between jobs*.
2. Select each of these items:
  - ◆ a job name in the *Job to copy from* field.
  - ◆ a job name in the *Job to copy to* field.
  - ◆ the items to be copied in the *Copy* field.If you select the *Copy duplicate points* check box, the option to *Overwrite* appears.
3. If you want to copy duplicate points, and overwrite and delete the duplicate points in the job you are copying to, select the appropriate check boxes.
4. When the *Copy* field is set to Points, various point selection options become available in the *Select Point* menu. Select the appropriate option.

When copying points between jobs, make sure that the points you are copying use the same coordinate system as the job that the files are being brought into.

To create a new job with **all** the defaults (including Coordinate System settings) from another job, see [Job operations](#).

# Key In

## Key in Menu

This menu lets you enter data into the Trimble Survey Controller software from the keypad. You can key in points, lines, arcs, roads, templates, and notes.

For more information, see:

[Points](#)

[Lines](#)

[Arcs](#)

[Roads](#)

[Notes](#)

## Key in – Points

With this function, you can enter coordinates to define a new point:

1. From the main menu, select *Key in / Points*.
2. Enter the point name.
3. Enter the values.
4. Tap *Store* to calculate or store the point.

To enter a point from the map:

1. Make sure the current selection is cleared.
2. Tap and hold on the area of the map to which you want to add the point.
3. From the shortcut menu, select *Key in point*. The *Key in / Point* screen appears.
4. Complete the fields as required.

## Key in – Lines

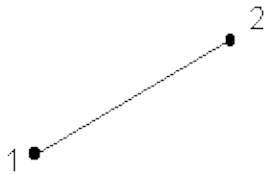
Use this function to define a new line by one of the following methods:

[Two points](#)

[Brng–dist from a point](#)

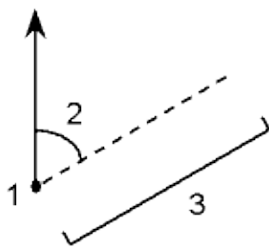
### To define a new line by the Two points method:

1. Do one of the following:
  - ◆ From the map, select the *Start point (1)* and the *End point (2)*. (See the diagram below.) Tap and hold on the map and select *Key in line* from the shortcut menu.
  - ◆ Select *Key in / Line* from the main menu. In the *Method* field, select *Two points*. Enter the names of the *Start point* and the *End point*.
2. Use *Options* to specify ground, grid, or sea level distances.
3. Enter the name of the line.
4. For stationing, enter a value for the *Start station* and the *Station interval*.



### To define a new line by the Brng–dist from a point method:

1. From the main menu, select *Key in / Line*.
2. Use *Options* to specify ground, grid or sea level distances.
3. Enter the name of the line.
4. In the *Method* field, select *Brng–dist from a point*.
5. Enter the name of the Start point (1), the azimuth (2), and the length of line (3). See the diagram below.
6. Specify the *Grade* between the start and end points.
7. For stationing, enter a value for the *Start station* and the *Station interval*.



## Key in – Arcs

Use this function to define a new arc by one of the following methods:

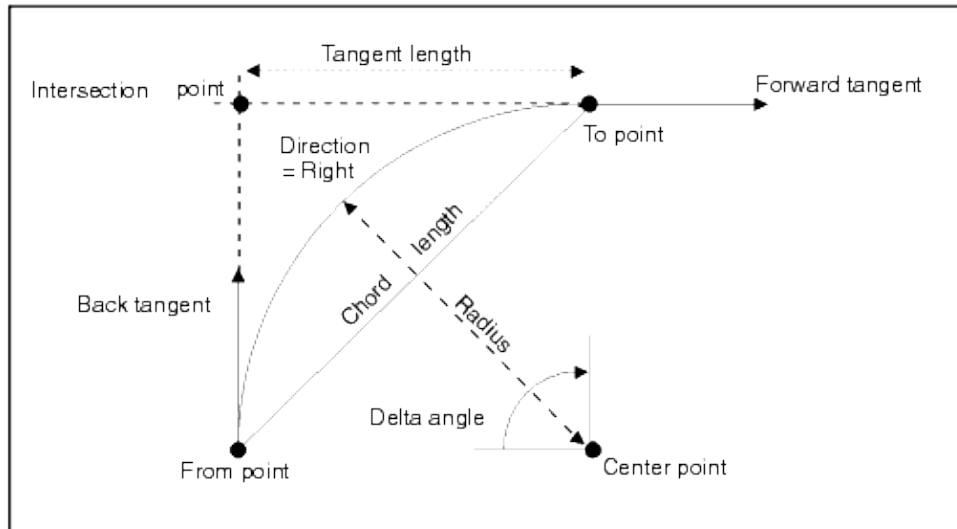
[Two points and radius](#)

[Arc length and radius](#)

## Delta angle and radius

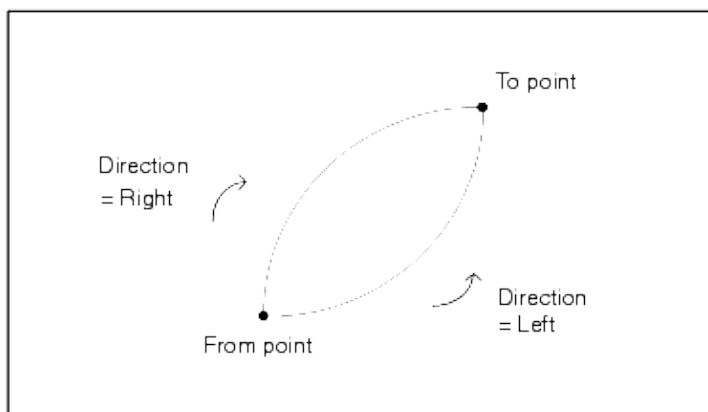
## Intersect point and tangents

The following diagram explains the terms used to define features of an arc.



The back tangent value is related to the direction in which the stationing or chainage increases. For example, when you stand at the intersection point looking in the direction of increasing stationing or chainage, the forward tangent is in front of you and the back tangent is behind you.

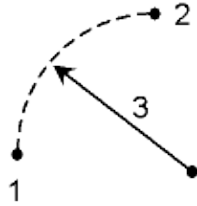
The direction field defines whether the arc turns to the left (counterclockwise) or right (clockwise) from the start point. The following diagram shows both a left and right arc.



### To define an arc using the Two points and radius method:

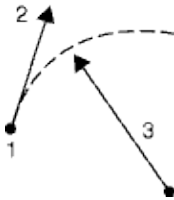
1. From the main menu, select *Key in / Arc*.
2. Use *Options* to specify ground, grid, or sea level distances.
3. Enter the name of the arc.
4. In the *Method* field, select *Two points and radius*.

5. As shown in the diagram below, enter the name of the start point (1), the name of the end point (2), and the radius (3) of the arc.
6. Specify the direction of the arc.
7. For stationing, enter a value for the start station and the station interval.



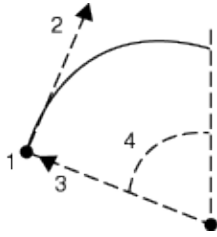
**To define an arc using the Arc length and radius method:**

1. From the main menu, select *Key in / Arc*.
2. Use *Options* softkey to specify ground, grid, or sea level distances and the grade entry method.
3. Enter the name of the arc.
4. In the *Method* field, select *Arc length and radius*.
5. As shown in the diagram below, enter the name of the start point (1), the back tangent (2), the radius (3) and the length of the arc.
6. Specify the direction of the arc and the grade between the start and end points.
7. For stationing, enter a value for the start station and the station interval.



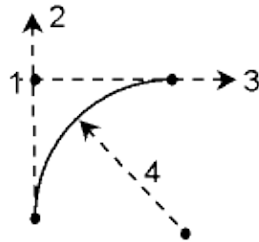
**To define an arc using the Delta angle and radius method:**

1. From the main menu, select *Key in / Arc*.
2. Use *Options* to specify ground, grid, or sea level distances and the grade entry method.
3. Enter the name of the arc.
4. In the *Method* field, select *Delta angle and radius*.
5. As shown in the diagram below, enter the name of the start point (1), the back tangent (2), the radius (3) and the turned angle (4) of the arc.
6. Specify the direction of the arc and the grade between the start and end points.
7. For stationing, enter a value for the start station and the station interval.



**To define an arc using the Intersect point and tangents method:**

1. From the main menu, select *Key in / Arc*.
2. Use *Options* to specify ground, grid or sea level distances.
3. Enter the name of the arc.
4. In the *Method* field, select *Intersect point and tangents*.
5. As shown in the diagram below, enter the name of the intersection point (1), the back tangent (2), the forward tangent (3) and the radius (4) of the arc.
6. For stationing, enter a value for the start station and the station interval.



## Key in – Roads

Use this option to:

- *Key in* and edit a Trimble road
- *Create* and edit a group from a GENIO file

Keyed in roads (known as *Trimble roads*) are saved to the Trimble data folder as 'road name'.rxl. Trimble roads are available for all jobs.

Groups defined from a GENIO file are saved as a comment to the end of the GENIO file. GENIO files and associated groups are available for all jobs.

## Trimble roads

To key in a Trimble road:

1. From the main menu, select *Key in / Roads*.

2. Tap *New* and enter a name for the road definition. (To edit an existing road, highlight the road name and tap *Edit*.)

**Tip** – Use the *Copy* option to copy an existing road definition with all its components into the current road.

3. Choose a component to key in:

**Horizontal Alignment**

**Vertical Alignment**

**Template Positioning**

**Superelevation and Widening**

**Templates**

4. Tap *Store* when all components have been defined.

**Tip** – Use *Rename* and *Delete* to rename or delete a road definition.

## Notes

- The Trimble Survey Controller software treats all road distances, including stationing and offset values, as grid distances. The value in the *Distances* field (accessed by selecting *Files / Properties of current job – Cogo settings*) has no effect on the road definition or the way road distances are displayed.
- If a ground coordinate system is defined in either the Trimble Geomatics or Trimble Survey Controller software, then the grid coordinates are, in effect, also ground coordinates.

## Horizontal Alignment

To add a horizontal alignment to a new road definition, select *Horizontal alignment*. You can enter the alignment using one of the following methods:

- ◆ **Length**
- ◆ **End station**
- ◆ **End coordinates**

## Entry by Length

To add a horizontal alignment to a new road definition by entering the lengths of the elements, select *Horizontal alignment* and then do the following:



1. Tap *New* to enter the first element that defines the alignment. The *Element* field is set to *Start point*. You cannot change this.
2. Enter the *Start station*.
3. In the *Method* field, choose one of the following options:
  - ◆ *Key in coordinates*
  - ◆ *Select point*

If you choose the *Key in coordinates* method, enter values in the *Start north* and *Start east* fields.

If you choose the *Select point* method field, enter a value in the *Point name* field. The *Start north* and *Start east* fields will update with the values for the entered point.

**Tip** – To edit the *Start north* and *Start east* values when they have been derived from a point, change the method to *Key in coordinates*.

4. Enter the *Station interval*. To add the horizontal element, tap *Store*.
5. To enter the next horizontal element tap *New*. In the *Entry Method* field select *Length*, and then tap *Ok*.
6. Select the *Element* method, enter the required information, and then tap *Store*.
7. To enter further elements, see the following:

#### Line elements

#### Arc elements

#### Entry spiral/Exit spiral elements

8. When you have entered the last element, tap *Accept*.

**Tip** – To delete an element, highlight it and tap *Delete*. When you add an element, it appears below the previous element that you added. To insert it at a particular place in the list, highlight the element that you want it to follow. Tap *New* and enter details of the element.

9. Enter the other road components or tap *Store* to store the road definition.

**Tip** – Tap *Method* to change the entry method to *End station*.

#### Line elements

If you select *Line* in the *Element* field, the *Start station* field displays the start station value for the line that you are defining. You cannot edit this.

In the *Azimuth* and *Length* fields, enter values that define the line. The *End North* and *End East* fields update to display the coordinates at the end of the element just added.

If this line is not the first line to be defined, the *Azimuth* field displays an azimuth calculated from the previous element. To edit the azimuth, select *Edit azimuth* from the pop-up menu in the *Azimuth* field. The software indicates that the element is non tangential by colouring the element icon red.

**Tip** – To reload the original azimuth select *Restore tangency* from the pop-up menu.

### Arc elements

If you select *Arc* in the *Element* field, the *Start station* field displays the start station value for the arc that you are defining. You cannot edit this.

The following table shows the available methods and the fields that appear when you select each one.

Method	Procedure
Radius and length	Specify arc direction. In the <i>Radius</i> and <i>Length</i> fields, enter values that define the arc.
Delta angle and radius	Specify arc direction. In the <i>Angle</i> and <i>Radius</i> fields, enter values that define the arc.
Deflection angle and length	Specify arc direction. In the <i>Angle</i> and <i>Length</i> fields, enter values that define the arc.

The *End North* and *End East* fields update to display the coordinates at the end of the element just added.

The *Azimuth* field displays the azimuth as calculated from the previous element. To edit the azimuth, select *Edit azimuth* from the pop-up menu in the *Azimuth* field. The software indicates that the element is non tangential by colouring the element icon red.

**Tip** – To reload the original azimuth select *Restore tangency* from the pop-up menu.

### Entry spiral/Exit spiral elements

If you select *Entry spiral/Exit spiral* in the *Element* field, the *Start station* field displays the start station value for the entry spiral or exit spiral that you are defining. You cannot edit this.

Specify the arc direction. In the *Start radius*, *End radius* and *Length* fields, enter values that define the spiral.

The *End North* and *End East* fields update to display the coordinates at the end of the element just added.

The *Azimuth* field displays the azimuth as calculated from the previous element. To edit the azimuth, select *Edit azimuth* from the pop-up menu in the *Azimuth* field. The software indicates that the element is non tangential by colouring the element icon red.

**Tip** – To reload the original azimuth select *Restore tangency* from the pop-up menu.

## Entry by End station

To add a horizontal alignment to a new road definition by entering end station values, select *Horizontal alignment* and then do the following:

1. Tap *New* to enter the first element that defines the alignment. The *Element* field is set to *Start point*. You cannot change this.
2. Enter the *Start station*.
3. In the *Method* field, choose one of the following options:
  - ◆ *Key in coordinates*
  - ◆ *Select point*

If you choose the *Key in coordinates* method, enter values in the *Start north* and *Start east* fields.

If you choose the *Select point* method field, enter a value in the *Point name* field. The *Start north* and *Start east* fields will update with the values for the entered point.

**Tip** – To edit the *Start north* and *Start east* values when they have been derived from a point, change the method to *Key in coordinates*.

4. Enter the *Station interval*. To add the horizontal element, tap *Store*.
5. To enter the next horizontal element, tap *New*. In the *Entry Method* field select *End station* and then tap *Ok*.
6. Select the *Element* method, enter the required information, and then tap *Store*.
7. To enter further elements, see the following:

#### Line elements

#### Arc elements

#### Entry spiral/Exit spiral elements

8. When you have entered the last element, tap *Accept*.

**Tip** – To delete an element, highlight it and tap *Delete*. When you add an element, it appears below the previous element that you added. To insert it at a particular place in the list, highlight the element that you want it to follow. Tap *New* and enter details of the element.

9. Enter the other road components or tap *Store* to store the road definition.

**Tip** – Tap *Method* to change the entry method to *Length*.

#### Line elements

If you select *Line* in the *Element* field, the *Start station* field displays the start station value for the line that you are defining. You cannot edit this.

In the *Azimuth* and *End station* fields, enter values that define the line. The *End North* and *End East* fields update to display the coordinates at the end of the element just added.

If this line is not the first line to be defined, the *Azimuth* field displays an azimuth calculated from the previous element. To edit the azimuth, select *Edit azimuth* from the pop-up menu in the *Azimuth* field. The software indicates that the element is non tangential by colouring the element icon red.

**Tip** – To reload the original azimuth select *Restore tangency* from the pop-up menu.

### Arc elements

If you select *Arc* in the *Element* field, the *Start station* field displays the start station value for the arc that you are defining. You cannot edit this.

The following table shows the available methods and the fields that appear when you select each one.

Method	Procedure
Radius and end station	Specify arc direction. In the <i>Radius</i> and <i>End station</i> fields, enter values that define the arc.
Deflection angle and end station	Specify arc direction. In the <i>Angle</i> and <i>End station</i> fields, enter values that define the arc.

The *End North* and *End East* fields update to display the coordinates at the end of the element just added.

The *Azimuth* field displays the azimuth as calculated from the previous element. To edit the azimuth, select *Edit azimuth* from the pop-up menu in the *Azimuth* field. The software indicates that the element is non tangential by colouring the element icon red.

**Tip** – To reload the original azimuth select *Restore tangency* from the pop-up menu.

### Entry spiral/Exit spiral elements

If you select *Entry spiral/Exit spiral* in the *Element* field, the *Start station* field displays the start station value for the entry spiral or exit spiral that you are defining. You cannot edit this.

Specify arc direction. In the *Start radius*, *End radius* and *End station* fields, enter values that define the spiral.

The *End North* and *End East* fields update to display the coordinates at the end of the element just added.

The *Azimuth* field displays the azimuth as calculated from the previous element. To edit the azimuth, select *Edit azimuth* from the pop-up menu in the *Azimuth* field. The software indicates that the element is non tangential by colouring the element icon red.

**Tip** – To reload the original azimuth select *Restore tangency* from the pop-up menu.

## Entry by end coordinates

To add a horizontal alignment to a new road definition by entering end coordinates or points, select *Horizontal alignment* and then do the following:

1. Tap *New* to enter the first element that defines the alignment. The *Element* field is set to *Start point*. You cannot change this.
2. Enter the *Start station*.

3. In the *Method* field, choose one of the following options:

- ◆ *Key in coordinates*
- ◆ *Select point*

If you choose the *Key in coordinates* method, enter values in the *Start north* and *Start east* fields.

If you choose the *Select point* method field, enter a value in the *Point name* field. The *Start north* and *Start east* fields will update with the values for the entered point.

**Tip** – To edit the *Start north* and *Start east* values when they have been derived from a point, change the method to *Key in coordinates*.

4. Enter the *Station interval*. To add the horizontal element, tap *Store*.

5. To enter the next horizontal element tap *New*. In the *Entry method* field select *End coordinates* and then tap *Ok*.

6. Select the *Element* method, enter the required information, and then tap *Store*.

7. To enter further elements, see the following:

### Line elements

### Arc elements

8. When you have entered the last element, tap *Accept*.

**Tip** – To delete an element, highlight it and tap *Delete*. When you add an element, it appears below the previous element that you added. To insert it at a particular place in the list, highlight the element that you want it to follow. Tap *New* and enter details of the element.

9. Enter the other road components or tap *Store* to store the road definition.

## Line elements

If you select *Line* in the *Element* field, the *Start station* field displays the start station value for the line that you are defining. You cannot edit this.

In the *Method* field, choose one of the following options:

- *End coordinates*
- *Select end point*

If you choose the *End coordinates* method, enter values in the *End north* and *End east* fields. The *Azimuth* and *Length* fields will update with the values for the entered coordinates.

If you choose the *Select end point* method field, enter a value in the *Point name* field. The *Azimuth* and *Length* fields and the *End north* and *End east* fields will update with the values for the entered point.

**Tip** – To edit the *End north* and *End east* values when they have been derived from a point, change the method to *End coordinates*.

## Arc elements

If you select *Arc* in the *Element* field, the *Start station* field displays the start station value for the arc that you are defining. You cannot edit this.

In the *Method* field, choose one of the following options:

- *End coordinates*
- *Select end point*

If you choose the *End coordinates* method, enter values in the *End north* and *End east* fields. The *Azimuth*, *Arc direction*, *Radius* and *Length* fields will update with the values for the entered coordinates.

If you choose the *Select end point* method field, enter a value in the *Point name* field. The *Azimuth*, *Arc direction*, *Radius* and *Length* fields and the *End north* and *End east* fields will update with the values for the entered point.

**Tip** – To edit the *End north* and *End east* values when they have been derived from a point, change the method to *End coordinates*.

## Vertical Alignment

To add a vertical alignment to a new road definition, select *Vertical alignment*. You can enter the alignment using one of the following methods:

- **Vertical Points of Intersection**
- **Start and end points**

**Note** – The selected entry method applies to all elements defining the vertical alignment.

## Entry by Vertical Points of Intersection (VPI)

To add a vertical alignment to a new road definition by entering Vertical Points of Intersection (VPI), select *Vertical alignment* and then follow these steps:

1. To enter the first element that defines the alignment, tap *New*.
2. In the *Station* and *Elevation* fields, key in the values that define the first vertical point of intersection. The *Element* field is set to *Start point*. You cannot change this.
3. Tap *Store* to add the vertical element record.
4. Tap *New*. In the entry method field select *VPI* and then tap *Ok*.
5. Select the *Element* method, enter the required information, and then tap *Store*.
6. To enter further elements, see the following:

### Point elements

### Circular arc elements

### Symmetric parabola elements

### Asymmetric parabola elements

7. When you have entered the last element, tap *Accept*.

**Tip** – To delete an element, highlight it and tap *Delete*.

8. Enter the other road components or tap *Store* to store the road definition.

### Point elements

If you select *Point* in the *Element* field, use the *Station* and *Elevation* fields to key in values that define the VPI. The *Slope in* field updates to display the calculated slope value. The *Slope out* field updates when the next element is added.

**Note** – A vertical alignment defined by VPIs must end with a point.

### Circular arc elements

If you select *Circular arc* in the *Element* field, use the *Station* and *Elevation* fields to key in values that define the VPI. Enter the radius of the circular arc in the *Radius* field. The *Slope in* field updates to display the calculated slope value. The *Length*, *K factor* and *Slope out* fields update when the next element is added.

### Symmetric parabola elements

If you select *Sym parabola* in the *Element* field, use the *Station* and *Elevation* fields to key in values that define the VPI and a length for the parabola. The *Slope in* field updates to display the calculated slope value. The *K factor* and *Slope out* fields update when the next element is added.

### Asymmetric parabola elements

If you select *Asymmetric parabola* in the *Element* field, use the *Station* and *Elevation* fields to key in values that define the VPI. Enter the In and Out lengths of the parabola. The *Slope in* field updates to display the calculated slope value. The *K factor* and *Slope out* fields update when the next element is added.

**Note** – When you edit an element, only the selected element is updated. All adjoining elements remain unchanged.

**Tip** – To confirm the entry, use the *Slope in*, *Slope out*, and *K factor* values.

## Entry by start and end points

To add a vertical alignment to a new road definition by entering Start and end points, select *Vertical alignment* and then follow these steps:

1. To enter the first element that defines the alignment, tap *New*.
2. In the *Station* and *Elevation* fields, key in the values that define the first vertical point of intersection. The *Element* field is set to *Start point*. You cannot change this.
3. Tap *Store* to add the vertical element record.
4. Tap *New*. In the entry method field select *Start and End points* and then tap *Ok*.
5. Select the *Element* method, enter the required information, and then tap *Store*.
6. To enter further elements, see the following:

### Point elements

### Circular arc elements

### Symmetric parabola elements

7. When you have entered the last element, tap *Accept*.

**Tip** – To delete an element, highlight it and tap *Delete*.

8. Enter the other road components or tap *Store* to store the road definition.

### Point elements

If you select *Point* in the *Element* field, use the *Station* and *Elevation* fields to key in values that define the start point. The *Slope in* field updates to display the calculated slope value. The *Slope out* field updates when the next element is added.

### Circular arc elements

If you select *Circular arc* in the *Element* field, use the *Start station*, *Start elevation*, *End station*, *End elevation*, and *Radius* fields to key in values that define the circular arc. The *Length*, *Slope in*, and *Slope out* fields update to display the calculated values.

### Symmetric parabola elements

If you select *Sym parabola* in the *Element* field, use the *Start station*, *Start elevation*, *End station*, *End elevation*, and *K factor* fields to key in values that define the parabola. The *Length*, *Slope in*, and *Slope out* fields update to display the calculated values.

**Note** – When you edit an element, only the selected element is updated. All adjoining elements remain unchanged.

**Tip** – To confirm the entry, use the *Slope in*, *Slope out*, and *Length* values.



# Template Positioning

Define the position of templates in a road definition by specifying the station at which the Trimble Survey Controller software starts to apply each template. A template is applied at the start station and template element values are then interpolated linearly (applied on a pro rata basis) from that point to the station where the next template is applied.

To define the template positioning:

1. Select *Template positioning*.
2. Tap *New*.
3. In the *Start station* field, specify the start station for the template(s).
4. Select the templates to apply. The options in the drop-down list for the *Left template* and *Right template* fields are as follows:
  - ◆ <None> – no template is assigned. Use this option to create a gap in the road definition.
  - ◆ <Interpolate> – the template for this station is interpolated from the previous and next templates in the road definition.
  - ◆ Templates – defined using the *Key in / Templates* option.
6. Tap *Store* to apply the templates.
7. Tap *New* to enter more templates at other positions.
8. When all template positions are entered tap *Accept*.

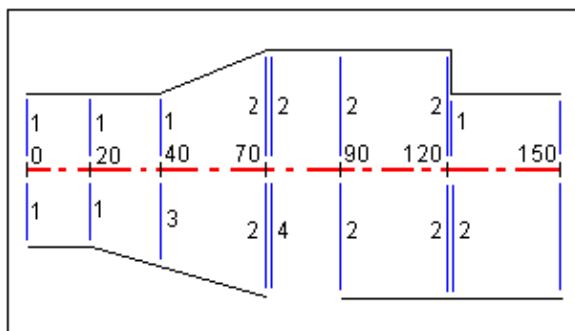
**Tip** – To delete a highlighted entry, tap *Delete*.

9. Enter the other road components or tap *Store* to store the road definition.

For more information, see the [example alignment](#) with the associated table. That topic shows how the template assignments, including the templates "None" and "Interpolate", can be used to achieve the required road definition.

## Roding Template – Example Alignment

The following discussion explains how positioning of templates and use of system templates can be used to control a Trimble road definition. See the plan in the following figure.



## Right side of the road

On the right side, template 1 is assigned to stations 0 and 20. The road transitions from template 1 at station 20 to template 2 at station 70. Because a template must be assigned at station 40 on the left side, the system template <Interpolate> 3 must be assigned to the right side of the road to maintain correct interpolation. To correctly represent the gap between stations 70 and 90, the system template <None> 4 is assigned at a nominal distance after station 70 (5 mm). To complete the right side of the road, template 2 is assigned to stations 90, 120, and 120.005.

## Left side of the road

On the left side, template 1 is assigned to stations 0, 20, and 40. The road transitions from template 1 at station 40 to template 2 at station 70. To correctly represent the design, template 1 is assigned a nominal distance after station 120 (5 mm).

Assign the templates at the specified start stations as shown in the following table:

Start station	Left templates	Right templates
0.000	Template 1	Template 1
20.000	Template 1	Template 1
40.000	Template 1	<Interpolate> 3
70.000	Template 2	Template 2
70.005	Template 2	<None> 4
90.000	Template 2	Template 2
120.000	Template 2	Template 2
120.005	Template 1	Template 2

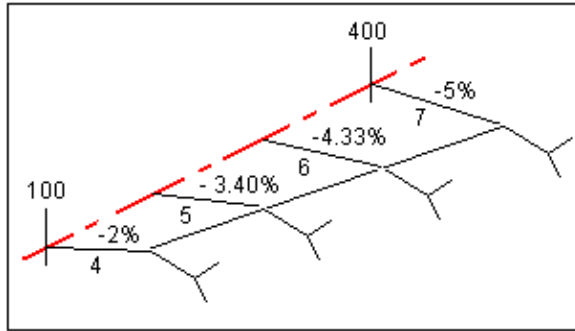
## Template Interpolation

The two methods of interpolating templates are:

- both templates have an equal number of design line elements
- the templates have a different number of design elements

### Interpolating between templates with an equal number of design line elements

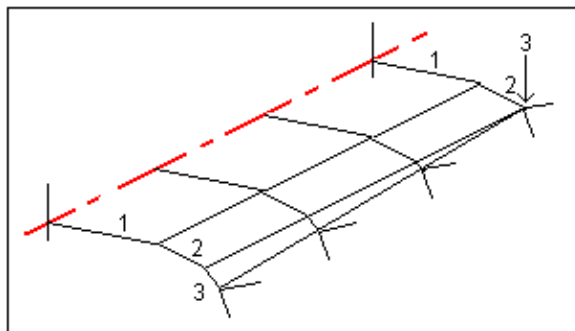
Templates with an equal number of design line elements interpolate to their equivalent element in the next template. See the figure below.



The template at station 100 includes a first element with a crossfall of  $-2\%$  and an offset of 4.0. The next template is assigned at station 400 and has a first element with a crossfall of  $-5\%$  and an offset of 7.0. The cross section for stations 200 and 300 are interpolated as shown to provide even grading from station 100 to 400.

### Interpolating between templates that have a different number of design elements

For templates with an unequal number of design line elements, the template with the least elements has zero length elements added before the side slope element. The interpolation is then performed given an equal number of elements exist. See the figure below, where a zero length element 3 has automatically been inserted.



By adding zero length template elements, you can further control the interpolation process to best represent the road design.

### Notes

- If the design requires a gap in its definition use the None templates.
- No interpolation occurs between a null and a valid template.
- Templates are interpolated after superelevation and widening have been applied.

### Interpolation of side slopes

If consecutive templates contain side slopes of differing values intermediate stations have side slopes interpolated based on the slope value as a percentage.

For example, if the side slope value at station 600 is 50% (1:2) and at station 800 it is 16.67% (1:6) the side slope value at station 700 will be  $50\% + 16.7\% / 2 = 33.33\%$  (1:3).

## Superelevation and Widening

Define where superelevation and widening values are applied in a road definition by specifying the station at which the Trimble Survey Controller software starts to apply them. Superelevation and widening values are applied at the start station, and values are then interpolated linearly (applied on a pro rata basis) from that point to the station where the next superelevation and widening values are applied.

To add superelevation and widening values to a new road definition:

1. Select *Superelevation & widening* and tap *New*.
2. In the *Start station* field, specify the station where the superelevation and widening starts.
3. In the *Left super* and *Right super* fields, enter superelevation values for the left and right sides of the horizontal alignment.

**Tip** – To change the way a superelevation value is expressed, tap *Options* and change the *Grade* field as required.

4. In the *Pivot* field, specify the position about which the template rotates. The options are *Pivot left*, *Pivot crown*, and *Pivot right*.
5. In the *Left widening* field, enter the widening value to be applied.

This value is applied to each element in the template that has the *Widening* check box selected.

6. Do the same for the *Right widening* field. Tap *Store* to add these superelevation and widening values to the road definition.

**Note** – Widening is expressed as a positive value.

7. To enter more superelevation and widening records tap *New*.
8. After entering the last superelevation and widening record, tap *Accept*.

**Tip** – To delete an entry, highlight it and tap *Delete*.

9. Enter the other road components, or tap *Store* to store the road definition.

## Templates

To define a template for a new road definition, select *Templates* and then do the following:

1. To create a new template, tap *New*, enter a template name, and then tap *OK*.
2. To edit an existing template highlight the template name, tap *Edit*, and then tap *OK*.

**Tip** – Use the *Copy* option to copy an existing template definition into the current template.

3. Tap *New* to enter the first element defining the template.
4. Select an option from the *Element* field and enter the required information. For more information, see the appropriate section below.

### Crossfall and offset

### Delta elevation and offset

### Side slope

4. To add the template element, tap *Store*.
5. To enter more elements that define this template, tap *New*.
6. When you have entered the last element, tap *Store*.

**Tip** – To delete an element, highlight it and tap *Delete*.

7. Tap *Store* to store the template.

### Crossfall and offset

If you selected *Crossfall and Offset* in the *Element* field:

1. In the *Crossfall* and *Offset* fields, enter the values that define the element.

**Tip** – To change the way a crossfall value is expressed, tap *Options* and change the *Grade* field as required.

2. Enter a value in the *Code* field (this step is optional).

**Tip** – The annotation entered in the *Code* field is assigned to the end of the element and is displayed during stakeout.

3. Select the *Apply superelevation* and *Apply widening* check boxes as required.

**Note** – The *Apply widening* check box is only available after the *Apply superelevation* check box has been selected.

### Delta elevation and offset

If you selected *Delta elevation and Offset* in the *Element* field:

1. In the *Delta elevation* and *Offset* fields, enter the values that define the element.
2. Enter a value in the *Code* field (this step is optional).

**Tip** – The annotation entered in the *Code* field is assigned to the end of the element and is displayed during stakeout.

3. Select the *Apply superelevation* and *Apply widening* check boxes as required.

**Note** – The *Apply widening* check box is only available after the *Apply superelevation* check box has been selected.

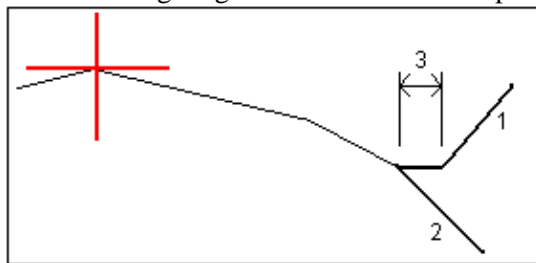
## Side slope

If you selected *Side Slope* in the *Element* field:

1. In the *Cut slope* (1), *Fill slope* (2), and *Cut ditch width* (3) fields, enter the values that define the element.

**Note** – Cut and fill slopes are expressed as positive values.

The following diagram shows the side slope.



2. Enter a value in the *Code* field (this step is optional).

**Tip** – The annotation entered in the *Code* field is assigned to the end of the element and is displayed during stakeout.

## Group strings

To define a new group from a GENIO file:

1. Select a GENIO file from the list. Tap *Edit*.
2. Do one of the following:
  - ♦ To define a new group, tap *New*.
  - ♦ To edit an existing group, highlight the GENIO file name and then tap *Edit*.
3. Enter a group name and then tap *OK*.
4. Define the group.

To define the group:

1. From the graphics window, tap strings to select them. Alternatively, drag a box outline to select multiple strings. Selected master strings are shown as solid red circles. Selected sub strings are shown as solid blue circles. Tap a selected string to deselect it.
2. To clear your current selection or to undo your last selection, tap and hold in the graphics window and then select the appropriate option from the pop-up menu.
3. To select strings from a list of string names, tap and hold in the graphics window and then select *List selection* from the pop-up menu. Tap the string names you want to select. Selected strings appear in

the list with a check mark next to them. To clear your current selection, tap *Clear*.  
4. Tap *Accept*.

**Tip** – Tap *Rename* to rename an existing group.

## Notes

- A group can include only one master string (6D). If the GENIO file does not include a 6D string but does include a 12D string, then the Trimble Survey Controller software will generate a 6D string with the same geometry as the 12D string and positions every 5 meters / feet.
- Because the station values for 3D and 5D strings are defined relative to the selected 6D string, select strings for the group that obviously define a road.
- Where available, Trimble recommends that you include the 12D string that is coincident with the selected master string in the group. 12D strings include the geometry for the vertical alignment that enables the Trimble Survey Controller software to correctly interpolate elevations between positions along the master string.
- Unselected master and geometry strings appear as open red circles. Unselected sub strings (3D and 5D) appear as open dark gray circles.
- Tap and hold on a string to browse the string name.
- To define a new 3D string, tap and hold in the graphics view and then select *New string* from the pop-up menu. This option is not available until you have selected a master (6D) string.

## New string

Use this function to [define](#) a new string, [edit](#) a string you have defined, or [delete](#) a string.

### Defining a new string

1. From the *Group strings* option, create a new group or edit an existing group.
2. Tap and hold in the graphics screen and then select *New string* from the pop-up menu.
3. Enter a string name.
4. Select the string that the new string will be derived from.
5. Select a string derivation method.
6. Enter the *Offset and slope* or *Offset and Vertical* diff values that define the new string.
7. Tap *Accept*.

## Notes

- When you define a new group, you must select a master (6D) string before the *New string* menu option is available.
- New strings are created as 3D strings.
- You cannot define a new string relative to a 5D string.

### Editing a new string

1. From the *Group strings* field, select *Edit* and then select the group containing the string to edit.



2. Tap and hold in the graphics screen and select *Edit string* from the pop-up menu.
3. Select the string to edit. You can only edit strings that have been defined using the *New* string functionality and that belong to the current group.
4. Edit the details as required.
5. Tap *Accept*.


### Deleting a string

1. From the *Group strings* field select *Edit* and then select the group containing the string to delete.
2. Tap and hold in the graphics screen and then select *Delete string* from the pop-up menu.
3. Select the string to delete. You can only delete strings that have been defined using the *New* string function and that belong to the current group.
4. Tap *OK*.

## Key in – Notes

You can enter a note in the Trimble Survey Controller database at any time. To do this:

1. To access the *Key in note* screen, do one of the following:
  - ◆ From the main menu, select *Key in / Notes*.
  - ◆ Tap *Favorites / Key in note*.
  - ◆ On the controller keyboard, press **CTRL + N**.
2. Type in the details to be recorded. Alternatively tap *T/Stamp* to generate a record of the current time.
3. To store the note do one of the following:
  - ◆ Tap *Store* to store the note in the database.
  - ◆ Tap  *Prev* to attach the note to the previous observation.
  - ◆ Tap  *Next* to attach the note to the next observation to be stored.

**Note** – When you use  *Next*, the note is only stored with the next observation if another observation is stored during the current survey. If the survey is ended without storing another observation the note is discarded.

4. To exit *Key in notes*, tap *Esc*. Alternatively, if the *Note* form is empty, tap *Store*.

**Note** – If a feature code list is already selected for the job, you can use codes from the list when keying in a note. From the *Note* screen, press Space to display the feature code list. Select a code from the list or type the first few letters of the code.

In *Review*, tap *Note* to add a note to the current record.

In *Point manager*, scroll to the right and tap in the *Note* field to add a note to the point record.



# Cogo

## Cogo Menu

This menu lets you carry out Coordinate Geometry (Cogo) functions. You can use the menu options to calculate distances, azimuths, and point positions by various methods.

For some calculations, you must define a projection, or select a Scale factor—only coordinate system.

You can display ellipsoid, grid, or ground distances by changing the *Distances* field in the [Cogo settings](#) screen.

For more information, see:

[Compute Inverse](#)

[Compute Point](#)

[Compute Area](#)

[Compute Azimuth](#)

[Compute Distance](#)

[Compute Average](#)

[Subdivide a Line](#)

[Subdivide an Arc](#)

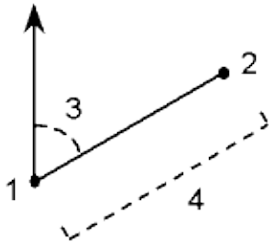
[Taped distances](#)

[Traverse](#)

## Cogo – Compute Inverse

To calculate the azimuth, horizontal, vertical, and slope distances between two existing points:

1. From the map, select the From point (1) and To point (2), as shown in the diagram below.
2. Tap and hold on the map and select *Compute inverse* from the shortcut menu. Alternatively, select *Cogo / Compute inverse* from the main menu.
3. The azimuth (3), horizontal distance (4), change in elevation, slope distance and grade are shown.



## Cogo – Compute Point

Use this Cogo function to calculate the coordinates of an intersection point from 1 or 2 existing points. You can store the results in the database.

Use *Options* to specify ground, grid, or sea level distances.

**Note** – When entering an existing point name you can select from the list, perform a fast fix or measure a point. Fast fix stores an automatic rapid point with a temporary point name.

**Warning** – In general, do not compute points and then change the coordinate system or perform a calibration. If you do, these points will be inconsistent with the new coordinate system. An exception to this is points computed using the *Brng–dist from a point* method.

**Note** – If you use the *Four point intersection* method or the *From a baseline* method and then change the antenna height record for one of the source points, the coordinates of the point will not be updated.

**Note** – If the measured points were measured using GPS, the coordinates of the point can only be displayed as grid values if a projection and a datum transformation are defined.

**Note** – For all methods when the point is stored use the *Store as* field to specify if the calculated point is to be stored as WGS84, Local or Grid coordinates values.

**Note** – You can compute an azimuth from two points in the database directly in an azimuth field. To do this, enter the point names in the *Azimuth* field, separated by a hyphen. For example, to compute the azimuth from point 2 to point 3, enter "2–3". This method works with most alphanumeric point names, but it does not support point names that already contain a hyphen.

Calculate coordinates using one of the following methods:

[Brng–dist from a point](#)

[Turned angle and distance](#)

[Brng–dist intersect](#)

[Brng–brng intersect](#)

Dist–dist intersect


Four point intersection

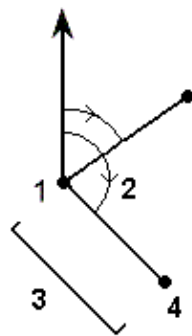
From a baseline

Vertical plane and angle

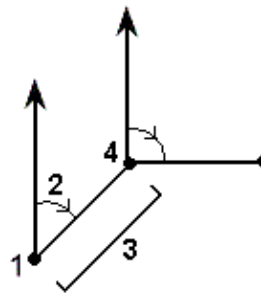
### Brng–dist from a point

To calculate the coordinates of an intersection using the Brng–dist from a point method:

1. From the main menu, select *Cogo / Compute point*.
2. Enter a *Point name*.
3. In the *Method* field, select Bearing and distance.
4. In the *Start point* field, use the advanced pop–up arrow (  ) to select either a Radial or Sequential measurement method. When *Sequential* is selected the *Start point* field is automatically updated to the last stored intersection point (see diagrams below).
5. Set the *Azimuth origin* to either Grid 0°, True, Magnetic, or Sun (GPS only).
6. As shown in the diagrams below, enter the name of the Start point (1), the azimuth (2) and the horizontal distance (3).
7. Tap *Calc* to calculate the intersection point (4).
8. Store the point in the database.



Radial



Sequential



To compute the misclosure of a loop of points:

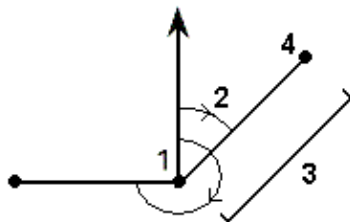
1. Give the last point the same name as the first start point.
2. Tap *Calc* for the point coordinates.

When you tap *Store*, the loop misclosure appears on the screen. Store the last point as a check to avoid overwriting the first point.

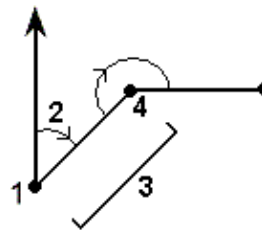
## Turned angle and distance

To calculate the coordinates of an intersection using the turned angle and distance method:

1. From the main menu, select *Cogo / Compute point*.
2. Enter a *Point name*.
3. In the *Method* field, select Turned angle and distance.
4. In the *Start point* field, tap the advanced pop-up arrow (  ), then select either a *Radial* or *Sequential* measurement method. When *Sequential* is selected, the Start point name automatically updates to the last stored intersection point (see diagrams below).
5. In the *End point* field, tap the advanced pop-up arrow (  ), then select either an *Azimuth* or *End point* to define a reference orientation.  
When using the sequential method, the reference orientation for new points moving forward is the computed reverse azimuth from the previous turned angle.
6. As shown in the diagrams below, enter the name of the Start point (1), the azimuth (2) and the horizontal distance (3).
7. Tap *Calc* to calculate the intersection point (4).
8. Store the point in the database.



**Radial**

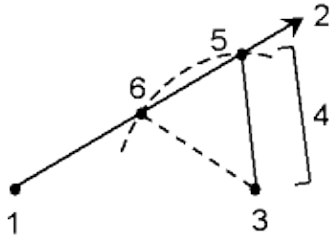


**Sequential**

## Brng-dist intersect

To calculate the coordinates of an intersection using the Brng-dist intersect method:

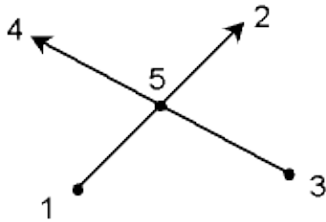
1. From the main menu, select *Cogo / Compute point*.
2. Enter a *Point name*.
3. In the *Method* field, select Brng-dist intersection.
4. As shown in the diagram below, enter the name of Point 1 (1), the azimuth (2), the name of Point 2 (3) and the horizontal distance (4).
5. Tap *Calc*.
6. There are two solutions (5,6) for this calculation; tap *Other* to see the second solution.
7. Store the point in the database.



### Brng-brng intersect

To calculate the coordinates of an intersection using the Brng-brng intersect method:

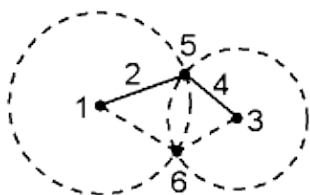
1. From the main menu, select *Cogo / Compute point*.
2. Enter a *Point name*.
3. In the *Method* field, select Brng-brng intersect.
4. As shown in the diagram below, enter the name of Point 1 (1), the azimuth from point one (2), the name of Point 2 (3), and the azimuth from point two (4).
5. Tap *Calc* to calculate the intersection point (5).
6. Store the point in the database



### Dist-dist intersect

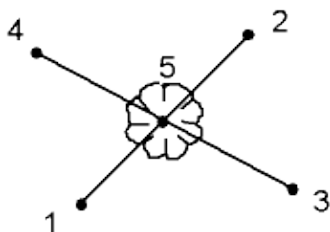
To calculate the coordinates of an intersection using the Dist-dist intersect method:

1. From the main menu, select *Cogo / Compute point*.
2. Enter a *Point name*.
3. In the *Method* field, select Dist-dist intersect.
4. As shown in the diagram below, enter the name of Point 1 (1), the horizontal distance (2), the name of Point 2 (3) and the horizontal distance (4).
5. Tap *Calc*.
6. There are two solutions (5,6) for this calculation; tap *Other* to see the second solution.
7. Store the point in the database.

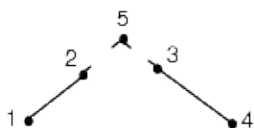


### To record an offset using the Four point intersection method:

1. From the main menu, select *Cogo / Compute point*.
2. Enter a *Point name*.
3. In the *Method* field, select Four point intersection.
4. As shown in the diagram below, enter the names of the start point of line 1 (1), the end point of line 1 (2), the start point of line 2 (3) and the end point of line 2 (4).
5. Enter any change in the vertical position as a vertical distance from the end of line 2.
6. To calculate the offset point (5), tap *Calc*.



**Note** – The two lines do not have to intersect, but they must converge at some point, as shown below.



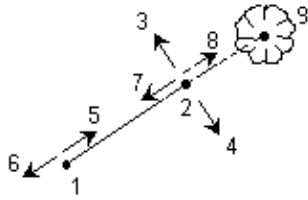
### To record an offset using the From a baseline method:

1. From the main menu, select *Cogo / Compute point*.
2. Enter a *Point name*.
3. In the *Method* field, select From a baseline.
4. As shown in the diagram below, enter the names of the start point (1) and the end point (2) of the baseline.
5. Enter a *Distance* and select the *Distance direction* method (5, 6, 7, or 8).
6. Enter the offset distance and select the *Offset direction* (3 or 4).
7. Enter the vertical distance from the end of the line.

**Note** – Enter a positive offset if the point is offset to the right (4) of the end point, or a negative offset if it is to the left (3). Enter 0 for either the distance or the offset if you do not want the point offset in

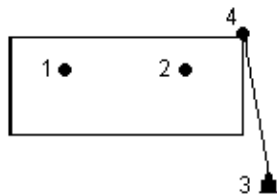
that direction.

8. To calculate the offset point (9), tap *Calc*.



### To calculate the coordinates of a point using the Vertical plane and angle method:

1. From the main menu, select *Cogo / Compute point*.
2. Enter a *Point name*.
3. In the *Method* field, select Vertical plane and angle.
4. As shown in the diagram below, enter the names of the points (1) and (2) that define the vertical plane, for example, the side of a building. Name and measure new points, or enter the names of existing points.
5. Tap *Meas HA VA* to measure the angle from the instrument (3) to the required point (4).  
The intersection of the vertical plane and the measured angle is used to calculate coordinates for the required point.
6. Tap *Store* to store the point in the database.



## Cogo – Compute Area

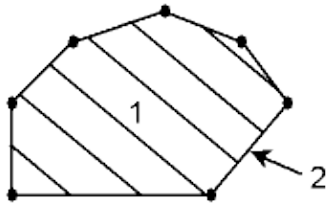
To calculate an area enclosed by points in the database:

1. From the map, select the points on the perimeter of the area to be calculated. Use the order that they occur on the perimeter.
2. Tap and hold on the map and select *Compute area* from the shortcut menu.

Alternatively, select *Cogo / Compute area* from the main menu.

**Note** – The computed area varies according to the [Distance](#) display setting.

The diagram below shows the calculated area (1) and perimeter (2).



## Cogo – Compute Azimuth

You can use keyed-in data, and points stored in the database, to calculate an azimuth by various methods. You can also store the results in the database. For some methods, you have to tap *Calc* to display the results.

The data that you enter can have different units. For example, you can add an angle in degrees to an angle in radians—the answer is returned in whatever format you specified in the job configuration.

Calculate an azimuth using one of the following methods:

[Between two points](#)

[Bisected azimuths](#)

[Bisected corner](#)

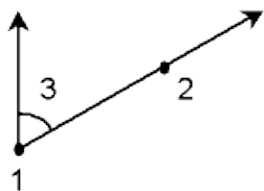
[Azimuth plus angle](#)

[Azimuth to line offset](#)

### Between two points

To calculate the azimuth between two points:

1. From the main menu, select *Cogo / Compute azimuth*.
2. In the *Method* field, select *Between two points*.
3. As shown in the diagram below, enter the name of the From point (1) and the To point (2).
4. The azimuth between them (3) is calculated.



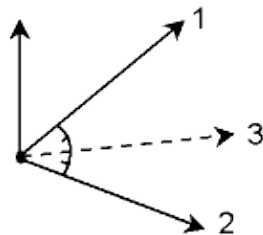


**Note** – You can compute an azimuth from two points in the database directly in an azimuth field. To do this, enter the point names in the *Azimuth* field, separated by a hyphen. For example, to compute the azimuth from point 2 to point 3, enter "2-3". This method works with most alphanumeric point names, but it does not support point names that already contain a hyphen.

### Bisected azimuths

To calculate bisected azimuths:

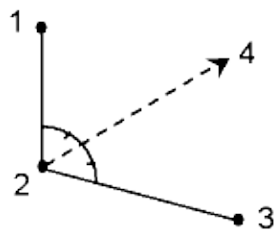
1. From the main menu, select *Cogo / Compute azimuth*.
2. In the *Method* field, select Bisected azimuths.
3. As shown in the diagram below, enter values for *Azimuth 1* (1), and *Azimuth 2* (2).
4. The azimuth halfway between them (3), is calculated.



### Bisected corner

To calculate a bisected corner azimuth:

1. From the main menu, select *Cogo / Compute azimuth*.
2. In the *Method* field, select Bisected corner.
3. As shown in the diagram below, enter the names of the *Side point 1* (1), the *Corner point* (2), and *Side point 2* (3).
4. The azimuth (4), halfway between Side point 1 and Side point 2, from the Corner point, is calculated.

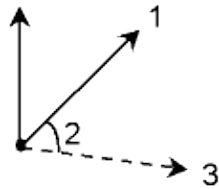


### Azimuth plus angle

To calculate the azimuth plus angle:

1. From the main menu, select *Cogo / Compute azimuth*.
2. In the *Method* field, select Azimuth plus angle.
3. As shown in the diagram below, enter the *Azimuth* (1) and the *Turned angle* (2).

4. The sum of the two (3) is calculated.



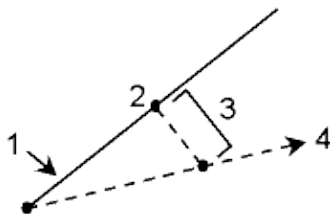
### Azimuth to line offset

To calculate the azimuth to line offset:

1. From the main menu, select *Cogo / Compute azimuth*.
2. In the *Method* field, select Azimuth to line offset.
3. As shown in the diagram below, enter the name of the line (1), the stationing (2) and the horizontal offset (3).

**Tip** – If the line does not already exist, tap the advanced pop-up arrow and then select *Two points*. You can then enter the start point and end point to define the line.

4. The azimuth (4), from the start point of the line to the offset point is calculated.



## Cogo – Compute Distance

You can use keyed-in data, and points stored in the database, to calculate a distance by various methods. You can also store the results in the database.

The data that you enter can have different units. For example, if you add a distance in meters to a distance in feet, the answer is returned in whatever format you specified in the job configuration.

For some methods you have to tap *Calc* to display the results.

[Between two points](#)

[Between point and line](#)

## Between point and arc

### Between two points

To compute the distance between two points:

1. From the main menu, select *Cogo / Compute distance*.
2. In the *Method* field, select *Between two points*.
3. Enter the *From point* and the *To point*.
4. The distance between the two points is calculated.

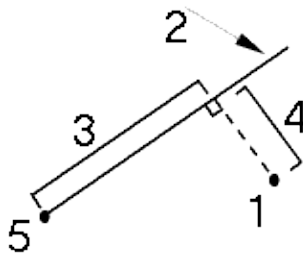
### Between point and line

To compute the distance between a point and a line:

1. From the main menu, select *Cogo / Compute distance*.
2. In the *Method* field, select *Between point and line*.
3. As shown in the diagram below, enter the *Point name* (1) and the *Line name* (2).

**Tip** – If the line does not already exist, tap the advanced pop-up arrow and select *Two points*. You can then enter the start point and end point to define the line.

4. The distance along the line (3) and the perpendicular distance (4) to the line is calculated. The distance along the line is from the point specified (5).



### Between point and arc

To compute the distance between a point and an arc:

1. From the main menu, select *Cogo / Compute distance*.
2. In the *Method* field, select *Between point and arc*.
3. As shown in the diagram below, enter the *Point name* (1) and the *Arc name* (2).
4. The distance along the arc (3) and the perpendicular distance (4) to the arc is calculated. The distance along the arc is from the point specified (5).



## Cogo – Compute Average

Use the *Compute average* option to compute and store the average position for a point that has been measured more than once.

Enter the name of the point to compute the average position for into the *Point name* field. You can select the point name from a list using the [pop-up menu](#) for the field.

If the point you entered has only one position fix, or has been stored as a control point, then an error message appears to tell you that an average position cannot be computed.

Once you enter a point name for which an average position can be computed, Trimble Survey Controller searches the database to find all the positions for that point. Once computed, the average point grid position appears, along with the standard deviations for each ordinate.

**Note** – Any Mean Turned Angle (MTA) observed to the point is ignored and the original observations are used to compute the average position.

If there are more than two positions for the point, a *Details* softkey appears. Tap *Details* to view the residuals from the average position to each individual position. You can use this residuals form to include or exclude specific positions from the average computation.

**Tip** – Trimble Survey Controller averages all positions in the current job database with the same name (except Control points). Tap *Details* to ensure that only the required positions are averaged.

To store the computed average position for the point, tap *Store*. If an averaged position for the point already exists in the database, the existing point is automatically deleted when the new average position is stored.

## Cogo – Subdivide a line

Use this function to subdivide a line into segments. The points created are automatically stored in the database and the point names are automatically incremented from the Start point name.

You can predefine the code of a subdivided point. For more information, see [Subdivide Pts Code](#).

Subdivide a line using one of the following methods:

[Fixed segment length](#)

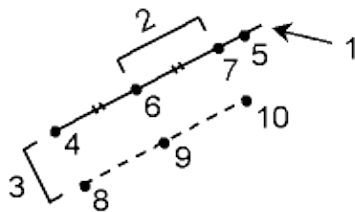
## Fixed number of segments

**Tip** – If the line does not already exist, tap the advanced pop-up arrow and then select *Two points*. You can then enter the start point and end point to define the line.

## Fixed segment length

To subdivide a line into segments of fixed length:

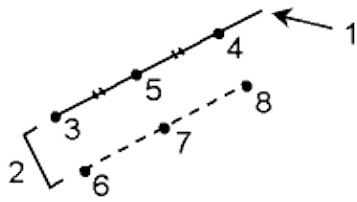
1. Do one of the following:
  - ◆ From the map, select the line to be subdivided (1). Tap and hold on the screen and then select the *Subdivide a line* option from the shortcut menu.
  - ◆ From the main menu, select *Cogo / Subdivide a line*. Enter the name of the defined line.
2. In the *Method* field, select Fixed segment length.
3. Enter the segment length (2), and any horizontal offset (3) and vertical offset from the line.
4. Enter the names of the *Start at station* (4), the *End at station* (5), and the *Start point name*.
5. Tap *Start* to calculate the new points (4, 6, 7, or 8, 9, 10).



## Fixed number of segments

To subdivide a line into a fixed number of segments:

1. Do one of the following:
  - ◆ From the map, select the line to be subdivided. Tap and hold on the screen and then select the *Subdivide a line* option from the shortcut menu.
  - ◆ From the main menu, select *Cogo / Subdivide a line*. Enter the name of the defined line.
1. In the *Method* field, select Fixed number of segments.
2. Enter the number of segments, and any horizontal offset (2) and vertical offset from the line.
3. Enter the names of the *Start at station* (3), the *End at station* (4), and the *Start point name*.
4. Tap *Start* to calculate the new points (3, 5, 4, or 6, 7, 8).



## Cogo – Subdivide an arc

Use this function to subdivide an arc using one of the following methods:

[Fixed segment length](#)

[Fixed number of segments](#)

[Fixed chord length](#)

[Fixed angle subtended](#)

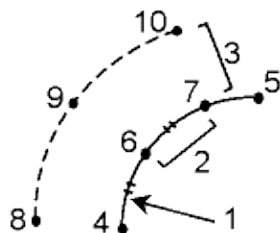
The points created are automatically stored in the database and the point names are incremented from the Start point name.

You can predefine the code of a subdivided point. For more information, see [Subdivide Pts Code](#).

### Fixed segment length

To subdivide an arc into segments of fixed length:

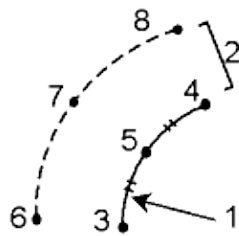
1. Do one of the following:
  - ◆ From the map, select the arc to be subdivided. Tap and hold on the screen and select the *Subdivide an arc* option from the shortcut menu.
  - ◆ From the main menu, select *Cogo / Subdivide an arc* . Enter the name of the defined arc.
2. In the *Method* field, select Fixed number of segments.
3. Enter the segment length (2), and any horizontal offset (3) and vertical offset from the arc.
4. Enter the names of the *Start at station* (4), the *End at station* (5), and the *Start point name*.
5. Tap *Start* to calculate the new points (4, 6, 7, or 8, 9, 10).



## Fixed number of segments

To subdivide an arc into a fixed number of segments:

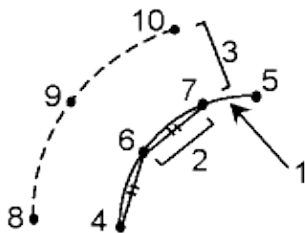
1. Do one of the following:
  - ◆ From the map, select the arc to be subdivided. Tap and hold on the screen and select the *Subdivide an arc* option from the shortcut menu.
  - ◆ From the main menu, select *Cogo / Subdivide an arc* . Enter the name of the defined arc.
2. In the *Method* field, select Fixed number of segments.
3. Enter the number of segments, and any horizontal offset (2) and vertical offset from the arc.
4. Enter the names of the *Start at station* (3), the *End at station* (4), and the *Start point name*.
5. Tap *Start* to calculate the new points (3, 5, 4, or 6, 7, 8).



## Fixed chord length

To subdivide an arc into segments of fixed chord length:

1. Do one of the following:
  - ◆ From the map, select the arc to be subdivided. Tap and hold on the screen and select the *Subdivide an arc* option from the shortcut menu.
  - ◆ From the main menu, select *Cogo / Subdivide an arc* . Enter the name of the defined arc.
2. In the *Method* field, select Fixed chord length.
3. Enter the chord length (2), and any horizontal offset (3) and vertical offset from the arc.
4. Enter the names of the *Start at station* (4), the *End at station* (5), and the *Start point name*.
5. Tap *Start* to calculate the new points (4, 6, 7, or 8, 9, 10).

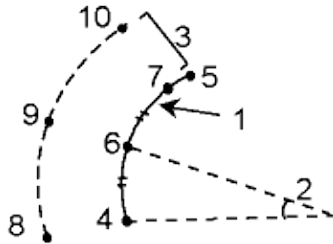


## Fixed angle subtended

To subdivide an arc into fixed angle subtended segments:

1. Do one of the following:

- ◆ From the map, select the arc to be subdivided. Tap and hold on the screen and select the *Subdivide an arc* option from the shortcut menu.
  - ◆ From the main menu, select *Cogo / Subdivide an arc*. Enter the name of the defined arc.
2. In the *Method* field, select Fixed angle subtended.
  3. Enter the *Angle subtended* (2), and any horizontal offset (3) and vertical offset from the arc.
  4. Enter the names of the *Start at station* (4), the *End at station* (5), and the *Start point name*.
  5. Tap *Start* to calculate the new points (4, 6, 7, or 8, 9, 10).



## Taped distances

Use this function to add points to your Trimble Survey Controller job. Use a graphical right angle and distance interface to define rectangular structures, such as a building or building foundations. Key in or measure two points to define the first side, orientation, and location of the object.

**Tip** – To select the elevation from the Start point or End point, use the pop-up menu in the *Elevation* field.

To select the direction for your next point graphically on the plan view, tap the screen or use the right and left arrow keys. The dashed red line shows the current direction for the next side. To create the next side, tap *Add*, and then enter the distance to the next point using the angle defined in the plan view.

Alternatively, select a point that already exists in your job and the software will calculate the distance to that point for you.

To measure a point using GPS or Conventional, select *Fastfix* or *Measure* from the pop-up menu on the *Point name* field.

**Tip** – If your style is configured for a laser rangefinder, *Laser* is available in the pop-up menu for *Length* and *H. Dist* fields. Tap *Laser* to measure distances using the laser.

To close the object back onto the start point, tap *Close*. A horizontal distance will be computed and displayed. Use this as a check against your plan or your taped distance. To complete the function, tap *Store*. To add further sides to the object, tap *Add*.

**Tip** – If you need more detailed information on the quality of the close, use a different point name for the end point, and store the object. Then compute an inverse between the start point and the end point.

To change a keyed in distance before the feature is stored, tap *Edit*, and then select the end point of the side to edit. When you adjust the distance, the plan view updates. You can then continue to add more sides.

### Notes



- Once the feature has been stored, you can no longer edit the lengths of the sides.
- The orientation is defined by the first side. Only parallel or 90° angles can be added from this side. To use a different angle, store the object, and then create a new side.
- Because new points are stored as polars, taped distances will not work without a Scale factor only or fully defined Projection in the coordinate system.
- In addition to the new points that are created, lines are created automatically and stored to the Trimble Survey Controller database. These are visible in the map and can be used to stake out lines.

## Cogo – Transformations

Use this Cogo function to transform a single point, or a selection of points, using one or a combination of Rotation, Scale, and Translations. When performing more than one translation, the order is always Rotation, Scale, then Translation.

### Rotate

To rotate a selection of points about a specified origin point:

1. From the main menu, select *Cogo / Transformations*.
2. Set the *Rotate* check box, then tap *Next*.
3. Enter an *Origin point*.
4. Enter a *Rotation*.
5. Tap *Next* and then select the point(s) to rotate.
6. To store the transformed point(s) to the database, tap *Accept*.

A transformation deletes the original point(s) and stores new grid points of the same name.

### Scale

To scale the distances between the origin point and the selected points:

1. From the main menu, select *Cogo / Transformations*.
2. Set the *Scale* check box, then tap *Next*.
3. Enter an *Origin point*.
4. Enter a *Scale factor*.
5. Tap *Next*, then select the point(s) to scale.
6. To store the transformed point(s) to the database, tap *Accept*.

A transformation deletes the original point(s) and stores new grid points of the same name.

### Translate

To move a selection of points on a grid surface:

1. From the main menu, select *Cogo / Transformations*.
2. Set the *Translate* check box, then tap *Next*.

3. In the *Method* field, select either *Deltas* or *Two points*.

If you choose *Deltas*:

1. Enter a delta Northing, Easting, and/or Elevation. You can select a single delta, for example a Northing, or any combination of deltas for the transformation.

If you choose *Two points*:

1. Select a *From point*.
2. Select a *To point*.
4. Tap *Next*, then select the point(s) to transform.
5. To store the transformed point(s) to the database, tap *Accept*.

A transformation deletes the original point(s) and stores new grid points of the same name.

## Notes

- Only points that can be displayed as grid coordinates can be transformed.
- When transforming by both rotate and scale, the origin for the scale defaults to the origin for the rotate. You can change this.
- When entering a point name, you can select from the list, key in a point, perform a fast fix, measure a point, or make a map selection. Fast fix stores an automatic rapid point with a temporary point name.

**Warning** – If you select a base point to be transformed, then vectors flowing from this base become null.

## Cogo – Traverse

Use this function to calculate a traverse misclosure, and adjust a conventional traverse. The software helps you select the points to be used, calculates the misclosure, and then lets you compute either a Compass or Transit adjustment.

**Note** – The Compass adjustment is sometimes known as the Bowditch adjustment.

You can calculate closed-loop traverses and closed traverses that start and end on pairs of known points.

To calculate a traverse:

1. Enter the *Traverse name*.
2. In the *Start station* field, tap *List*.
3. Select a point from the list of valid traverse points that can be used as the start station. Tap *Enter*.

A valid start station has one or more backsights and one or more observations to the next traverse station.

4. Tap *Add* to add the next point in the traverse.
5. Select the next station in the traverse.

A valid traverse station has one or more backsight observations to the previous traverse station, and one or more observations to the next traverse station. When there is only one valid traverse station, it is added automatically.

**Note** – To view the observed azimuth and distance between two points in the list, highlight the first point and tap the Info softkey.

6. Repeat steps 4 and 5 until all points in the traverse have been added.

A valid end station has one or more backsights, and one or more observations to the previous traverse station.

If you need to remove any points from the list, highlight the point and tap *Delete*. When you delete a point, all points after it are deleted as well.

7. Tap *Close* to compute the traverse misclosure.

**Note** – You cannot add more points after selecting a control point, or a station with more than one backsight.

**Note** – To compute a traverse closure, there must be at least one distance measurement between successive points in the traverse list.

**Note** – The *Azimuth* fields do not have to be completed.

If the backsight azimuth is null:

- ◆ the traverse cannot be oriented.
- ◆ adjusted coordinates cannot be stored.
- ◆ an angular adjustment cannot be computed on an open traverse. (A distance adjustment can be computed.)

If the foresight azimuth is null in a loop traverse, and if all angles have been observed, you can compute an angular and distance adjustment.

The backsight and foresight points that provide the orientation for the traverse are shown.


If necessary, tap *Enter* to edit the fields as follows:

1. Inspect the results of the traverse and do one of the following:
  - ◆ To store the closure results, tap *Store*.
  - ◆ To adjust the traverse, go to the next step.
2. Tap *Options* to check the traverse settings. Make any changes as required, then tap *Enter*.
3. Tap *Adj. Ang.* to adjust the angular misclosure. The angular misclosure is distributed according to the setting in the *Options* screen.
4. Inspect the results of the traverse, then do one of the following:
  - ◆ To store the angular adjustment details, tap *Store*.


- ◆ To adjust the distance misclosure, tap *Adj. dist.* The distance misclosure is distributed according to the setting in the *Options* screen and the traverse is stored.

When the traverse is stored, each point used in the traverse is stored as an adjusted traverse point with a search classification of adjusted. If there are any previously adjusted traverse points of the same name, they are deleted.

## Pop-Up Menu Controls

To insert a feature name into a field, enter the name or tap the pop-up menu button  and select one of the following options from the list that appears:

List	select features from the database
Key in	key in details
Measure	measure a point
Fast fix	automatically measure a construction class point
Map selections	select from a list of the features currently selected in the map
Calculator	shortcut to the Calculator
Units	select units for the field

To change the method of data entry, tap the advanced pop-up menu button . The first two or three fields change.

## Cogo Settings

Use this screen to configure the distance type (grid, ground, or ellipsoid), and the grid coordinate system orientation to be used by the Trimble Survey Controller software.

You can select a south azimuth, or set the grid coordinates to increase in north-east, south-west, north-west, or south-east directions.

For a GPS survey, specify an ellipsoid (in Datum transformation) if ground distances are to be displayed, otherwise the WGS-84 ellipsoid is used.

When you select *Scale factor only* in a conventional instrument only survey, grid and ground distances can be displayed.

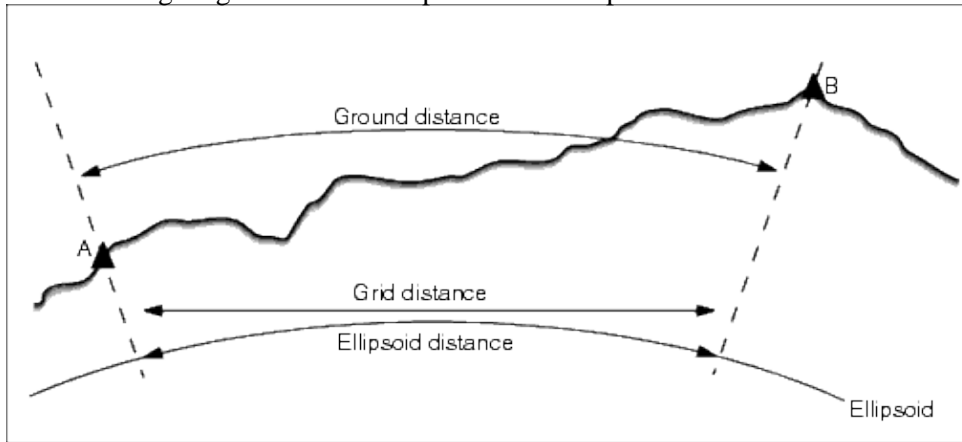
To configure the Cogo settings, select *File / New job / Cogo settings* when creating a new job. For an existing job select *File / Properties of current job / Cogo settings*.

### Distance Display

The *Distances* field defines how distances are displayed and which distances are used for calculations in the Trimble Survey Controller software. Select one of the following options:

- Ground (the default setting)
- Ellipsoid
- Grid

The following diagram shows the options between points A and B.



### Ground distance

A ground distance is the horizontal distance calculated between the two points at the mean elevation parallel to the chosen ellipsoid.

If an ellipsoid has been defined in the job and the *Distances* field is set to *Ground*, the distance is calculated parallel to that. If no ellipsoid has been defined, the WGS84 ellipsoid is used.

### Ellipsoid distance

If the *Distances* field is set to *Ellipsoid* then a correction is applied and all distances are calculated as if on the local ellipsoid, which usually approximates to sea level. If no ellipsoid has been specified, the WGS84 ellipsoid is used.

**Note** – If the coordinate system for a job is defined as *Scale factor only*, ellipsoid distances cannot be displayed.

### Grid distance

If the *Distances* field is set to *Grid*, the grid distance between two points is displayed. This is the simple trigonometrical distance between the two sets of two-dimensional coordinates. If the coordinate system for the job is defined as *Scale factor only*, and the *Distances* field is set to *Grid*, the Trimble Survey Controller software displays ground distances multiplied by the scale factor.

**Note** – A grid distance between two measured GPS points cannot be displayed unless you have specified a datum transformation and a projection, or performed a site calibration.

### Curvature Correction

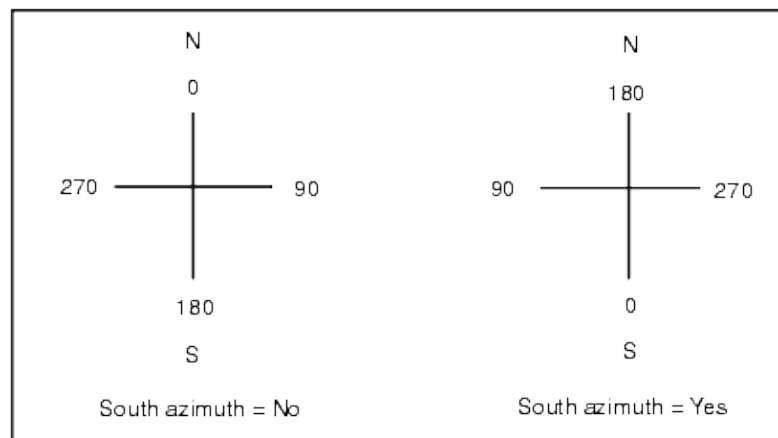
In the Trimble Survey Controller system, all ellipsoid and ground distances are parallel to the ellipsoid.

## Azimuth Display

The azimuth displayed and used by the Trimble Survey Controller software depends on the coordinate system that you defined for the current job:

- If you defined both a datum transformation and a projection, or if you selected *Scale factor only*, the grid azimuth is displayed.
- If you defined no datum transformation and/or no projection, the best available azimuth is displayed. A grid azimuth is the first choice, then a local ellipsoidal azimuth, then the WGS84 ellipsoid azimuth.
- If you are using a laser rangefinder, the magnetic azimuth is displayed.

If a south azimuth display is required, set the *South azimuth* field to *Yes*. All azimuths still increase clockwise. The following diagram shows the effect of setting the *South azimuth* fields to No or Yes.

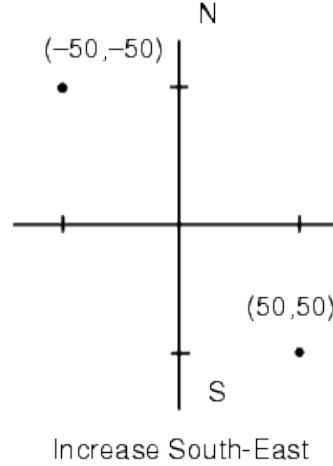
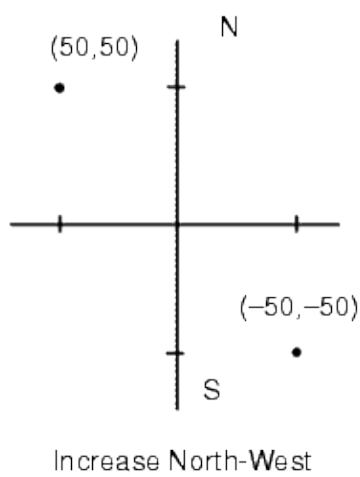
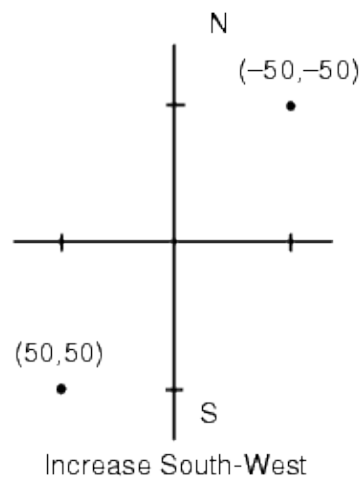
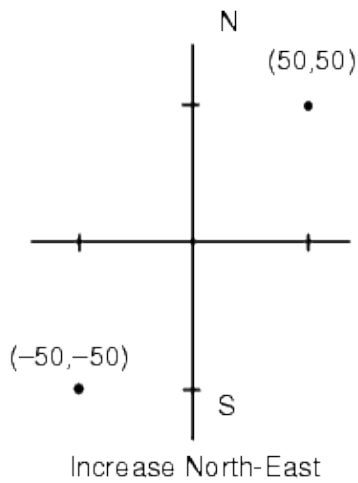


## Grid Coordinates

Use the *Grid coords* field to set the grid coordinates to increase in one of the following sets of directions:

- north and east
- south and west
- north and west
- south and east

The following diagram shows the effect of each setting.



## Magnetic Declination

Set the magnetic declination for the local area if magnetic bearings are being used in the Trimble Survey Controller software. You can use magnetic bearings if you choose the *Cogo / Compute* point using the Brng-dist from a point method.

The magnetic declination defines the relationship between magnetic north and grid north for the job. Enter a negative value if magnetic north is west of grid north. Enter a positive value if magnetic north is east of grid north. For example, if the compass needle points  $7^\circ$  to the east of grid north, the declination is  $+7^\circ$  or  $7^\circ\text{E}$ .

**Note** – Use the published declination values if available.

**Note** – If grid north in the job has been rotated away from true north due to the coordinate system definition (possibly via a GPS calibration) then this must be allowed for in the magnetic declination specified.

## Neighborhood adjustment

You can apply a *Neighborhood adjustment* to all conventional foresight observations made from a Station setup plus or Resection, and to all GPS observations made in a job that has a valid GPS site calibration. To apply Neighborhood adjustment, select the check box in *Properties of current job / Cogo settings*.

Neighborhood adjustment uses the residuals from *Station setup plus*, *Resection* or *GPS site calibration* to calculate delta grid values to apply to subsequent observations made during the survey. Each observation is adjusted according to its distance from each of the backsight points (for a conventional survey) or calibration points (for a GPS survey). The following formula is used to calculate the weight to give the residuals of each backsight or calibration point:

$$p = 1/D^n \text{ where:}$$

p is the weight of the backsight or calibration point  
D is the distance to the backsight or calibration point  
n is the weight exponent

A weighted average is then computed and the resulting delta values are applied to each new observation to get an adjusted grid position.

**Note** – A high value for the weight exponent results in low impact (weight) of distant backsight or calibration points.

For *Neighborhood adjustment* to be applied, the station setup or calibration must have at least 3 known points with 2D grid residuals. That is, if you perform a:

- Station setup plus, you must have HA VA SD observations to at least 2 backsight points, each with known 2D coordinates.
- Resection, you must have HA VA SD observations to at least 3 backsight points, each with known 2D coordinates.
- Calibration, you must have GPS observations to at least 3 control points, each with known 2D coordinates.

## Notes

- Neighborhood adjustment will use a *GPS site calibration* only if it has been observed in the current Trimble Survey Controller job. This is because a GPS calibration that is part of the coordinate system in an uploaded job does not include the GPS calibration residuals.
- For *Station setup plus*, the known station coordinate is included in the neighborhood adjustment calculation. In the calculation, the station coordinate is given grid residuals of zero.
- Neighborhood adjustment is a 2D-only adjustment. Any vertical residuals from station setup or calibration are not used in the neighborhood adjustment calculations.
- Neighborhood adjustment using GPS site calibration residuals is applied to all WGS84 points in the job, not just GPS observations.

**Warning** – Make sure that the backsight or calibration points are around the perimeter of the site. Do not survey outside the area enclosed by the backsight or calibration points (and for Station setup plus, the station point). The neighborhood adjustment is not valid beyond this perimeter.



# Survey – General

## Survey Menu

Use this menu to measure and stake out points using the [Survey Styles](#) defined in the Trimble Survey Controller software.

For more information, see:

[Conventional Surveys](#)

[FastStatic Surveys](#)

[PPK Surveys](#)

[RTK Surveys](#)

[RTK and Infill Surveys](#)

## Getting Started

All surveys in Trimble Survey Controller are controlled by a Survey Style. Survey Styles define the parameters for configuring and communicating with your instruments, and for measuring and storing points. This whole set of information is stored as a template and used each time you start a survey.

Configure the style only if the defaults do not suit your needs. To change the configuration of the Trimble Survey Controller software for different types of survey, select *Configuration / Survey Styles* from the main menu.

After this, whenever you want to use a particular survey style, you can select it from the [Survey menu](#).

**Note** – If there is only one survey style, it is automatically selected when you choose *Survey* from the main menu. Otherwise, select a style from the list that appears.

For details on how to set up these two types of surveys, see [Conventional Surveys](#), or [Real-Time Kinematic Surveys](#).

For more information on other types of GPS surveys, see [GPS Surveys](#).

## Getting Connected

The Trimble Survey Controller software can automatically connect to Trimble GPS and conventional instruments.



To auto-connect to a Trimble instrument, the software cycles through a set of connection protocols for each type of instrument. It can take up to 15 seconds to complete the cycle, which means it can take up to 15 seconds to automatically connect to a Trimble instrument, depending on where the software is in the auto-connect cycle when the instrument is connected.

There are three main groups of Trimble instruments that can be automatically connected: *Trimble GPS receivers*, *Trimble S Series total stations*, *Trimble 5600/3600 total stations*.

If you connect to only one of these types of instrument, you can speed up the automatic connection time by clearing the check box for the instrument type(s) you do not connect to.

To set the auto-connect options, tap the auto-connect icon in the status bar **before** you connect to an instrument.

When the software is trying to automatically connect to an instrument, the auto-connect icon flashes. There is a different icon for each type of instrument. For example, if you select only *Trimble GPS receivers*, then only the Trimble GPS receiver icon flashes.

If the auto-connect icon displays all three icons, and is not flashing, then auto-connect has been disabled for all three groups of instruments.

You do not have to wait for auto-connect to connect to your instrument. To force a connection, select the survey style and start the survey at any time.

To connect to a non-Trimble instrument, you must force a connection by starting the surveying.

**Tip** – When using non-Trimble instruments, disable auto-connect. Some commands used by auto-connect can interfere with the communication of non-Trimble instruments.

## Integrated Surveying

The Trimble Survey Controller software can switch between a GPS survey and a conventional survey, within the same job.

To start a second, integrated survey, begin your first survey as usual, select *Survey / Integrated surveying* and then select the name of your second style.

To switch between the two different surveys, select *Survey / Switch to <style name>*. Alternatively, tap *Switch to* and then select the name of the other survey style.

When you switch to the other survey, the connection to the first survey is automatically ended, and the second survey is automatically started. When the survey is automatically restarted, the standard start survey records are recorded to the job database. In a conventional survey, a *Use last* station setup is automatically performed.

The process of ending the survey automatically closes all open survey forms. Some forms (such as measure codes and stakeout) are opened again automatically. You must manually open other forms that were closed when you switched survey styles.

When you end an integrated survey, both surveys are ended.

## GPS Surveys

**Note** – If there is only one survey style, it is automatically selected when you choose Survey from the main menu. Otherwise, select a style from the list that appears.

The Trimble Survey Controller software provides Survey Styles for the following GPS survey types:

[FastStatic](#)

[Postprocessed Kinematic](#)

[Real-Time Kinematic](#)

[Real-Time Kinematic and Infill](#)

To use one of the following survey types, you must create your own survey style.

[Real-Time Kinematic and Data Logging](#)

[Real-Time Differential Survey](#)

[Real-Time Differential and Data Logging](#)

For information on how to configure settings for GPS surveys, see the following topics:

[Start Base Receiver](#)

[Measure Points](#)

[Measure Codes](#)

[Continuous Topo Points](#)

[Swap Base Receiver](#)

[Stakeout](#)

[Initialization](#)

[Configuring the Survey Style for a Site Calibration](#)

# Conventional Surveys

**Note** – If there is only one survey style, it is automatically selected when you choose *Survey* from the main menu. Otherwise, select a style from the list that appears.

The Trimble Survey Controller software provides a default style for use with a conventional instrument. Configure this type of survey when you create or edit a survey style, then follow these steps to carry out a conventional survey.

1. [Configure your survey style](#)
2. [Prepare for a robotic survey](#)
3. [Perform a station setup](#)
4. [Begin the survey](#)
5. [End the survey](#)

## Configure your survey style

Trimble Survey Controller automatically connects to Trimble S Series, 5600, and 3600 instruments. Configure the style only if the defaults do not suit your needs.

To configure a survey style:

1. From the main menu, select *Configuration / Survey styles / <Style name>*.
2. Select each of the options in turn, and set them to suit your equipment and survey preferences.
3. Once you configure all the settings, tap *Store* to save them, and then tap *Esc* to return to the main menu.

For more information, see:

[Instrument](#)

[Laser rangefinder](#)

[Duplicate point tolerance](#)

[Traverse options](#)

## Prepare for a robotic survey

To prepare a Trimble S Series or 5600 instrument for a robotic survey, the instrument must be turned on, leveled, with the correct radio settings, and if required, a search window defined.

If the instrument is level, has the correct radio settings, and you are using the autocentered search window, press the trigger button to turn on the instrument for a robotic survey.

To configure the Radio channel and Network ID on a Trimble S Series instrument without using the Trimble Survey Controller software, select [Radio settings] on the instrument through the *Face 2* menu display.

For more information, refer to the documentation for your instrument.

**Note** – Trimble Survey Controller cannot communicate with the Trimble S Series instrument when the onboard programs are in use. Once you finish using the instrument's onboard programs, select [Exit] from the [Setup] menu to return to the [Waiting for connection] menu.

The following section describes how to level the instrument, configure the radio settings, and set the search window on the instrument through the Trimble ACU controller.

### Preparing the Trimble 5600 instrument for a Robotic survey

1. With the ACU attached to the Trimble 5600 instrument, press the trigger button to turn on the instrument and controller.
2. Start the Trimble Survey Controller software, level the instrument and then tap *Accept* in the leveling screen.  
Tap *Esc* to exit the *Corrections* screen and the *Trimble Survey Controller Basic* screen if they appear.
3. From the Trimble Survey Controller main menu, select *Instrument / Radio settings*.
4. Set the *Radio channel*, *Station address* and *Remote address* and then tap *Accept*.
5. Do one of the following:
  - To set a search window:
    - a. From the main menu, select *Survey / Start Robotic*.
    - b. Aim the instrument to the Top left corner of the search window and tap *OK*.
    - c. Aim the instrument to the Bottom right corner of the search window and tap *OK*.
    - d. Tap *OK* to suspend the controller ready for robotic operation.
  - If you plan to use an [Autocentered search window](#), press the power key on the Trimble ACU to suspend the controller.  
You do not need to define the search window now.
6. Remove the controller from the instrument and then attach the controller to the robotic holder:
  - a. Connect the ACU to Port A on the remote radio using the ACU holder or a 0.4 m, 4-pin Hirose cable.
  - b. Turn on the active target or connect it to Port B on the remote radio.
7. Press the power key on the ACU. The Trimble Survey Controller software auto-connects to the instrument radio and displays the leveling screen. If required, level the instrument and then tap *Accept*.

You are now ready to perform a station setup.

**Note** – The 5600 is re-initialized to compensate for the earlier removal of the controller.

When the instrument is suspended ready for robotic operation, it switches off to conserve power. The internal radio remains switched on so that the rover radio can communicate with the instrument when you start the rover survey.

**Note** – The internal radio settings are set when the Trimble Survey Controller software connects to the instrument. The remote radio settings are set later when you start the rover survey.

For more information, see [Radio settings](#).

## Perform a station setup

To get the most out of the Station setup routine, tap *Options* to configure *Station setup* to match the way that you prefer to work.

You can configure the default point names, default heights, default instrument coordinates, and the default azimuth. Default instrument coordinates and default azimuth are used only if the instrument point is not already coordinated, and an azimuth to the backsight cannot be computed.

The *Default point names* option determines the default values for the instrument and the backsight point name fields each time you perform a station setup:

- If you always use the same names for your instrument and backsight points, select *Last used*. Use this method if you always use the default instrument coordinates, or if you repeatedly set up on the same known point.
- If you are performing a traverse type survey, select *Traversing*. When you start a new station setup, by default, the instrument uses the first foresight point observed from the last station setup for the *Instrument point name*, and the instrument point name used in the last station setup for the *Backsight point name*.
- If you want to key in or select the instrument and backsight point names each time you perform a station setup, select *All null*.

**Note** – These are only default values. You should select the option that matches your normal workflow. You can override the default values for any particular station setup.

**Note** – Do not confuse the *Last used* option with the *Use last* survey menu option.

The *Last used* option applies to a new station setup. The last values are used even across different jobs.

The *Use last* menu option reinstates the last station setup. No new station setup is performed.

The *Default heights* option determines the default values for the instrument and the backsight point height fields each time you perform a station setup.

- If you always use the same heights for your instrument and backsight points, select *Last used*. This option is available only if you set the *Default point names* option to *Last used*.
- If you are using the Trimble traverse kit (so that the last measured foresight and instrument heights can be used as the new instrument and backsight heights), select *Move forward*. This option is available only if you set the *Default point names* option to *Traversing*.
- If you want to key in a new instrument and backsight height for each station setup, select *All null*.

If the instrument point does not exist, the default instrument coordinates are used. This is particularly useful if you work in a local coordinate system, and always set up your instrument on coordinate (0,0,0) or (1000N, 2000E, 100EI), for example. If you leave the *Default instrument coordinates* set to null, you can key in coordinates for instrument points that do not exist when you perform a station setup.

If an azimuth cannot be computed between the instrument and backsight points, the *Default azimuth* is used.

**Note** – If you always set up your instrument on a known point, and use a known azimuth, then leave the *Default instrument coordinates* and *Default azimuth* fields set to null. This ensures that you do not accidentally use default values if you incorrectly enter the name of the instrument and/or the backsight point names.

The Trimble Survey Controller software normally expects you to measure a backsight point to orient your survey. If your survey practice does not require you to measure to the backsight, clear the *Measure backsight* checkbox on the second page of options. The software automatically creates a virtual backsight, *Backsightxxxx* (where xxxx is a unique suffix, for example, *Backsight0001*), using the current instrument orientation as the azimuth.

**Tip** – If the instrument is correctly set up and oriented, you are satisfied that the last station setup is still valid, and you wish to continue observing points from this station, select Survey / Use last to use the last completed station setup.

**Note** – Before you can use the Turn to or Joystick functions to turn a servo or robotic instrument, you must have a current station setup.

To perform a station setup:

1. From the main menu, select Survey / *Station setup* , *Station setup plus* , *Resection* , or *Refline*.

**Note** – If you have only one style, it is automatically selected.


Set the *corrections* associated with the instrument.

If the *Corrections* form does not appear, set the corrections by selecting *Options* from the *Station setup* screen. To have the *Corrections* form display on startup, select the *Show corrections on startup* option.

For some instruments, the Trimble Survey Controller software automatically checks to see if various corrections (PPM, prism constant, and curvature and refraction) are being applied correctly. When you select *Station setup*, messages showing what has or has not been checked are displayed in the status line. If the Trimble Survey Controller software finds that the corrections are being applied twice, a warning message appears. When using the 5600 3600 instrument style, all corrections are applied in Trimble Survey Controller.

**Note** – When using a non-Trimble instrument, you must select the correct survey style **before** you connect the controller to the instrument. Otherwise, the instrument and controller may fail to connect.

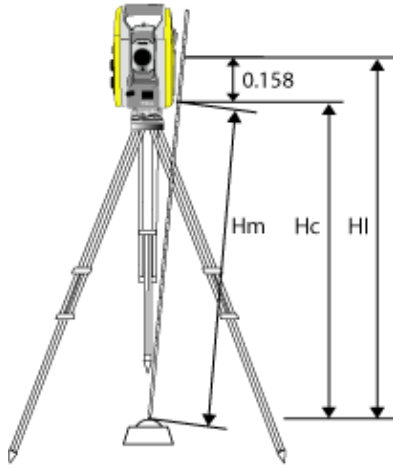
2. Enter the instrument point name and the instrument height.

When measuring to the bottom notch on a Trimble S Series instrument, tap the advanced pop-up arrow (  ) and then select *Bottom notch*. Enter the height measured to the top ridge of the bottom notch on the instrument.

Trimble Survey Controller corrects this measured slope value to true vertical and adds the offset 0.158

m (0.518 sft) to calculate true vertical to the trunnion axis.

For details, see the following figure and table.



0.158m	Offset from bottom notch to trunnion axis.
Hm	Measured slope distance.
Hc	Hm corrected from slope to true vertical.
HI	Hc + 0.158m. True vertical instrument height.

**Note** – For a 2D or planimetric survey, leave the *Instrument height* field set to null (?). No elevations will be calculated. Unless you are using a *Scale only* projection, you must define a project height in the coordinate system definition. The Trimble Survey Controller software needs this information to reduce measured ground distances to ellipsoid distances, and to compute 2D coordinates.

3. Enter the backsight point name.

**Tip** – If the point is available from a linked file, select the linked file for the job and enter the point name in the Instrument point name or *Backsight point name* field. The point is automatically copied to the job.

4. Choose an option in the *Method* field. The options are:

- ◆ *Angles and distance* – measure horizontal and vertical angles and slope distance
- ◆ *Angles only* – measure horizontal and vertical angles
- ◆ *H. Angle only* – measure horizontal angle only
- ◆ *Averaged observations* – measure horizontal and vertical angles, and slope distance for a predefined number of observations

5. If necessary, enter the target height for the backsight.

When measuring to the bottom notch on a **Trimble prism base**, tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

6. Sight the center of the backsight target and tap *Measure*.



7. If you are performing a [resection](#) or [station setup plus](#) , you can add more backsight points/observations to the station setup.
8. If the residuals for the station setup are acceptable, tap *Close* and then tap *Store*.

Station Setup is complete.


## Begin the survey

To do this:

1. From the main menu, select either *Survey / Measure points* or *Survey / Stakeout*.

If you chose *Measure points*:

- a. Enter a point name and code.
- b. Choose one of the methods of observation.
- c. Enter a target height, if required.

When measuring to the bottom notch on a [Trimble prism base](#), tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

- d. Tap *Measure* to observe the point.
- e. Tap *Store* to save the observation to the database.
- f. Tap *Check* to measure check shots to any known points.
- g. Move to the next point and measure it.

If you chose *Stakeout*:

- a. Tap *Add* to add the points you want to stake out to the stakeout list.
- b. Select the point to stake out now, and use the graphics and text to stake out the point.
- c. When the instrument is within the angular tolerance (as indicated by two hollow/outline arrows), tap *Measure*.
- d. Tap *Accept* to view the stakeout deltas.
- e. Tap *Store* to save the point.
- f. Continue until all points have been staked out.
- g. To make a servo instrument turn to the point, tap *Turn*. If *Servo auto turn* is set to HA and VA or HA only, the instrument automatically turns, if it can compute the angle to the point.
- h. To review stored points, select *Review current job* from the *Files* menu.

## End the survey

To do this:

1. From the main menu, select *Survey / End survey*.
2. Tap *Yes* to confirm.
3. Turn off the controller.

**Warning** – The current station setup is lost when you select *End Survey*.

If a survey is running, end it before editing the current survey style or changing survey styles. You must also end the survey before accessing job functions such as copying. For more information, see [Job](#).

For more information, see:

[Station Setup – Single backsights](#)

[Station Setup Plus](#)

[Resection](#)

[Reflines](#)

[Target](#)

[Prism constant](#)

[Measure Points](#)

[Measure Codes](#)

[Remote Object](#)

[Surface Scan](#)

[Measure a point in two faces](#)

[Measure Rounds](#)

[Station and offset](#)

[Stakeout](#)

[End Survey](#)

## Measure Points

The process of recording GPS or conventional instrument data is known as measuring. To measure points, do one of the following:

- From the *Favorites* menu, select *Measure points*.
- From the *Survey* menu, select *Measure points* or *Measure topo*.
- From the Map, select *Measure* (only available when nothing in the map is selected).

The types of points that you can measure depend on your survey style and the survey method used.

## Conventional Surveys

In conventional surveys, you can measure the following types of points:

- *Measure topo*
- *Check points*

If you are measuring points with codes, you can use *Measure topo*, but you may find *Measure codes* more useful. *Measure codes* uses a 9-button pallet that makes measuring codes easier and faster.

To measure a line of points at a fixed interval, select *Continuous topo* from the *Survey* menu.

If a point is inaccessible, you can also measure *horizontal angle* and *distance* offsets to the point.

To measure a point that cannot be observed directly with a pole in a plumb position use the *Dual prism* measurement method.

To calculate a center point of a circular object such as a water tank or silo, use the *Circular object* option.

To measure multiple sets of observations, select *Measure rounds* from the *Survey* menu.

To calculate the height of a remote object if the instrument does not support DR mode, or you cannot measure a distance, use the *Remote Object* method.

To automatically store measurements along a remote surface that you have defined, use the *Surface Scan* method.

You can also *Measure a point on two faces*.

**Tip** – In *Point name* fields there is a *Find* softkey that lets you search for the next available point name. For example, if your job contains points numbered in the 1000s, 2000s and 3000s, and you want to find the next available point name after 1000:

1. In the *Point name* field, tap *Find*. The *Find next free point name* screen appears.
2. Enter the point name you want to start searching from (in this example, 1000) and tap *Enter*.

The Trimble Survey Controller software searches for the next available point name after 1000 and inserts it in the *Point name* field.

## GPS Surveys

In GPS surveys, you can measure the following types of points:

- *Topo point*
- *Observed control point*
- *Calibration point*
- *Rapid point*
- *FastStatic points*. This is the only type possible in a FastStatic survey.

To measure a line of points at a fixed interval, select [Continuous topo](#) from the *Survey* menu.

## Measure Codes

To measure and code Conventional or GPS observations in one step, select the feature code you want to measure and store from a coding form containing nine buttons that you can define. You can define multiple groups or pages of codes, each consisting of up to nine codes.

In the *Measure codes* form, if you activate the *Code* button, it affects the behavior of the nine configurable code buttons. When you then tap one of the configurable code buttons, the code on that button is added to the code field at the bottom of the *Measure codes* form. Typically, you can use the *Code* button to combine codes from multiple code buttons where features combine, either from the current group, or a combination of groups. You can also use it to enter a new code.

If a code has attributes, the attribute values appear at the bottom of the *Measure codes* form. You cannot directly edit these attribute values in the form. To change the attribute values, do one of the following:

- Tap *Attrib* in the *Measure codes* form.
- Tap *Attrib* in the *Measure topo/Measure points* form.
- If *Prompt for attributes* is enabled, enter the attributes when prompted.
  - ◆ If you pre-entered attributes using the *Attrib* softkey, you are not prompted for attributes.

For more information, see [Using Feature Codes with Predefined Attributes](#).

### To add a feature code group and assign codes to the buttons:

1. Select *Survey / Measure codes* and then tap *Add group*.
2. Enter a *Group name* and then tap *OK*.
3. To add a code to a button:
  - ◆ Tap and hold on the button. When the tooltip message appears, remove the stylus from the screen. In the dialog that appears, enter the code, or select a code from the feature code library.
  - ◆ Navigate to the button using the arrow keys, and then press the Space key, which emulates the 'tap and hold' action.

In the dialog that appears, enter the code, or select a code from the feature code library. Tap *OK*. The code you entered now appears on the button.

If required, you can also enter additional [descriptions](#).

4. To add another code, or remove a code from a button, repeat Step 3.
5. To add more groups of feature code buttons, tap *Add group*.

To navigate to a particular group, select it from the drop down list in the top left of the form. Alternatively, use A – Z to quickly switch to group pages 1 – 26. This method is not available if the *Code* button is enabled.

## To measure and code observations using Measure codes:

1. Select *Survey / Measure codes*.
2. To initiate a measurement, activate the button using one of the following methods:
  - ◆ Tap the button.
  - ◆ Press the numeric key on the controller keyboard corresponding to the button. Keys 7,8, 9, activate the top row of buttons, keys 4, 5, 6 activate the middle row of buttons, keys 1, 2, 3 activate the bottom row of buttons.
  - ◆ Use the arrows keys on the controller to navigate to the button and then press **Enter**.

If the code has attributes, the attribute values appear at the bottom of the *Measure codes* form.

3. To automatically start the measurement when the button is selected, tap *Options* and then select the *Auto measure* check box.

**Note** – When the method is set to *Distance offset*, *Angles only*, and *H Angle only*, *Automeasure* is temporarily paused.

4. To configure the position of the highlight for the next code, tap *Options* and then configure the *Direction* of the *Template pickup*.
5. The code field is set to the code on the button and the measurement is initiated. The measurement is automatically stored depending on the setting in *Options*:
  - ◆ In a GPS survey, set the Topo point options to *Auto store point*.
  - ◆ In a Conventional survey, clear the *View before storage* check box in the *Measure point options* form.

If descriptions were defined on the Measure codes button, the descriptions are also set to the descriptions on the button.

6. Once you store the measurement, the *Measure codes* form appears, ready for the next measurement.

Tap [Enter] to measure a point with the same code again, or use one of the methods described in step 2 above to measure with a different code.

The *Measure topo/Measure points* form, where the measurement was initiated, remains open in the background. If you need to change the point name or measurement method, tap *Switch to* to switch to this form, change the fields as required and then tap *Switch to* again to return to the *Measure codes* form.

## Using Template pickup

Use the *Template pickup* feature to automatically move the highlight from the current button to the next button after storing a measurement. Template pickup is particularly useful when coding observations in a regular pattern, for example, across a road template.


To configure template pickup, tap *Options* and then configure:

- The template pickup *Direction*:
  - ◆ Left to right

- ◆ Right to left
- ◆ Zig zag
- The *Number of template elements*:
  - ◆ The *Number of template elements* configured should match the number of elements across the template, and the number of buttons configured in Measure codes.

To skip a code, tap a different button, or use the arrow keys to select an alternative code button.

## Notes

- The first time that you use *Measure codes*, the measurement may not begin automatically if you have not defined the point name and target height. If this occurs, complete these fields and then tap *Measure* to begin the measurement.
- To change target or antenna heights, tap the target icon in the status bar.
- During a measurement, you can change the point name, and the target or antenna height and code. However, you can do this only if you start editing before the observation is stored. Alternatively, tap *Esc* as soon as the measurement begins, make the required changes, then tap *Measure* to restart the measurement.
- To change the EDM or measurement method, tap *Esc* during the measurement, make the required changes, then tap *Measure* to restart the measurement.
- To change the point name or measurement method before you start a measurement, tap *Switch to* to switch to the *Measure topo/Measure points* form, change the fields as required and then tap *Switch to* again to return to the *Measure codes* form.
- To measure a point with a null code, activate a blank code button. Alternatively, tap *Code*, ensure that the code field is empty and then tap *Measure*.
- To store a [note](#) with an observation, tap .
- To delete an entire group of codes, select the group and then tap *Delete*.

## Stringing support

Measure codes has '+' and '-' softkeys that enable you to apply a suffix to the code on the button. This is useful when you use the stringing method for feature coding.

You can configure the suffix to 1, 01, 001, or 0001.

When the suffix is configured to 01, tap '+' to increase the code "Fence" to "Fence01". Tap '-' to decrease the code by 01.

**Note** – The suffix is applied to the code on the button. If the suffix is 01 and you select '+' for a button that has the code "Fence01", the code increases to "Fence0101".

Tap *Find* to find the next available string for the currently highlighted button.

## Attributes and Base codes

You can configure the Trimble Survey Controller software to provide attributes for the complete code, or from a portion of the code – the "base code".

Typically, base codes are used when you use the '+' and '-' softkeys to "string" feature codes. For example, when you code a fence where all observations coded "Fence01" are joined together and all observations coded "Fence02" are joined together, and so on, and they all have the same attributes. In this example, you can create feature code libraries that contain all the "Fence\*" codes, or contain just the base code "Fence".

If you do not string codes, or if you do string codes but you include the entire code in the feature code library, then you are not using base codes. Disable *Use attributes of base code* (clear the check box).

If you do string codes, and the feature and attribute library includes only the base code, then enable *Use attributes of base code* (select the check box).

In the Trimble Survey Controller software, you can use the extra power of Measure codes to create a button that contains a numeric or alpha-numeric code (the base code) and then append a numeric suffix using the '+' or '-' softkeys. For codes entered into any other code field in the Trimble Survey Controller software, you cannot use the '+' or '-' softkeys to append a suffix, so when you use base codes, the software can only attempt to determine the base code by stripping the numeric characters from the end of the codes.

The following rules help to explain the base code:

- **In Measure codes:**

1. When *Use attributes of base code* is disabled, the code displayed on a button is the base code.
  - ◇ Enter "Fence", string the code to become "Fence01", the attributes are derived from "Fence01".
2. When *Use attributes of base code* is enabled, the code entered on a button is the base code.
  - ◇ Enter "Fence", string the code to become "Fence01", the attributes are derived from "Fence".
3. If you edit or change the code on a button, the base code resets, using rule 1 or rule 2 above.
4. If you change the configuration of the *Use attributes of base code* setting, the base code resets, using rule 1 or rule 2 above.
5. When Measure codes 'passes' the code to the Measure topo, or Measure points system, the base code from within Measure codes is retained.

- **In any other code field** of the Trimble Survey Controller software:

1. When *Use attributes of base code* is disabled, the code entered is the base code.
2. When *Use attributes of base code* is enabled, the base code is determined by 'internally' stripping any numeric characters from the end of the code.
3. When *Use attributes of base code* is enabled, and you edit a code that is 'passed' from Measure codes, the base code is re-derived by 'internally' stripping any numeric characters from the end of the code.

## Notes

- If you use attributes and numeric codes with a string suffix, you must use Measure codes to define the suffix and start the measurement. Measure codes understands where the code ends and the suffix starts. If you do not use Measure codes, the entire numeric code + suffix will be treated as the code, the suffix cannot be determined, and attributes for the base code will not be available.
- To configure *Use attributes of base code*, from within Measure codes, use the up arrow softkey to select *Options*, and then select the check box as required.

- The *Use attributes of base code* setting is configured within Measure codes, but is applied throughout the Trimble Survey Controller software.
- If you edit the code on a button when *Use attributes of base code* is disabled, the entire code from the code button is displayed in the Edit field.
- If you edit the code on a button when *Use attributes of base code* is enabled, the base code is displayed in the Edit field.
  - ◆ The code on the button is "Fence01" and the base code is "Fence". If you edit this code, the base code "Fence" is displayed.
- You can string alphanumeric codes when *Use attributes of base code* is disabled. The code displayed on the button is the base code.
- You cannot string numeric only codes when *Use attributes of base code* disabled.

**Tip** – If you use multiple codes with attributes, enter all the codes **before** you enter the attributes.

### Sharing Measure codes groups between controllers

The groups, and the codes within each group, are stored in a Measure Codes Database file (\*.mcd).

If you use a feature and attribute library, the Measure Codes Database file (\*.mcd) is tied to that feature and attribute library and has a matching name. If you use the same feature and attribute library on other controllers, you can copy the \*.mcd file to use in the other controllers. To use the feature and attribute library \*.mcd file, you must assign the feature and attribute library to the job.

If you do not use a feature and attribute library, a [Default.mcd] file is created. The [Default.mcd] file can also be copied to other controllers. When the Trimble Survey Controller software does not have a feature and attribute library assigned to a job, the [Default.mcd] file is used in *Measure codes*.

## Roading

You can stake out, or measure your position relative to a:

- Trimble road
- road defined in a GENIO file

And you can stake out:

- road defined in a LandXML file

For more information, see:

[Key in – Roads](#)

[Key in – Templates](#)

[Stakeout – Roads](#)



[Trimble Roads](#)

[GENIO roads](#)

[LandXML roads](#)

## Stakeout – Overview

In a real-time GPS survey, or a conventional survey, you can stake out points, lines, arcs, DTMs, and roads.

To stake out an item:

- Define the item to be staked out.
- From the map, or from *Survey / Stakeout*, select the item to be staked out.
- Navigate to the point, or direct the person holding the rod to the point.
- Mark the point.
- Measure the point (optional).

You can define the item to be staked out in the *Key in* menu, or you can use a [linked file](#) to add the points to the stakeout list. You can also add lines and arcs transferred in a DC file to the stakeout list.

To stake out a line between two points without keying the line into the job database, you can select two points from the map, tap and hold in the map to access the pop-up menu and then select *Stake out line*.

To use GPS to stake out lines, arcs, Digital Terrain Models, and roads, you must define a projection and datum transformation.

**Warning** – Do not change the coordinate system or calibration after you have staked out points.

For more information, see:

[Arcs](#)

[Lines](#)

[Points](#)

[DTMs](#)

[Roads](#)

[Stakeout – Display mode](#)

[Stakeout – Options](#)

[Using the Graphical display](#)

## Fast Fix

Tap *Fast fix* to quickly measure and automatically store a construction point. Alternatively, select *Fast fix* from the pop-up menu in the *Point name* field.

**Note** – In a GPS survey, *Fast fix* uses the *Rapid point* method. In a conventional survey, *Fast fix* uses the current measurement mode.

If you need more flexibility, select *Measure* from the pop-up menu in the *Point name* field.

Typically, a construction point is used in *Cogo – compute points* or *Key in – lines and arcs*.

Construction points are stored in the Trimble Survey Controller database with autopoint names that increment from Temp0000. They are classified higher than as-staked points and lower than normal points. For more information, see [Database Search Rules](#).

To view construction points in a map or list, tap *Filter* and select them from the *Select filter* list.

## Topo Point

This is a previously configured method of measuring and storing a point. Configure this type of point when you create or edit a Survey Style.

Use the *Auto point step size* field to set the increment size for automatic point numbering. The default is 1, but you can use larger step sizes and negative steps.

Select the *View before storage* check box to view observations before they are stored.

You can store quality control information with each point measurement. Options may include *QC1*, *QC1 & QC2*, and *QC1 & QC3*, depending on the type of survey.

The *Occupation time* and *Number of measurements* together define the time that the receiver is static while measuring a point and the criteria for both must be met before the point can be stored. When the *Occupation time* and *Number of measurements* criteria have been met, *Store* is available. Alternatively, if *Auto store point* is enabled the point is stored automatically.

During the occupation, the RTK engine in the GNSS receiver converges on a solution and it is this converged solution that is saved in the Trimble Survey Controller job file when the point is stored.

You can configure *Occupation time* and *Number of measurements* criteria in the Survey style or under *Options*.

In an RTK survey, when you select the *Auto tolerance* check box, the software calculates horizontal and vertical precision tolerances that meet the GPS receiver's RTK specifications for the baseline length you are measuring. If you want to enter your own precision tolerances, clear this check box.

### Measuring a Topo Point in a GPS Survey



You can measure a topo point in every type of survey except a FastStatic survey.

To measure a topo point:

1. Do one of the following:
  - ◆ From the main menu, select *Survey / Measure points*
  - ◆ Tap *Favorites* and select *Measure points*
  - ◆ From the Map, select *Measure* (only available when nothing in the map is selected).  
To automatically start the measurement when you select *Measure* from the map, tap *Options* and then select the *Auto measure* check box.
2. Enter values in the *Point name* and *Code* fields (the *Code* field entry is optional), and select *Topo point* in the *Type* field.
3. Enter a value in the *Antenna height* field and make sure that the setting in the *Measured to* field is set appropriately.
4. When the antenna is vertical and stationary, tap *Measure* to start recording data. The static icon appears in the status bar.

**Tip** – You can tap *Enter* to accept the measurement before the occupation time or precisions have been satisfied.

5. When the preset occupation time and precisions have been reached, tap *Store*.

**Tip** – In the survey style, select the *Auto store point* check box to automatically store the point when the preset occupation time and precisions have been met.

## Check Point

### GPS


In a GPS survey, measure a point twice. Give the second point the same name as the first point. If the duplicate point tolerances are set to zero, the Trimble Survey Controller software warns that the point is a duplicate when you try to store it. Select *Store as check* to store the second point as a check class point. For more information, see [Duplicate point: Out of tolerance screen](#).

### Conventional

In a conventional total station survey, tap *Check* to measure a check class point.

To measure a check point:

1. In the *Point name* field, enter the name of the point to check.
2. In the *Method* field, select a measurement method and enter the required information in the fields that appear.
3. In the *Target height* field, enter the height of the target and then tap *Measure*.

When measuring to the bottom notch on a [Trimble prism base](#), tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

If you did not select the *View before storage* check box, the point is stored with a classification of *Check*. If you selected the *View before storage* check box, the check shot deltas appear on the *Check shot* screen.

When you observe the point, if the station setup is the same as when you originally measured the point, the deltas are the difference in values between the original observation and the check observation. The deltas displayed are horizontal angle, vertical distance, horizontal distance, and slope distance.

If the station setup is different from when you originally measured the point, the deltas are in terms of the best coordinates from the original point to the check point. The deltas displayed are azimuth, vertical distance, horizontal distance, and slope distance.

4. Tap *Enter* to store the check point. Tap *Esc* to abandon the measurement.

Tap *Chk BS* to display the *Check backsight* screen. This is similar to the *Check point* screen, but the *Point name* field shows the backsight of the current station setup. You cannot edit this field.

To observe a check shot to the backsight, use the same procedure as described above.

To return to the *Check point* screen, tap *Chk topo*.

## End Survey

To end the current survey, select *End survey* from the *Survey*.

When you end a GPS survey, the software asks you if you want to power down the receiver.

When you end a Conventional survey with Robotic instruments, the software asks you if you want to power down the instrument. If the instrument is powered down this way, starting the survey again automatically starts the instrument.

**Warning** – The current station setup is lost when you select *End Survey*.

# Survey – Conventional

## Measuring topo points in a Conventional Survey

To measure a topographic point using the Trimble Survey Controller software and a conventional instrument:

1. From the main menu, select *Survey* and then perform a [station setup](#), [station setup plus](#), [resection](#), or [refline](#).
2. From the *Survey* menu, select *Measure topo*.
3. Enter a value in the *Point name* field.
4. If necessary, enter a feature code in the *Code* field.
5. In the [Method](#) field, select a measurement method.
6. Enter a value in the *Target height* field and then tap *Measure*.

When measuring to the bottom notch on a [Trimble prism base](#), tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

If you selected the [View before storage](#) check box in the survey style, the measurement information appears on the screen. If necessary, edit the target height and code. Tap the view display button on the left of the measurement information to change the display and then do one of the following:

- To store the point, tap *Store*.
- Turn the instrument to the next point and then tap *Read*. The last point is stored and a measurement is made to the next point.

If you did not select the *View before storage* check box, the point is stored automatically and the point name increments (based on the *Auto point step size* setting). The Trimble Survey Controller software stores the raw observations (HA, VA, and SD).

### Notes

- If you selected the *Auto average* option, and an observation to a duplicate point is within the specified duplicate point tolerances, the observation and the computed average position (using all the available point positions) are automatically stored.
- To produce an averaged coordinate, Trimble Survey Controller software averages the grid coordinates calculated from the underlying coordinates or observations. Observations that do not allow a grid coordinate to be resolved (for example, angles only observations) are not included in the average coordinate.

To change the settings for the current survey, tap *Options*. You can not change the current survey style or the system settings.

If you are using a servo or robotic instrument to measure a known (coordinated) point, tap *Turn*. Alternatively, with a servo instrument, set the *Servo auto turn* field in the survey style to *HA & VA*, or *HA only* to automatically turn the instrument to the point.

## Tips

- You can tap *Enter* while measuring an *Averaged observation* to accept the measurement before the required number of observations has been completed.
- You can tap *Enter* while measuring a *Direct Reflex (DR)* point with a defined standard deviation to accept the measurement before the standard deviation has been satisfied.

If you are measuring topo points with feature codes, you may find [Measure codes](#) faster and easier to use than *Measure topo*.

If you are using a Leica TPS1100 instrument with *Measure topo*, you can initiate the measurement on the instrument and then store the measurement in the Trimble Survey Controller software. For more information on how to do this and on how to configure the Leica TPS1100 instrument, see [Configuring a Leica TPS1100 Instrument to Record data to Trimble Survey Controller](#).

## Measurement Methods

For more information on the different measurement methods see the following:

[Angles and distance](#)

[Angles only, H.Angle only](#)

[Angle Offset, H. Angle Offset, and V. Angle Offset](#)

[Distance offset](#)

[Dual Prism](#)

[Circular Object](#)

[Remote Object](#)

[Surface Scan](#)

You can also [Measure a point on two faces](#).

Use the *Auto point step size* field to set the increment size for automatic point numbering. The default is 1, but you can use larger step sizes and negative steps.

Select the *View before storage* check box to view observations before they are stored.

## Station Setup

In a conventional survey, you must complete a station setup to orientate the instrument:

1. From the main menu, select *Survey / (Selected survey style) / Station setup*.

The menu that appears varies according to whether or not you have a current station setup.


**Note** – If you have only one style, it is automatically selected.

2. Set the [corrections](#) associated with the instrument.

If the *Corrections* form does not appear, tap *Options* from the *Station setup* screen to set the corrections.

To make the *Corrections* form appear on startup, select the *Show corrections on startup* option.

3. Enter the instrument point name and the instrument height. If the point is not already in the database, you can key it in or leave it as null.

When measuring to the bottom notch on a Trimble S Series instrument, tap the advanced pop-up arrow (  ) and then select *Bottom notch*. Enter the height measured to the top ridge of the bottom notch on the instrument.

Trimble Survey Controller corrects this measured slope value to true vertical and adds the offset 0.158 m (0.518 sft) to calculate true vertical to the trunnion axis.

#### Notes

- ◆ If the coordinates for the instrument point are not known, perform a [resection](#) to known points to coordinate the point.
- ◆ For a 2D or planimetric survey, leave the *Instrument height* field set to null (?). No elevations are calculated. Unless you are using a Scale only projection, a project height must be defined in the coordinate system definition. Trimble Survey Controller software needs this information to reduce measured ground distances to ellipsoid distances and to compute 2D coordinates.

4. Enter the backsight point name and the target height. If there are no coordinates for the point, you can key in an azimuth.

When measuring to the bottom notch on a [Trimble prism base](#), tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

#### Notes

- ◆ If you do not know the azimuth, you can enter an arbitrary value and then edit the azimuth record later, in review.
- ◆ If you cannot determine the coordinates for the instrument or backsight point, you can key them in or measure them later using GPS (provided that there is a valid GPS site calibration). The coordinates of any points measured from that station are then computed.
- ◆ When you enter the instrument point later, make sure that you choose to overwrite the original instrument point in the *Duplicate point* form. The coordinates of any points measured from that station are then computed.

**Tip** – If the point is available from a linked file, select the linked file for the job and then enter the point name in the *Instrument point name* or *Backsight point name* field. The point is automatically copied to the job.

5. Choose an option in the *Method* field. The options are:
  - ◆ Angles and distance – measure horizontal and vertical angles and slope distance
  - ◆ Averaged observations – measure horizontal and vertical angles and slope distance for a predefined number of observations
  - ◆ Angles only – measure horizontal and vertical angles
  - ◆ H. Angle only – measure horizontal angle only
6. Sight the center of the backsight target and then tap *Measure*.
7. If the residuals for the station setup are acceptable, tap *Store*.

**Tip** – To change the display, tap the view display button on the left of the measurement information.

**Note** – The residuals are the differences between the known position and the observed position of the backsight point.

Station setup is complete.

**Tip** – To get the most out of the Station setup routine, tap *Options* to configure *Station setup* to match the way that you prefer to work. For more information, see [Perform a station setup](#).

**Note** – If you want to measure more than one backsight point, use [Station setup plus](#).

### Loading station data to a Trimble 5600 and ATS instrument

When you complete a station setup, Station setup plus, Resection, or Refline station setup with a Trimble 5600 or ATS instrument, the Trimble Survey Controller software loads the station information into the instrument.

#### Notes

- The instrument does not accept a null instrument height. If the instrument height is set to null in the Trimble Survey Controller software, then the software writes 0 to label V,50 and clears bit 1 in label PV,52.
- The instrument does not accept a null H.Distance. If the Trimble Survey Controller software cannot compute an H.Distance between the instrument and the backsight point (that is, Keyed in azimuth, Angles only, or H.Angle only backsight observation) then the software writes 0 to label PV,51.

For more information, see:

- [Conventional surveys](#)
- [Station setup plus](#)
- [Resection](#)
- [Traverse](#)
- [Advanced Geodetics support](#)



## Station setup plus

In a conventional survey, use *Station setup plus* to perform a station setup on a known point by making observations to one or more backsight points.

**Warning** – If the station setup point is a traverse station that you plan to adjust, do not measure more than one backsight point. Clear the *Backsight* check box for any additional points so that they are measured as foresights.

For more details, see:

- [Performing a Station setup plus](#)
- [Station setup – Residuals screen](#)
- [Point – Residuals screen](#)
- [Point details screen](#)
- [Station setup results screen](#)

### Performing a Station setup plus

To perform a Station setup plus:


1. From the main menu, select *Survey / Station setup plus*.
2. Set the [corrections](#) associated with the instrument.

If the *Corrections* form does not appear, tap *Options* and then select the *Show corrections on startup* check box.

3. Enter the instrument point name. If the point is not already in the database, key it in or leave it as null.

If the coordinates for the instrument point are not known, perform a [Resection](#) to known points. This will provide the coordinates.

4. If applicable, enter the instrument height and then tap *Accept*.

When measuring to the bottom notch on a Trimble S Series instrument, tap the advanced pop-up arrow (  ) and then select *Bottom notch*. Enter the height measured to the top ridge of the bottom notch on the instrument.


Trimble Survey Controller corrects this measured slope value to true vertical and adds the offset 0.158 m (0.518 sft) to calculate true vertical to the trunnion axis.

– For a 2D or planimetric survey, leave the *Instrument height* field set to null (?). No elevations is calculated.

– Once the station setup is started, you cannot enter a different instrument height.

**Warning** – Before you continue, tap *Options* and make sure that the *Face order* setting is correct. You cannot change this setting after you start measuring points.

5. Enter the first backsight point name and the target height, if applicable. If there are no coordinates for the point, you can key in an azimuth.

When measuring to the bottom notch on a [Trimble prism base](#), tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

If the point is available from a linked file, select the linked file for the job and then enter the point name in the *Instrument point name* or *Backsight point name* field. The point is automatically copied to the job.

**Note** – To include foresight points during Station setup plus, clear the *Backsight* check box. Foresight points do not contribute to the station setup result.

6. Choose an option in the *Method* field.
7. Sight the target and then tap *Measure*.

The *Station setup residuals* screen appears.

### Station setup – Residuals screen

The *Station setup residuals* screen lists the residuals for each point observed in the station setup.

Use the *Station setup residuals* screen to do the following:

- To observe more points, tap + *Point*.
- To view the Station setup results, tap *Close*.
- To store the station setup, tap *Close* and then tap *Store*.
- To view/edit the details of a point, highlight the point and then tap *Details*.
- To view/edit the residuals of each individual observation to a point, tap the point in the list once.
- To start measuring rounds of observations to the points, tap *End face*.

### Tips

- To highlight an item in a list, tap and hold the item for at least half a second.
- To sort a column in ascending or descending order, tap the column header. Tap the *Point* column header to sort the point in ascending or descending observed order.
- To change the residual display view, select an option from the drop-down list in the *Residuals* screen.

### Notes

- A residual is the difference between the known position and the observed position of the backsight point(s).
- A foresight point that does not yet exist in the database has null residuals in the *Residuals* form.
- You cannot add the same point to a station setup more than once. To take further measurements to points already measured, select *End Face*. For more information, see [Measuring Rounds in Station setup plus or Resection](#).

### Point – Residuals screen

The *Point residuals* screen lists the residuals for each observation to a point in the station setup.

Use the *Point residuals* screen to do the following:

- To disable an observation, highlight it and then tap *Use*.
- To view the details of an observation, highlight it and then tap *Details*.
- To return to the *Station setup residuals* screen, tap *Back*.

**Note** – If you have measured face 1 and face 2 observations to a point, turning off the observation for one face will also turn off the observation for the other face.

**Warning** – If you turn off some (but not all) of the observations to a backsight point, the solution for the resection will be biased. There will be a different number of observations to each backsight point.

### Point details screen

Use the *Point details* screen to:

- view the mean observation for a point in the station setup
- change the target height and/or prism constant for all observations to a point

### Station setup results screen

The *Station setup results* screen shows information about the station setup solution.

Use the *Station setup results* screen to:

- return to the *Station Setup Residuals* screen (tap *Esc*)
- store the station setup (tap *Store*)

**Note** – During a *Station setup plus*, nothing is stored in the job until you tap *Store* in the *Results* screen.

Station setup is complete.

For more information, see:

- [Measuring Rounds in Station setup plus or Resection](#)
- [Advanced Geodetics support](#)
- [Conventional surveys](#)
- [Resection](#)
- [Traverse](#)

## Measuring Rounds in Station setup plus or Resection

This topic describes how to measure multiple sets (rounds) of observations during a *Station setup plus* or *Resection*.

A round can consist of either:

- a set of single face 1 observations
- a set of matched face 1 and face 2 observations

Using *Station setup plus* or *Resection*, measure the points that you want to include in the rounds. When the rounds list has been built, tap *End Face*.

Trimble Survey Controller software:

- Directs you to change face when required. With servo-driven instruments, this happens automatically.
- Defaults to the correct point details for each observed point.
- Displays the results. This allows you to delete bad data.

For more details, see:

- [Building a rounds list](#)
- [Measuring rounds of observations](#)
- [Skipping observations](#)
- [Residuals screen](#)
- [Point – Residuals screen](#)
- [Point details screen](#)
- [Automated rounds](#)

### Building a rounds list

The rounds list contains the points used in the rounds observations. As each point is added to a *Station setup plus* or *Resection*, Trimble Survey Controller software automatically builds this list. For more information, see [Station setup plus](#) or [Resection](#).

When the rounds list is complete, tap *End face*. Trimble Survey Controller software prompts you for the next point to be measured in the rounds of observations.

### Notes

- You can not edit the rounds list. Before you tap *End face*, be sure to observe all points to include in the rounds observations.
- The top of the *Measure rounds* screen shows which face the instrument is on, the number of the current round, and the total number of rounds to be measured (shown in brackets). For example, Face 1 (1/3) shows that the instrument is on face 1 of the first round of three.

### Measuring rounds of observations

Once the rounds list has been built, tap *End face*. Trimble Survey Controller software enters the default point name and target information for the next point in the rounds. To measure a point, tap *Measure*. Repeat this until all observations in the round are completed.

When all observations are complete, Trimble Survey Controller software shows the [Residuals](#) screen.

## Notes

- When using servo or robotic instruments, check that the instrument has sighted the target accurately. Manually adjust it if necessary. Some instruments can perform accurate sighting automatically. For information on the instrument specifications, refer to the instrument manufacturer's documentation.
- If you are using a servo or robotic instrument to measure a known (coordinated) point, tap *Turn*. Alternatively, with a servo instrument, set the *Servo auto turn* field in the survey style to *HA & VA*, or *HA only* to automatically turn the instrument to the point.
- If you tap *Esc* in the *Measure* screen, the current round is discarded.

## Skipping observations

During rounds observations, if the current point cannot be measured, tap *Skip* to skip an observation. The Trimble Survey Controller software defaults to the next point in the rounds list.

When the Trimble Survey Controller software reaches the end of a rounds list in which points have been skipped, the following message appears:

*Observe skipped points?*

Tap *Yes* to observe the points that were skipped during that round. The observations can be skipped again if required. Tap *No* to end the round.

Points that are skipped on the first face are automatically skipped on the second face. Similarly, if a point is skipped on the second face, Trimble Survey Controller turns off the first face observation. If a point is skipped in one round, all subsequent rounds continue to prompt for observations to that point.

## Residuals screen

At the end of each round, the *Residuals* screen appears. For more information, see [Station setup plus](#) or [Resection](#).

After you measure rounds, *Std Dev* becomes available in the *Residuals* screen. To view the standard deviations of the observations for each point, tap *Std Dev*.

## Notes

- To change the residual display view, use the drop-down list in the *Residuals* screen.
- During a station setup plus or resection, nothing is stored to the job until you tap *Close* and *Store* to complete the station setup.

## Point – Residuals screen

The *Point – Residuals* screen shows the residuals for the individual observations to a particular point. For more information, see [Station setup plus](#) or [Resection](#).

**Note** – If you have measured both face 1 and face 2 observations to a point, when you turn off a face 1 observation, you also turn off the corresponding face 2 observation. Similarly, when you turn off a face 2 observation, you also turn off the corresponding face 1 observation.

### Point details screen

The *Point details* screen shows the point name, code, backsight status, target height, prism constant, mean observation, and standard errors for the observed point. For more information, see [Station setup plus](#) or [Resection](#).

### Automated rounds

The *Automate rounds* option is available for Trimble S Series and 5600 instruments. When you select *Automate rounds*, the instrument automatically completes all rounds after the rounds list has been built.

If you tap + *Round* after the instrument has completed the required number of rounds, the instrument performs one more round of observations. If you want the instrument to perform more than one extra round, enter the total number of required rounds **before** you tap + *Round*.

For example, to measure three rounds automatically, and then measure another three rounds:

1. Enter 3 in the *Number of rounds* field.
2. Once the instrument has measured 3 rounds, enter 6 in the *Number of rounds* field.
3. Tap + *Round*. The instrument measures the second group of 3 rounds.

**Note** – Targets observed without Autolock are automatically paused.

## Station Elevation

In a conventional survey, use the station elevation function to determine the elevation of the instrument point by making observations to points with known elevations.

**Note** – Use only points that can be viewed as grid coordinates. (The station elevation calculation is a grid calculation.)


A station elevation needs at least one of the following:

- one angles and distance observation to a known point, or
- two angles only observations to different points

To perform a station elevation:

1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [refline](#).
2. Select *Survey / Station elevation*. The instrument point name and code appear. If you entered the instrument height during the station setup, that also appears. Otherwise, enter the instrument height

now. Tap *Accept*.

When measuring to the bottom notch on a Trimble S Series instrument, tap the advanced pop-up arrow (  ) and then select *Bottom notch*. Enter the height measured to the top ridge of the bottom notch on the instrument.

Trimble Survey Controller corrects this measured slope value to true vertical and adds the offset 0.158 m (0.518 sft) to calculate true vertical to the trunnion axis.

3. Enter the point name, code, and target details for the point with the known elevation. Tap *Measure*. Once the measurement is stored, the *Point residuals* appear.
4. From the *Point residuals* screen, tap one of the following softkeys:

- ◆ + *Point*, to observe additional known points
- ◆ *Details*, to view or edit point details
- ◆ *Use*, to enable or disable a point

5. To view the station elevation result, tap *Close* in the *Point residuals* screen. To accept the result, tap *Store*.

**Note** – The elevation determined through this station elevation method overwrites any existing elevation for the instrument point.

## Resection

In a conventional survey, the resection function is used to perform a station setup and determine coordinates for an unknown point by making observations to known backsight points. The Trimble Survey Controller software uses a least-squares algorithm to compute the resection.

**Note** – To determine the elevation of a point with known 2D coordinates, perform a station elevation once you have completed a station setup.

A resection needs at least one of the following:

- Two angles and distance observations to different backsight points
- Three angles—only observations to different backsight points
- One angles and distance observation to a close-by point and one angles—only observation to a backsight point. This is a special case called eccentric station setup.

For more details, see:

- [Performing a resection](#)
- [Resection – Residuals screen](#)
- [Point – Residuals screen](#)
- [Point details screen](#)
- [Resection results screen](#)
- [Eccentric station setup](#)

## Performing a resection

To perform a resection:


1. From the main menu, select *Survey / Resection*.

**Note** – If you have only one style, it is automatically selected.

2. Set the **corrections** associated with the instrument.

If the *Corrections* form does not appear, tap *Options* and then select the *Show corrections on startup* check box.

3. Enter an instrument point name and instrument height, if applicable.

When measuring to the bottom notch on a Trimble S Series instrument, tap the advanced pop-up arrow (  ) and then select *Bottom notch*. Enter the height measured to the top ridge of the bottom notch on the instrument.

Trimble Survey Controller corrects this measured slope value to true vertical and adds the offset 0.158 m (0.518 sft) to calculate true vertical to the trunnion axis.

**Note** – Once the resection is started you cannot enter a different instrument height.

4. Set the *Compute station elevation* check box and then tap *Accept*.

**Note** – For a 2D or planimetric survey, clear the *Compute station elevation* check box. No elevations is calculated

**Warning** – Before you continue, tap *Options* and make sure that the *Face order* setting is correct. You cannot change this setting after you start measuring points.

5. Enter the first backsight point name and the target height, if applicable.

When measuring to the bottom notch on a **Trimble prism base**, tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

**Note** – In a resection, you can only use backsight points that can be viewed as grid coordinates. This is because the resection calculation is a grid calculation.

6. Choose an option in the *Method* field.
7. Sight the target and then tap *Measure*.
8. Measure further points.

**Note** – To include foresight points during resection, clear the *Backsight* check box. Foresight points do not contribute to the resection result.

9. When there is enough data for the Trimble Survey Controller software to calculate a resected position, the *Resection residuals* screen appears.



## Resection – Residuals screen

The *Resection residuals* screen lists the residuals for each point observed in the resection.

Use the *Resection residuals* screen to do the following:

- To observe more points, tap + *Point*.
- To view the resection results, tap *Close*.
- To store the resection, tap *Close* and then tap *Store*.
- To view/edit the details of a point, highlight the point and then tap *Details*.
- To view/edit the residuals of each individual observation to a point, tap the point in the list once.
- To start measuring rounds of observations to the points, tap *End face*.

## Tips

- To highlight an item in a list, tap and hold the item for at least half a second.
- To sort a column in ascending or descending order, tap the column header. Tap the *Point* column header to sort the point in ascending or descending observed order.
- To change the residual display view, select an option from the drop-down list in the *Residuals* screen.

## Notes

- A residual is the difference between the known position and the observed position of the backsight point(s).
- A foresight point that does not yet exist in the database has null residuals in the *Residuals* form.
- You cannot add the same point to a resection more than once. To take further measurements to points already measured, select *End Face*. For more information, see [Measuring Rounds in Station setup plus or Resection](#).

## Point – Residuals screen

The *Point residuals* screen lists the residuals for each observation to a point in the resection.

Use the *Point residuals* screen to do the following:

- To disable an observation, highlight it and then tap *Use*.
- To view the details of an observation, highlight it and then tap *Details*.
- To return back to the *Resection residuals* screen, tap *Back*.

**Note** – If you have measured face 1 and face 2 observations to a point, turning off the observation for one face will also turn off the observation to the other face.

**Warning** – If you turn off some (but not all) of the observations to a backsight point, the solution for the resection will be biased because there will be a different number of observations to each backsight point.

## Point details screen

The *Point details* screen shows the mean observation for a point in the resection.

Use the *Point details* screen to do the following:

- change whether the horizontal component or the vertical component of a point will be used in the resection calculation
- change the target height and/or prism constant for all observations to that point

**Note** – You can only change which components of a point will be used in the resection calculation if you have selected the compute station elevation option, and the observed point has a 3D grid position.

The *Used for* field shows the point components used in the resection calculation. See the following table.

Option	Description
H (2D)	Use only the horizontal values for that point in the calculation
V (1D)	Use only the vertical values for that point in the calculation
H,V (3D)	Use both the horizontal and vertical values for that point in the calculation

### Resection results screen

The *Resection results* screen shows information about the resection solution.

Use the *Resection results* screen to do the following:

- To return to the *Resection residuals* screen, tap *Esc*.
- To store the resection, tap *Store*.

**Note** – During a resection, nothing is stored in the job until you tap *Store* in the *Results* screen.

Resection is complete.

### Eccentric station setup

You can use the resection function to perform an eccentric station setup, where the station setup is performed in view of a close-by control point and in view of at least one backsight point. For example, use this setup if you cannot set up over the control point, or you cannot see any backsight points from the control point.

An eccentric station setup needs at least one angles and distance observation to a close-by control point, and one angles-only observation to a backsight point. Additional backsight points can also be observed during an eccentric station setup. You can measure backsight points with angles-only observations or with angles and distance observations.

For more information, see:

- [Measuring Rounds in Station setup plus or Resection](#)
- [Advanced Geodetics support](#)
- [Conventional Surveys](#)
- [Station setup plus](#)

- [Traverse](#)

## Refline


Refline is the process of establishing the position of an occupied point relative to a baseline. To perform a refline station establishment, take measurements to two known or unknown baseline definition points. Once this occupation point is defined, all subsequent points are stored in terms of the baseline using station and offset. This method is often used when setting out buildings parallel to other objects or boundaries.

To perform a Refline station setup:

1. From the main menu, select *Survey / Refline*.
2. Set the [corrections](#) associated with the instrument.

If the *Corrections* form does not appear, tap *Options* and then select the *Show corrections on startup* check box.

3. Enter an *Instrument point name* and *Instrument height*, if applicable.

When measuring to the bottom notch on a Trimble S Series instrument, tap the advanced pop-up arrow (  ) and then select *Bottom notch*. Enter the height measured to the top ridge of the bottom notch on the instrument.

Trimble Survey Controller corrects this measured slope value to true vertical and adds the offset 0.158 m (0.518 sft) to calculate true vertical to the trunnion axis.

4. Tap *Accept*.
5. Enter the *Point 1 name*, and *Target height*.
  - If point 1 has known coordinates, the coordinates are displayed.
  - If point 1 does not have known coordinates, default coordinates are used. Select *Options* to change the default coordinates.
6. Tap *Meas 1* to measure the first point.
7. Enter the *Point 2 name*, and *Target height*.
  - If point 1 has known coordinates, a point with known coordinates can be used for point 2.
  - If point 1 does not have known coordinates then a point with known coordinates can not be used at point 2.
  - If point 1 does not have known coordinates, the default coordinates are used. Select *Options* to change the default coordinates.
  - If point 1 and point 2 had known coordinates the computed refline azimuth is displayed, otherwise the default azimuth 0° is displayed.
8. Enter a *Refline azimuth*, if applicable.
9. Tap *Meas 2* to measure the second point.

The instrument point coordinates are displayed.

10. Tap *Store* to complete the reline station establishment.

Once the Reline setup is stored, all subsequent points are stored in terms of the baseline as a station and offset.

**Note** – In a reline station establishment, you can only use existing points that can be viewed as grid coordinates. This is because the reline calculation is a grid calculation. You can use 2D and 3D grid coordinates to define the baseline.

## Measure Rounds

This topic describes how to measure multiple sets (rounds) of observations with a conventional instrument and the Trimble Survey Controller software.

A round can consist of either:

- a set of single face 1 observations
- a set of matched face 1 and face 2 observations

To measure rounds of observations:

1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [reline](#).
2. From the *Survey* menu, select *Measure rounds*.
3. Measure the points to include in the rounds.

### Notes

- If the station setup has a single backsight (from station setup or station setup plus), you can choose to include or exclude the backsight point in the rounds list.
- If the station setup has multiple backsights (from station setup plus or resection), the backsight points are excluded from the rounds list.

4. When the rounds list is built, tap *End Face*. Trimble Survey Controller software:

- Directs you to change face when required. With a servo-driven instrument, this happens automatically.
- Defaults to the correct point details for each observed point.
- Displays the results. You can then delete bad data as required.

For more details see:

- [Building a rounds list](#)
- [Measuring a Point in a Round of Observations](#)
- [Skipping observations](#)

- [Standard Deviations screen](#)
- [Point – Residuals screen](#)
- [Point details screen](#)
- [Automated rounds](#)
- [Monitoring](#)

### Building a rounds list

The rounds list contains the points used in the rounds observations. As each point is added, Trimble Survey Controller automatically builds this list.

**Warning** – Before you continue, tap *Options* and make sure that the *Face order* setting is correct. You cannot change this setting after you start measuring points.

To add a point to the rounds list:

1. Follow the same procedure as for [measuring a topo point](#).

**Note** – To specify the prism constant or the height of the target for each observation in the rounds list, tap the target icon. If the prism constant is to be subtracted from measured distances, enter a negative value. You cannot alter the prism constant or the target height for subsequent rounds. Instead, Trimble Survey Controller uses those values stored when building the rounds list.

2. When the rounds list is complete, tap *End face*. Trimble Survey Controller software prompts you for the next point to measure in the rounds of observations.

### Notes

- You cannot add the same point to the rounds list more than once. To take more measurements to points already measured, tap *End face*.
- You cannot edit the rounds list. Before you tap *End face*, be sure to observe all points to include in the rounds observations.
- The top of the *Measure rounds* screen shows which face the instrument is on, the number of the current round, and the total number of rounds to be measured (shown in brackets). For example, Face 1 (1/3) shows that the instrument is on face 1 of the first round of three.

### Measuring a Point in a Round of Observations

Once the rounds list has been built, tap *End face*. Trimble Survey Controller software enters the default point name and target information for the next point in the round. To measure a point, tap *Measure*. Repeat this until all observations in the round are completed.

When all observations are complete, Trimble Survey Controller software shows the [Standard deviations screen](#).

### Notes

- When using servo or robotic instruments, check that the instrument has sighted the target accurately. Manually adjust it if necessary. Some instruments can perform accurate sighting automatically. For information on the instrument specifications, refer to the instrument manufacturer's documentation.
- If you are using a servo or robotic instrument to measure a known (coordinated) point, tap *Turn*. Alternatively, with a servo instrument, set the *Servo auto turn* field in the survey style to *HA & VA*, or *HA only* to automatically turn the instrument to the point.
- If you tap *Esc* in the *Measure* screen, the current round is discarded.

## **Skipping Observations**

During rounds observations, if the current point cannot be measured, tap *Skip* to skip an observation. The Trimble Survey Controller software defaults to the next point in the rounds list.

When the Trimble Survey Controller software reaches the end of a rounds list in which points have been skipped, the following message appears:

Observe skipped points?

Tap *Yes* to observe the points that were skipped during that round. The observations can be skipped again if required. Tap *No* to end the round.

Points that are skipped on the first face are automatically skipped on the second face. Similarly, if a point is skipped on the second face, Trimble Survey Controller turns off the first face observation. If a point is skipped in one round, all subsequent rounds continue to prompt for observations to that point.

## **Standard deviations screen**

At the end of each round, the *Standard deviations* screen appears. This screen shows the Standard deviations of each point in the rounds list.

Do one of the following:

- To observe another round, tap *+ Round*.
- To store the current rounds session, tap *Close*.
- To view/edit the Details of a point, highlight the point and then tap *Details*.
- To view or edit the residuals of each individual observation to a point, tap the point in the list once.
- To exit from rounds and delete all rounds observations, tap *Esc*.

## **Notes**

- Each individual round is stored to the job only when you tap *Close* or *+ Round* to exit the *Standard deviations* screen.
- To change the rounds configuration settings, tap *Options*.

## **Tips**

- To highlight an item in a list, tap and hold the item for at least half a second.

- To sort a column in ascending or descending order, tap the column header. Tap the *Point* column header to sort the point in ascending or descending observed order.
- To change the residual display view, select an option from the drop-down list in the *Residuals* screen.


### Point – Residuals screen

The *Point residuals* screen shows the differences between the mean observed position and the individual observations to a particular point.

Do one of the following:

- To disable an observation, highlight it and then tap *Use*.
- To view the details of an observation, highlight it and then tap *Details*.
- To return to the *Standard deviations* screen, tap *Back*.

### Notes

- If you have measured face 1 and face 2 observations to a point, when you disable the observation for one face, the corresponding observation on the opposite face is automatically disabled.
- Whenever you make a change in the *Point residuals* screen, the mean observations, residuals, and standard deviations are recalculated.
- If the current station setup has a single backsight only, the *Use* softkey is not available for observations to the backsight. Observations to the backsight are used to orientate observations and cannot be deleted.
- If you remove observations, the  icon appears. If you skipped observations in a round, no icon appears.

**Tip** – If the residuals for an observation are high, it may be better to disable the observation from the round.

### Point details screen

The *Point details* screen shows the mean observation details for a particular point.

### Automate rounds

The *Automate rounds* option is available for Trimble S Series and 5600 instruments. When you select *Automate rounds*, the instrument automatically completes all rounds after the rounds list has been built.

If a target has been blocked, the instrument tries to measure the point for up to 60 seconds. After 60 seconds has elapsed it skips the observation and moves to the next point in the rounds list.

If you tap + *Round* after the instrument has completed the required number of rounds, the instrument performs one more round of observations. If you want the instrument to perform more than one extra round, enter the total number of required rounds **before** you tap + *Round*.

For example, to measure three rounds automatically, and then measure another three rounds:

1. Enter 3 in the *Number of rounds* field.

2. Once the instrument has measured 3 rounds, enter 6 in the *Number of rounds* field.
3. Tap + *Round*. The instrument measures the second group of 3 rounds.

**Note** – Manually observed targets are automatically paused.

## Monitoring

When *Automated rounds* is enabled, monitoring controls are also enabled. Enter a value for the time delay between automated rounds.

With a Trimble 5600 instrument, you can automatically measure to non-active targets. To do this, select the *Auto-measure passive targets* check box.

**Note** – If you select the *Auto-measure passive targets* check box, manually observed targets are automatically measured rather than paused. If you clear this check box, the software prompts you to aim the instrument to non-active targets.

## Continuous topo – Conventional

Use the *Continuous topo* function to measure points continuously.

A point is stored when one of the following conditions occurs:

- a predefined time has elapsed
- a predefined distance has been exceeded
- both predefined time and/or distance settings have been met
- a predefined stop time and distance settings have been met

To measure Continuous topo points:

1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [refline](#).
2. From the main menu, select *Survey / Continuous topo*.
3. Enter a value in the *Start point name* field. This increments automatically.
4. Enter a value in the *Target height* field.
5. In the *Method* field, select *Fixed distance*, *Fixed time*, *Time and distance*, or *Time or Distance*.
6. Enter a value in the *Distance* field and/or the *Time interval* field, depending on which method you are using.
7. Tap *Start* to start recording data and then move along the feature to be surveyed.
8. To stop measuring continuous points, tap *End*.

**Tip** – To store a position before the predefined conditions have been met, tap *Store*.

**Note** – The Trimble Survey Controller software uses the latest angles and the latest distance when it stores a position. When a synchronized angle and distance is not available (within approximately 1 second) a newer angle may be paired with an older distance. To minimize any potential position error, you may need to slow the prism movement during Continuous topo.



To measure Continuous topo points using the *Stop and go* method:

1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [refline](#).
2. From the main menu, select *Survey / Continuous topo*.
3. Enter a value in the *Start point name* field. This increments automatically.
4. Enter a value in the *Target height* field.
5. In the *Method* field select *Stop and go*.
6. Enter a value in the *Stop time* field for the period of time the target must be stationary before the instrument starts to measure the point.

The user is deemed to be stationary when their velocity is less than 5 cm/sec.

7. Enter a value in the *Distance* field for the minimum distance between points.

When you use an instrument that has a tracklight that has been enabled, the tracklight will be disabled for 2 seconds when the measured point has been stored.

## Surface Scan

Surface scanning is an automated direct reflex (DR) measuring process where measurements are automatically stored along a remote surface that you have defined.

To perform a surface scan using Trimble Survey Controller:

1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [refline](#).
2. From the *Survey* menu, select *Surface scan*.
3. Enter the *Start point name* and *code* (if necessary).
4. In the *Method* field, select a measurement method.
5. Define the area for the scan and grid interval.
6. Tap the Trimble functions button and set the EDM measurement method (TRK is fastest).

The total number of points to scan, scan grid dimensions, and estimated scan time are displayed. Change the scan size, step sizes or EDM measurement method to increase or decrease the number of points and scan time.

7. Tap *Start*.

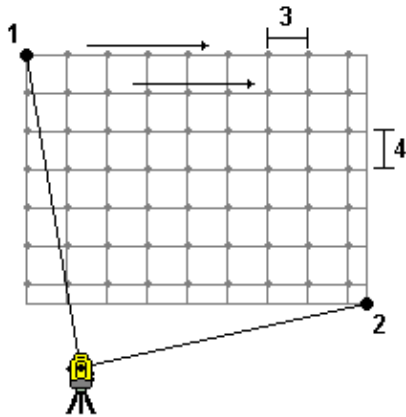
To define the scan area, do one of the following:

- If the point already exists, enter the point name, or use menu arrow to select it from the list.
- From the pop-up menu in the *Top left* and *Bottom right* fields select *Fast fix* or *Measure* to measure and store points that define the limits of the search.

Define the scan area with one of the following methods.

**HA VA interval** – Use this method on complex surfaces when you cannot use a rectangular plane to approximate the surface you are scanning (see the following diagram):

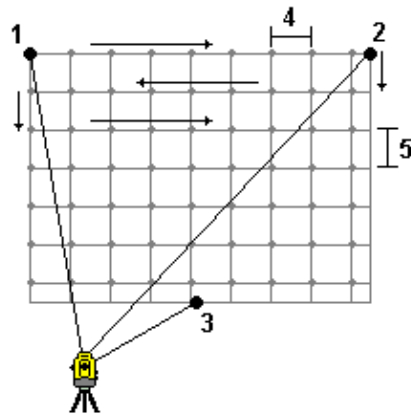
1. Aim to the top left corner of the scan area (1) and measure a point.
2. Aim to the bottom right corner of the scan area (2) and measure another point.
3. Define the angular grid interval, where:
  - 3 is the Horizontal angle
  - 4 is the Vertical angle



**Tip** – To define a Horizontal only scan of a 360° scan area, set the Top left and Bottom right points to the same name, and set the VA interval to null.

**Rectangular plane** – Use this method on a plane surface where you need a regular grid interval. Trimble Survey Controller determines the angle of the plane, and uses this and the grid interval to approximate how far to turn the instrument for each subsequent point (see the following diagram):

1. Aim to the first corner of the scan area (1) and measure a point.
2. Aim to the second corner of the scan area (2) and measure another point.
3. Aim to the third point on the opposite side of the plane (3) and measure a point.
4. Define the distance grid interval, where:
  - 4 is the Horizontal distance
  - 5 is the Vertical distance



**Line and offset** – Use this method to define the area to scan from a center line that has equal offsets to the left and right. Trimble Survey Controller defines the surface using horizontal offsets perpendicular to the center line. The software then uses this definition and the station interval to determine approximately how far to turn the instrument for each subsequent point (see the following diagram):

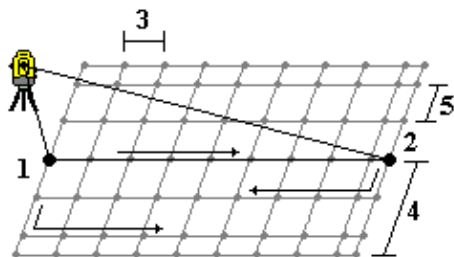
1. Do one of the following:

- Two point method:

1. Aim to the start point of the center line (1) and measure a point.
2. Aim to the end point of the center line (2) and measure another point. These two points (1 and 2) define the center line.

- Access the pop-up menu in the *Start point* field. Change the method and then define the line by a start point with azimuth and length.

2. Define the station interval (3).
3. Define the maximum offset distance (4).
4. Define the offset interval (5).



Trimble Survey Controller scans the center line first, then the points on the right-hand side, and finally the left-hand side.

**Note** – With all of the above methods, the defined scan area may not exactly fit the grid interval. There may be an area left over along the scan extents that is smaller than the grid interval. If the width of this area is less than one-fifth of the grid interval, the points along this scan area will not be measured. If the width is more than one-fifth of the grid interval, then an extra point is scanned.

## Station and offset

The *Station and Offset* option is available for both GPS and Conventional surveys enabling points to be measured or staked out relative to a line, arc or road.

1. Select *Survey / Station and offset* from the Trimble Survey Controller main menu.
2. Select *Measure* or *Stakeout*.
3. In the *Type* field of the *Station and offset* screen, select the arc, line, or road relative to which you want to measure or stake out.
4. Tap *Enter*. The appropriate stakeout screens appear as follows:
  - Select *Station and Offset / Measure relative to a line*. The *Stakeout line* screen appears and the stakeout method is set to *To the line*.
  - Select *Station and Offset / Measure relative to an arc*. The *Stakeout line* screen appears and the stakeout method is set to *To the arc*.
  - Select *Station and Offset / Measure relative to a road*. The *Stakeout road* screen appears. Select the stakeout method *Position on road*.
  - Select *Station and Offset / Stakeout relative to a line*. The *Stakeout line* screen appears and the stakeout method is set to *Station/Offset from line*.
  - Select *Station and Offset / Stakeout relative to an arc*. The *Stakeout arc* screen appears and the stakeout method is set to *Station/offset from arc*.
  - Select *Station and Offset / Stakeout relative to a road*. The *Stakeout road* screen appears. Select the stakeout method *Station and offset*.

## Averaged Observations

In a conventional survey, use the Averaged observations method to:

- increase the measurement precision with a predefined number of observations
- view the associated measurement standard deviations

To measure a point using the Averaged observations method:

1. From the main menu, select *Survey* and then perform a *station setup* , *station setup plus* , *resection* , or *refline*.
2. From the *Survey* menu, select *Measure topo*.
3. In the *Point name* field, enter the name of the point.
4. In the *Code* field, enter a feature code (optional).
5. Select *Averaged observations* as the method.

6. Sight the target and tap *Measure*.

While the instrument is carrying out the measurements, standard deviations are displayed for the horizontal (HA) and vertical (VA) angles, and the slope distance (SD).

7. View the resulting observation data, and the associated standard deviations, in the *Store* screen.  
If acceptable, tap *Store*.

**Note** – Use the options available in the *Measure topo* screen to change the number of observations taken by the instrument using averaged observations.

## Angle Offset, H. Angle Offset, and V. Angle Offset

In a conventional survey, there are three angle offset methods that you can use to observe a point that is inaccessible; Angle offset, H. Angle offset, and V. Angle offset.

The *Angle offset* method holds the horizontal distance from the first observation, and combines this with the horizontal angle and vertical angle from the second observation to create an observation to the offset location.

The *V.Angle offset* method holds the horizontal distance and horizontal angle from the first observation, and combines this with the vertical angle from the second observation to create an observation to the offset location.

The *H.Angle offset* method holds the slope distance and vertical angle from the first observation, and combines this with the horizontal angle from the second observation to create an observation to the offset location.

All raw observables from the first and second observations are stored internally in the job file and are available in Custom ASCII Export.

To measure a point using one of the Offset methods:

1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [refline](#).
2. From the *Survey* menu, select *Measure topo*.
3. In the *Point name* field, enter the name of the point.
4. In the *Code* field, enter a feature code (optional).
5. In the *Method* field, select *Angle offset*, *H. Angle Offset*, or *V. Angle Offset*.
6. In the *Target height* field, enter the height of the target.
7. Place the target beside the object to be measured, sight the target and then tap *Measure*.

The first observation is displayed.

8. Turn to the offset location and then tap *Measure*. The two observations are combined into one:

- if you selected the [View before storage](#) check box in the survey style, the measurement values appear.  
Tap *Store* to store the point.
- if you did not select the [View before storage](#) check box, the point is stored automatically.

**Note** – The observation is stored in the database as raw HA, VA, and SD records.

## Distance Offset

In a conventional survey, use this observation method when a point is inaccessible but a horizontal distance from the target point to the object can be measured.

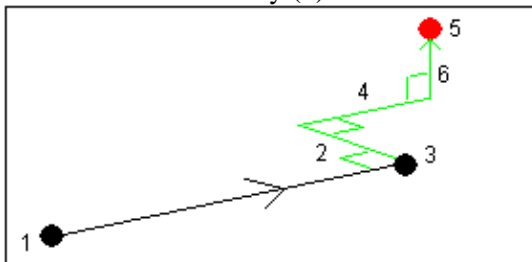
Distance offset allows you to offset in one, two, or three distances in one step.

To measure a point using the *Distance offset* method:

1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [refline](#).
2. From the *Survey* menu, select *Measure topo*.
3. In the *Point name* field, enter the name of the point.
4. In the *Code* field, enter a feature code (optional).
5. In the *Method* field, select *Distance offset*.
6. In the *Target height* field, enter the height of the target.
7. Tap *Options*, and set the [Offset directions](#) perspective.
8. Enter the *L/R offset* (left or right offset) from the target to the object, if applicable.
9. Enter the *In/Out offset* from the target to the object, if applicable.
10. Enter the *V.Distance offset* from the target to the object, if applicable.

Refer to the following diagram for an example where point 5 is measured with the *Offset directions* set to *Instrument perspective* :

- ◆ offset to the left (2) of the target (3)
- ◆ offset out (4) from the instrument station (1)
- ◆ offset vertically (6)



11. Tap *Measure*.

If you selected the *View before storage* check box in the survey style, the observation adjusted for the offset distance appears. Tap *Store* to store the point.

If you did not select the *View before storage* check box, the point is stored automatically.

The Trimble Survey Controller software stores the adjusted horizontal angle, vertical angle, and slope distance in the point record, as well as an offset record with the offset measurement details.

## Offset directions

The left and right directions used in *Distance offset* are dependant on the *Offset directions* setting. This setting can be configured from *Options*.

When looking from the instrument to the object, an object that is offset to the left when the *Offset directions* is set to *Instrument perspective* will be to the left, but when the *Offset directions* is set to *Target perspective* it will be to the right.

When the *Offset directions* is set to *Automatic* the offset directions will be with respect to the instrument perspective in a Servo survey, and target perspective in a Robotic survey.

The measurements are editable in *Review current job* and are always displayed in the perspective in which they were observed. The perspective cannot be changed in review. The measurement is always stored relative to the instrument position.

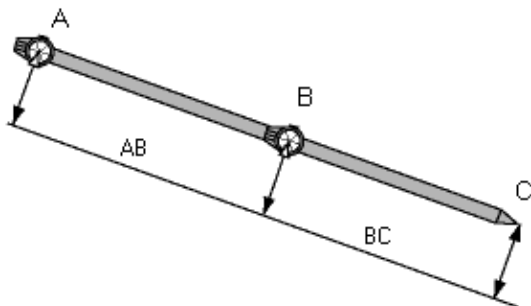
## Dual-prism Offset

In a conventional survey, use this measurement method to coordinate a point that cannot be observed directly with a pole in a plumb position.

To measure a point using the dual-prism offset method:

1. As shown in the following diagram, space two prisms (A and B) apart on the range pole. The distance BC is known.
1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [refline](#).
2. From the *Survey* menu, select *Measure topo*.
3. In the *Point name* field, enter the name of the point.
4. In the *Code* field, enter a feature code (optional).
5. In the *Method* field, select *Dual-prism offset*.
6. Complete the fields as required.
7. Take two measurements (tap *Measure*).

The Trimble Survey Controller software calculates the obscured position (C) and then stores it as a raw HA VA SD observation.



## Circular object

In a conventional survey, use this measurement method to calculate the center point of a circular object, such as a water tank or silo. To do this:

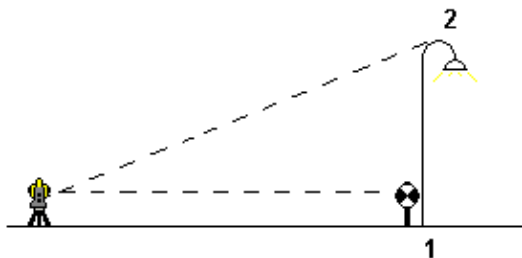
1. From the main menu, select *Survey* and then perform a [station setup](#) , [station setup plus](#) , [resection](#) , or [refline](#).
2. From the *Survey* menu, select *Measure topo*.
3. Use the *Circular object* method to measure an angle and distance to the front center face of the circular object.
4. Observe an angles only measurement to the side of the circular object.

From these two measurements Trimble Survey Controller calculates the center point of the circular object and stores it as a raw HA VA SD observation. The radius is also calculated and stored as a note.

## Remote Object

In a conventional survey, if the instrument does not support DR mode, or if you cannot measure a distance, use this method to calculate the height and/or width of a remote object. See the following diagram.

1. Start a conventional survey.
2. Select *Measure Topo / Remote object*.
3. Measure an angle and distance to the bottom of the remote object (1).
4. Set the method as required.
5. Sight to the Remote point (2).
6. Tap *Store* to store the observation.
7. To make multiple remote object observations, repeat steps 5 and 6.



Using the first measurement and continuous HA VA angles, Trimble Survey Controller calculates the position of the remote object, showing the width and elevation difference from the base point. The observation to the base of the remote object is stored as an HA, VA, SD. The Remote point is stored as an HA, VA with a computed SD, including the Object height and Object width.



## Conventional Instrument – Corrections

You can set the corrections associated with conventional observations.

**Note** – If you intend to perform a network adjustment in the Trimble Geomatics Office software using data from a conventional survey, make sure that you enter a pressure, temperature and, curvature and refraction correction.

Use the *PPM* (Parts Per Million) field to specify a PPM correction to be applied to electronic distance measurements. Key in the PPM correction, or enter the pressure and temperature of the surrounding environment and let the Trimble Survey Controller software compute the correction.

**Note** – If you are using a Trimble S Series instrument, the pressure field is set automatically from the sensor in the instrument. To disable this, tap the advanced pop-up arrow and then clear the *From instrument* check box.

Use the *Curvature and refraction* field to specify the index of refraction value. This is used to compute the curvature and refraction correction that is applied to vertical angle observations. See the following table for a description of the curvature and refraction options.

Option	Description
0.142	for use during the day
0.2	for use at night
None	no correction applied

**Note** – Do not set corrections in both devices. To set them in the Trimble Survey Controller software, make sure the instrument settings are null.

For some instruments, the Trimble Survey Controller software automatically checks to see if various corrections (PPM, prism constant, and curvature and refraction) are being applied correctly. If it finds that the corrections are being applied twice, a warning message appears.

In the following table, the \* symbol in a field indicates that the correction at the top of that column is applied.

**Note** – \* applies only to computed coordinates when a station setup has been defined.

Displayed / Stored data	Corrections applied										
	C+R	PPM	PC	SL	Orient	Inst ht	Tar ht	Proj Cor	Stn SF	NA	POC
Status line	—	—	—	—	—	—	—	—	—	—	—
HA VA SD (raw)	—	—	—	—	—	—	—	—	—	—	*
HA VA SD	*	*	*	—	—	—	—	—	—	—	*
Az VA SD	*	*	*	—	*	—	—	—	—	—	*
Az HD VD	*	*	*	—	*	*	*	*	*	—	*
HA HD VD	*	*	*	—	—	*	*	*	*	—	*

<b>Grid</b>	*	*	*	*	*	*	*	*	*	*	*
<b>delta Grid</b>	*	*	*	*	*	*	*	*	*	*	*
<b>Station and offset</b>	*	*	*	*	*	*	*	*	*	*	*
<b>DC file (observations)</b>	—	—	—	—	—	—	—	—	—	—	*
<b>DC file (reduced coordinates)</b>	*	*	*	*	*	*	*	*	*	*	*
<b>JobXML (observations)</b>	—	—	—	—	—	—	—	—	—	—	*
<b>JobXML (reduced coordinates)</b>	*	*	*	*	*	*	*	*	*	*	*
<b>SC Basic</b>	*	*	*	*	*	*	*	*	*	*	*

The following table explains the corrections used above.

<b>C+R</b>	Curvature and Refraction correction.
<b>PPM</b>	Atmospheric Parts Per Million correction – PPM is calculated from temperature and pressure.
<b>PC</b>	Prism constant correction.
<b>SL</b>	Sea level (ellipsoid) correction. – this correction is applied only if a fully defined coordinate system definition is being used; the correction is not applied in the <i>Scale factor only</i> definition.
<b>Orient</b>	Orientation correction.
<b>Inst ht</b>	Instrument height correction.
<b>Tar ht</b>	Target height correction.
<b>Proj Cor</b>	Projection correction. – this includes the application of a scale factor specified in the <i>Scale factor only</i> definition.
<b>Stn SF</b>	Station setup scale factor. – in any station setup, a scale factor for this setup can be specified or computed. This scale factor is applied in the reduction of all observations from this station setup.
<b>NA</b>	Neighborhood adjustment. – in a station setup defined using <i>Station setup plus</i> or <i>Resection</i> , a neighborhood adjustment can be applied. The neighborhood adjustment is computed based on the observed residuals to the control points used during the station setup. The adjustment is applied, using the specified exponent value, in the reduction of all observations from this station setup.
<b>POC</b>	Prism offset correction – only applied when using a Trimble 360° prism or a Trimble MultiTrack target.

## Target Details

You can configure the details of the target during a conventional survey.


When connected to a conventional instrument the Target icon appears in the status bar. The number next to the target icon indicates the target currently in use. To alternate between targets or to edit the target height and the [prism constant](#), tap the target icon. To select the target to use, tap the appropriate target in the pop-up list.

You can create up to five non-DR targets.

**Tip** – To change to a target, select the target name. To edit entries in the *Target* form, select the target height or prism constant.

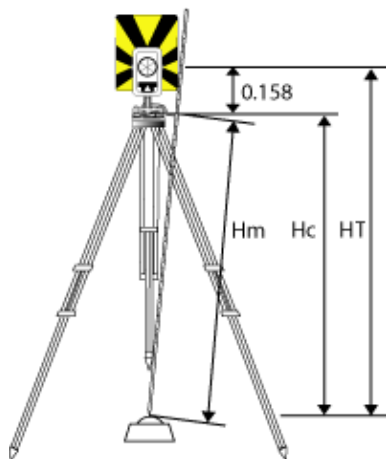
**Note** – If you are using a Trimble S Series instrument, the *Pressure* field is set automatically from the sensor in the instrument. To disable this, tap the advanced pop-up arrow and then clear the *From instrument* check box.

When connected to a DR instrument, Target DR is used to define the DR target height and prism constant. To enable DR, select Target DR. To disable DR and return the instrument to its last state, select target 1 – 5.

When measuring to the bottom notch on a Trimble prism base, tap the advanced pop-up arrow (  ) and then select *Bottom notch*.

Trimble Survey Controller corrects this measured slope value to true vertical and adds the offset 0.158 m (0.518 sft) to calculate the true vertical height to the center of the prism.

For details, see the following figure and table.



0.158m	Offset from bottom notch to center of prism.
Hm	Measured slope distance.
Hc	Hm corrected from slope to true vertical.
HT	True vertical target height. Hc + 0.158m.

To add a new target:

1. Tap the target icon in the status bar and then tap the height or prism constant for Target 1.
2. In the *Target 1* screen, tap *Add* to create Target 2.
3. Enter the details for *Target 2* and then tap *Accept*.
4. Target 2 now becomes the active target.

To delete a target from the list:

1. Tap the target icon in the status bar and then tap the height or prism constant.
2. In the *Target* screen, tap *Delete*. The Target is removed from the list.

**Note** – You can not delete Target 1 or Target DR.

To edit a target height:

1. Tap the target icon in the status bar.
2. Tap the target height for the target you want to edit.
3. Edit the target details and then tap *Accept*.

To edit target heights of observations already stored to the job, do one of the following:

- For a single observation or multiple observations using the same or different targets, use [Point Manager](#).
- For a single target record, and subsequently a group of observations that use that target, use [Review current job](#).

### Target tracking with the Trimble S Series

If you use a Trimble S Series instrument with search capabilities and a Trimble S Series 360° prism or a Trimble MultiTrack target, you can configure the software to use an Active Target ID.

**Note** – If you use a Trimble S Series instrument with the Trimble MultiTrack target, you must upgrade the instrument to firmware version R7.0.35 or later. The Trimble S Series firmware is available on [www.trimble.com](http://www.trimble.com).

- When using the Trimble MultiTrack target, the **Tracking mode** can be set to *Passive* or *Active*. When the tracking mode is set to *Active*, you can configure the Target ID.
- When using the Trimble S Series 360° prism, the **Target ID** can be set to *Off*, *Search*, *Search and measure*, or *Always*. When the tracking mode is set to *Search*, *Search and measure*, or *Always*, you can configure the Target ID.

From the following, select the target ID checking method that best suits the equipment you have and the environment that you are working in:

- [Active](#) – the instrument is always locked to the active target.
- [Search](#) – check the ID when a search is initiated.
- [Search and measure](#) – check the ID when a search is initiated, and when a measurement is initiated.
- [Always](#) – the ID is constantly being checked by the instrument.

### Tracking mode – Active

- If you operate in a highly reflective environment, or on a site with many prisms, set the *Tracking mode* to *Active* to ensure that you maintain constant lock to the correct target.

To do this:

1. Tap the target icon on the status bar.
2. Do one of the following:
  - If available, select the *Target ID* field.  
The *Target ID* field is available only when you use a Trimble MultiTrack target, and *Tracking mode* is set to Active.
  - Select the *Target height* or *Prism constant* field to open the *Target* form.
3. Set the *Prism type* to VX/S Series MultiTrack.
4. Set the *Tracking mode* to Active.
5. Set the *Target ID* to match the identification number in the Target ID on the robotic rover.

### Check the target ID – Search

If you operate in an environment with few reflective surfaces, but you want to ensure that if you do a search you will lock to the correct target, set *Check target ID* to *Search*.

To do this:

1. Tap the target icon on the status bar.
2. Do one of the following:
  - If available, select the *Target ID* field.  
The *Target ID* field is available only when you use an S Series 360° prism, and *Check target ID* is not set to Off.
  - Select the *Target height* or *Prism constant* field to open the *Target* form.
3. Set the *Prism type* to S Series 360°.
4. Set the *Check target ID* to Search.
5. Set the *Target ID* to match the identification number in the Target ID on the Trimble Standard Rod.

### Check the target ID – Search and measure

If you operate in an environment with few reflective surfaces, but you want additional assurance if you do a search or when you measure that you will lock to the correct target, set *Check target ID* to *Search and measure*.

To do this:

1. Tap the target icon on the status bar.
2. Do one of the following:
  - If available, select the *Target ID* field.  
The *Target ID* field is available only when you use an S Series 360° prism, and *Check target ID* is not set to Off.
  - Select the *Target height* or *Prism constant* field to open the *Target* form.
3. Set the *Prism type* to S Series 360°.

4. Set the *Check target ID* to Search and measure.
5. Set the *Target ID* to match the identification number set in the Target ID on the Trimble Standard Rod.

### Check the target ID – Always

If you operate in a highly reflective environment, or on a site with many prisms, set *Check target ID* to *Always* to ensure that you maintain constant lock to the correct target.

To do this:

1. Tap the target icon on the status bar.
2. Do one of the following:
  - If available, select the *Target ID* field.  
The *Target ID* field is available only when you use an S Series 360° prism, and *Check target ID* is not set to Off.
  - Select the *Target height* or *Prism constant* field to open the *Target* form.
3. Set the *Prism type* to S Series 360°.
4. Set the *Check target ID* to Always.
5. Set the *Target ID* to match the identification number in the Target ID on the Trimble Standard Rod.

For more information on the different *Check target ID* modes, see [Target ID – Target tracking with Trimble S Series](#).

### Remote Measuring Target (RMT) ID – Target tracking with Trimble 5600

When you work on a site with multiple RMTs, configure the RMT channel ID to lock onto a specific RMT target.

This is only available on supported instruments.

To do this:

1. Tap the target icon on the status bar.
2. Select the *Target ID* field to open the *Target* screen.
3. Set the RMT ID in the Trimble Survey Controller software to match the ID set in the RMT. For more information, refer to the *Trimble 5600 Series User Guide*.

**Tip** – To lock to RMTs that do not support RMT ID, set the RMT ID to 4.

## Prism Constant

The prism constant (distance offset) must be set for each prism that is used as a target in a conventional survey.

To edit a prism constant:

1. Tap the target icon in the status bar.
2. Tap the prism constant for the target you want to edit.
3. Edit the prism constant details and then tap *Accept*.  
Enter a negative value if the prism constant is to be subtracted from measured distances. Enter the Prism constant in millimeters (mm).

When using a Trimble S Series, 5600, or 3600 instrument, all corrections are applied in Trimble Survey Controller.

For some non-Trimble instruments, the Trimble Survey Controller software checks to see if a prism constant has been applied by the instrument **and** the software. When you select *Station setup*, status line messages show what has or has not been checked.

If the Trimble Survey Controller software cannot check the setting on the conventional instrument, do one of the following:

- If there is a prism constant set on the instrument, make sure that the prism constant in the Trimble Survey Controller software is set to 0.000.
- If there is a prism constant set in the Trimble Survey Controller software, make sure that the prism constant in the instrument is set to 0.000.

To review or edit the prism constant on previously stored observations, tap *Favorites / Review current job* or tap *Files / Point manager*. For more information, see [Point Manager](#).

## Measuring a Point in Two Faces

To start a conventional survey in the Trimble Survey Controller software, you must first perform a *Station setup* using one of the following methods:

- [Station setup](#)
- [Station setup plus](#)
- [Resection](#)
- [Reflines](#)

You can observe points using face 1 (direct) and face 2 (reverse) measurements during a station setup and during [Measure rounds](#) or [Measure topo](#).

Consider the station setup and the new point measurement method together and choose which to use according to how you want to capture and store the data.

If you only want to use a single backsight (measured on one or both faces), and measure some topo points (on one or both faces), then use *Station setup* and *Measure topo*. When you measure on both faces, remember to also measure the backsight on face 2 in *Measure topo*. Otherwise, all foresights on face 2 will be oriented using the face 1 backsight observation.

If you want to measure multiple backsights, measure multiple rounds, or obtain better quality control of your observations, see below for more information on different station setup and new point measurement methods in Trimble Survey Controller.

Use **Station setup plus** to:

- measure a single backsight point or multiple backsight points
- measure backsight and foresight points
- pair the face 1 and face 2 observations and create MTA records
- measure face 1 only observations and create MTA records
- measure one or more rounds of observations
- review the quality of the observations and remove bad observations

Use **Resection** to:

- coordinate the instrument point
- measure multiple backsight points
- measure backsight and foresight points
- pair the face 1 and face 2 observations and create MTA records
- measure face 1 only observations and create MTA records
- measure one or more rounds of observations
- review the quality of the observations and remove bad observations

Use **Station setup** to:

- perform a station setup with a single backsight measurement on one face only

## Notes

- When measuring points on both faces, use *Measure topo* to observe the backsight on the other face. Alternatively, use *Measure rounds* and include the observation to the backsight point in the rounds.
- When you make topo observations after a *Station setup*, and you subsequently select *Measure rounds*, you must reobserve the backsight to include it in the rounds, generate an MTA to the backsight, and calculate turned angles from the backsight MTA for all foresight points.
- MTAs are not created during *Station setup*, but are created later if you make further observations to the backsight using *Measure topo* or *Measure rounds*.

Use **Measure rounds** (after performing a station setup) to:

- measure one or more foresight points
- pair the face 1 and face 2 observations and create MTA records
- measure face 1 only observations and create MTA records
- measure one or more rounds of observations
- review the standard deviations of the observations and remove bad observations

## Notes

- Standard deviations are only available after the second round of observations.



- If the station setup has a single backsight (from *Station setup* or *Station setup plus*), you can choose whether or not to include the backsight point in the rounds list.
- If the station setup has multiple backsights (from *Station setup plus* or *Resection*), the backsight points are not included in the rounds list.
- If you do not measure the backsight on face 2, then face 2 measurements observed using *Measure rounds* will not be used when calculating the MTAs.
- When you use *Measure rounds* after a station setup with a single backsight, and you do not include the backsight point in the rounds list, all turned angles are calculated using the backsight observation(s) made during the station setup.

Use **Measure topo** (after performing a station setup) to:

- measure face 1 or face 2 observations and create MTA records

**Note** – You can measure multiple rounds using *Measure topo*. However, Trimble recommends *Measure rounds* as a more suitable method to use.

#### **Additional notes about MTA records**

- When you use *Station setup plus* or *Resection*, all observations are stored when the station setup is complete. When you use *Measure rounds*, the observations are stored at the end of each round. In all three options, the MTAs are stored at the end.
- When you use *Measure topo*, MTAs are calculated and stored on the fly.
- You can create MTAs during a station setup using *Station setup plus* and *Resection*, and also after a station setup using *Measure rounds* or *Measure topo*. When you measure the same point(s) using *Measure rounds* or *Measure topo* after *Station setup plus* and *Resection*, the Trimble Survey Controller software may produce two MTAs for the one point. When more than one MTA exists for the same point in one station setup, the Trimble Survey Controller software always uses the first MTA. To avoid having two MTAs for the same point, do not use both methods to measure a point.
- Once an MTA record is written to the job database, you cannot change it.
- You can delete a face 1 and face 2 observation but the MTA records are not updated.
- You cannot delete MTA records in review.
- In *Station setup plus*, *Resection*, or *Measure rounds*, when you use the F1... F2 or F1/F2... face order, MTAs that are created pair face 1 and face 2 observations.
- In *Station setup plus*, *Resection*, or *Measure rounds*, when you use the F1 only face order, MTAs that are created group face 1 observations.
- In *Measure topo*, MTAs that are created group together all observations for the same point.


## **GDM CU Programs**

Trimble Survey Controller offers similar functionality to the GDM Control Unit.

To access GDM CU programs, use the Trimble function key as you would the PRG key on the GDM CU.

The following table shows where to find specific GDM CU programs within Trimble Survey Controller.

## GDM CU programs in Trimble Survey Controller

GDM CU program	Trimble Survey Controller		
	Select ...	to ...	Shortcut (  + number)
20 – Station setup	<i>Survey / Station setup</i>	perform a known station setup.	20
	<i>Survey / Station setup plus</i>	perform a known station plus setup.	
	<i>Survey / Resection</i>	perform a free station or eccentric station setup.	
	<i>Survey / Refline</i>	perform an instrument setup relative to a known or unknown baseline	
21 – Z/IZ	<i>Survey / Station elevation</i>	calculate an instrument elevation	21
22 – Angle measurement	<i>Survey / Measure rounds</i>	measure one or more Face 1 (CI) and Face 2 (CII) measurements.	22
	<i>Survey / Measure topo</i>	measure individual Face 1 and/or Face 2 measurements.	30
23 – Set Out	<i>Survey / Stakeout / Points</i>	set out points with known coordinates. Points can be defined via <i>Keyin / Points</i> or obtained from a linked CSV, TXT or Trimble Survey Controller JOB file.	23
24 – Refline	<i>Survey / Station and Offset</i>	measure or set out relative to a line, arc, or road. The line, arc, or road can be defined through <i>Keyin / Line</i> , <i>Keyin / Arc</i> , or <i>Keyin / Road</i> , or imported to the Trimble Survey Controller job.	24
25 – Area Calculation	<i>COGO / Compute area</i>	calculate an area.	25
26 – Distob	<i>COGO / Compute inverse</i>	calculate an inverse between two points.	26
27 – Moving Coordinates Forward	the Trimble Survey Controller software stores raw data and automatically calculates point coordinates. There is no specific program required in the Trimble Survey Controller software to move coordinates forward. Instead, select <i>Station setup plus</i> or <i>Measure rounds</i> .		27
28 – Obstructed Point	<i>Survey / Measure topo</i> and set the method to <i>Dual–prism offset</i> .		28
29 – Roadline	<i>Survey / Stakeout / Roads</i>	measure or set out relative to a road. Roads are defined by strings or by horizontal alignments, vertical alignments, and templates defining cross sections.	29
30 – Measure Coordinates	the Trimble Survey Controller software stores raw data and automatically calculates point coordinates. There is no specific program required in the Trimble Survey Controller software to measure coordinates. Instead, use <i>Measure topo</i> . Points can be exported to a CSV or TXT file, through <i>Files / Import/Export / Send data to another device</i> , for use as a control file. To access the control file		30

	from another job, select the CSV, TXT, or JOB file as a linked file through <i>Files / Properties of current job</i> .		
32 – Angle measurement plus	<i>Survey / Measure rounds</i>	measure one or more Face 1 (CI) and Face 2 (CII) measurements.	32
	<i>Survey / Measure rounds / Options</i>	configure the number of rounds to be measured; select automatic measurements; set the observation order; measure distances on Face 2(CII); define a time interval between rounds (automatic measurements only).	
33 – Robotic Lite	Not supported		–
39 – Roadline 3D	<i>Survey / Stakeout / Roads</i>	measure or set out relative to a road. Roads are defined by strings or horizontal alignments, vertical alignments, and templates defining cross sections.	39
43 – Enter coordinates	<i>Keyin / Points</i>	enter the coordinates for a point.	43
45 – Pcode	<i>Configuration / Feature and attribute libraries</i>	create a feature library with codes. To create a full feature and attribute library, or a feature and attribute library with both codes and attributes, use Feature and Attribute Editor or Autodraft Configuration File Editor. You can then transfer the feature and attribute library to the controller.	45
60 – Athletics	Not Supported		–
61 – COGO	<i>COGO / Compute point</i>	perform similar coordinate calculations.	61
65 – Direct Reflex	<i>COGO / Compute point</i>	perform a From a baseline (Corner + distance), Brng–Line intersect (Corner + angle), or Four point intersection (Two lines intersection) measurement.	65
	<i>Survey / Measure topo</i>	perform a Circular Object (Eccentric object) measurement.	
	<i>Survey / Surface scan</i>	perform a surface scan.	
66 – Monitoring	<i>Survey / Measure rounds</i>	configure the number of rounds to be measured, automatically store points, and define a time interval between rounds.	66
	<i>Survey / Measure rounds / Options</i>		
Menu 2 (View/Edit)	<i>Files / Review current job</i>	review and edit the data stored in the job.	
	<i>Favorites / Review</i>		
	<i>Favorites / Point manager</i>		
F 6 (Change target height)	the target icon on the status bar	quickly change the target details for new observations.	
F 33 (Change prism constant)			
Edit target height or Prism constant	<i>Favorites / Review current job</i>	edit the target record to change the target height or prism constant. Changes then apply to all observations that use that target.	

	<i>Favorites / Point manager</i>	use <i>Point manager</i> to edit the height or prism constant values for individual observations For more information, refer to the Help.
GDM Job Files export	Trimble Data Transfer (connected to Trimble Survey Controller)	transfer the GDM Job file. For more information about transferring data, see <a href="#">Transferring Files between the Controller and the Office Computer</a> .
	<i>Files / Import/Export / Export custom format files</i>	create a GDM Job file

## Advanced Geodetic Support

Tap *Configuration / Options* to enable the following options in Advanced Geodetic support:

- **Station setup scale factor**
- **Helmert transformation for Resection**

### Station setup scale factor

When you turn on Advanced Geodetic support, you can apply an additional scale factor to every conventional station setup. All measured horizontal distances are adjusted by this scale factor. To configure the scale factor settings, select *Options* during a [Station setup](#) , [Station setup plus](#) , or [Resection](#).

This station setup scale factor can be Free (computed) or Fixed. If you have chosen to compute a station setup scale factor, you must observe at least one distance to a backsight during the station setup so that a scale factor can be calculated.

### Helmert transformation for Resection

When you turn on Advanced Geodetic support, *Resection* has an additional computation method called Helmert transformation. To perform a resection using a Helmert transformation, select *Options* during a *Resection*, and then set the *Resection type* to *Helmert*.

**Note** – The standard resection type is the same as the resection method used when Advanced Geodetics is turned off.

For a Helmert transformation, you must measure distances to the backsight points. The resection calculation will not use a backsight point without a distance measurement.

For more information, see [Neighborhood Adjustment](#).

## Angles and distance

In a conventional survey, use this measurement method to measure a point by angles and a distance.

### **Angles only and H.Angle only**

In a conventional survey, use this measurement method to measure a point by both a horizontal and vertical angle or by a horizontal angle only.

# Survey – Calibration

## Calibration

A calibration calculates parameters for transforming WGS–84 coordinates into local grid coordinates (NEE). It either calculates a [horizontal](#) and [vertical](#) adjustment, or a transverse mercator projection and a 3–parameter datum transformation, depending on what has already been defined.

For accurate calibration, your site should be within at least four control points with known 3–D grid coordinates.

**Warning** – You must complete a calibration **before** you compute offset or intersection points, or stake out points. If you change the calibration after computing or staking out these points, they will not be consistent with the new coordinate system and any points computed or staked out after the change.

To calibrate point coordinates:

1. Enter the grid coordinates of your control points. Key these in, transfer them from your office computer, or measure them using a conventional total station.
2. Measure the points with GPS.
3. Perform either an [automatic](#) or a [manual](#) calibration.
4. To obtain the current list of points being used in the calibration, select *Survey / Site calibration*.

### Notes and Recommendations

- You can perform a calibration using one of the real–time GPS survey styles in the Trimble Survey Controller software. Do this manually, or let the Trimble Survey Controller software do it automatically. If all the points have been measured, you do not need to connect the Trimble controller to a receiver during a manual calibration.
- Multiple calibrations can be performed in one job. The last calibration performed and applied is used to convert the coordinates of all previously surveyed points in the database.
- You can use up to 20 points for a calibration. Trimble strongly recommends that you use a minimum of four 3D local grid coordinates (N, E, E) and four observed WGS84 coordinates, with the local projection and datum transformation parameters (the coordinate system). This should provide enough redundancy.

**Note** – You can use a combination of 1D, 2D, and 3D local grid coordinates. If no projection and no datum transformation are defined, you must have at least one 2D grid point.

If you did not specify the coordinate system, the Trimble Survey Controller software calculates a Transverse Mercator projection and a three–parameter datum transformation.

- Use the Trimble Geomatics Office software, Trimble's Data Transfer utility, or ASCII transfer to transfer control points.
- Be careful when naming points that are to be used in a calibration. Before you begin, familiarize yourself with the [Database search rules](#).

- The set of WGS–84 coordinates must be independent of the set of grid coordinates.
- You select the grid coordinates. Select the vertical coordinates (elevation), the horizontal coordinates (northing and easting values), or all of these together.
- Place the calibration points around the perimeter of the site. Do not survey outside of the area enclosed by the calibration points, as the calibration is not valid beyond this perimeter.
- The origin of the horizontal adjustment is the first point in the calibration.  
The origin of the vertical adjustment is the first point in the calibration with an elevation.
- When reviewing a calibration point in the database, notice that the WGS84 values are the *measured* coordinates. The grid values are derived from these, using the current calibration.

The original keyed-in coordinates remain unchanged. (They are stored elsewhere in the database as a point with the *Type* field showing *Keyed in coordinates* and the *Stored as* field showing *Grid*.)

- When you are calibrating a no projection, no datum job, (where ground coordinates are required after calibration) you must define the project height (average site height). When the job is calibrated, the project height is used to compute a ground scale factor for the projection, using the inverse of the ellipsoid correction.
- When you start a Scale Factor Only job and then introduce GPS data, you must perform a site calibration to relate the GPS data to the Scale Factor Only point coordinates.

When you select *Site Calibration*, you must specify whether the Scale Factor Only coordinates in the job represent grid coordinates or ground coordinates. The site calibration computations then set up a grid coordinate system or a ground-based coordinate system, that best fits the existing data in the job to the GPS data.

## Configuring the Survey Style for a Site Calibration

A calibration calculates parameters for transforming WGS–84 coordinates into local grid coordinates (NEE). Set the parameters for computing a calibration when you create or edit a Survey Style.

To set the parameters for computing a calibration, select the *Site calibration* survey style option from *Configuration / Survey styles*, selecting a real time survey, and do the following:

1. The *Fix H. scale field to 1.0*: check box details whether the calibration computation should compute a horizontal scale factor or not:
  - ◆ To compute the horizontal scale factor, make sure the check box is clear. (This is the default setting.) Use this option only if GPS measurements need to be scaled to fit the local control. (GPS measurements are usually more precise.)
  - ◆ To fix the horizontal scale factor to 1.0, select the check box. Select the check box to avoid distorting the geometry of the GPS network, but note that the calibration residuals will be higher.
2. Select an observation type appropriate to a calibration point. The options for a calibration point are Topo point or Observed control point.
3. For the Trimble Survey Controller software to automatically perform a calibration when you measure a calibration point, select the *Auto calibrate* check box. To switch automatic calibration off, clear the check box.
4. If necessary, set the tolerances for maximum horizontal and vertical residuals, and maximum and

minimum horizontal scale settings. These settings only apply to automatic calibration and do not affect manual calibration.

You can also specify the maximum slope of the vertical adjustment plane. The Trimble Survey Controller software warns you if the slope in the north direction or the slope in the east direction exceeds this. Generally the default settings are appropriate.

5. Specify how the calibration points you measure will be named:

- ◆ In the *Method* field, choose one of the following options: *Add prefix*, *Add suffix*, or *Add constant*.
- ◆ In the *Add* field, enter the prefix, suffix, or constant.

The table below shows the different options and gives an example of each.

Option	What the software does	Example value in the Add field	Grid point name	Calibration point name
Same	Gives the calibration point the same name as the grid point	—	100	100
Add prefix	Inserts a prefix before the grid point name	GPS_	100	GPS_100
Add suffix	Inserts a suffix after the grid point name	_GPS	100	100_GPS
Add constant	Adds a value to the grid point name	10	100	110

For more information, see:

- [Calibration](#)
- [Calibration – Automatic](#)
- [Calibration – Manual](#)

## Calibration – Manual

Key in the grid coordinates of your control points. Alternatively, transfer them from your office computer, or use a conventional instrument to measure them. Then measure the points with GPS.

To carry out a manual calculation:

1. From the main menu, select *Survey / Site calibration*.
2. For *Scale factor only* jobs:
  - ◆ If the job uses ground coordinates, select *Ground*.
  - ◆ If the job uses grid coordinates, select *Grid*.
3. Use *Add* to add a point to the calibration.
4. Enter the name of the grid point and the WGS–84 point in the appropriate fields.

The two point names do not have to be the same, but they should correspond to the same physical



point.

5. Change the *Use* field as required and tap *Accept*.

The residuals for each point are not displayed until at least three 3D points are included in the calibration to provide redundancy.

6. Tap *Results* to see the horizontal and vertical shifts that the calibration has calculated.
7. To add more points, tap *Esc* to return to the calibration screen.
8. Repeat steps 3 through 6 until all the points are added.
9. Do one of the following:
  - ◆ If the residuals are acceptable, tap *Apply* to store the calibration.
  - ◆ If the residuals are not acceptable, recalculate the calibration.

### Recalculating a Calibration

Recalculate a calibration if the residuals are not acceptable, or if you want to add or delete points.

To recalculate a calibration:

1. From the *Survey* menu, choose *Site calibration*.
2. Do one of the following:
  - ◆ To remove (exclude) a point, highlight the point name and then tap *Delete*.
  - ◆ To add a point, tap *Add*.
  - ◆ To change the components used for a point, highlight the point name and tap *Edit*. In the *Use* field, choose whether to use the vertical coordinate of the grid point, the horizontal coordinates, or both horizontal and vertical coordinates.
3. Tap *Apply* to apply the new calibration.

**Note** – Each calibration calculation is independent of the previous one. When a new calibration is applied, it overwrites any previously calculated calibration.

## Calibration – Automatic

When you use this function to measure calibration points, the calibration calculations are performed and stored automatically.

Define a projection and datum transformation. Otherwise, a transverse mercator projection will be used and the datum will be WGS–84.

To use automatic calibration:

1. Select your *RTK Survey Style*.
2. Select *Site calibration*.
3. Select the *Auto calibrate* check box. Alternatively, tap *Options* when you measure a *Calibration point*.

4. Use *Options* to configure the naming relationship between the grid and WGS–84 points.
5. Enter the grid coordinates of your Calibration points. Key these in, transfer them from your office computer, or measure them using a conventional total station.

For keyed in coordinates check that the coordinate fields are *North*, *East*, and *Elevation*. If they are not, tap *Options* and change the *Coordinate view* to Grid. Key in the known grid coordinates and tap *Enter*.

Select the *Control point* check box. (This ensures that the point is not overwritten by a measured point.)

For transferred coordinates make sure that these coordinates are:

- ◆ transferred as grid coordinates (N, E, E), not as WGS84 coordinates (L, L, H)
  - ◆ control class points
6. Measure each point as a Calibration point.

In the *Method* field, select Calibration point.

7. Enter the grid point name. The Trimble Survey Controller software names the GPS point automatically, using the naming relationship that you configured earlier. The Auto–calibrate function then matches the points (grid and WGS–84 values), and calculates and stores the calibration. The calibration is applied to all previously measured points in the database.
8. When you measure the next Calibration point, a new calibration is calculated using all of the Calibration points. It is stored and applied to all previously measured points.

When one point has been calibrated, or a projection and datum transformation have been defined, the *Find* softkey appears. You can use this to navigate to the next point.

The calibration residuals are only displayed if the calibration tolerances are exceeded.

If this happens, consider removing the point with the most extreme residuals. Do one of the following:

- If at least four points are left after removing that point, recalibrate using the remaining points.
- If not enough points are left after removing that point, measure it again and recalibrate.

It may be necessary to remove (re–measure) more than one point. To remove a point from the calibration calculations:

1. Highlight the point name and tap *Enter*.
2. In the *Use* field, select *Off* and tap *Enter*. The calibration is recalculated and the new residuals are displayed.
3. Tap *Apply* to accept the calibration.

To view the results of an automatic calibration:

1. From the *Survey* menu, choose *Site calibration*. The *Site calibration* screen appears.

2. Tap *Results* to see the *Calibration results*.

To change a calibration that has been calculated using the *Auto calibrate* function, select *Site calibration* from the *Survey* menu. Then proceed as described in [Performing a Manual Site Calibration](#) .

# Survey – GPS

## Starting the Base Receiver

This chapter describes how to start the base receiver for a GPS survey.

For more information, go directly to these topics in this section:

[Base Station Coordinates](#)

[Setting up the Equipment for a Real-Time Survey](#)

[Setting up the Equipment for a Postprocessed Survey](#)

[Setting up the Equipment for a Real-Time and Postprocessed Survey](#)

[Starting a Base Survey](#)

[Starting a Trimble 4000 SSe/SSi Base](#)

[Ending a Base Survey](#)

[Radios for GPS Surveys](#)

### Base Station Coordinates

When you set up a base, it is important to know the WGS84 coordinates of the point as accurately as possible.

**Note** – Every 10 m of error in a base station coordinate can introduce up to 1 ppm scale error on every measured baseline.

The following recognized methods, listed in descending order of accuracy, are used to determine base station WGS–84 coordinates:

- Published or precisely–determined coordinates.
- Coordinates computed from published or precisely–determined grid coordinates.
- Coordinates derived using a reliable differential (RTCM) broadcast based on published or precisely–determined coordinates.
- A WAAS or EGNOS position generated by the receiver. Use this method if no control exists for the location and you have a receiver that tracks WAAS/EGNOS satellites.
- An autonomous position generated by the receiver–use this method for real–time surveys in a location where no control exists. Trimble strongly recommends that you calibrate any jobs started by this method on a minimum of four local control points.

**Tip** – In the U.S.A., you can regard NAD83 geodetic coordinates as equivalent to WGS–84 coordinates.

**Note** – If the keyed in WGS–84 coordinates differ from the current autonomous position generated by the receiver by more than 300 m, a warning message appears.

For more information about entering base station coordinates, see [Starting a Base Survey](#).

## Survey Integrity

To preserve the integrity of a GPS survey, consider the following:

- When you start subsequent base receivers for a particular job, make sure that each new base coordinate is in the same terms as the initial base coordinate.

**Note** – Within a job, only use an autonomous position to start the *first* base receiver. An autonomous position is equivalent to an assumed coordinate in conventional surveying.

- Coordinates published by a reliable source and coordinates determined by control surveys should be in the same system.
- If subsequent base coordinates are not in the same terms, regard observations from each base as a separate job. Each needs a separate calibration.
- Because measured real-time kinematic points are stored as vectors from the base station, not as absolute positions, the origin of the survey must be an absolute WGS–84 position from which the vectors radiate.

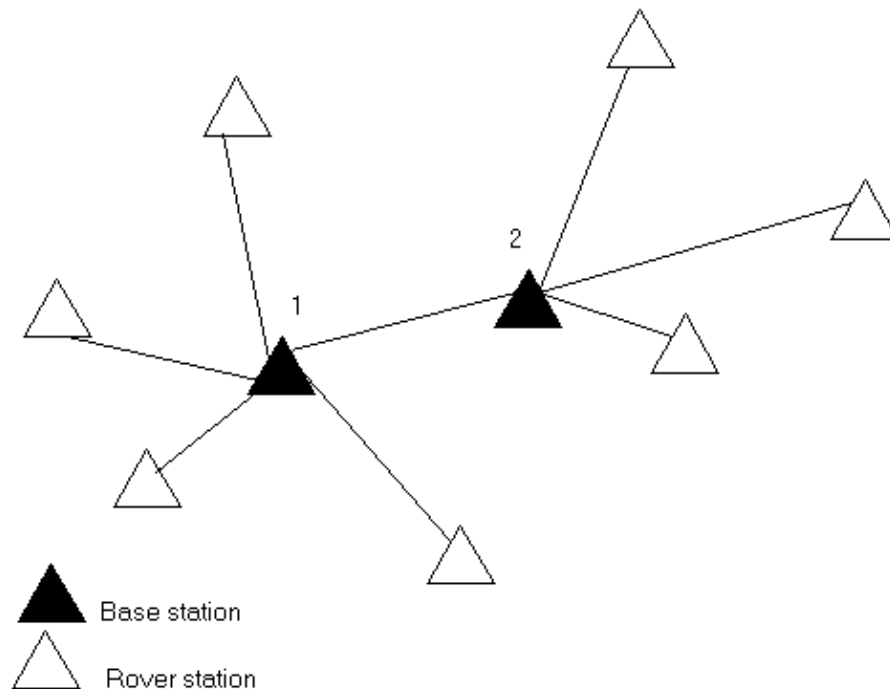
If other base stations are subsequently set up on points measured from the original base station, all vectors are resolved back to the original base station.

- It is possible to start the base on any kind of coordinates, for example, grid or local ellipsoid coordinates. However, in a realtime survey, the Trimble Survey Controller software must store a WGS–84 position for the base when a rover survey is started. It is this position that is held fixed as the origin of the network.

When you start a rover survey, the Trimble Survey Controller software compares the WGS–84 position broadcast by the base receiver with points already in the database. If a broadcast point has the same name as a point in the database, but different coordinates, the Trimble Survey Controller software uses the coordinates that are in the database. These coordinates were keyed in or transferred by you, so it assumes that you want to use them.

If a point in the database has the same name as the one being broadcast by the base, but the coordinates are NEE or local LLH rather than WGS–84 coordinates, the Trimble Survey Controller software converts this point to WGS–84 coordinates using the current datum transformation and projection. It then uses these as the base coordinates. If no datum transformation and projection are defined, the broadcast WGS–84 point is automatically stored and used as the base.

The following diagram shows a survey using two base stations.



In this survey, Base station 2 was first surveyed as a roving point from Base station 1.

**Note** – Base stations 1 and 2 **must** be linked together by a measured baseline, and Base station 2 **must** be started with the same name that it had when it was surveyed as a roving point from Base station 1.

### Setting up the Equipment for a Real-Time Survey

This section describes how to assemble the hardware components at the base receiver for a Real-time kinematic (RTK) or Real-time differential (RT differential) survey. Follow these steps if you are using a Trimble R7 or 5700 GPS receiver.

#### Using a Trimble R7 or 5700 GPS Receiver

To set up a base receiver for a real-time survey using a Trimble R7 or 5700 GPS receiver:

1. Set the Zephyr antenna over the ground mark using a tripod, a tribrach, and a tribrach adaptor.
2. Use the tripod clip (part number 43961) to hang the Trimble R7 or 5700 GPS receiver on the tripod.
3. Connect the Zephyr antenna to the yellow GPS receiver port labeled "GPS". Use the yellow GPS antenna cable (part number 41300-10).

**Note** – Instead of hanging the receiver on the tripod, you can place the receiver in its base case. Run the antenna cable out of the portal in the side of the base case to the antenna so that the case can stay closed while the receiver is running.

4. Assemble and erect the radio antenna.
5. Connect the radio antenna to the radio using the cable attached to the antenna.
6. Connect the radio to the GPS receiver port 3.

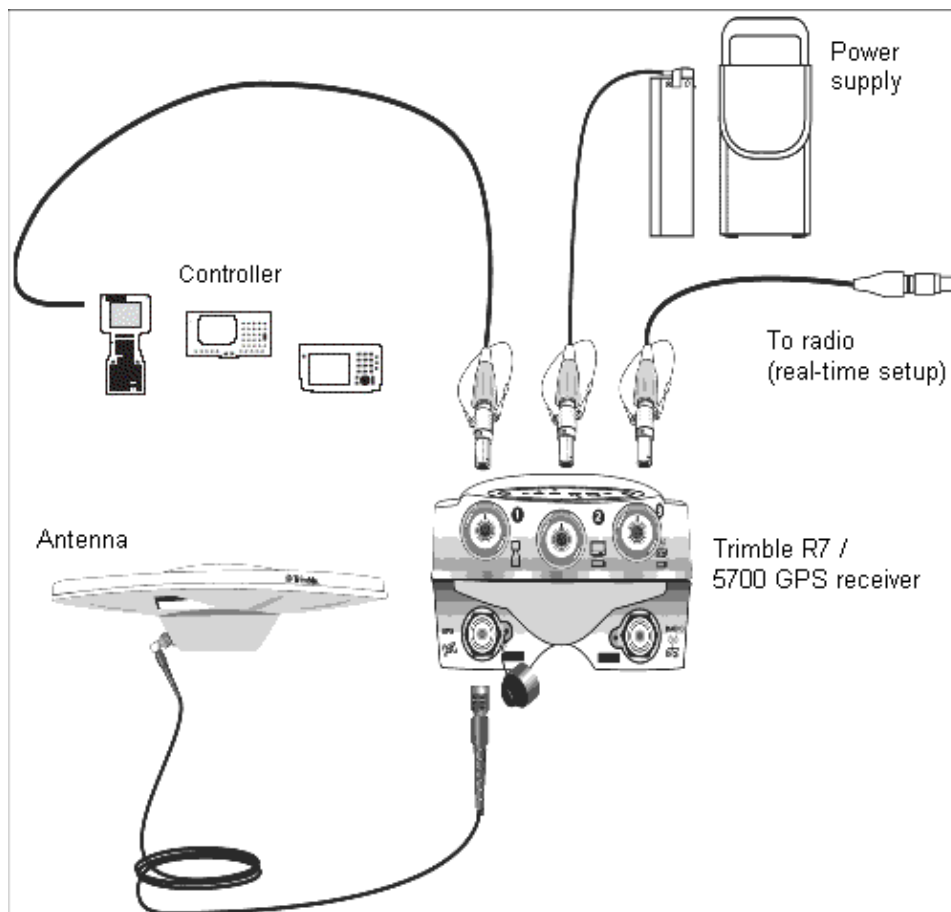
- ◆ If using a Trimble radio, use the supplied cable.
- ◆ If using a radio provided by a third party, use the appropriate cable.

**Note** – For some third-party radios, a separate power supply is needed for the radio.

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

7. If external power is required, connect the power supply with a 0-shell Lemo connection to port 2 or port 3 on the receiver.
8. Connect the controller to the GPS receiver port 1 using the 0-shell Lemo-to-Hirose cable.
9. Turn on the controller, then follow the instructions in [Starting a Base Survey](#).

The following diagram shows how to set up the base receiver for a real-time survey using a Trimble R7 or 5700 GPS receiver.



### Setting up the Equipment for a Postprocessed Survey

This section shows how to assemble the hardware components at the base receiver for a postprocessed kinematic, a postprocessed differential or a FastStatic survey. Follow these steps when using a Trimble R7 or 5700 GPS receiver.

## Using a Trimble R7 or 5700 GPS Receiver

To set up the base receiver for a postprocessed survey using a Trimble R7 or 5700 GPS receiver. For more information, see the [diagram](#) on setting up the base receiver. Then do the following:

1. Set the Zephyr antenna over the ground mark using a tripod, a tribrach, and a tribrach adaptor.
2. Use the tripod clip (Part Number 43961) to hang the Trimble R7 or 5700 GPS receiver on the tripod.
3. Connect the Zephyr antenna to the yellow GPS receiver port labeled GPS. Use the yellow GPS antenna cable (part number 41300–10).

**Note** – Instead of hanging the receiver on the tripod, you can place the receiver in its base case. Run the antenna cable out of the portal in the side of the base case to the antenna so that the case can stay closed while the receiver is running.

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

4. If external power is required, connect the power supply with a 0-shell Lemo connection to Port 2 or Port 3 on the receiver.
5. Connect the controller to the GPS receiver port 1 using the 0-shell Lemo to 0-shell Lemo cable.
6. Turn on the controller, then follow the instructions in [Starting a Base Survey](#).

## Setting up the Equipment for a Real-Time and Postprocessed Survey

To conduct a survey that uses both real-time and postprocessed techniques, follow the assembly instructions for real-time surveys. If the receiver has no memory (or has a limited memory), use a controller to store raw data at the base receiver.

### Starting a Base Survey

To conduct a survey using a predefined survey style, make sure that the required job is open. The title of the main menu should be the current job name.

From the main menu, choose *Survey* and select a survey style from the list.

A *Survey* menu is generated. It displays items specific to the chosen survey style and includes the *Start base receiver* and *Start survey* items.

**Warning** – In a real-time survey, make sure that the radio antenna is connected to the radio before starting the base survey. If it is not, the radio will be damaged.

To start a base survey:

1. From the *Survey* menu, choose *Start base receiver*.
  - ◆ If the controller is connected to a receiver that was logging data, the data logging stops.
  - ◆ The first time that you use this survey style, the Style wizard prompts you to specify the equipment you are using.



The *Start base* screen appears.

**Note** – When you start a survey, the Trimble Survey Controller software automatically negotiates the highest possible baud rate for communicating with the connected receiver.

2. Enter the base station name and coordinates. Use one of the following methods:

- ◆ If WGS84 coordinates are known:

Access the *Point name* field and enter the point name. Tap *Key in*.

In the *Key in point* screen, set the *Method* field to *Keyed in coordinates*. Check that the coordinate fields are *Latitude*, *Longitude*, and *Height (WGS84)*. If they are not, tap *Options* and change the *Coordinate view* setting to *WGS84*. Key in the known WGS84 coordinates for the base station, and tap *Store*.

- ◆ If grid coordinates are known, and projection and datum transformation parameters are defined:

Access the *Point name* field and enter the point name. Tap *Key in*.

In the *Key in point* screen, set the *Method* field to *Keyed in coordinates*. Check that the coordinate fields are *Northing*, *Easting*, *Elevation*. If they are not, tap *Options* and change the *Coordinate view* setting to *Grid*. Key in the known grid coordinates for the base station, then tap *Store*.

- ◆ If local geodetic coordinates are known and a datum transformation is defined:

Access the *Point name* field and enter the point name. Tap *Key in*.

In the *Key in point* screen, set the *Method* field to *Keyed in coordinates*. Check that the coordinate fields are *Latitude*, *Longitude*, and *Height (Local)*. If not, tap *Options* and change the *Coordinate view* setting to *Local*. Key in the known local coordinates for the base station, then tap *Store*. In a real-time survey, select either the current WAAS/EGNOS position, or the current autonomous position, derived by the GPS receiver. Then, access the *Point name* field and enter the point name. Tap *Key in* to access the *Key in point* screen. Tap *Here* and the current position is displayed. Tap *Store* to accept and store this position.

**Note** – If you want a WAAS/EGNOS position, ensure the receiver is tracking a WAAS/EGNOS satellite by checking the WAAS/EGNOS icon is displayed on the status line when you tap *Here*. The receiver can take 120 seconds to lock on to WAAS/EGNOS. Alternatively, check the *Observation class* field before starting the base.

**Warning** – Within a job, only use an autonomous position (the *Here* softkey) to start the first base receiver.

## Notes

- ◆ If you carry out a real-time survey using RTCM 2.x corrections and use a base point name that is more than eight characters long, the name will be shortened to eight characters when it is broadcast.

- ◆ If you carry out a real-time survey using RTCM 3.0 corrections, you must use a base point name (in upper case) that is within the range RTCM0000 to RTCM4095.
- 3. The *Observation class* field shows the observation class of the base point. For more information, see [Storing GPS points](#).
- 4. Enter values in the *Code* (optional) and *Antenna height* fields.
- 5. Set the *Measured to* field as appropriate.
- 6. In the *Station index* field, enter a value.

This value is broadcast in the correction message, and must be in the range 0–31.

**Tip** – Tap *Scan* to view a list of other base stations operating on the frequency you are using. The list shows the station index numbers of the other bases and the reliability of each. Choose a different station index number to those displayed.

- 7. If the receiver you are using supports transmission delays, the *Transmission delay* field appears. Choose a value depending on how many base stations you intend to use. For more information about transmission delays, see [Operating Several Base Stations on One Radio Frequency](#).
- 8. Tap *Start*.

The base receiver starts to record data.

- 9. Do one of the following:

- ◆ If you are carrying out a real-time survey, the following message appears:

Disconnect the controller from the base receiver but **do not** turn off the receiver. You can now set up the rover receiver.

**Note** – For a real-time survey, check that the radio is working before leaving the equipment. The data light should be flashing.

- ◆ If you are logging data in the controller, the *Base* screen appears. It shows which point is being surveyed and the time that has elapsed since data logging started. Leave the Trimble controller connected to the base receiver and set up the rover using another Trimble controller.

## Starting a Trimble 4000 SSe/SSi Base

To start a base using a Trimble 4000 SSe/SSi GPS receiver, you must select the *Use 4000 SSe/SSi base* check box in the base options of the survey style.

You can log base data to the Trimble 4000 SSe/SSi GPS receiver, but you cannot log base data to a controller when you use a Trimble 4000 SSe/SSi GPS receiver.

You must end the survey using the front panel of the Trimble 4000 SSe/SSi receiver.

**Note** – You cannot tap the status bar icons to view additional information, for example, satellites. Use the front panel of the 4000 receiver to access and view additional information not available from the Trimble Survey Controller software.

**Note** – You cannot use Trimble Survey Controller to configure the base radio when the radio is connected to the 4000 SSe/SSi receiver. To configure the radio, connect it directly to the Trimble controller.

## Ending a Base Survey

After an RTK survey, or after logging data in the receiver, end the survey as follows:

1. Return to the equipment and select *Survey / End survey*. Tap *Yes* to confirm that you want to end the survey, and again to power down the receiver.
2. Turn off the controller.
3. Disconnect the equipment.

After logging base station data in the Trimble controller, end the survey as follows:

1. Return to the equipment and tap *Enter*.
2. Tap *Yes* to confirm that you want to end the survey, and again to turn off the receiver.
3. Turn off the controller.
4. Disconnect the equipment.

## Base Options

To configure the Base survey when you create or edit a Survey Style:

1. From the main menu, select *Configuration / Survey Styles / <Selected GPS Survey Style> / Base options*.
2. Choose a survey type.
3. Set the elevation mask.
4. Set the antenna type.

## Output additional code RTCM

For real-time surveys, the base receiver can broadcast the RTK message and the RTCM–104 differential message at the same time. To do this, select the *Output additional code RTCM* check box. (The *RTCM output* option must be installed on your receiver.)

**Note** – When RTCM–104 code and CMR messages are being broadcast, the behavior of rover GPS receivers varies according to type. When you are broadcasting CMR with *Output additional code RTCM* enabled, only use Trimble R7 or 5700 GPS receivers, or 4700 and 4800 GPS receivers with firmware later than v1.2. Not all receivers will function correctly in this environment because their behavior is receiver- and manufacturer-dependent. Most RTCM-only receivers will work correctly. For more information contact your local Trimble dealer.

**Warning** – Do not use the *Output additional code RTCM* option when using time delays for sharing the radio frequency.

## Tracking L2C

For real-time surveys where the base receiver and all rover receivers that will receive base data from that base receiver can track the L2 civil signal, select the *L2C* check box. This sets up the base GPS receiver to track the civil signal on the L2 GPS frequency and send those L2C observations to the rovers.

## **Tracking GLONASS**

For real-time surveys where the base receiver and rover receivers that will receive base data from that base receiver can track the GLONASS signal, select the *GLONASS* check box if you want to use the GLONASS observations. This sets up the base GPS receiver to track the GLONASS signals and send those GLONASS observations to the rovers.

For postprocessed surveys where the base receiver and rover receivers can track the GLONASS signal, select the *GLONASS* check box if you want to use the GLONASS observations. This sets up the GPS receivers to track the GLONASS signals and include the signals in the logged data.

The GLONASS data for postprocessing must be logged to the receiver. You cannot log GLONASS data for postprocessing to the Trimble controller.

## **Setting Up the Equipment for a Trimble R8, R6 or 5800 GPS Survey**

This section describes how to assemble the hardware at the rover receiver for a real-time and postprocessed kinematic (PP kinematic) survey. It describes the steps for a Trimble R8, R6, or 5800 GPS receiver.

For more information, go directly to these topics in this section:

[Setting up the equipment for a real-time survey](#)

[Setting up the equipment for a postprocessed survey](#)

[Starting a rover survey](#)

[Recommended RTK initialization procedure](#)

[Postprocessed initialization methods](#)

[Swapping bases during a real-time rover survey](#)

[Ending a rover survey](#)

### **Setting Up the Equipment for a 'Real-Time' Survey**

To set up a rover receiver for a real-time survey using a Trimble R8, R6, or 5800 GPS receiver:

1. Mount the Trimble R8/R6/5800 receiver onto a range pole. Power for the Trimble R8/R6/5800 receiver is supplied by the internal battery in the receiver.

2. Attach the controller to the holder. See: [Attaching and Detaching the Trimble ACU Controller](#).
3. Connect the controller holder to the range pole.
4. Turn on the Trimble R8/R6/5800 receiver.
5. Turn on the controller.

### Setting Up the Equipment for a 'Postprocessed' Survey

1. Mount the Trimble R8/R6/5800 receiver onto a range pole. Power for the Trimble R8/R6/5800 is supplied by the internal battery in the receiver.

**Note** – It may be useful to use a bi-pole to hold the range pole while taking measurements.

2. Attach the controller to the holder. See: [Attaching and Detaching the Trimble ACU Controller](#).
3. Connect the controller holder to the range pole.
4. Turn on the Trimble R8/R6/5800 receiver.

### Starting a Rover Survey

Only start a survey after you have started the base receiver. For more information, see [Starting the Base Receiver](#).

To conduct a survey:

1. Make sure that the required job is open. The title of the main menu should be the current job name.
2. From the main menu, choose *Survey*. Select a survey style from the list.

**Note** – If you have only one survey style, it is automatically selected.

A *Survey* menu is generated. It displays items specific to the chosen survey style and includes the *Start base receiver* and *Start survey* items.

When you start a survey using a particular Trimble survey style for the first time, the Trimble Survey Controller software prompts you to customize the style for your specific hardware.

When the survey starts, the menu items *Start base receiver* and *Start survey* no longer appear. For kinematic surveys, a new item, *Initialization*, appears.

### Trimble R8, Trimble R7, Trimble R6, 5800, 5700, 4800, or 4700 GPS receiver

**Warning** – If you start a survey while the receiver is logging data, logging stops. If you start a survey that specifies data logging, logging restarts to a different file.

**Note** – When you start a survey, the Trimble Survey Controller software automatically negotiates the highest possible baud rate for communicating with the connected receiver.

### Starting a Real-Time Rover Survey

To start the rover receiver for a real-time survey:

1. Select *Start survey*.
2. Make sure the rover is receiving radio corrections from the base.

**Note** – An RTK survey needs radio corrections.

3. If the receiver you are using supports transmission delays and you select the *Prompt for station index* check box in the *Rover options* field, the *Select base station* screen appears. It shows all the base stations operating on the frequency you are using. The list shows the station index numbers of each base and the reliability of each. Highlight the base you want to use and tap *Enter*.

For more information about using transmission delays, see [Multiple bases on one frequency](#).

**Tip** – If you want to check the point name of the base station being used in the rover survey, select *Files / Review current job* and inspect the *Base point record*.

4. If necessary, initialize the survey.

**Note** – If you are carrying out an RTK survey but do not require centimeter–level results, select *Survey / Initialization*. Tap *Init* and set the *Method* field to *No initialization*.

For an RTK survey, initialize before starting centimeter–level surveying. If you are using a dual–frequency receiver with the OTF option, the survey automatically starts to initialize using the *OTF initialization* method.

5. When the survey is initialized, you can perform a site calibration, measure points, or stakeout.

## Starting an RTK & Infill Rover Survey

**Note** – If you are using postprocessed techniques, to process the data you must have the Baseline Processing module of the Trimble Geomatics Office software installed.

To start the rover receiver for an RTK & infill survey:

1. Select *Start Survey*.
2. Make sure the rover is receiving radio corrections from the base.

**Note** – An RTK survey needs radio corrections.

3. If the receiver you are using supports transmission delays and the *Prompt for station index* check box in the *Rover options* option in the survey style is selected, the *Select base station* screen appears. It shows all the base stations operating on the frequency you are using. The list shows the station index numbers of each base and the reliability of each. Highlight the base you want to use and tap *Enter*.

For more information about using transmission delays, see [Multiple bases on one frequency](#).

**Tip** – If you want to check the point name of the base station being used in the rover survey, select *Files / Review current job* and inspect the *Base point record*.

4. Initialize the survey using an [RTK initialization](#) method.
5. Measure points as usual.

### Switching to PP infill

During periods when no base corrections are received, the following message flashes in the status line:

Radio link down

To continue surveying select *Start PP infill* from the *Survey* menu. When postprocessing infill starts, this item changes to *Stop PP infill*.

Raw data is logged at the rover during postprocessing (PP) infill. For successful baseline resolution, you must now use postprocessed kinematic observation techniques.

**Note** – Initialization cannot be transferred between the RTK survey and the PP infill survey. Initialize the PP infill survey like any other postprocessed kinematic survey. For more information, see [Postprocessed Initialization Methods](#).

Only rely on the OTF (automatic) initialization if you are certain that the receiver will observe at least five satellites, without interruption, for the next 15 minutes. Otherwise, select *Initialization* from the *Survey* menu and perform an initialization.

**Note** – You cannot stake out points during a postprocessed survey.

When base corrections are received again, one of the following messages appears in the status line, depending on the initialization mode of the RTK survey:

- Radio link up (RTK=Fixed)
- Radio link up (RTK=Float)

The first message is displayed if the receiver has retained the RTK initialization during the PP infill survey. That is, if the number of satellites did not fall below four throughout the PP infill survey.

Select *Stop PP infill* from the *Survey* menu to stop data logging at the rover. When postprocessing infill stops, this item changes back to *Start PP infill*. Real-time measurements are resumed.

### Starting a Postprocessed Rover Survey

To start the rover receiver for a postprocessed survey, select *Start survey*.

**Note** – If using postprocessed techniques, to process the data you must have the Baseline Processing module of the Trimble Geomatics Office software installed.

You can begin surveying immediately, you do not need to initialize a [FastStatic](#) or [differential](#) survey.

You must initialize a PP kinematic survey to achieve centimeter-level precisions when the data is processed. With dual-frequency receivers, the initialization process begins automatically if at least five L1/L2 satellites

are being observed.

For more information about initializing a postprocessed survey, see [Postprocessed Initialization Methods](#). For information about measuring points, see [Measure Points](#).

## Working in Float mode

Work in Float mode if you do not want to initialize a survey. Start the survey and select *Initialization*. When the *Initialization* screen appears, press *Init*. Set the *Method* field to *No initialization* and tap *Enter*.

## Starting a Rover Survey

Starting a rover survey is the same as for a [Real-time](#) survey.

To start a survey using VRS or SAPOS FKP, you must send an approximate position for the rover receiver to the control station. When you start the survey, this position is automatically sent through your radio communications link in a standard NMEA position message. It is used to compute the RTK corrections your receiver will use.

## Swapping Bases During a Real-Time Rover Survey

If you are using multiple bases on the same frequency, you can swap bases during the rover survey. For more information, see [Multiple bases on one frequency](#).

To swap bases, do the following:

- From the *Survey* menu, select *Swap base receiver*.

The *Select base station* screen appears. It shows all the base stations operating on the frequency you are using. The list shows the station index numbers of each base and the reliability of each. Tap the base you want to use.

**Note** – When you change to a different base, your OTF receiver automatically starts the initialization.

## Ending a Rover Survey

When you have measured or staked out all points required, do the following:

1. From the *Survey* menu, choose *End survey*.

The Trimble Survey Controller software asks if you want to power down the receiver. Tap *Yes* to confirm this.

2. Turn off the controller **before** disconnecting the equipment.
3. Return to the base station and end the base survey. For more information, see [Ending a Base Survey](#).



## Rover Options

To configure the Rover survey when you create or edit a Survey Style:

1. From the main menu, select *Configuration / Survey Styles / <Selected GPS Survey Style> / Rover options*.
2. Choose a survey type and set the associated parameters.

Generally, when a GPS Total Station setup consists of one base and one rover receiver, make sure the survey type selected in the *Rover options* field and the *Base options* field is the same. However, when there are multiple rovers, you can have various configurations. The following table shows the rover survey types that are possible when the base survey type is RTK & infill or PP Kinematic.

Base survey type	Possible rover survey types
RTK & infill or RTK & data logging	RTK RTK & infill PP Kinematic FastStatic
PP Kinematic	PP KinematicFastStatic

### Broadcast format

For Real-time Kinematic surveys, the format of the broadcast message can be CMR, CMR +, or RTCM RTK. CMR is Compact Measurement Record; RTCM is Radio Technical Commission for Maritime Services.

The default is CMR +, which is a format used by the modern Trimble receivers. It is a modified type of CMR record that improves the efficiency of a low bandwidth radio link in realtime surveys. Only use CMR + if all the receivers have the CMR + option installed. To check if this option is installed in the receiver, select *Instrument / Options* on the controller that is connected to a receiver.

**Note** – If you want to operate several base stations on one frequency, use CMR+. For more information, see [Operating several base stations on one radio frequency](#).

For [wide-area](#) RTK surveys, the broadcast message format can be from the following wide-area RTK solutions: SAPOS FKP, VRS (CMR), and VRS (RTCM). For more information, see [Starting a wide area RTK survey](#).

For [wide-area](#) RTK surveys, the broadcast message format can be from the following wide-area RTK solutions: SAPOS FKP, VRS (CMR), VRS (RTCM), and RTCM3Net. For more information, see [Starting a wide area RTK survey](#).

Network RTK is also supported in the form of "Multi station" surveys with both CMR and RTCM formats. These surveys allow you to connect to a network service provider by cellular modem or through the Internet, and receive CMR or RTCM data from the nearest physical reference station in the network.

The rover selection should always correspond to the broadcast message format generated by the base.

## Satellite differential

When the radio link is down in a real-time survey, the receiver can track and use signals from a Wide Area Augmentation System (WAAS) available in North America, or from the European Global Navigation Overlay Service (EGNOS) available in Europe. These systems provide WAAS/EGNOS positions instead of autonomous GPS positions.

To use WAAS/EGNOS positions for more accurate navigation when the radio link is down, set the *Satellite differential* field to either WAAS or EGNOS. To use WAAS/EGNOS at times when the satellites are broadcasting in test mode, select the *Ignore health* option.

**Note** – For WAAS/EGNOS surveys, you must use a receiver that can track WAAS/EGNOS satellites.

## Use station index

If you want to use multiple base stations on one radio frequency, enter the station index number that you want to use first in the *Use station index* field.

If you do not want to use multiple base stations on one frequency, enter the same station index number that you enter in the *Base options* screen.

To use any base station operating on the frequency set in the rover radio, tap *Any*.

**Warning** – If you tap *Any* and there are other base stations operating on the frequency, your rover survey could receive corrections from the wrong base.

For information about using multiple bases, see [Multiple bases on one frequency](#).

## Prompt for station index

When you use a receiver that supports multiple base stations on one radio frequency, the Trimble Survey Controller software asks you to specify the base to use when you start the rover survey. You can stop this question from appearing by clearing the *Prompt for station index* check box. The station index number in the *Use station index* field is used.

## Elevation mask

You must define an elevation mask below which satellites are not considered. For kinematic applications, the default of 10° is ideal for both the base and rover.

For differential surveys where the base and rover are separated by more than 100 kilometers, Trimble recommends that the base elevation mask be lower than the rover setting by 1° per 100 kilometers of separation between the base and rover. Generally, the base elevation mask should be no lower than 10°.

## PDOP mask

For the rover option, define a PDOP mask. The Trimble Survey Controller software issues high PDOP warnings when the satellite geometry goes above this threshold. The default value is 6.

## Logging device

With survey types that involve postprocessing, set the Logging device to be either the Receiver or Controller.

To define the logging interval, enter a value in the *Logging interval* field. The base and rover logging intervals must correspond to (or be multiples of) each other.

## Antenna type

To set the default antenna height, enter a value in the *Antenna height* field.

To define the antenna details, access the *Type* field and select the correct antenna from the list of antennas. Access the *Measured to* field and select the correct measurement method for the equipment and type of survey. The field that displays the part number is automatically filled. Key in the serial number.

## Tracking L2C

For real-time surveys where the base data contains L2C observations, select the *L2C* check box. This sets up the rover GPS receiver to track the civil signal on the L2 GPS frequency to match what the base station receiver is tracking.

Use this option only when the base receiver can track L2C, and when you selected the *L2C* box in the base options when you started the base survey.

## Tracking GLONASS

For real-time surveys where the base data contains GLONASS observations, select the *GLONASS* check box. This sets up the rover receiver to track the GLONASS satellites to match what the base station receiver is tracking.

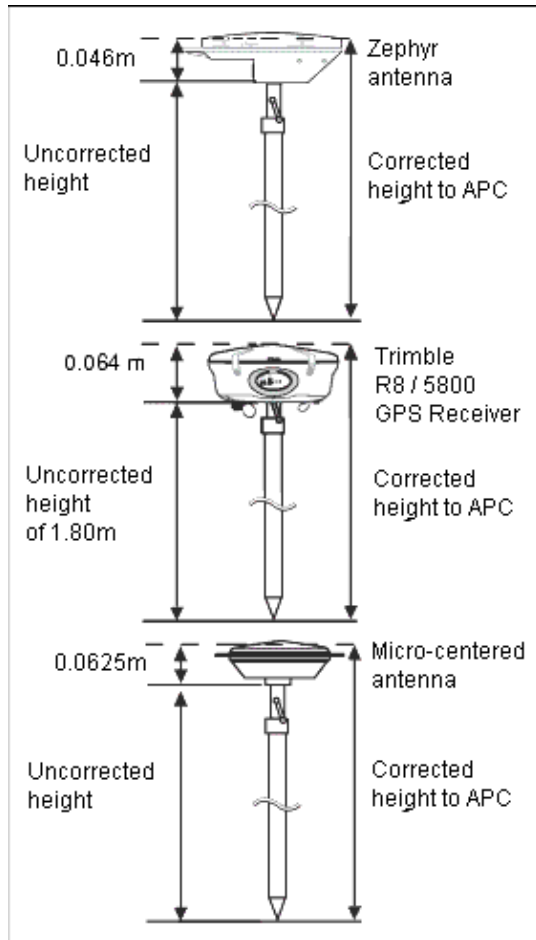
You can use this setting to track GLONASS satellites at the rover even if the base receiver is not tracking GLONASS. However, the satellites will not be used in the RTK processing.

For postprocessed surveys where the base receiver and rover receivers can track the GLONASS signal, select the *GLONASS* check box if you want to use the GLONASS observations. This sets up the GPS receivers to track the GLONASS signals and include the signals in the logged data.

The GLONASS data for postprocessing must be logged to the receiver. You cannot log GLONASS data for postprocessing to the Trimble controller.

## Measuring Antenna Heights

The diagram below shows how to measure the height of an antenna mounted on a range pole when the *Measured to* field is set to *Bottom of antenna* or *Bottom of antenna mount*. With a fixed height range pole, the height is a constant value.



## Measuring the Height of an Antenna on a Tripod

The way to measure this depends on the equipment used.

### Zephyr antenna

If this antenna is mounted on a tripod, measure the height to the top of the notch on the side of the antenna. See the diagram below.

### Zephyr Geodetic antenna

If this antenna is mounted on a tripod, measure the height to the bottom of the notch on the side of the antenna. See the diagram below.

### Trimble R8, R6, and 5800 GPS receiver

If this receiver is mounted on a tripod, measure the height to the bottom of the groove between the gray base and the white top of the antenna, and select *Center of bumper* in the *Measured to* field.

**Tip** – If you are using a fixed height tripod, you can measure the height to the bottom of the antenna housing

and select *Bottom of antenna mount* in the *Measured to* field.

### Micro-centered L1/L2 antenna

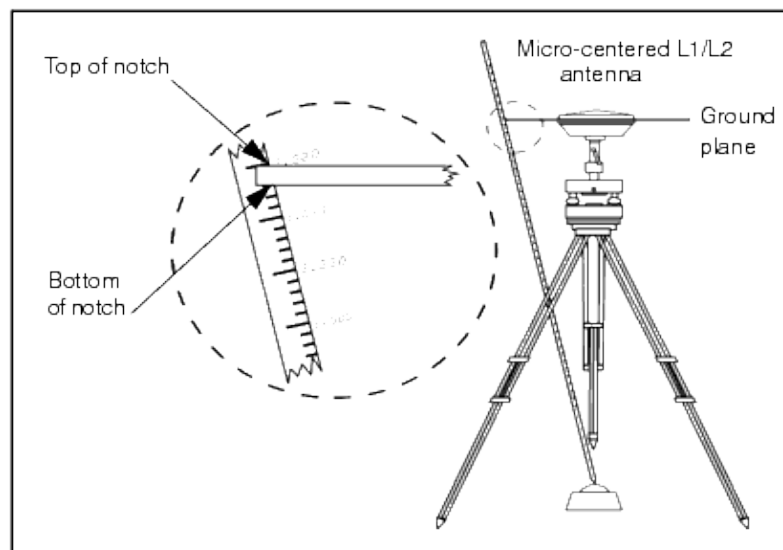
If this antenna is mounted on a tripod, measure the height to the bottom of the plastic housing. Enter this value in the *Antenna height* field and set the *Measured to* field to *Bottom of antenna*.

### Ground plane

If you are using a ground plane, see the next section.

### Measuring the Height of an Antenna When Using a Ground Plane

The following diagram shows how to measure the uncorrected height of a Micro-centered antenna (or a Compact L1/L2 antenna) that has a ground plane. Measure to the underside of the notch in the ground plane.



**Tip** – Measure the height to three different notches around the perimeter of the ground plane. Then record the average as the uncorrected antenna height.

## Antenna.ini File

The Trimble Survey Controller software includes an integrated Antenna.ini file that contains a list of antennas that you can choose from when creating a survey style. You cannot edit this list in the Trimble Survey Controller software. However, if you want to shorten the list or add a new antenna type, you can edit and transfer a new Antenna.ini file.

To edit the antenna.ini file, use a text editor such as Microsoft Notepad. Edit the *Trimble Survey Controller* group, and transfer the new Antenna.ini file to the Trimble Survey Controller software, using Trimble's Data Transfer utility.

**Note** – When you transfer an Antenna.ini file, it overwrites any existing file of that name. The information in this file is also used in preference to the antenna information built into the Trimble Survey Controller software.

## RTK Initialization Methods

If base corrections are being received and there are sufficient satellites, the survey is initialized automatically when you start the survey. A survey must be initialized before centimeter-level surveying can begin.

The number of satellites required depends on whether you are using GPS satellites only, or a combination of GPS and GLONASS satellites. The following table summarizes the requirements.

### Minimum L1/L2 satellites required for initialization

Satellite Systems	GPS	GLONASS
GPS only	5	0
GPS + GLONASS	4	2
GPS + GLONASS	3	3
GPS + GLONASS	2	4
GLONASS only	N/A	N/A

**Note** – You cannot initialize if the DOP is greater than 20.

After initialization, a position can be determined and the initialization can be maintained with one satellite less than the number required to initialize. If the number of satellites drops below this number, the survey must be reinitialized.

The following table summarizes the requirements.

### Minimum L1/L2 satellites required to maintain initialization and produce positions

Satellite Systems	GPS	GLONASS
GPS only	4	0
GPS + GLONASS	4	1
GPS + GLONASS	3	2
GPS + GLONASS	2	3
GPS + GLONASS	1	4
GLONASS only	N/A	N/A

After initialization, the survey mode changes from Float to Fixed. The mode remains Fixed if the receiver continuously tracks the minimum number of satellites. If the mode changes to Float, you must reinitialize the survey.

### Multipath



Initialization reliability depends on the initialization method used and on whether or not multipath occurred during the initialization phase. Multipath occurs when GPS signals are reflected off objects, such as the ground or a building.

The occurrence of multipath at the GPS antenna adversely affects GPS initializations and solutions:

- If initialization is by the Known Point method, multipath can cause an initialization attempt to fail.
- During initialization by the OTF method, it is difficult to detect multipath, which may cause initialization to be lengthy or unsuccessful. For more information, see [Recommended RTK Initialization Procedure](#).


The initialization process in Trimble receivers is very reliable, but if an incorrect initialization does occur, Trimble's RTK processing routines detect it within 15 minutes (if the mode has remained Fixed). When the error is detected, the receiver automatically discards the initialization and issues a warning.

**Note** – If you survey points with a bad initialization, you will get position errors. To minimize the effect of multipath during an OTF initialization, move around.

### Known Point Initialization

To perform a Known Point initialization:

1. Position the rover antenna over a known point.
2. From the *Survey* menu, choose *Initialization*.
3. Set the *Method* field to *Known Point*.
4. Access the *Point name* field and tap *List*. Select the point from the list of known points.
5. Enter values in the *Antenna height* field, and make sure that the setting in the *Measured to* field is correct.
6. When the antenna is centered and vertical over the point, tap *Start*.

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

7. When the receiver is initialized, the following message appears:

Initialization change. Initialization has been gained. The results are displayed. Tap *Accept* to accept the initialization.

8. If the initialization fails, the results are displayed. Tap *Retry* to retry the initialization.

### Recommended RTK Initialization Procedure

This section describes the procedure that Trimble recommends for performing a check on an OTF RTK initialization.

Minimize the chance of surveying with a bad initialization by adopting good survey techniques. A bad initialization occurs when the integer ambiguities are not correctly resolved. The Trimble Survey Controller software automatically reinitializes when this is detected, but cannot do so if you end the survey too soon. As a precaution, always perform the RTK initialization described below.

When initializing, always choose a site that has a clear view of the sky and is free of obstructions that could cause multipath.

**Note** – Known Point is the quickest method of initialization when known points exist.

To perform an On–The–Fly initialization:

1. Initialize the survey using the OTF method of initialization.

**Tip** – When performing an OTF initialization, move around to reduce the effect of multipath.

2. When the system is initialized, establish a mark about 9 meters (30 feet) from where the initialization occurred.
3. Conduct a static point measurement over the mark. Once this is done, discard the current initialization.
4. If you are using an adjustable height range pole, change the height of the antenna by approximately 8 inches.
5. Reoccupy the mark observed in step 2, and reinitialize the survey using either the OTF or Known Point method of initialization. Remember to enter the new antenna height details.

Follow this procedure to substantially improve the quality of an initialization.

Measuring a new point creates a known point on which the first initialization is tested. Changing the antenna height moves the GPS antenna from the environment in which the test point was initially surveyed. Always enter the new antenna height before starting the Known Point initialization.

## Postprocessed Initialization Methods

In a postprocessed survey you must initialize to attain centimeter–level precisions.

Use one of the following methods to initialize dual–frequency postprocessed kinematic surveys in the field:

- On–The–Fly
- Known Point

**Note** – In a postprocessed survey, collect enough data during initialization so that the WAVE processor can successfully process it. The following table shows Trimble's recommended times.

Initialization method	4 SVs	5 SVs	6+ SVs
L1/L2 OTF initialization	N/A	15 min	8 min
Known Point initialization	at least four epochs		

After initialization, the survey mode changes from Float to Fixed. The mode remains Fixed if the receiver continuously tracks at least four satellites. If the mode changes to Float, reinitialize the survey.

**Note** – If you do an On–The–Fly initialization in a postprocessed kinematic survey, it is possible to measure points before initialization is gained. The Trimble Geomatics Office software can back–process the data later



to give a fixed solution. If you do this but lose lock on the satellites while initializing, re-measure any one of the points that you surveyed before lock was lost.

To work without initializing the survey (in Float mode), start a survey and select *Initialization*. When the *Initialization* screen appears, tap *Init*. Set the *Method* field to *No initialization* and tap *Enter*.

### Known Point Initialization

In a postprocessed survey you can initialize on:

- a point measured previously in the current job
- a point that you will provide coordinates for later (before the data is postprocessed)

See [Known Point initialization](#) for instructions.

## RTK Survey

Real-time kinematic surveys use a radio to broadcast signals from the base station to the rover. The rover then calculates its position in real time. Configure this type of survey when you create or edit a Survey Style, then follow these steps to carry out an RTK survey:

1. [Configure the survey style](#)
2. [Configure the base receiver](#)
3. [Configure the rover receiver](#)
4. [Begin the survey](#)
5. [End the survey](#)

### Configure the survey style

To do this:

1. From the main menu, select *Configuration / Survey styles / RTK*.
2. Select each of the options in turn, and set them to suit your equipment and survey preferences.
3. When you have configured all the settings, tap *Store* to save them.

For more information, see:

[Rover options](#)

[Base options](#)

[Radios](#)

[Laser rangefinder](#)

[Topo point](#)

Observed control point

Rapid point

Continuous points

Stakeout

Configuring the Survey Style for a Site Calibration

Duplicate Point Tolerance

### Configure the base receiver

To do this:

1. Set up the base station and connect the data collector.
2. From the main menu, select *Survey / RTK / Start base receiver*. If you are using this Survey Style for the first time, the Style wizard prompts you to specify the type of equipment you are using.

The style wizard customizes the chosen survey style, setting any parameters specific to the hardware.

**Tip** – To correct a mistake when customizing a survey style, first complete the process and then edit the style.

**Note** – With the Trimble R7, 5800, 5700, 4800 or 4700 GPS receivers, use an external radio at the base even if you use the internal radio at the rover.

**Tip** – You can use a Custom radio if the radio you have is not listed.

3. Enter the point name. If the WGS–84 point is not already in the database, the *Key in / Point* screen appears.
4. Enter values, or tap *Here* to use the current position. Only use *Here* once in a job.
5. Enter the code.
6. Enter the antenna height and tap *Enter*.
7. Disconnect the data collector from the base station.

**Note** – The first time that you start the base or the rover receiver, you must select the type of antenna that you are using from a list. The following table shows some common choices.

Receiver and station	GPS Total Station receivers		
	Trimble R7 / 5700	4800	4700
Base receiver	Zephyr Geodetic	4800 Internal	Micro–centered L1/L2 w/GP
Rover receiver	Zephyr	4800 Internal	Micro–centered L1/L2

### Configure the rover receiver

To do this:

1. Set up the Rover receiver and connect the data collector.
2. From the main menu, select *Survey / RTK / Start survey*. Again, the Style wizard may prompt you to specify the type of equipment you are using.
3. Initialize the survey. If you have selected the *On–The–Fly (OTF)* option, initialization is automatic. Otherwise, the *Initialization* screen appears.
4. Once the rover is initialized, the survey mode in the status line shows as RTK:Fixed. You can then measure points.

## **Begin the survey**

To do this:

1. From the main menu, select *Survey / Measure points*.
2. Enter the point name and code.
3. In the *Type* field, select *Topo point*.
4. Enter the antenna height.
5. Tap *Measure*. The antenna must remain stationary and vertical while you measure a point.
6. Tap *Store* to store the point.
7. Move to the next point and measure it.
8. To review stored points, select *Review current job* from the *Files* menu.

## **End the survey**

To do this:

1. From the main menu, select *Survey / Conventional / End survey*.
2. Tap *Yes* to confirm.
3. Turn off the data collector.

For more information, see:

[Start base receiver](#)

[Measure points](#)

[Continuous topo](#)

[Stakeout](#)

[Configuring the Survey Style for a Site Calibration](#)

[Swap base receiver](#)

# **Operating Several Base Stations on One Radio Frequency**

In an RTK survey you can reduce the effects of radio interference from other base stations on the same

frequency by operating your base station with a different transmission delay. This allows you to operate several base stations on one frequency. The general procedure is as follows:

1. Check that you have the correct hardware and firmware.
2. Set up the equipment and start a survey at each base station, specifying a transmission delay and a station index number.
3. Start a rover survey and specify which base to use.

### Hardware and firmware requirements

To operate several base stations on one frequency, you must use receivers that support the CMR + correction record format.

All other base and rover receivers must be Trimble R8, R7, R6, 5800, or 5700 GPS receivers, or 4700 or 4800 GPS receivers with firmware version 1.20 or later.

**Note** – Do not use transmission delays if you intend to use radio repeaters.

### Starting the base with a transmission delay

When you use multiple base stations, you set the transmission delay for each base when you start the base survey. Each base must broadcast with a different transmission delay and station index number. The delays allow the rover to receive corrections from all of the base stations at once. The station index numbers let you select which base station to use at the rover.

**Note** – You can set the base radio transmission delay only when using Trimble R8, R7, R6, 5800, or 5700 GPS receivers, or 4700 or 4800 GPS receivers with firmware version 1.20 or later.

When you carry out surveys using different base stations in one job, make sure that the coordinates of the base stations are in the same coordinate system and are in terms of each other.

Before you start the base receiver, do the following:

1. Select the CMR + correction message format. Select this in the survey style for both the base and the rover.
2. Set the over air baud rate in the radio to at least 4800 baud.

**Note** – If you use a 4800 over air baud rate you can only use two base stations on one frequency. Increase the over air baud rate if you want to increase the number of base stations on one frequency.

When you start the base survey, do the following:

1. In the *Station index* field, enter a value within the range 0–31. This number is broadcast in the correction message.

**Tip** – You can configure the default station index number in the survey style. For more information, refer to [Station index](#).

2. If the receiver you are using supports transmission delays, the *Transmission delay* field appears. Choose a value, depending on how many base stations you want to use. See the following table.

No. of base stations	Use these delays (in ms) ...			
	Base 1	Base 2	Base 3	Base 4
One	0	–	–	–
Two	0	500	–	–
Three	0	350	700	–
Four	0	250	500	750

For more information about starting the base survey, see [Starting a Base Survey](#).

For information about starting the rover and selecting which station index to use, see [Starting a Rover Survey](#).

## Starting a Real Time Survey Using a Dial-up GSM connection

If you are receiving corrections from a single base station, do not start the survey until you have started the base receiver. For more information, see [Starting the Base Receiver](#).

To start the rover receiver for a real-time survey:

1. If you are using a cellular modem, make sure that the modem is switched on, then connect it to the receiver (or to the controller if you selected the [Route through SC](#) option).
2. If you are using a Trimble Internal GSM/GPRS module, make sure that the receiver is turned on and is connected to the controller.
3. From the main menu, select *Survey / (Selected Survey Style) / Start Survey*.  
The message *Connecting to modem appears*. Once the connection is completed, the modem dials the base station or Wide Area RTK service provider.  
Once the cellular modem or Trimble Internal GSM/GPRS module signals are received, and the corrections data link is established, the cellular phone icon appears on the status bar.

To end the survey, select *Survey / (Selected Survey Style) / End survey*.  
The modem hangs up during the end survey process.

**Note** – When you send initialization strings to the modem, if you see the error message "No response from modem", check that the strings you set in the survey style are valid for your particular modem. Some modems accept only upper case AT commands.

**Note** – To configure a Survey style for a real-time dial-up GSM survey see [Configuring a Survey Style for a Dial-up Real Time Survey](#).

## Starting a Real Time Survey Using a GPRS internet connection

If you are receiving corrections from a single base station, do not start the survey until you have started the base receiver. For more information, see [Starting the Base Receiver](#).

To start the rover receiver for a real-time survey:

1. If you are using a cellular modem, make sure that the modem is switched on, then connect it to the receiver.
2. If you are using a Trimble Internal GSM/GPRS module, make sure that the receiver is turned on and is connected to the controller.
3. From the main menu, select *Survey / (Selected Survey Style) / Start Survey*.

The message "Establishing network connection" appears. Once the connection is completed, the modem receives corrections from the base station or Wide Area RTK service provider through the Internet connection.

Once the corrections data link is established, the radio icon appears on the status bar.

**Note** – To configure a Survey style for a real-time internet survey see [Configuring a Survey Style for an Internet Real Time Survey](#).

**Note** – When you start a survey with the controller already connected to the Internet, the existing connection is used for the base data. The Internet connection does not close when you end the survey.

When you start a survey with the controller not connected to the Internet, the controller will open an Internet connection using the connection specified in the Survey Style. This connection closes when you end the survey.

## Redialing the Base Station

If you lose the phone connection during a GSM dial-up survey, use the Redial function to reconnect to the base station or [Wide Area RTK network](#).

Alternatively, you can hang up the modem using the Trimble Survey Controller software, continue the survey, and later redial the base to re-establish corrections.

To hang up and redial:

1. Tap the Cellular phone icon on the status bar. The *Rover radio* screen appears.
2. To hang up the modem, tap *Hang up*.
3. To redial the base station, tap *Redial*.

**Note** – When you redial a VRS service provider, a new base station position is sent through the data link. When the Trimble Survey Controller software switches to the new base, the survey continues with this new position.

# Starting a Wide–Area RTK Survey

Wide Area RTK (WA RTK) systems consist of a distributed network of reference stations communicating with a control center to calculate GPS error corrections over a wide area. Real–time correction data is transmitted by radio or cellular modem to the rover receiver within the network area.

The system improves reliability and operating range by significantly reducing systematic errors in the reference station data. This lets you increase the distance at which the rover receiver can be located from the physical reference stations, while improving on–the–fly (OTF) initialization times.

The Trimble Survey Controller software supports broadcast formats from the following WA RTK solutions:

- SAPOS FKP
- Virtual Reference Station (VRS)
- RTCM3Net

To use a WA RTK system, first check that you have the necessary hardware and firmware.

## Hardware Requirements

All rover receivers must have firmware that support WA RTK. For details of availability, check the Trimble website or contact your local dealer.

Real–time correction data is provided by radio or cellular modem. For details about the delivery option for your system, contact your local dealer.

## Configuring the Survey Style

Before you start a survey using a WA RTK system, configure the RTK survey style.

To select a WA RTK broadcast format:

1. In the survey style, select *Rover options*.
2. In the *Broadcast format* field, select one of the following options from the list:
  - ◆ SAPOS FKP
  - ◆ VRS (RTCM)
  - ◆ VRS (CMR)
  - ◆ RTCM3Net

To store VRS vectors to the nearest Physical Base Station (PBS) in the VRS network, the VRS system must be configured to output the PBS information. If the VRS system does not output PBS data, VRS data must be stored as positions.

To select a radio solution:

1. In the survey style, select *Rover radio*.
2. In the *Type* field, select your radio from the list.

**Note** – If you are using a radio in a VRS system, you must select a two-way radio. You cannot use Trimble internal 450 MHz or 900 MHz radios.

## RTK and Infill Survey

This type of survey allows you to continue a kinematic survey when radio contact is lost. The infill data must be postprocessed.

Configure an RTK and Infill survey when you create or edit a Survey Style.

To do this:

1. From the main menu, select *Configuration / Survey Styles / RTK & infill / Base options*.
2. In the *Survey type* field, select *RTK and infill*.
3. Specify the logging device and logging interval.
4. Do the same for *Rover options*.

To receive WAAS/EGNOS positions instead of autonomous positions when the radio is down, set the *Satellite differential* field to WAAS (North America) or EGNOS (Europe).

To receive GLONASS positions as well as GPS positions, select the *GLONASS* check box.

The logging interval is for the infill session only and should be the same for each receiver, typically 5 seconds. The RTK interval remains at 1 second.

When radio contact is lost, the following message flashes in the status line: 'Radio link down'.

To start infill:

1. From the main menu, select *Survey / RTK & infill / Start PP infill*.
2. Initialize, and continue as for a postprocessed kinematic survey.

When the radio link returns, select *Survey / Stop PP infill* from the main menu and continue with your RTK survey.

For more information, see:

[Rover Options](#)

[Base Options](#)

[Radio](#)

[Laser Rangefinder](#)

[Topo Point](#)



[Observed Control Point](#)

[Rapid Point](#)

[Continuous Points](#)

[Stakeout](#)

[Configuring the Survey Style for a Site Calibration](#)

[Duplicate Point Tolerance](#)

## RTK and Data Logging

This type of survey records raw GPS data during an RTK survey.

As this survey style is not provided by the Trimble Survey Controller software, you must create the style the first time that you want to use it.

To do this:

1. From the main menu, select *Configuration / Survey Styles* and tap *New*.
2. Type in RTK and data logging and tap *Enter*.
3. Select *Base options*.
4. In the *Survey type* field, select *RTK and logging*.
5. Specify the logging device and the logging interval.
6. Repeat steps 4–6 for *Rover options*.

The logging interval should be the same for each receiver – typically 5 seconds. The RTK interval remains at 1 second.

To receive GLONASS positions as well as GPS positions, select the *GLONASS* check box.

For more information, see:

[Rover Options](#)

[Base Options](#)

[Radio](#)

[Laser rangefinder](#)

[Topo Points](#)

[Observed Control Point](#)

[Rapid Point](#)

[Continuous Topo Points](#)

[Stakeout](#)

[Configuring the Survey Style for a Site Calibration](#)

[Duplicate Point Tolerance](#)

## FastStatic Survey

A FastStatic survey is a postprocessed survey using occupations of up to 20 minutes to collect raw GNSS data. The data is postprocessed to achieve sub-centimeter precisions. Typically, the occupation times vary based on the number of satellites. A minimum of four satellites is required.

Configure a FastStatic survey when you create or edit a Survey Style.

To do this:

1. From the main menu, select *Configuration / Survey Styles / FastStatic / Base options*.
2. In the *Survey Type* field select *FastStatic*.
3. Do the same for *Rover options*.

To receive GLONASS positions as well as GPS positions, select the *GLONASS* check box.

For more information, see:

[Rover Options](#)

[Base Options](#)

[Laser Rangefinder](#)

[FastStatic Point](#)

[Duplicate Point Tolerance](#)

## PPK Survey

Postprocessed Kinematic surveys store raw observations and process them later.

Configure a PPK survey when you create or edit a Survey Style.

To do this:



1. From the main menu, select *Configuration / Survey Styles / PPK / Base options*.
2. In the *Survey Type* field select *PP Kinematic*
3. Do the same for *Rover options*.

To store GLONASS positions as well as GPS positions, select the *GLONASS* check box.

When you use this type of survey, the default logging interval is five seconds. If your receiver is capable of storing data, the first time that you use this survey style, the Style wizard prompts you to specify where you want to store the data.

Before you measure points, **initialize** the survey using one of the following methods:

- Known point
- New point
- On-The-Fly (OTF)

When you are familiar with the equipment, you can configure the PP initialization times.

## PP Initialization Times

Select the *PP initialization times* survey style option to define initialization times. Generally the default settings are appropriate.

**Warning** – Reducing any of these times can affect the outcome of a postprocessed survey. Increase these times rather than decrease them.

The number of satellites required depends on whether you are using GPS satellites only, or a combination of GPS and GLONASS satellites. The following table summarizes the requirements.

### Minimum L1/L2 satellites required for On-The-Fly initialization

Satellite Systems	GPS	GLONASS
GPS only	5	0
GPS + GLONASS	4	2
GPS + GLONASS	3	3
GPS + GLONASS	2	4
GLONASS only	N/A	N/A

**Note** – You cannot initialize if the DOP is greater than 20.

After initialization, a position can be determined and the initialization can be maintained with one satellite less than the number required to initialize. If the number of satellites drops below this number, the survey must be reinitialized.

The following table summarizes the requirements.

## Minimum L1/L2 satellites required to maintain initialization and produce positions

Satellite Systems	GPS	GLONASS
GPS only	4	0
GPS + GLONASS	4	1
GPS + GLONASS	3	2
GPS + GLONASS	2	3
GPS + GLONASS	1	4
GLONASS only	N/A	N/A

After initialization, the survey mode changes from Float to Fixed. The mode remains Fixed if the receiver continuously tracks the minimum number of satellites. If the mode changes to Float, you must reinitialize the survey.

## RT Differential Survey

This survey type uses a radio to broadcast a correction message (RTCM–104) from the base station to the rover which then calculates its position. A real–time differential survey gives sub meter level precisions.

Differential surveys require four satellites that are common to the base and the rover receivers. Differential surveys do not require initialization.

The two differential survey types are described in the following sections:

- RT differential – This survey uses the RTCM broadcast message and relies on a reliable radio for the duration of the survey. Alternatively, use WAAS/EGNOS signals to provide real–time positions instead of a radio.
- RT diff & logging – This survey works in the same way as an RT differential survey, except that data is recorded for the entire survey both at the base and at the rover receivers. This method is useful if raw data is required for quality assurance purposes.

As this survey style is not provided by the Trimble Survey Controller software, you must create the style the first time that you want to use it.

To do this:

1. From the main menu, select *Configuration / Survey Styles*.
2. Tap *New*.
3. Enter a name in the *Style name* field.
4. In the *Style type* field, choose *GPS* and tap *Accept*.
5. Choose *Rover options* or *Base options* and make the appropriate changes to the *Type* field. In this case, change it to the differential method that you want to use. The survey type you select depends on whether the technique you choose is real–time or postprocessed.
6. For both real–time and postprocessed techniques, define an elevation mask and antenna for the base and the rover. For the *Rover options*, define Broadcast format, the PDOP mask, and the RTCM age

limit. In a differential survey you can choose to set the *Broadcast format* field to RTCM, WAAS (North America), or EGNOS (Europe).

7. For methods that involve data logging, specify whether the data is to be logged in the receiver or in the controller, and define the interval. For real-time techniques, the RTCM-SC104 version 2 broadcast message format is used. Real-time signals are generated at 1second intervals.
8. To use [Wide Area Augmentation System](#) positions when you do not have a radio, set the broadcast format to WAAS (North America) or EGNOS (Europe).
9. To receive WAAS/EGNOS positions instead of autonomous positions when the radio is down, set the broadcast format to RTCM and set the *Satellite differential* field to WAAS or EGNOS.

**Note** – For WAAS/EGNOS surveys, you must use a receiver that can track WAAS/EGNOS satellites.

For more information, see:

[Rover Options](#)

[Base Options](#)

[Radio](#)

[Laser rangefinder](#)

[Topo Points](#)

[Observed Control Point](#)

[Rapid Point](#)

[Continuous Topo Points](#)

[Stakeout](#)

[Configuring the Survey Style for a Site Calibration](#)

[Duplicate Point Tolerance](#)

## Wide Area Augmentation System (WAAS) and European Global Navigation Overlay Service (EGNOS)

WAAS is a satellite-based delivery system for differential positions. It is available only in North America. The equivalent system in Europe is the European Global Navigation Overlay Service (EGNOS), and in Asia it is MSAS.

WAAS and EGNOS signals provide real-time, differentially corrected positions without the need for a radio link. You can use WAAS or EGNOS in real-time surveys when the ground-based radio link is down.

To use WAAS signals, in the *Rover options* screen of your survey style, set *Satellite differential* to WAAS or EGNOS, depending on your location.

In real-time differential surveys, you can set the broadcast format to WAAS or EGNOS to always store WAAS/EGNOS positions without the need for a radio link.

When WAAS/EGNOS signals are being received, the radio icon changes to a WAAS/EGNOS icon, and in an RTK survey, RTK:WAAS is displayed on the status line.

The availability of WAAS/EGNOS signals depends on your location and the receiver that you are using. See your Trimble dealer for details.

## Rapid Point

This is a method for measuring GPS points quickly. Configure this type of point when you create or edit a GPS Survey Style. The point is stored when the preset precisions have been satisfied. There is no minimum occupation time.

The Trimble Survey Controller software collects just one epoch of data when the preset precisions are reached, so the default precision values should ideally be higher than for other point measurement types. The software uses this single epoch of data to define the point, making Rapid point the least precise measurement method.

Alternatively, you can change the *Type* field to *Rapid point* in the *Measure points* screen, and tap *Options*.

In an RTK survey, when you select the *Auto tolerance* check box, the software calculates horizontal and vertical precision tolerances that meet the GPS receiver's RTK specifications for the baseline length you are measuring. If you want to enter your own precision tolerances, clear this check box.

To measure a Rapid point:

1. Do one of the following:
  - ◆ From the main menu, select *Survey / Measure points*.
  - ◆ Tap *Favorites* and select *Measure points*.
2. Enter values in the *Point name* and *Code* fields (the *Code* field entry is optional), and enter *Rapid point* in the *Type* field.
3. Enter a value in the *Antenna height* field and make sure that the setting in the *Measured to* field is set appropriately.
4. Tap *Measure* to start recording data. The point is automatically stored when the preset precisions are reached.

## Continuous Topo

Use the continuous topo function to measure points continuously.

A point is stored when one of the following conditions occurs:

- a predefined time has elapsed
- a predefined distance has been exceeded
- both predefined time and/or distance settings have been met
- a predefined stop time and distance settings have been met

To configure the survey style for Continuous topo:

In an RTK survey, when you select the *Auto tolerance* check box, the software calculates horizontal and vertical precision tolerances that meet the GPS receiver's RTK specifications for the baseline length you are measuring. If you want to enter your own precision tolerances, clear this check box.

If you are doing a postprocessed survey, the time interval is the logging interval. Configure this logging interval in the *Rover options* screen of the postprocessed survey style.

To measure Continuous topo points:

1. From the main menu, select *Survey / Continuous topo*.
2. In the *Type* field, select *Fixed time*, *Fixed distance*, *Time and distance*, *Time or distance* or *Stop and go*.

**Note** – For a postprocessed survey, you can only use the *Fixed time* continuous method. The time interval is set by default to the same value as the logging interval.

3. Enter a value in the *Antenna height* field and make sure that the setting in the *Measured to* field is set appropriately.
4. Enter a value in the *Time interval* field, or the *Stop and go* field and/or the *Distance* field, depending on the method you are using.
5. To generate offsets, set the *Offset* field to *One* or *Two*. The *Fixed time* method does not support offsets.
6. Enter a value in the *Start point name* field (or enter a start point name for the center line when measuring offset points). This increments automatically.
7. If you are measuring an offset line, enter the offset distances and the start point name. To enter a left horizontal offset, enter a negative offset distance or use the *Left* or *Right* pop-up menus.
8. Tap *Measure* to start recording data, and then move along the feature to be surveyed.

When using the *Stop and go* method, enter a value in the *Stop time* field for the period of time the antenna must be stationary before the receiver starts to measure the point. The user is deemed to be stationary when their velocity is less than 5cm/sec.

**Note** – To change the distance interval, time interval, or offset while measuring points, enter new values in the fields.

9. To stop measuring continuous points, tap *End*.

**Tip** – To store a position before the predefined conditions have been met, tap *Store*.

## FastStatic Point

This type of point is measured in a [FastStatic survey](#). Configure the preset times at which a FastStatic point is measured when you create or edit a FastStatic Survey Style – usually the default time is sufficient.

**Note** – If you do not record enough data, the points may not be successfully postprocessed.

The Trimble Survey Controller software terminates a FastStatic occupation automatically if the *Auto store point* check box is selected and the specified occupation time is satisfied.

The default occupation times are satisfactory for most users. If you change an occupation time, choose a setting according to the number of satellites being tracked by that receiver. Remember that both receivers must track the same satellite at the same time for the data to be useful.

**Tip** – Use a mobile phone or a walkie-talkie radio to verify that both receivers are tracking the same satellites.

Changing the occupation times directly affects the outcome of a FastStatic survey. Any changes should increase this time rather than decrease it.

You can only measure a FastStatic point in a FastStatic survey.

**Note** – FastStatic surveys are postprocessed and do not need to be initialized.

To measure a FastStatic point:

1. Do one of the following:
  - ◆ From the main menu, select *Survey / Measure points*.
  - ◆ Tap *Favorites* and select *Measure points*.
2. Enter values in the *Point name* and *Code* fields (the *Code* field entry is optional).
3. Enter a value in the *Antenna height* field and make sure that the setting in the *Measured to* field is set appropriately.
4. Tap *Measure* to start measuring the point.
5. When the preset occupation time is reached, as shown in the following table, tap *Store* to store the point.

Receiver type	4 SVs	5 SVs	6+ SVs
Single-frequency	30 min	25 min	20 min
Dual-frequency	20 min	15 min	8 min

**Tip** – No satellite tracking is necessary between measuring points. You can turn off the equipment.

## Observed Control Point

This is a previously configured method of measuring and storing a point. Configure observed control points when you create or edit a Survey Style. The point is stored with a search classification of Normal.



The Trimble Survey Controller software can terminate observed control point measurements and store the results automatically if the *Auto store point* check box is selected and the occupation times are satisfied. For RTK surveys, the number of measurements and the horizontal and vertical precisions must also be satisfied. The default setting for the *Number of measurements* field is 180. The extended occupation time suggests that this measurement type is ideally suited to points that will be used for control purposes.

**Note** – When the *Auto store point* check box is cleared, tap *Store* when it appears on the *Enter* button to store the point. The *Enter* softkey is blank until the specified occupation time has been met. To store a point before that time has elapsed, tap *Enter*. When you do this, the Trimble Survey Controller software asks you to confirm storing the point. Tap *Yes* to store the point.

Quality control information is automatically stored with each point:

- Real-time observed control points can store QC1, QC1 & QC2, or QC1 & QC3 records.
- Postprocessed observed control points only store QC1 records.

If the *Topo point* option is configured to perform 180 measurements, the positional result is similar to a point measured using the observed control point measurement type. Differences are:

- the default value in the *Quality control* field
- the observation class given by the office software when the point is downloaded

When the Trimble Survey Controller software measures an observed control point, it stores a point when the preset number of epochs has elapsed and the precisions have been attained.

In an RTK survey, when you select the *Auto tolerance* check box, the software calculates horizontal and vertical precision tolerances that meet the GPS receiver's RTK specifications for the baseline length you are measuring. If you want to enter your own precision tolerances, clear this check box.


To measure an observed control point:


1. Do one of the following:
  - ◆ From the main menu, select *Survey / Measure points*.
  - ◆ Tap *Favorites* and select *Measure points*.
2. Enter values in the *Point name* and *Code* fields (the *Code* field entry is optional), and select *Observed control point* in the *Type* field.
3. Enter a value in the *Antenna height* field and make sure that the setting in the *Measured to* field is set appropriately.
4. Tap *Measure* to start recording data.
5. When the preset number of epochs and precisions are reached, tap *Store* to store the point.


**Note** – For an RTK survey, initialize the survey before starting to measure the point. For a Postprocessed Kinematic survey, you can start measuring a point, but you cannot store it until you have initialized the survey.


## RTK On Demand

If you are using an Internet connection to send RTK data from the base to the rover, then you can use Trimble Survey Controller's RTK on Demand functionality to control the amount of data broadcast from the base receiver. You can request the base station to send data only when you require it. This will reduce the amount of data received by your cellular phone and may reduce costs from your cellular network service provider.

Once the RTK survey is running over an Internet connection, you can access the *RTK on Demand* controls by tapping the  icon in the status bar.

When the survey is started, Trimble Survey Controller will default to Play  mode. When in Play mode, RTK data will be streamed continuously.

If you tap the  softkey, your survey will go into Pause mode and data will only be streamed when required. Trimble Survey Controller will request data from the base station when initialization is lost, or when you choose to measure a point, or when you start continuous topo, or when you use the stakeout functionality. As soon as the receiver has regained initialization, or the survey task is complete, then Trimble Survey Controller will request the base station to stop streaming data.

If you tap the  softkey then your survey will go into Stop mode and no RTK data will be streamed. This can be used in situations where you do not wish to end your survey, but do not require the receiver to stay initialized until you are ready to start surveying again.

### Hardware requirements

The RTK on Demand functionality requires an Internet connection at both the GPS base station and rover. This means that you will require two cellular phones, either GPRS capable or GSM connected to a dial-up Internet connection. Either Trimble Survey Controller is required to be at both the GPS base station and rover (this means that you will require two Trimble Controllers running Trimble Survey Controller version 11.00 or later), or you must be connected to a Trimble GPSNet or GPSBase infrastructure system.

# Survey – Stakeout

## Stakeout – Configuring the Display Mode

The display varies depending on whether you are performing a [Conventional](#) or [GPS](#) survey.

### Conventional Surveys

For a conventional survey the [Stakeout graphical display](#) screen displays directions using the conventional instrument as a reference point.

For a conventional survey, you can configure the *Stakeout directions* and the *Display mode* of the [Stakeout graphical display](#).

*Stakeout directions* allows you to configure the stakeout directions to be from an instrument perspective, target perspective, or automatic. *Automatic* configuration sets the stakeout directions automatically, based on whether you have a servo connection or a robotic connection to the instrument.

*Display mode* allows you to configure the graphical navigation display.

When the *Display mode* is set to *Direction and distance*, the navigation screen displays:

- ◆ A large arrow pointing in the direction you have to move. When you are close to the point, the arrow changes to the in/out and left/right directions, relative to the instrument.

When the *Display mode* is set to *In/out and left/right*, the navigation screen displays:

- ◆ In/out and left/right directions, with the conventional instrument as a reference point.

To configure the display:

1. From the main menu, select *Configuration / Survey styles / <style name> / Stakeout*.
2. Set the *Stakeout directions*:
  - ◆ Automatic – navigation directions are from *Instrument perspective* (during a servo connection), or *Target perspective* (during a robotic survey).
  - ◆ Instrument perspective (standing behind the instrument) – in/out and left/right navigation directions given from an instrument perspective, looking from the instrument towards the target.
  - ◆ Target perspective (standing at the target) – in/out and left/right navigation directions given from a target perspective, looking from the target towards the instrument.
3. Set the *Display mode*:
  - ◆ Direction and distance – navigate using the large arrow, similar to GPS stakeout. When you are close to the point, the display automatically changes to the in/out and left/right display.
  - ◆ In/out and left/right – navigate using in/out and left/right directions, with the instrument as a reference point.

4. Choose a setting in the *Deltas* field. The options are:

- ◆ Distances – navigate to a point using distances only
- ◆ Angle and distance – navigate to a point using angle and distance
- ◆ Station and offset – navigate to a point using station and offset when staking a line or arc.

When staking to the line or arc the station and offset view displays the Station, H.offset, V.dist and the Grade.

When staking to the Station on the line / arc or the Station/offset from line / arc the view displays the Station, H.offset, V.dist, delta Station and delta H.offset.

5. Use the *Distance tolerance* field to specify the allowable error in distance. If the target is within this distance from the point, the graphical stakeout display indicates that the distance(s) is correct.
6. Use the *Angle tolerance* field to specify the allowable error in angle. If the conventional instrument is turned away from the point by less than this angle, the graphical stakeout display indicates that the angle is correct.
7. If a DTM file has been transferred into the Trimble Survey Controller software, you can select the *Display cut/fill to DTM* check box, and the graphical display screen will display the cut or fill relative to that DTM. Use the *DTM* field to specify the name of the DTM to be used. If necessary, specify a vertical offset to raise or lower the DTM.

Alternatively, tap *Options* from the *Stakeout* screen to configure the settings for the current survey.

## GPS Surveys

For a GPS survey, you can set the mode of the *Stakeout graphical display* so that the point stays fixed in the center of the screen, or so that your position stays fixed in the center of the screen.

To configure the display:

1. From the main menu, select *Configuration / Survey styles / <style name> / Stakeout*.
2. In the *Display mode*, select either *Target centered*, or *Surveyor centered*.
3. You can enter a value in the *Zoom factor* field. This is the amount that the display zooms in when you switch from Coarse mode to Fine mode while navigating to a point. The default value is 4.0. When you zoom in by this amount, the width of the graphical display corresponds to approximately one meter (or three feet).
4. Select the *Auto change to Fine* option to automatically change to fine mode when you get within 1 foot (0.3048m) of the point.
5. Choose a setting in the *Deltas* field. The options are:
  - ◆ Azimuth and distance – navigate to a point using azimuth and distance
  - ◆ Delta grid – navigate to a point using delta grid values
  - ◆ Station and offset – navigate to a point using station and offset

When staking To the line or arc the station and offset view displays the Station, H.offset, V.dist and the Grade.

When staking to the Station on the line or arc, or the Station/offset from line or arc the view displays the Station, H.offset, V.dist, delta Station and delta H.offset.

6. If a DTM file has been transferred into the Trimble Survey Controller software you can select the *Display cut/fill to DTM* check box, and the graphical display screen will display the cut or fill relative to that DTM. Use the *DTM* field to specify the name of the DTM to be used. If necessary, specify a vertical offset to raise or lower the DTM.

Alternatively, tap *Options* from the *Stakeout* screen to configure the settings for the current survey.

## Stakeout – Using the Graphical Display

The graphical display in *Stakeout* helps you to navigate to a point. The display orientation assumes you are moving forwards at all times. The display varies depending on whether you are performing a **Conventional** or **GPS** survey.

When you stake out a road, a **cross-section** view is also available.

### Conventional

To use the graphical display in a conventional survey:

If you are using the *Direction and distance* mode:

1. Hold the display screen in front of you as you walk forwards in the direction that the arrow is pointing. The arrow points in the direction of the point.
2. When you get to within 3 meters (10 feet) of the point, the arrow disappears, and the in/out and left/right directions appear, with the instrument as a reference point. Follow the instructions below to navigate in this mode.

If you are using the *In/out and left/right* mode:

1. The first display shows which way the instrument should be turned, the angle that the instrument should display and the distance from the last point staked to the point currently being staked.
2. Turn the instrument (two outline arrows will appear when it is on line), and direct the rod person on line.

If you are using a servo instrument, and the *Servo auto turn* field in the survey style is set to *HA & VA*, or *HA only* the instrument automatically turns to the point.

If you are working robotically, or when the *Servo auto turn* field in the survey style is set to *Off*, the instrument does not turn automatically. To turn the instrument to the angle indicated on the screen, tap *Turn*.

3. If the instrument is not in *TRK* mode, tap *Measure* to take a distance measurement.
4. The display shows how far the person holding the rod should move towards or away from the instrument.
5. Direct the person holding the rod, and take another distance measurement.
6. Repeat steps 2 – 5 until the point has been located (when four outline arrows are displayed), then

mark the point.

7. If a measurement to the target is within the angular and distance tolerances, tap *Store* at any time to accept the current measurement.

If the instrument is in TRK mode and you require a higher precision distance measurement, tap *Measure* to take an STD measurement and then tap *Store* to accept that measurement.

To discard the STD measurement and return the instrument to TRK mode, tap *Esc*.

If you are operating a robotic instrument remotely from the target:

- ◆ the instrument automatically tracks the prism as it moves
- ◆ the instrument continuously updates the graphical display
- ◆ the graphical display is reversed and the arrows are shown from the target (prism) to the instrument

## GPS

When you use the graphical display in a GPS survey to navigate to a point, the screen first displays a large navigation arrow when you are some distance away from the point ("coarse navigation mode") and then automatically changes to a bull's-eye target as you move in closer.

- The arrow assumes that you are moving forward at all times.
- The bull's-eye target does not assume that you are moving forward.

To use the graphical display in a GPS survey:

1. Hold the display screen in front of you as you walk forwards in the direction that the arrow is pointing. The arrow points in the direction of the point that you intend to measure.
2. When you get to within 10 feet (3 meters) of the point, the arrow disappears and a bull's-eye target appears.

When the bull's-eye target is displayed, do not change your orientation. Keep facing in the same direction and only move forwards, backwards, left or right.

3. When you get even closer to the point, tap *Fine* to make the screen zoom in.

Select the *Auto change to fine* option to automatically change to fine mode when you get within 1 foot (0.3048m) of the point.

4. Continue moving forwards until the cross, representing your current position, covers the bull's-eye target, representing the point. Mark the point.

## Stakeout – Options

Configure the stakeout settings when you create or edit a Survey Style.

Select *Stakeout* and set the *As-staked point details* , *Stakeout display mode* , and *Available Station* options.

The *Available station* option is only available in *Road stakeout*.

If you want a 5D string in a GENIO file to be treated as a 3D string, clear the *Auto side slope* check box. See [Stakeout GENIO roads](#).

If you do not want the total station EDM set to *TRK* mode when you enter stakeout, clear the *Use TRK for stakeout* check box.

Alternatively, tap *Options* from the *Stakeout* screen to configure the settings for the current survey.

## As–Staked Point Details

Configure the *As–staked point* details either in the *Stakeout* option, when you create or edit a survey style, or by tapping *Options* in the *Stakeout* screen.

You can configure the [View before storage](#) , [Horizontal tolerance](#) , [Staked deltas format](#) , [As–staked name](#) , [As–staked code](#) , and [Store grid deltas](#) .

### View before storage and Horizontal tolerance

If you want to see the differences between the design point and the as–staked point before you store the point, select the *View before storage* check box and then choose one of these options:

- To see the differences every time, set the Horizontal tolerance to 0.000 m.
- To see the differences only if the tolerance is exceeded, set the Horizontal tolerance to 0.100 m.

**Note** – The *Stake delta* values are reported as differences **from** the measured/as–staked point **to** the design point.

### User definable stakeout reports

The Trimble Survey Controller software supports user definable stakeout reports, which enable you to configure the display of staked information on the *Confirm staked deltas* screen that appears when you enable *View before storage*.

The content and format of the stakeout reports is controlled by XSLT style sheets. Translated default XSLT Stakeout Style Sheet (\*.sss) files are included with the language files, and accessed by the Trimble Survey Controller software from the language folders. You can create new formats in the office and then use Microsoft ActiveSync technology to copy them to the *Trimble Data* folder on the controller.

From the *Staked deltas format* field, select an appropriate display format.

**Tip** – When you use multiple Stakeout Style Sheet files, Trimble recommends that you set the Staked deltas format from the *Configuration / Survey Styles* menu, where you can configure unique formats for Points, Lines, Arcs, DTMs, and Roads. You can also select the format within *Options* during stakeout.

**Note** – The development of the XSLT style sheets is an advanced procedure recommended for users with programming experience. For more information, please refer to the *Trimble Survey Controller software CD*.

### As–staked name and As–staked code

You can set the **name** of the As–staked point to be one of the following:

- the next *Auto point name*
- the *Design point name* (not available for roads)

You can also set the **code** of the As–staked point to be one of the following:

- *Design name*
- *Design code*
- *Last code used*
- *Design station and offset*

### Store grid deltas

Set the *Store grid deltas* check box. Do one of the following:

- Select the check box to display and store the delta northing, delta easting, and delta elevation during stakeout.
- Clear the check box to display and store the deltas as a horizontal distance, vertical distance, and azimuth.

**Note** – If you use a user definable stakeout report, the *Store grid deltas* option is not used, unless it is referenced in your report.

## Stakeout – Points

To stake out a point:

1. From the map, select the point(s) to be staked out. Tap *Stakeout*.

If you have selected more than one point from the map for staking out, the *Stake out points* screen appears. Go to the next step. If you have selected one point from the map, go to step 4.

**Tip** – To stake out a point, double tap it on the map.

2. The *Stake out points* screen lists all points selected for stakeout. To add more points to the list, do one of the following:
  - ◆ Tap *Map* and then select the required points from the map. Tap *Stakeout* to return to the *Stake out points* screen.
  - ◆ Tap *Add*.



Choose the method to select points:

- Use the *Select from list* option to select from a list of all points in the Trimble Survey Controller database.
- Use the *Select from file* option to select points in a linked file

#### Notes

- Points in linked files can not be displayed or staked if a point of the same name exists in the current job.
- If two points of the same name exist in 2 different linked files, the point in the first linked file is displayed.
- If a linked job contains two points of the same name, the point with the higher class is displayed.

3. To select a point for stakeout, highlight the point from the *Stake out points* screen and tap *Stakeout*. The *Stake out point* screen appears.
4. In the *Stake* field, select one of the following methods for staking out the point:
  - ◆ *To the point* – stake out the point with directions from your current position.
  - ◆ *From fixed point* – stake out the point with cross-track information and directions from another point. Enter a point name in the *From point* field. Select from a list, key in, or measure this value.
  - ◆ *From start position* – stake out the point with cross-track information and directions from the current position when you start to navigate.
  - ◆ *From last point staked* – stake out the point with cross-track information and directions from the last point that was staked out and measured. The **staked** point is used, not the design point.

To stake out from the current position, access the *From point* field and tap *Null*.

**Note** – The cross-track function creates a line between the point to be staked out and one of the following: a fixed point, the start position, or the last point staked. The Trimble Survey Controller software displays this line, and an extra field in the graphical stakeout screen gives the offset to the line. The extra field is *Go left* or *Go right*.

5. In a GPS survey, enter a value in the *Antenna/Target height* field and make sure the setting in the *Measured to* field is set appropriately. The graphical display screen appears.

In a conventional survey, tap the Target icon to change target details.

The screen displays the angle to which you should turn the instrument and the distance from the instrument to the point, together with a graphical representation of this.

6. Locate the point using the [graphical display](#), and then mark it.
7. When the point has been marked, you can measure it as an as-staked point by tapping *Accept* or *Measure*.

## Stakeout – Lines

To stake out a line in an RTK or conventional survey:

1. Do one of the following:

- ◆ From the map, select two points to define a line, tap and hold and then select *Stake out line*.
- ◆ From the map, select the line to be staked out. Tap *Stakeout*, or tap and hold on the map and then select *Stake out line* from the shortcut menu.
- ◆ From the main menu, select *Survey / Stakeout / Lines*. Enter the name of the line to be staked out.

**Tip** – In the *Line name* field (or the *Start point or the End point* field) use the advanced pop-up arrow to select staking either a keyed-in line or one defined from two points.

2. In the *Stake* field, select one of the following options:

- *To the line*
- *Station on the line*
- *Station/offset from line*
- *Slope from line*

3. Enter the *Antenna/Target height*, the value of the station to be staked out (if any), and any further details, such as horizontal and vertical offsets. Tap *Start*.

4. Use the [graphical display](#) to navigate to the point.

5. Mark the point.

6. When the point has been marked, tap *Measure* to open the *Measure points* screen. Measure the point as an as-staked point.

## To the line

Use this option, as shown in the diagram below, to stake out points on a defined line starting with the closest point (1) from your current position (2).

To stake out a line using the *To the line* method:

1. Do one of the following:

- ◆ From the map, select the line to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stake out line* from the shortcut menu.
- ◆ From the main menu, select *Survey / Stakeout / Lines*. Enter the line name.

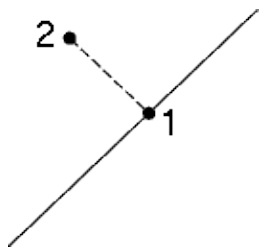
**Tip** – To stake out a line, double tap it on the map.

2. In the *Stake* field, select *To the line*.

3. Enter the antenna/target height and tap *Start*.

4. Use the graphical display to navigate to the point.

5. Mark the point and tap *Measure* to measure it.

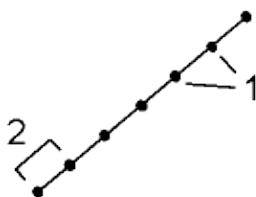


### Station on the line

Use this option, as shown in the diagram below, to stake out stations (1) on a defined line at the stationing intervals (2) along the line.

To stake out a line using the *Station on the line* method:

1. Do one of the following:
  - ◆ From the map, select the line to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stake out line* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Lines*. Enter the line name.
2. In the *Stake* field, select *Station on the line*.
3. Enter the antenna/target height and the station to be staked out and tap *Start*.
4. Use the graphical display to navigate to the point.
5. Mark the point and tap *Measure* to measure it.



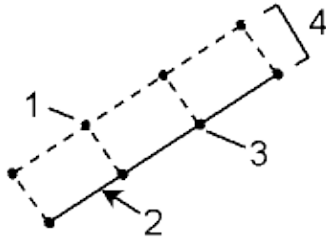
### Station/offset from line

Use this option, as shown in the diagram below, to stake out points (1) perpendicular to stations (3) on a defined line (2) and offset to the left or right by a set distance (4).

To stake out a line using the *Station/offset from line* method:

1. Do one of the following:
  - ◆ From the map, select the line to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stake out line* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Lines*. Enter the line name.
2. In the *Stake* field, select *Station/offset from line*.
3. Enter the antenna/target height and the station to be staked out.
4. Specify the *Horizontal offset* (a negative value is left of the line) and the *Vertical offset* and tap *Start*.

5. Use the graphical display to navigate to the point.
6. Mark the point and tap *Measure* to measure it.



### Slope from line

Use this option, as shown in the diagram below, to stake out points on surfaces (2), at different defined grades (3), either side of the defined line (cross section = 1). See the diagram below.

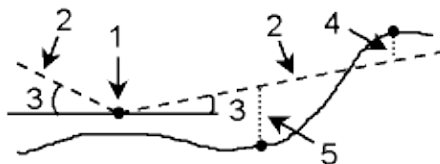
To stake out a line using the *Slope from line* method:

1. Do one of the following:
  - ◆ From the map, select the line to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stake out line* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Lines*. Enter the line name.
2. In the *Stake* field, select *Slope from line*.

Use the *Slope left* field and the *Slope right* field to define the type of grade in one of the following ways:

- ◆ horizontal and vertical distance
  - ◆ grade and slope distance
  - ◆ grade and horizontal distance
3. Enter the antenna or target height, specify the grade of the left and right slopes and tap *Start*.
  4. Use the graphical display to navigate to the point.
  5. Mark the point and tap *Measure* to measure it.

At any point on the surface, the display shows the closest station, the Horizontal offset, and the Vertical distance as a cut (4) or a fill (5).



## Stakeout – Arcs

Follow these steps to stake out an arc in an RTK or conventional survey:

1. Do one of the following:
  - ◆ From the map, select the arc to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stakeout* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Arcs*. Enter the name of the arc to be staked out.

**Tip** To stake out an arc, double tap it on the map.

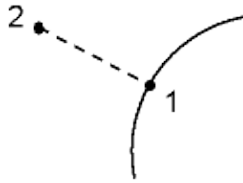
2. In the *Stake* field, select one of the following options:
  - ◆ *To the arc*
  - ◆ *Station on the arc*
  - ◆ *Station/offset from arc*
  - ◆ *Slope from arc*
  - ◆ *Intersect point of arc*
  - ◆ *Center point of arc*
3. Enter the antenna/target height and the value of the station to be staked out (if any).
4. Enter any further details, such as horizontal and vertical offsets, and tap *Start*.
5. Use the [graphical display](#) to navigate to the point.
6. Mark the point.
7. When the point is marked, tap *Measure* to open the *Measure points* screen. Measure the point as an as-staked point.

### To the arc

Use this option, as shown in the diagram below, to stake out points on a defined arc, starting with the closest point (1) from your current position (2).

To stake out an arc using the *To the arc* method:

1. Do one of the following:
  - ◆ From the map, select the arc to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stakeout* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Arcs*. Enter the arc name.
2. In the *Stake* field, select *To the arc*.
3. Enter the antenna/target height and then tap *Start*.
4. Use the graphical display to navigate to the point.
5. Mark the point and tap *Enter* to measure it.



### Station on the arc

Use this option, as shown in the diagram below, to stake out points (1) on a defined arc at the stationing intervals (2) along the arc.

To stake out an arc using the *Station on the arc* method:

1. Do one of the following:
  - ◆ From the map, select the arc to be staked out. Tap *Stakeout* or tap and hold on the map and select *Stakeout* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Arcs*. Enter the arc name.
2. In the *Stake* field, select *Station on the arc*.
3. Enter the antenna/target height and the station to be staked out and tap *Enter*.
4. Use the graphical display to navigate to the point.
5. Mark the point and tap *Measure* to measure it.



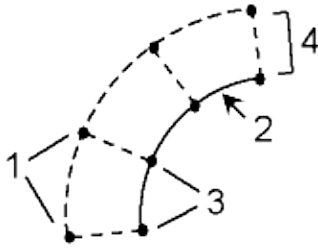
### Station/offset from arc

Use this option, as shown in the diagram below, to stake out points (1) perpendicular to stations (3) on a defined arc (2) and offset to the left or right by a specified distance (4).

To stakeout an arc using the *Station/offset from arc* method:

1. Do one of the following:
  - ◆ From the map, select the arc to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stakeout* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Arcs*. Enter the arc name.
2. In the *Stake* field, select *Station/offset from arc*.
3. Enter the antenna/target height and the station to be staked out.
4. Specify the *Horizontal offset* (a negative value is left of the arc) and the *Vertical offset* and tap *Start*.
5. Use the graphical display to navigate to the point.

6. Mark the point and tap *Measure* to measure it.



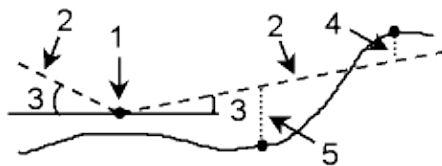
### Slope from arc

Use this option, as shown in the diagram below, to stake out points on surfaces (2), at different defined grades (3) either side of the defined arc (cross section=1).

To stake out an arc using the *Slope from arc method*:

1. Do one of the following:
  - ◆ From the map, select the arc to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stakeout* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Arcs*. Enter the arc name.
2. In the *Stake* field, select *Slope from arc*.
3. Enter the antenna/target height and tap *Start*.
4. Use the graphical display to navigate to the point.
5. Mark the point and tap *Measure* to measure it.

At any point on the surface the graphical display shows the closest station, the Horizontal offset and the Vertical distance as a cut (4) or a fill (5).



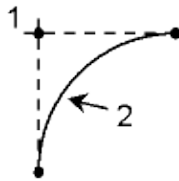
### Intersect point of arc

Use this option as shown in the diagram below, to stake out the Intersection point (1) of an arc (2).

To stake out an arc using the *Intersect point of arc method*:

1. Do one of the following:
  - ◆ From the map, select the arc to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stakeout* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Arcs*. Enter the arc name.

2. In the *Stake* field, select *Intersect point of arc*.
3. Enter the antenna/target height and tap *Start*.
4. Use the graphical display to navigate to the point.
5. Mark the point and tap *Measure* to measure it.



### Center point of arc

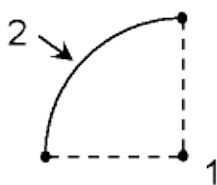
Use this option, as shown in the diagram below, to stake out the Center point (1) of a defined arc (2).

To stake out an arc using the *Center point of arc* method:

1. Do one of the following:
  - ◆ From the map, select the arc to be staked out. Tap *Stakeout*, or tap and hold on the map and select *Stakeout* from the shortcut menu.
  - ◆ From the main menu, select *Survey / Stakeout / Arcs*. Enter the arc name.
2. In the *Stake* field, select *Center point of arc*.

Use the *Slope left* field and the *Slope right* field to define the type of grade in one of the following ways:

- ◆ horizontal and vertical distance
  - ◆ grade and slope distance
  - ◆ grade and horizontal distance
3. Enter the antenna/target height and tap *Start*.
  4. Use the graphical display to navigate to the point.
  5. Mark the point and tap *Measure* to measure it.





## Stakeout – Digital Terrain Models (DTM)

A Digital Terrain Model is an electronic representation of a 3D surface. The Trimble Survey Controller software supports gridded and triangulated DTMs.

When you specify a DTM, you can view the cut and fill relative to the DTM. You must define a projection and datum transformation before you use a DTM in a GPS or conventional survey.

To stake out a DTM:

1. Transfer a DTM file into the Trimble Survey Controller software then select *Survey / Stakeout / DTMs*.
2. Select the file to be used.
3. If necessary, specify a vertical offset to raise or lower the DTM.
4. Enter a value in the *Antenna/Target height* field.
5. Tap *Start*. The stakeout [graphical display](#) screen appears, displaying the coordinates of the current position and the vertical distance above (cut) or below (fill) the DTM.

**Note** – Unless you are using a conventional instrument that supports tracking (for example, a Trimble 5600), the values appear only after you have taken a distance measurement.

When staking out the DTM, the *Cut/Fill* value will be null (?) when you are outside the extent of the DTM or in a "hole". To display the cut/fill to a DTM when staking out a point, line, arc, or road:

1. Tap *Options* in the *Stakeout* screen.
2. Select the *Display cut/fill to DTM* check box and specify the model.

**Note** – This does not apply to the *Slope from line* or *Slope from arc* stake methods.

## Stakeout – Roads

The Trimble Survey Controller software supports stakeout for three road formats:

- [Trimble](#) roads
- Roads derived from a [GENIO](#) file
- Roads derived from a [LandXML](#) file

### Trimble roads

Trimble roads can be:

- Keyed in using *Key in Roads*.
- Uploaded from Trimble RoadLink software (a module of the Trimble Geomatics Office software).
- Uploaded via Trimble Link from a number of third party design packages including Autodesk Land Desktop, Autodesk Civil 3D, Bentley Inroads, and Bentley Geopak.
- Imported as a DC file.

Keyed in roads are stored as \*.rxl files in the Trimble data folder.

For information on how to key in a road, see [Roads](#), and [Templates](#).

When a job that contains a road is uploaded to the Trimble Survey Controller software, the road is removed from the job and a new file that defines the road is created and renamed with the name of the road and the job, and the filename extension RXL. The RXL file is saved to the Trimble data folder. If there is a road of the same name in this folder, it is overwritten by the uploaded road file.

When a DC file that contains a road is copied to the Trimble Survey Controller software and then converted to a job, a new file that defines the road is created and renamed with the name of the road and the job, and the filename extension RXL. If an RXL file of the same name exists the RXL file has "(1)" added to the name. If the DC file is converted a second time, the resulting RXL file has "(2)" added to the file name, and so on, each time that file is converted.

For more information on how to transfer files, see [Transferring Files between the Controller and the Office Computer](#).

**Note** – Trimble roads are not job specific. They are available for all jobs.

For more information on staking Trimble roads, see [Staking Trimble roads](#).

## **GENIO files**

GENIO files that define a road can be exported from a number of third party road design software packages, including MX and [12D Model](#).

GENIO files must be copied to the Trimble Survey Controller's Trimble Data folder for staking out.

The file extension for the GENIO file must be \*.CRD, \*.INP, or \*.MOS. Files with the extension MOS are exported from [12D Model](#).

**Note** – Roads from GENIO files are not job specific. They are available for all jobs.

For more information on staking roads from GENIO files, see [Staking roads from GENIO files](#).

## **LandXML files**

LandXML files that define a road can be exported from a number of third-party road design software packages.

LandXML files must be copied to the Trimble Survey Controller Trimble Data folder for staking out.

**Note** – LandXML files are available for stakeout for all jobs.

For more information on staking roads from LandXML files, see [Staking roads from LandXML files](#).

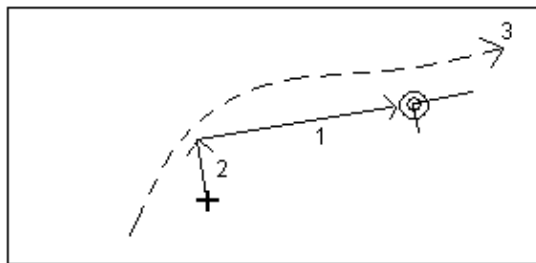
## **Road stakeout details that apply to all three road formats**

The Trimble Survey Controller software treats all road distances, including *Stationing* and *Offset* values, as grid distances. The value in the *Distances* field (accessed by selecting *Files / Properties of current job – Cogo settings*) has no effect on the road definition or the way road distances are displayed.

If a ground coordinate system is defined in either the Trimble Geomatics Office or Trimble Survey Controller software, then the grid coordinates are, in effect, also ground coordinates.

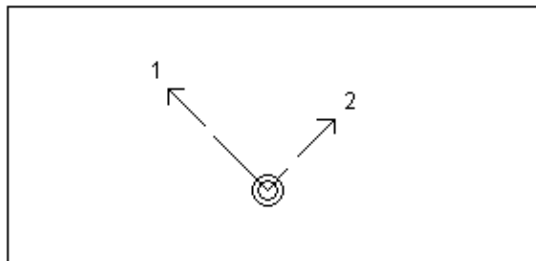
### Go Forward/Go Backward directions

As shown in the diagram below, the values in the *Go Forward/Go Backward* (1) and *Go Right/Go Left* (2) fields in the graphical display are relative to the cross-section of the point that you are staking out. They are **not** relative to the current direction of travel, or to the current stationing. The direction of increasing stationing is shown by (3).



### Target in the graphical display

As shown in the diagram below, the bull's-eye symbol in the graphical display also shows the road-space coordinate frame. The longer line (1) on the symbol shows the direction of increasing stationing and the shorter line (2) shows the direction of increasing offset (the right side of the road).



## Exporting GENIO files from 12D Model

To export a road as a GENIO file from 12D Model:

1. Start 12D Model and select a project.
2. Select *File I/O / Data output – GENIO*.
3. From the *Write GENIO File for* dialog, select the alignment string as the data to write.
4. Enter a file name.
5. Set the *Alignment dimension* field to 6D.
6. Select the *77 Format* check box.
7. Write the file but do not select *Finish*.

8. Select the remaining strings that define the road as the data to write.
9. Retain the file name used to write the alignment string.
10. Set the *Alignment dimension* field to 3D.
11. Write the file and then select *Yes* to append to the end of the existing file.
12. Select *Finish*.

**Tip** – Use the filter option to aid string selection.

## Staking Trimble Roads

The Trimble Survey Controller software enables you to stake out a Trimble road by the following methods:

[Station and offset](#)

[Position on road](#)

[Nearest offset](#)

[Side slope from alignment](#)

**Note** – You must specify a coordinate system before you can stake out roads with the Trimble Survey Controller software.

**Warning** – Do not stake out points and then change the coordinate system or perform a calibration. If you do, these points will be inconsistent with the new coordinate system and any points computed or staked out after the change.

## Trimble roads – Station and offset

To stake out by station and offset in a Trimble road when you perform an RTK survey:

1. From the main menu, select *Survey / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.

**Tip** – If you are warned that the road is incomplete or invalid return to [Key in / Roads](#) and select the road. Open each component defining the road and tap *Accept*. This will validate the component and report any errors in the definition. Use the editing functionality to resolve the error.

3. In the *Stake* field, select *Station and offset*.
4. Enter a value in the *Antenna/Target height* field and make sure that the *Measured to* field is set correctly.
5. To select the point to be staked out, enter values in the [Station](#) and [Offset](#) fields.

The *Code* field displays the code of the offset to be staked out. The Trimble Survey Controller software uses the code from the template definition for the selected offset. When the offset is 0.000 m,

the code defaults to CL.

**Tip** – To reload the original elevation, select *Reload original elevation* from the pop-up menu.

6. To enable the elevation for the selected point to be edited, select *Edit elevation* from the pop-up menu in the *Design elevation* field.

**Note** – If the position that you select for stakeout has no elevation, the *Design elevation* field becomes available. Enter an elevation into this field.

7. If required, enter values in the *Construction offsets* fields.
8. Select *Start* and use the graphical display to navigate to the point.
9. Tap XS to view the *cross section* of the selected station.

To define a cross slope, see [Cross slope](#).

If the road consists of a horizontal and vertical alignment only, the *V. dist* value reports the vertical distance to the centerline.

12. If you are staking to a *catch point* with construction offsets, navigate to the catch point and then tap *Apply* to add the construction offsets. You are prompted to apply the offsets from your current position. If you are not on the catch position, select *No*, navigate to the catch position and then tap *Apply* again.

If you want to store the catch position and the construction offset, see [Construction offsets](#).

Select XS for further graphical navigation. The construction offsets are indicated by green lines with the smaller single circle indicating the calculated catch position and the double circle indicating the selected position adjusted for the specified construction offset(s). The construction offsets are only displayed after you have applied them.

13. Mark the point with a stake.
14. When the point has been marked, you can measure it as an As-staked point by tapping *Enter* to go into the *Stakeout / Point* screen.

If a road has a horizontal and vertical alignment, but has no templates, all offset points display a null (?) value in the *V. dist* field during stakeout. If a road definition is defined only as a horizontal alignment, you can only stake it out in two dimensions. The horizontal and vertical alignments of a road do not necessarily start and end at the same stationing. When they start and end at different stationing, you can only stake out points in three dimensions if their stations lie within the horizontal alignment.

See also:

[Catch point](#)

[Side slope offset selection](#)

[Staked deltas](#)

## Selecting a station

You can select a station by one of the following methods:

- Select from the list in the *Stationing* field pop-up menu.
- Key in a value.
- Tap *Sta+* or *Sta-* to select the next/previous station.

The stations in the list are controlled by the *Station interval* and by the *Available stations* option in the *Stakeout options* dialog. The following table lists the abbreviations that the Trimble Survey Controller software uses.

Abbreviation	Meaning	Abbreviation	Meaning
CS	Curve to spiral	SS	Spiral to spiral
PC	Point of curvature (Tangent to curve)	ST	Spiral to tangent
PI	Point of intersection	TS	Tangent to spiral
PT	Point of tangent (Curve to tangent)	VCE	Vertical curve end
RE	Road end	VCS	Vertical curve start
RS	Road start	VPI	Vertical point of intersection
SC	Spiral to curve	XS	Regular sections
Hi	Vertical curve high point	Lo	Vertical curve low point
SES	Superelevation start	SEM	Superelevation maximum
SEE	Superelevation end	WS	Widening start
WM	Widening maximum	WE	Widening end
T	Template assignment	–	–

## Selecting an offset

You can select an offset by one of the following methods:

- In the *Offset* field, select *List* from the pop-up menu and then select from the list.
- Key in a value.

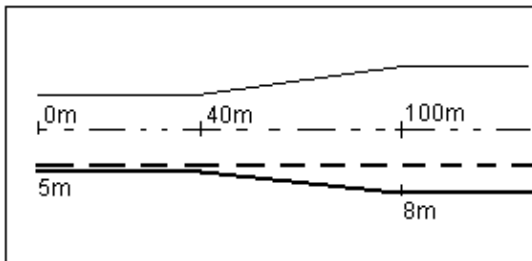
Enter a negative value for an offset to the left of the centerline; enter a positive value for an offset to the right. If you enter a value greater than the maximum offset in the template, a message appears to warn you that the offset is outside the range. The software asks if you want to use the left side slope, or right side slope, depending on the value entered. If you tap *No*, another message appears to warn you that point positions will be in two dimensions, and asks whether you want to continue. This option is useful if you need to stake out the 2D position of a feature not defined in the template (for example, the position of a lamppost).

- To select the next left/next right template element or the rightmost/leftmost element, tap *Offs>>*.

## Tips

- ◆ If you select an offset from the list, for all subsequent station values, the offset value is updated to reflect any widening or interpolation.
- ◆ If you enter an offset value, that value is maintained for all subsequent station values, even when the entered value corresponds to a value in the list.

Consider the following diagram. If you **select** offset 5 m at station 0 m, the offset value is updated to follow the solid line for subsequent stations. The value changes from offset 5 m to offset 8 m. If you **enter** offset 5 m for the offset, the offset follows the dashed line. The offset of 5 m is maintained for subsequent stations.



## Stakeout – Available Stations

**Note** – This function is not available for roads derived from GENIO or LandXML files.

When using Trimble roads, to configure the stations available for the *Stations* field, select the appropriate check boxes in *Available Stations*, accessed from the *Options* softkey in [Stake out road](#).

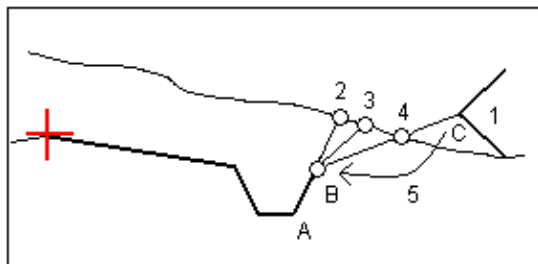
Select one of the following check boxes to make the appropriate stations available:

1. *Regular Sections* (stations defined by the station interval)
2. *Horiz. Curve* (key stations defined by the horizontal alignment)
3. *Vert. Curve* (key stations defined by the vertical alignment)
4. *Template* (stations where templates have been assigned)
5. *Super/Widen* (stations where superelevation and widening has been assigned)

## Selecting a New Offset for a Side Slope

**Note** – This function is not available for roads derived from GENIO or LandXML files.

For Trimble roads, if the designed road does not fit the field conditions well, you can select a new offset for the side slope. The following diagram shows a typical example of where you might use this option.



Key to the above diagram.

- 1 – Design side slope
- 2 – New catch position defined by the slope of the previous element (A – B)
- 3 – New catch position defined by the design cut slope value
- 4 – New catch point position defined by the slope of the next element (B – C)
- 5 – Side slope offset is moved from offset C to offset B to avoid an unwanted fill zone

To select a new side slope offset:

1. From the main menu, select *Survey / Stakeout Roads*.
2. Highlight the road name and tap *Stakeout*.
3. From the pop-up menu in the *Offset* field, select the *Select new offset for side slope* option. Select a new offset. You can not select offset 0.000 or the Side Slope.

**Note** – Select the offset immediately preceding a side slope (the hinge position of the original side slope) if you only want to edit the side slope values.

4. The *Side slope definition* group appears, showing the as-designed values for the selected station. You can edit these values if required.
5. If required, enter values in the *Construction offsets* fields.
6. Select *Start* and use the graphical display to navigate to the point.

In some situations, it may be preferable to adjust the cut or fill slope value to that of the next or previous template element. See 5 in the diagram above for a typical example.

To edit the slope value to that of the next or previous template element:

1. Access the *Side slope* definition group
2. In the pop-up menu in either the *Cut slope* field or the *Fill slope* field, select *Next element slope* or *Previous element slope*.  
The *Slope* field updates with the appropriate slope value.

## Notes

- The next or previous element slope options are available only if the next or previous elements exist.
- In the *Cut slope* field, the options are available only if the next or previous slope values are positive, that is, if they define a cut slope.
- In the *Fill slope* field, the options are available only if the next or previous slope values are negative,



that is, if they define a fill slope.

## Position relative to a Trimble road

To determine your current position relative to a Trimble road:

1. From the main menu, select *Survey / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.

**Tip** – If you are warned that the road is incomplete or invalid return to *Key in / Roads* and select the road. Open each component defining the road and tap *Accept*. This will validate the component and report any errors in the definition. Use the editing functionality to resolve the error.

3. In the *Stake* field, select *Position on road*.
4. Enter a value in the *Antenna/Target height* field and make sure that the *Measured to* field is set correctly.
5. If there is a value in the *V.Offset* field, the Trimble Survey Controller software reports your position relative to the design, as adjusted by the specified vertical offset:
  - ◆ A negative value offsets the design vertically down, a positive value up.

**Note** – The *V.Offset* value specified here is not applied to a DTM surface.

6. Tap *Start*. The graphical stakeout screen appears.

The graphical display in the plan view shows your current position relative to the road. The display includes the offset from the centerline and your current elevation. The right side of the screen reports your current position relative to the road in terms of station, offset, and vertical distance to the road surface.

7. Tap *XS* to view the *cross section* of the selected station.

You can measure your current position as an *As-staked* point by tapping *Enter* to go into the *Stake out point* screen.

**Note** – If you are using a conventional instrument, the road values only appear after you take a distance measurement.

If your current position is more than 30 meters from the road centerline, the graphical display navigates you to a position on the road centerline. This is calculated by projecting your current position at right angles to the centerline.

If the road consists of only a horizontal and vertical alignment the *V.dist* value will report the vertical distance to the centerline.

## Nearest offset

To stake relative to an offset for a Trimble road:

1. From the main menu, select *Survey / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.

**Tip** – If you are warned that the road is incomplete or invalid return to [Key in / Roads](#) and select the road. Open each component defining the road and tap *Accept*. This will validate the component and report any errors in the definition. Use the editing functionality to resolve the error.

3. In the *Stake* field, select *Nearest offset*.
4. Enter a value in the *Antenna/Target height* field and make sure that the *Measured to* field is set correctly.
5. To choose the offset to stake out, enter a value in the [Offset](#) field.

The *Code* field displays the code of the offset to be staked out. Trimble Survey Controller uses the code from the template definition for the selected offset. When the offset is 0.000 m, the code defaults to CL.

6. If required, enter values in the [Construction offsets](#) fields.
7. To navigate to the selected offset, select *Start* and then use the graphical display.
8. Tap XS to view the [cross section](#) of the selected station.

To define a cross slope, see [Cross slope](#).

9. If you are staking to a [catch point](#) with construction offsets, navigate to the catch point first and then tap *Apply* to add the construction offsets. You are prompted to apply the offsets from your current position. If you are not on the catch position, select *No*, navigate to the catch position and then tap *Apply* again.

If you want to store the catch position and the construction offset, see [Construction offsets](#).

10. Mark the point with a stake.
11. When the point has been marked, you can measure it as an *As-staked* point by tapping *Enter* to go into the *Stakeout / Point* screen.

**Note** – If you are using a conventional instrument, the road values only appear after you take a distance measurement.

The graphical display in the plan view shows your current position relative to the selected offset and also reports the offset from your current position to the centerline and your current elevation. The right side of the screen reports your current position in terms of station, offset to the selected offset, and vertical distance from your current position to the selected offset.

### Selecting an offset

You can select an offset by one of the following methods:

- In the *Offset* field, select *List* from the pop-up menu and then select an option from the list. If you select *Nearest* from the list, the software navigates you to the offset nearest to your current position.
- Key in a value.

Enter a negative value for an offset to the left of the centerline.

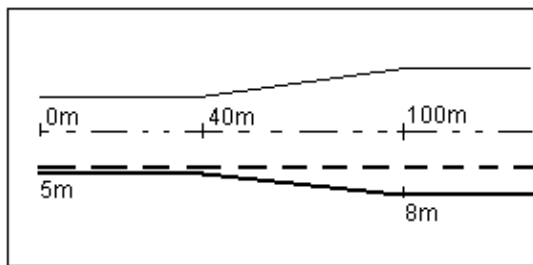
Enter a positive value for an offset to the right of the centerline.

### Tips

- ♦ If you select an offset from the list, for all subsequent station values, the offset value is updated to reflect any widening or interpolation.
- ♦ If you enter an offset value, that value is maintained for all subsequent station values, even when the entered value corresponds to a value in the list.

Consider the following diagram. If you **select** offset 5 m at station 0 m, the offset value is updated to follow the solid line for subsequent stations. The value changes from offset 5 m to offset 8 m.

If you **enter** offset 5 m for the offset, the offset follows the dashed line. The offset of 5 m is maintained for subsequent stations.



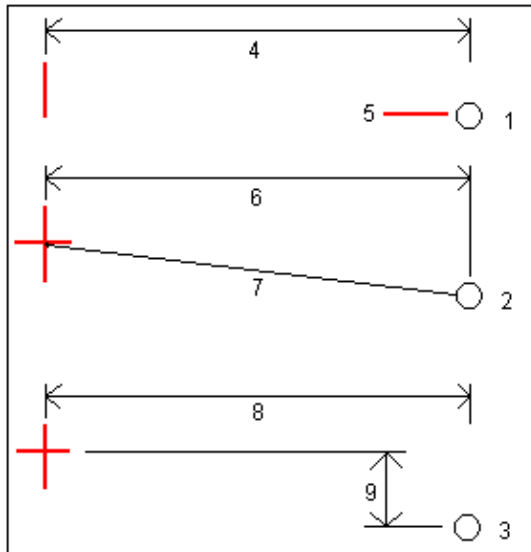
## Staking out a Side Slope Relative to an Alignment

To define and stake a side slope for a Trimble road:

1. From the main menu, select *Survey / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.

**Tip** – If you are warned that the road is incomplete or invalid return to [Key in / Roads](#) and select the road. Open each component defining the road and tap *Accept*. This will validate the component and report any errors in the definition. Use the editing functionality to resolve the error.

3. In the *Stake* field, select *Side slope from alignment*.
4. Enter a value in the *Antenna/Target height* field and make sure that the *Measured to* field is set correctly.
5. Entering a value in the *Stationing* field. For more information, see the section [Selecting a station in Stakeout Roads](#).
6. Select a *Hinge derivation* method and complete the appropriate fields. The following diagram explains the three hinge derivation methods:



Key to the above diagram:

- 1 – Offset and elevation. Enter an offset (4) from the horizontal alignment, and the elevation (5) of the hinge position.
- 2 – Offset and slope. Enter an offset (6) from the horizontal alignment, and the slope value (7) from the intersection of the horizontal and vertical alignments to the hinge position.
- 3 – Offset and vertical distance. Enter an offset (8) from the horizontal alignment, and the vertical difference (9) from the intersection of the horizontal and vertical alignments to the hinge position.

**Note** – If the road definition consists of only a horizontal alignment, the only hinge derivation method available is Offset and elevation.

- 8. Complete the appropriate fields to define the [Side slope](#).
- 9. If required, enter values in the [Construction offsets](#) fields.
- 10. Select *Start* and use the graphical display to navigate to the point.

The graphical display in the plan view shows your current position along with the target. Also displayed is a dashed line that connects the side slope catch position – the point where the side slope intersects with the ground – to the side slope hinge position. The calculated slope value (in blue) and the design slope value is displayed at the top of the screen.

- 11. Tap *XS* to view the [cross section](#) of the selected station.
- 12. If you are staking to a [catch point](#) with construction offsets, navigate to the catch point and then tap *Apply* to add the construction offsets. You are prompted to apply the offsets from your current position. If you are not on the catch position, select *No*, navigate to the catch position and then tap *Apply* again.

If you want to store the catch position and the construction offset, see [Construction offsets](#).

Select *XS* for further graphical navigation. The construction offsets are indicated by green lines with the smaller single circle indicating the calculated catch position and the double circle indicating the selected position adjusted for the specified construction offset(s). The construction offsets are only displayed after you have applied them.

13. Mark the point with a stake.
14. When the point has been marked, you can measure it as an *As-staked* point by tapping *Enter* to go into the *Stakeout / Point* screen.

**Note** – To also stake the appropriate hinge position, tap *Select>>* and select either the *Hinge point (Cut)* or *Hinge point (Fill)* option.

## Staking Roads from GENIO Files

The Trimble Survey Controller software enables you to stake out a road from a GENIO file by the following methods:

[Position on road](#)

[Along a string](#)

[Station on string](#)

The following tips help you to understand how to graphically activate the three methods of staking out a GENIO road:

- By default, the Trimble Survey Controller software is in the *Position on road* method until you select a string to stake or a position to stake.
- To select a string to stake, tap the linework that represents a string in the plan view.
- To select a string and station to stake, tap the circle that represents the position in the plan view. Once you activate the string and station method, the [cross section](#) view is available. You can also graphically select positions from that view.
- To return to the *Position on road* method, tap in a clear space to clear the current selection, or reselect the current selection.
- For all three methods, the current method is indicated in the title banner.
- To graphically activate a method, you must be in the plan view selection screen that appears immediately after you select the GENIO file and Group, and tap *Start*.

**Tip** – If the master string has been excluded (the master string appears greyed out in the plan view and does not appear at all in the cross section view) and you want to stake it out, return to the *Group* option, tap and hold in the graphics view and then select [Exclude master at stakeout](#) from the pop-up menu.

**Note** – You must specify a coordinate system before you can stake out roads with the Trimble Survey Controller software.

**Warning** – Do not stake out points and then change the coordinate system or perform a calibration. If you do,

these points will be inconsistent with the new coordinate system and any points computed or staked out after the change.

**Tip** – To improve performance when loading large GENIO files increase the available memory. The following is an indication of loading times for GENIO files:

For a 1 MB GENIO file the load time is approximately 20 seconds

For a 3 MB GENIO file the load time is approximately 1 minute

## Group strings

To define a new group of strings that describe a road to be staked:

1. From the *Group strings* option tap *New* and then enter a Group name.
2. From the graphics window, tap strings to select them. Alternatively, drag a box outline to select multiple strings. Selected master strings are shown as solid red circles. Selected sub strings are shown as solid blue circles. Tap a selected string to deselect it.
3. To clear your current selection or to undo your last selection, tap and hold in the graphics window and then select the appropriate option from the pop-up menu.
4. To select strings from a list of string names, tap and hold in the graphics window and then select *List selection* from the pop-up menu. Tap the string names you want to select. Selected strings appear in the list with a check mark next to them. To clear your current selection, tap *Clear*.

**Tip** – To activate the pop-up menu if the touch screen has been disabled, press the space bar.

### Notes

- A group can include only one master string (6D). If the GENIO file does not include a 6D string but does include a 12D string, then the Trimble Survey Controller software will generate a 6D string with the same geometry as the 12D string and positions every 5 meters / feet.
- Because the station values for 3D and 5D strings are defined relative to the selected 6D string, select strings for the group that obviously define a road.
- Where available, Trimble recommends that you include the 12D string that is coincident with the selected master string in the group. 12D strings include the geometry for the vertical alignment that enables the Trimble Survey Controller software to correctly interpolate elevations between positions along the master string.
- Unselected master and geometry strings appear as open red circles. Unselected sub strings (3D and 5D) appear as open dark gray circles.
- Tap and hold on a string to browse the string name.
- To define a new 3D string, tap and hold in the graphics view and select *New string* from the pop-up menu. This option is not available until you have selected a master (6D) string.
- To exclude the master string, tap and hold in the graphics view and select *Exclude master at stakeout* from the pop-up menu.

## Exclude Master at stakeout

If the Master string (6D) has a vertical geometry that is unrelated to the road design, you can exclude this string when staking out.

To do this:

- From the *Group strings* option, tap and hold in the graphics window and from the pop up menu select *Exclude master at stakeout*.

The master string will still be part of the group and will be used to calculate the station values at stakeout.

At stakeout, the master string will appear greyed out in the plan graphical selection screens and will not appear in the cross section view. The master string will also be unavailable from the string selection list.

**Tip** – To ensure that the master string is available at stakeout, clear *Exclude master at stakeout*.

## New Strings

Use this function to [define](#) a new string, [edit](#) a string you have defined, or [delete](#) a string.

### Defining a new string

1. From the *Group strings* option, create a new group or edit an existing group.
2. Tap and hold in the graphics screen and then select *New string* from the pop-up menu.
3. Enter a string name.
4. Select the string that the new string will be derived from.
5. Select a string derivation method.
6. Enter the *Offset and slope* or *Offset and Vertical* diff values that define the new string.
7. Tap *Accept*.

### Notes

- When you define a new group, you must select a master (6D) string before the *New string* menu option is available.
- New strings are created as 3D strings.
- You cannot define a new string relative to a 5D string.

### Editing a new string

1. From the *Group strings* field, select *Edit* and then select the group containing the string to edit.
2. Tap and hold in the graphics screen and select *Edit string* from the pop-up menu.
3. Select the string to edit. You can only edit strings that have been defined using the [New](#) string functionality and that belong to the current group.
4. Edit the details as required.
5. Tap *Accept*.

## Deleting a string

1. From the *Group strings* field select *Edit* and then select the group containing the string to delete.
2. Tap and hold in the graphics screen and then select *Delete string* from the pop-up menu.
3. Select the string to delete. You can only delete strings that have been defined using the [New](#) string function and that belong to the current group.
4. Tap *OK*.

**Tip** – To activate the pop-up menu if the touch screen has been disabled, press the space bar.

## Position relative to GENIO road

To determine your current position relative to a GENIO road:

1. From the main menu, select *Survey / Survey style / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.
4. Use the [Group strings](#) option to create and manage a group of strings that define a road. To view a list of existing groups, tap the arrow and select *List*. To define a new group, select *New*. You can also rename, edit or delete an existing group.
5. Enter a value in the *Antenna/Target height* field.
6. Tap *Start*. The graphical point selection screen appears displaying the road. Because you want to know your position relative to the road, do not select a position to stake.
7. To assign a vertical offset, tap and hold in the graphics window and then select *Define construction offsets* from the menu. If a vertical offset is specified, the software reports your position relative to the design, as adjusted by the specified vertical offset.  
A negative value offsets the design vertically down.  
A positive value offsets the design vertically up.

**Tip** – To activate the pop-up menu if the touch screen has been disabled, press the space bar.

**Note** – The *V.Offset* value specified here is not applied to a DTM surface.

8. Tap *Stakeout*.

The graphical display in the plan view shows your current position relative to the road. The base of the screen reports your current position relative to the road in terms of station, offset to the centerline, and vertical distance to the road surface.

To understand how your position is calculated between strings, see [String interpolation](#).

9. Tap *XS* to view the [cross section](#) of the selected station.

You can measure your current position as an *As-staked point* by tapping *Enter* to go into the *Stake out point* screen.

**Note** – If you are using a conventional instrument, the road values only appear after you take a



distance measurement.

If your current position is more than 30 meters from the road centerline, the graphical display navigates you to a position on the road centerline. This is calculated by projecting your current position at right angles to the centerline.

If the road consists of only a horizontal and vertical alignment the *V.dist* value will report the vertical distance to the centerline.

## Stakeout along a string

To stake out a GENIO file road along a string:

1. From the main menu, select *Survey / Survey style / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.
4. Use the *Group strings* option to create and manage a group of strings that define a road. To view a list of existing groups, tap the arrow and select *List*. To define a new group, select *New*. You can also rename, edit or delete an existing group.
5. Enter a value in the *Antenna/Target height* field.
6. To begin staking, press *Start*. The graphical selection screen appears displaying the road.

**Tip** – When you select *Start*, the software calculates the station values for all 3D strings relative to the 6D string for the group. The time taken to calculate the station values varies with the number of strings in the group and the length of the road. To improve performance when staking large GENIO files, Trimble recommends that you limit the number of strings in a group.

7. To select a string from the plan, do one of the following:

- ◆ Tap the linework that defines the string.
- ◆ Tap and hold in the graphics window and then select a string from the list.
- ◆ Tap and hold in the graphics window and then key in a string name.

**Tip** – To activate the pop-up menu if the touch screen has been disabled, press the space bar.

In the plan and cross section views, the bull's-eye icon (double circle) indicates the selected position. In the plan view a selected string is shown with solid circles. Tap and hold to browse the string name.

Tap the icon in the bottom right corner of the graphics window to change between the plan and cross section views.

8. To edit the side slope value of a selected 5D / Interface string, tap and hold in the graphics window and then select *Edit side slope* from the menu. If the ground conditions require the opposing slope value to be staked, you can edit the null (?) value.

**Note** – If the road includes multiple side slopes that define benched side slopes, only the 5D / Interface string that is furthest from the centerline will be converted to a side slope.

9. To apply construction offsets, tap and hold in the graphics window and then select [Construction offsets](#).
10. Tap *Stakeout* and then use either the plan or [cross section](#) graphical display to navigate along the string.  
For more information, see [String interpolation](#).

To define a cross slope, see [Cross slope](#).

To define a subgrade, see [Subgrade](#).

11. Mark the point with a stake.

**Note** – For 5D / Interface strings, the target may not coincide with the design position because the target is calculated relative to your current position.

12. When the point has been marked, you can measure it as an *As-staked point* by tapping *Enter* to go into the *Stakeout / Point* screen.

**Note** – If you are staking a [catch point](#) (5D / Interface string) with construction offsets, navigate to the catch point and then tap *Apply* to add the construction offsets. You are prompted to apply the offsets from your current position. If you are not on the catch position, select *No*, navigate to the catch position and then tap *Apply* again.

If you want to store the catch position and the construction offset, see [Construction offsets](#).

## Notes

- If the string selected to stake is a 5D string Trimble Survey Controller converts this string to a side slope. The calculated slope value is defined by the slope between the 5D string and the adjacent 3D string.

**Tip** – To configure the software to treat a 5D string as a 3D string, select [Options](#) and then clear the *Auto side slope* option.

- For GENIO files defined from 12D Model, Trimble Survey Controller treats all strings with a name that includes the letters INT as a 5D string and converts the string to a side slope. The calculated slope value is defined by the slope between the interface string and the adjacent 3D string.

## Stakeout station on string

To stake out a GENIO file road by the string and station method:

1. From the main menu, select *Survey / Survey style / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.
4. Use the [Group strings](#) option to create and manage a group of strings that define a road. To view a list of existing groups, tap the arrow and select *List*. To define a new group, select *New*. You can also rename, edit or delete an existing group.

5. Enter a value in the *Antenna/Target height* field.
6. Tap *Start*. The graphical selection screen appears displaying the road.

**Tip** – When selecting *Start* the Trimble Survey Controller software calculates the station values for all 3D strings relative to the 6D string for the group. The time taken to calculate the station values varies with the number of strings in the group and the length of the road. To improve performance when staking large GENIO files, Trimble recommends that you limit the number of strings in a group.

7. To select a position from the plan view, do one of the following:

- ◆ Tap the position.
- ◆ Tap any position and then use the arrow keys on the Trimble controller to navigate to the position.
- ◆ Tap and hold in the graphics window and then select a string and station value from the list.
- ◆ Tap and hold in the graphics window and then key in a string name and station value.

**Tip** – To activate the pop-up menu if the touch screen has been disabled, press the space bar.

The Trimble Survey Controller software also supports staking nominal offset and station values. To do this, tap and hold in the graphics window, select the string to stake and then key in a numeric value that represents the offset. Similarly, from the *Station to stake* field, key in a nominal station value. For more information, see [String interpolation](#).

Once you select a position, tap the icon in the bottom right corner of the graphics window to view the cross section. From the cross section view, you can select a new position to stake using any of the methods described above. To return to the plan view, tap the icon again.

In the plan and cross section views, the bull's-eye icon (double circle) indicates the selected position. In the plan view, a selected string is shown with solid circles. To browse the string name, tap and hold on a string.

To define a cross slope, see [Cross slope](#).

To define a subgrade, see [Subgrade](#).

To stake relative to a secondary road, see [Secondary road](#).

8. To edit the elevation of a selected position, tap and hold in the graphics window and then select *Edit elevation* from the menu. The field displays the design elevation for the selected point. Use this option to assign an elevation to a position on a 2D string.

**Tip** – To reload the original elevation, tap and hold in the graphics window and then select *Reload original elevation* from the menu.

9. To apply construction offsets, tap and hold in the graphics window and then select [Construction offsets](#).
10. Press *Stakeout* to begin navigating using either the plan or [cross section](#) graphical display to navigate to the point.

**Tip** – Use the arrow to the left of the navigation deltas to select the delta display. For a GPS survey deltas can either be relative to the road or to your current position. For a conventional survey deltas can either be relative to the road or to the instrument.

**Tip** – To edit the side slope value of a selected 5D / Interface string, tap and hold in the graphics window and then select *Edit side slope* from the menu. If the ground conditions require the opposing slope value to be staked, you can edit the null (?) value.

**Note** – If the road includes multiple side slopes that define benched side slopes, only the 5D / Interface string that is furthest from the centerline will be converted to a side slope.

12. Mark the point with a stake.

**Note** – For 5D / Interface strings, the target may not coincide with the design position because the target is calculated relative to your current position.

13. When the point has been marked, you can measure it as an *As-staked point* by tapping *Enter* to go into the *Stakeout / Point* screen.

**Note** – If you are staking a [catch point](#) (5D / Interface string) with construction offsets, navigate to the catch point and then tap *Apply* to add the construction offsets. You are prompted to apply the offsets from your current position. If you are not on the catch position, select *No*, navigate to the catch position and then tap *Apply* again.

If you want to store the catch position and the construction offset, see [Construction offsets](#).

## Notes

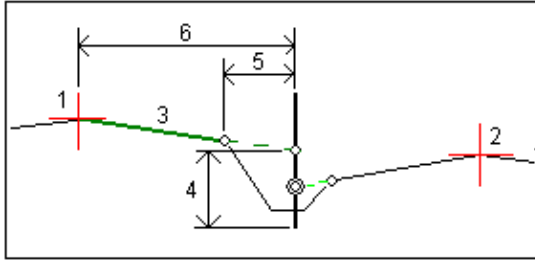
- If the string selected to stake is a 5D string Trimble Survey Controller converts this string to a side slope. The calculated slope value is defined by the slope between the 5D string and the adjacent 3D string.

**Tip** – To configure the software to treat a 5D string as a 3D string, tap [Options](#) and then clear the *Auto side slope* option.

- For GENIO files defined from 12D Model, Trimble Survey Controller treats all strings with a name that includes the letters INT as a 5D string and converts the string to a side slope. The calculated slope value is defined by the slope between the interface string and the adjacent 3D string.

## Staking relative to a secondary road

This function enables stakeout details from a secondary road to be referenced to a position being staked on a primary (current) road. See the following diagram:



To do this:

1. From the main menu, select *Survey / Survey style / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.
3. To define the primary and secondary groups, select the *Group strings* option.
4. Select the primary road (group) to stake.
5. Enter a value in the *Antenna/Target height* field.
6. Tap *Start*. The primary road is displayed. Select the position to stake.
7. From either the plan or cross section view, tap and hold in the graphics window and then select *Select secondary group* from the menu. From the list of groups, select the group representing the secondary road. The secondary road appears as unavailable in the plan view. From the plan view, you cannot select positions to stake on a secondary road.
8. From either the plan or cross section view, tap and hold in the graphics window and then select *View secondary cross section* from the menu. From the displayed cross section for the secondary road (1), tap the line (3) preceding the position you want to stake. A green line is projected to the stake position on the primary road (2).

**Note** – Stake details for the secondary road reported in the *As staked deltas* include:

- ◆ V.dist to road (4)
  - ◆ Horizontal construction offset (calc'd) (5)
  - ◆ Distance to centerline (6)
10. Tap *Accept* to confirm your selection.
  11. Press *Stakeout* to begin navigating using either the plan or *cross section* graphical display to navigate to the point.
  12. Mark the point with a stake.
  13. When the point has been marked, you can measure it as an *As-staked point* by tapping *Enter* to go into the *Stakeout / Point* screen.

## String interpolation

The following rules apply to keyed-in station values:

- For a 6D string elevation values are computed by linear interpolation for station positions between the 6D points. However, if there is a 12D string coincident with the 6D string, the software uses the vertical alignment data available in the 12D string to compute the elevation values for station positions between the 6D string points.

- For a 3D string elevation values are computed by linear interpolation for station positions between the 3D points.
- Interpolation between points along a spiral is calculated using a clothoid spiral for 12D and 6D strings and approximated for 3D strings.

When measuring your position relative to a GENIO road or where your station and offset are nominal values your position is computed by linear interpolation from the nearest positions on adjacent strings.

In all situations where your position is interpolated, closer station intervals give greater accuracy.

## Staking Roads from LandXML Files

The Trimble Survey Controller software enables you to stake out a road from a LandXML file.

To do this:

1. From the main menu, select *Survey / Survey style / Stakeout / Roads*.
2. Highlight the road name and tap *Stakeout*.
3. If the file contains multiple roads select the road to be staked. To view a list of available roads, tap the arrow and then select *List*.
4. Select the station to be staked from the *Stationing* field.
5. If the road contains multiple surfaces, select the surface to be staked out. To view the available surfaces, tap the arrow and then select *List*.
6. Enter a value in the *Antenna/Target height* field.
7. Select the offset to be staked out from the *Offset* field.
8. To enable the elevation for the selected point to be edited, select *Edit elevation* from the pop-up menu in the *Design elevation* field.
10. To apply construction offsets, tap and hold in the graphics window and then select *Construction offsets*.
11. Select *Start* and use the graphical display to navigate to the point.
12. To view the *cross section* of the selected station, tap *XS*.

To define a cross slope, see [Cross slope](#).

12. Mark the point with a stake.
13. When the point has been marked, you can measure it as an *As-staked point* by tapping *Enter* to go into the *Stakeout / Point* screen.

**Note** – You must specify a coordinate system before you can stake out roads with the Trimble Survey Controller software.

**Warning** – Do not stake out points and then change the coordinate system or perform a calibration. If you do, these points will be inconsistent with the new coordinate system and any points computed or staked out after the change.

### Selecting a station

You can select a station by one of the following methods:

- Select from the list in the *Stationing* field pop-up menu.
- Key in a value.

### Selecting an offset

You can select an offset by one of the following methods:

- In the *Offset* field, select *List* from the pop-up menu and then select from the list.
- Key in a value.

Enter a negative value for an offset to the left of the centerline; enter a positive value for an offset to the right of the centerline.

**Note** – You can key in a nominal station and offset to stake but, if the station value does not match those in the list, no surface will be available.

## Specifying Construction Offsets

A point to be staked can be offset by a:


- [Horizontal offset](#)
- [Vertical offset](#)
- [Station offset](#) (available for roads from a GENIO file only)

When you stake a side slope, select the *Store both catch and construction offset* check box if you want to measure **and** store the catch position.

### Horizontal construction offsets

You can offset a point horizontally where:

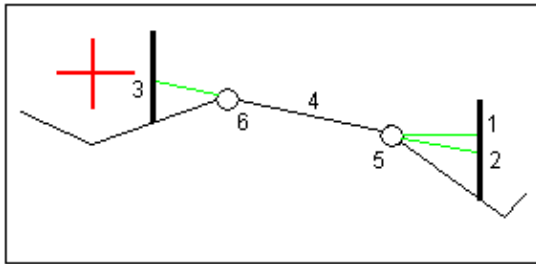
- A negative value offsets the point towards the centerline (in).
- A positive value offsets the point away from the centerline (out).

For roads derived from a GENIO file, use the advanced pop-up arrow (  ) to specify if the offset is to be applied:


- horizontal
- at the slope of the previous element in the cross section
- at the slope of the next element in the cross section

The following diagram shows a *Horizontal offset(1)* , *Slope previous offset(2)* and *Slope next offset(2)* applied to a position. For the *Slope previous* option, the slope of the offset is defined by the slope of the element (4) before the position (5) selected to stake. For the *Slope next* option, the slope of the offset is defined by the

slope of the element (4) after the position (6) selected to stake. The *Vertical offset* value in the diagram is 0.000.

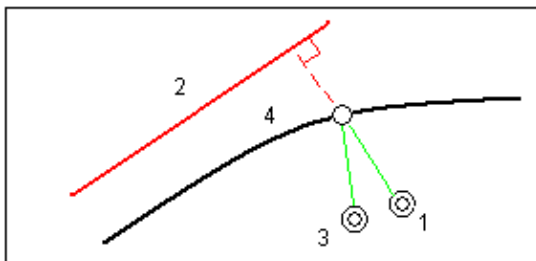


**Note** – For points with zero offset, you cannot apply construction horizontal offsets at the slope value of the previous template element.

For roads derived from a GENIO file, use the advanced pop-up arrow (  ) to specify if the offset is to be applied:

- perpendicular to the master string for the sub string being staked
- perpendicular to the sub string being staked

The following diagram shows a *Horizontal offset(1)* applied perpendicular to the master string(2) and a *Horizontal offset(3)* applied perpendicular to the sub string(4).



## Notes

- If you enter a value for the horizontal offset on the centerline (at offset 0.00 m), a negative value offset is to the left.
- Construction offsets are not automatically applied to a sideslope offset. For more information, see staking a [Catch point](#).

## Vertical construction offsets

You can offset a point vertically where a:

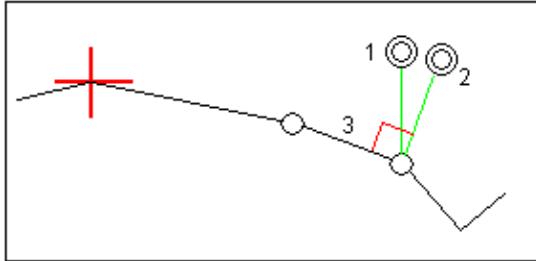
- A negative value offsets the point vertically down.
- A positive value offsets the point vertically up.

In the *Vertical offset* field, use the advanced pop-up arrow (  ) to specify if the offset is to be applied:



- vertically
- perpendicular to the element in the cross section before the point being staked

The following diagram shows a *Vertical offset* applied vertically(1) and a *Vertical offset* applied perpendicular(2) to the previous cross section element(3).



### Station construction offsets

For roads derived from a GENIO file you can offset a point along the station of the selected string where a.

- A positive value offsets the point in the direction of increasing station (Forward).
- A negative value offsets the point in the direction of decreasing station (Backward).

### Notes

- You cannot apply a Station offset to a 5D string that represents the catch position.
- The Station offset respects the geometry of the string being staked.

## Cross Section View

For Trimble roads and roads from a LandXML file:

- Tap XS to view the cross section of the selected station.

For roads from a GENIO file:

- Tap the icon in the bottom right corner of the graphics window to change between the plan and cross section views.

The cross section that appears is orientated in the direction of increasing station. Your current position and the target are shown. If the target has construction offsets specified, the smaller single circle indicates the selected position and the double circle indicates the selected position adjusted for the specified construction offset(s). The construction offset(s) appear as green lines.

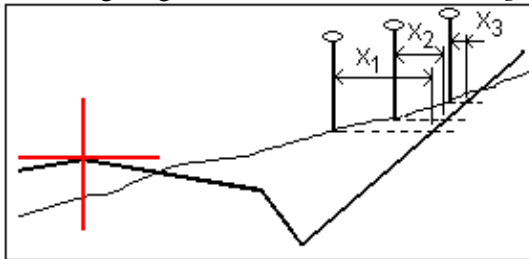
When you view the cross section, the appropriate cut or fill side slope appears for the side of the road that you are currently on.

For all road formats, see [Cross slope](#) to graphically define a cross slope.  
 For roads defined in a GENIO file, see [Subgrade](#) to graphically define a subgrade.

## Catch Point

The catch point is the point where the design side slope intersects with the ground.

The actual intersection position of the side slope with the existing ground surface – the catch point—is determined iteratively (by repetition). The Trimble Survey Controller software calculates the intersection of a horizontal plane passing through the current position, and either the cut or fill side slope, as shown in the following diagram, where  $x_n$  is the *Go Right/Left* value.



The graphical display in the plan view, shows the calculated catch position and a dashed line that connects the side slope catch position (the point where the side slope intersects with the ground) to the side slope hinge position. The calculated slope value (in blue) and the design slope value appears at the top of the screen.

Select *XS* for more graphical navigation. The cross section is displayed looking in the direction of increasing station. Your current position and the calculated target are indicated. A line is drawn (in blue) from the hinge position to your current position to indicate the calculated slope.

If the catch point has construction offsets specified, these appear in the cross-section view as green lines. The smaller single circle indicates the calculated catch position and the double circle indicates the selected position adjusted for the specified construction offset(s). The construction offsets appear only after you have applied them.

Tap [Report](#) to view the *Catch point deltas report* screen.

### The Select softkey

The following table explains the *Select* menu options for a side slope.

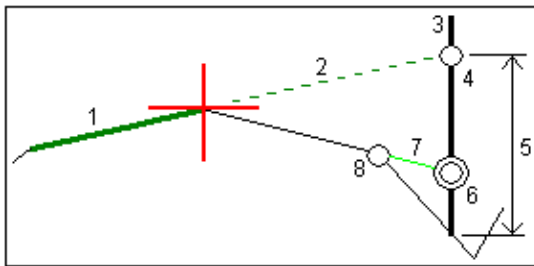
Option	Description
<i>Catch point (Auto)</i>	The Trimble Survey Controller software selects the side slope (cut or fill) to intersect with the ground. This is the default.
<i>Catch point (Cut)</i>	Fixes the side slope as a cut side slope.
<i>Catch point (Fill)</i>	Fixes the side slope as a fill side slope.

<i>Hinge point (Cut)</i>	Stakes out the base of the cut side slope. This is the most direct way to select the hinge point if the template includes a ditch offset.
<i>Hinge point (Fill)</i>	Stakes out the start of the fill side slope.

**Note** – For side slope offsets where the slope changes between templates, the Trimble Survey Controller software calculates the side slope for intermediate stations by interpolating the slope value.

## Defining a cross slope

You can use this special construction offsetting tool with Trimble, GENIO, and LandXML roads. Activate it graphically from the cross section view when in selection mode for GENIO roads and when in stakeout mode for Trimble and LandXML roads. Cross sloping enables you to stake two positions in a single operation, as shown in the following diagram:



To do this:

1. From the cross section view tap and hold and select *Define construction offsets* and then select a horizontal offset method, typically *Slope*, and enter a horizontal offset.
2. The smaller single circle (8) indicates the selected position and the double circle (6) indicates the selected position adjusted for the specified construction offsets. The construction offset(s) appear as a green line (7).
3. Tap the line (1) that will define the cross slope. From the pop-up menu select *Define cross slope*.

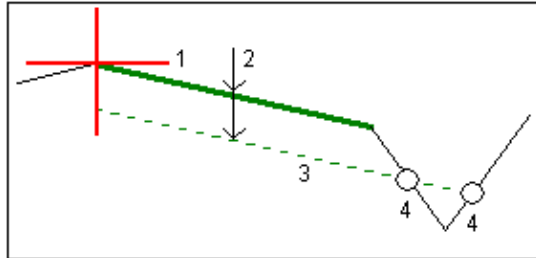
**Note** – For Trimble and LandXML roads, when you tap the line, the system immediately defines the cross slope. There is no pop-up menu.

4. The selected line appears as a bold green line. A dashed green line (2) extends from the selected line to intersect with a vertical line (4) at the target stake (3).
5. Navigate to the target and then stake the position.
6. From the *Confirm staked deltas* screen use the *V.Dist. cross slope* value (5) to mark the stake with the second position.

**Note** – The defined cross slope applies to all subsequent stations. To de-activate the cross slope function, tap the selected line (1).

## Defining a subgrade

This special subgrade calculation tool for GENIO roads is activated graphically from the cross section view when in selection mode. It enables you to stake a position at an offset to a line, as shown in the following diagram:



To do this:

1. From the cross section view, tap the line (1) that will define the subgrade. The selected line appears green and bolded.
2. From the pop-up menu, select *Define subgrade*.
3. Enter the subgrade depth (2) where the depth is from the selected line to the subgrade surface.
4. The dashed green line (3) that appears is parallel to the line selected and offset by the subgrade depth. The line extends to intersect with all encountered lines in the cross section. The single circles (4) indicate the computed positions.
5. Tap the computed position that you want to stake.
6. Navigate to the target and then stake the position.

**Note** – The defined subgrade applies to all subsequent stations. To de-activate the subgrade function, tap the selected line (1).

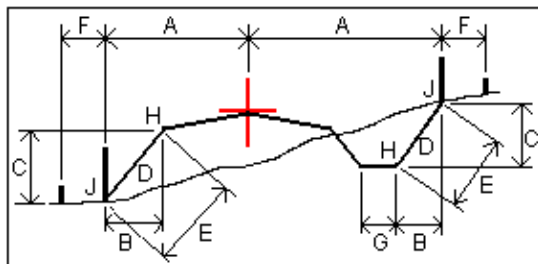
## Staked deltas

If you have the *View before storage* check box in the *Stakeout* options selected, the *Confirm staked deltas* screen appears before you store the point.

**Note** – The value in the *S.dist to hinge + Constr off* field includes any construction offset values specified and reports the slope distance from the hinge to the as-staked position. The value is null (?) if there is no horizontal construction offset specified or the horizontal construction offset is applied horizontally.

**Tip** – Tap *Report* to view the *Catch point deltas report* screen. This screen shows the horizontal and vertical distances from the catch point to the end of each template element, up to and including the centerline. If the template includes a cut ditch, the report includes the hinge position at the toe of the cut slope. The reported values exclude any construction offset specified.

The following diagram explains some of these fields.



Where:

A	=	Distance to center line
B	=	Horizontal distance to hinge point
C	=	Vertical distance to hinge point
D	=	Slope
E	=	Slope distance to hinge point
F	=	Horizontal construction offset
G	=	Ditch offset
H	=	Hinge point
J	=	Catch point

The Trimble Survey Controller software supports user definable stakeout reports, which enable you to configure the display of staked information on the *Confirm staked deltas* screen that appears when you enable *View before storage*. For more information, see [As-Staked Point Details](#).

## Fine and Coarse Modes – GPS Stakeout

Choose either the fine or coarse mode when navigating to a point. Use *Fine* or *Coarse* in the *Stakeout* graphical display to change from one to the other:

- *Fine* appears when the Trimble Survey Controller software is in coarse mode. Tap it to go into fine mode.  
The display updates at a rate of one position per second, and the precision of the position is higher.
- *Coarse* appears when the Trimble Survey Controller software is in fine mode. Tap it to go into coarse mode.

The display updates at a rate of five positions per second, and the precision of the position is lower.

**Note** – When you tap *Fine* the graphical display screen zooms in and magnifies the display by the zoom factor specified in the survey style.

**Note** – When you get within 1 foot (0.3048m) of the point, the stakeout mode will automatically change to fine mode. This can be disabled by unselecting the *Auto change to Fine* setting in the stakeout section of the RTK survey style.

## Station and offset

The *Station and Offset* option is available for both GPS and Conventional surveys enabling points to be measured or staked out relative to a line, arc or road.

1. Select *Survey / Station and offset* from the Trimble Survey Controller main menu.
2. Select *Measure* or *Stakeout*.
3. In the *Type* field of the *Station and offset* screen, select the arc, line, or road relative to which you want to measure or stake out.
4. Tap *Enter*. The appropriate stakeout screens appear as follows:
  - Select *Station and Offset / Measure relative to a line*. The *Stakeout line* screen appears and the stakeout method is set to *To the line*.
  - Select *Station and Offset / Measure relative to an arc*. The *Stakeout line* screen appears and the stakeout method is set to *To the arc*.
  - Select *Station and Offset / Measure relative to a road*. The *Stakeout road* screen appears. Select the stakeout method *Position on road*.
  - Select *Station and Offset / Stakeout relative to a line*. The *Stakeout line* screen appears and the stakeout method is set to *Station/Offset from line*.
  - Select *Station and Offset / Stakeout relative to an arc*. The *Stakeout arc* screen appears and the stakeout method is set to *Station/offset from arc*.
  - Select *Station and Offset / Stakeout relative to a road*. The *Stakeout road* screen appears. Select the stakeout method *Station and offset*.

# Survey Configuration

## Configuration Menu

Use this menu to:

- Change the language.
- Switch on or off sound events.
- Configure Bluetooth connections.
- Create and edit feature and attribute libraries.
- Create and edit survey styles.
- Create dial profiles for use with cellular modems.
- View the version number, serial number, authorization key and software warranty expiry.

For more information, see:

[Bluetooth](#)

[Feature and Attribute Library](#)

[Survey Styles](#)

[Dial Profiles](#)

[Options](#)

## Survey Styles

Survey Styles define the parameters for configuring and communicating with your instruments, and for measuring and storing points. In a GPS survey, the Survey Style instructs the base and rover receivers to perform the functions required for a specific [survey type](#). This whole set of information is stored as a template that can be called up and re-used when necessary.

If there is only one survey style, it is automatically selected. Otherwise, choose one from the list that appears when you select *Configuration / Survey styles*.

You can use the styles supplied with the system without configuring them, but you can change default settings as required. The 5600 3600 style works with both the Trimble 5600 and Trimble 3600 instruments. Trimble Survey Controller detects the instrument that you are connected to and automatically configures the appropriate controls.

Set the appropriate [Options](#) to view and use Survey Styles.

To change the configuration of the Trimble Survey Controller software for different types of survey, select

*Configuration / Survey Styles* from the main menu.

For more information, see:

[Integrated Surveying](#)

[Conventional Survey](#)

[FastStatic Survey](#)

[Postprocessed Kinematic Survey](#)

[Real-Time Kinematic and Infill Survey](#)

[Real-Time Kinematic Survey](#)

[Real-Time Kinematic and Data Logging](#)

## Software Options

To display a list of the available software options, select *Configuration / Options* from the main menu. Choose an option to enable one of the following:

- GPS surveying
- TS surveying
- [Advanced Geodetics support](#)

By default, all options are off. The GPS and TS survey style files are created in the Trimble data directory and are displayed only when these options are enabled.

**Note** – GPS surveying or TS surveying are automatically enabled when connecting to a GPS receiver or conventional instrument respectively.

You can set the software options and the [auto-connect](#) options independently of each other. For example, if you clear the *Trimble GPS receiver* check box in the *Auto connect options* dialog, that does not disable the *GPS surveying* option in the software *Options* dialog.

However, if the auto-connect options are disabled, then the software options cannot be automatically enabled, because it is the auto-connect process that detects the instrument and then configures the appropriate software options.

Select *Advanced Geodetic support* to enable the following options:

- Station setup scale factor
- Helmert transformation for Resection



# Survey Types

Your GPS survey type will depend on available equipment, field conditions, and the results required. Configure the survey type when you create or edit a Survey Style.

To do this:

1. From the main menu, select *Configuration / Survey Styles / <Selected Survey Style> / Base options*.
2. Change the *Type* field as required.
3. Do the same for Rover options.

The Trimble Survey Controller software provides survey styles for the following survey types:

[Conventional Survey](#)

[FastStatic Survey](#)

[Real-Time Kinematic Survey](#)

[Real-Time Kinematic and Infill Survey](#)

[Postprocessed Kinematic Survey](#)

To use one of the following survey types, you must create your own survey style:

[Real-Time Kinematic and Data Logging](#)

[Real-Time Differential Survey](#)

For more information, see:

[Integrated Surveying](#)

## Conventional Instrument – Configuration

Configure the conventional instrument type when you create or edit a Survey Style.

Select *Instrument*, choose the [instrument type](#), and then set the associated parameters.

### Baud rate and parity

Use the *Baud rate* field to configure the Trimble Survey Controller baud rate to match that of the conventional instrument.

Use the *Parity* field to configure the Trimble Survey Controller parity to match that of the conventional instrument.

When you change the instrument type, the baud rate and parity settings automatically change to the default settings for the selected instrument.

### HA VA status rate

Use the *HA VA status rate* field to set how often the Trimble Survey Controller software updates the horizontal and vertical angle display in the status line with information from the conventional instrument.

**Note** – Some instruments beep when communicating with the Trimble Survey Controller software. You can turn off the beep in the instrument or set the *HA VA status rate* to Never.

### Measurement mode

The *Measurement mode* field appears if the selected instrument type has more than one measurement mode that can be set by Trimble Survey Controller. Use this mode to specify how the EDM measures distances. Options vary according to the instrument type. Select the *Instr. default* option to always use the setting on the instrument.

**Tip** – Tap Trimble functions to quickly change the measurement mode when using Trimble S Series, 5600, 3600, and Leica TPS1100 instruments.

Trimble terminology matches the measurement modes on the Leica TPS1100 instruments as follows:

Trimble terminology	Leica terminology
STD	Standard
FSTD	Fast
TRK	Rapid tracking
DR	Reflectorless

### Averaged Observations

Use the Averaged observations method to:

- increase the measurement precision with a predefined number of observations
- view the associated measurement standard deviations

While the instrument is carrying out the measurements, standard deviations are displayed for the horizontal (HA) and vertical (VA) angles, and the slope distance (SD).

### Auto F1 / F2

When using a servo or robotic instrument, select the *Auto F1 / F2* check box to automatically measure a point on face 2 after the face 1 observation.

When *Auto F1 / F2* is selected, once the face 1 measurement is completed, the instrument automatically turns to face 2. The point name does not increment, which allows a face 2 observation to be measured with the same

point name as the face 1 observation. Once the face 2 measurement is completed, the instrument returns to face 1.

Auto F1 / F2 does not work when starting on face 2, or when the measurement method is set to:

- Angle offset
- H. Angle offset
- V. Angle offset
- Single dist. offset
- Dual-prism offset
- Circular object
- Remote object

### **Measure distance on face 2**

The *Measure distance on face 2* option is used in:

- Measure topo, when *Auto F1 / F2* is selected
- Measure rounds, Station setup plus, and Resection, when a distance observation is not required on face 2

When the Measure distance on face 2 option is selected, if the face 1 measurement method included a distance measurement, then the measurement method for face 2 is automatically set to *Angles only* after the face 1 measurement. After the face 2 measurement, the instrument returns to the method used on face 1.

### **Set backsight**

The *Set backsight* field appears if you can set the horizontal circle reading on the instrument when the backsight is observed. The options are *No*, *Zero*, and *Azimuth*. If you select the *Azimuth* option, when you observe the backsight the horizontal circle reading is set to the computed azimuth between the instrument point and the backsight point.

### **Servo auto turn**

When using a servo instrument, the *Servo auto turn* field in the survey style can be set to *HA & VA*, *HA only*, or *Off*. If you select *HA & VA*, or *HA only*, the instrument automatically turns to the point during stakeout, and when a known point is entered into a point name field.

If you are working robotically, or when the *Servo auto turn* field in the survey style is set to *Off*, the instrument does not turn automatically. To turn the instrument to the angle indicated on the screen, tap *Turn*.

### **Centering error**

The centering error is used to compute the observation weights as part of the Standard resection and Station Setup Plus computations. Set a value appropriate to the estimated accuracy of your instrument setup.

### **Instrument precision**

Use the *Instrument precision* fields to record the precisions of the instrument. Do one of the following:

- Leave them as null.
- Enter the manufacturer's values.
- Enter your own values based on your observing techniques.

If you leave the fields as null, the statistics are computed using Trimble Geomatics Office default values. If you enter values, they are used to weight observations in the calculation of the Mean orientation and Scale factor for Multiple backsights and Resections, as well as the Resected position. They are also used in Trimble Geomatics Office to compute the standard error statistics for an observation.

When you use a Trimble S Series, 5600, or 3600 instrument, the instrument precisions are not configured in the survey style. Trimble Survey Controller reads the instrument precisions from the instrument. These precisions are then used to weight and calculate the standard error statistics for an observation.

Observation standard error statistics are stored with each observation. The standard errors can be used in the office software to weight the observations during a network adjustment.

## Conventional Instrument – Type

In a conventional survey style, you need to specify the type of instrument being used.

Choose a model made by one of the following manufacturers:

- Trimble
- Leica
- Nikon
- Pentax
- Sokkia
- Spectra Precision
- Topcon
- Zeiss

Choose *Manual* when you want to key in the measurements.

Choose one of the following SET types:

- SET (Basic), when using a Nikon instrument (if your instrument does not support a Nikon survey style). Make sure that the units on the instrument are the same as the units in Trimble Survey Controller.
- SET (Extended), when using any Sokkia instrument.

**Tip** – When using non-Trimble instruments, disable auto-connect. Some commands used by auto-connect can interfere with the communication of non-Trimble instruments.

## Configuring a Leica TPS1100 Instrument for a Servo or Robotic Survey

In both a servo and robotic survey, Trimble Survey Controller communicates with a Leica TPS1100 model instrument using the RCS (Remote Control Surveying) protocol.

To configure the instrument:

1. From the Main menu on the Leica TPS1100, press 5 [Configuration] and then press 2 [Communication mode].
2. Press 1 [GSI parameters] and then set the [Baudrate] to 19200, [Protocol] to None, [Parity] to None, [Terminator] to CR/LF, and [Data Bits] to 8.
3. Press [Cont] to continue.
4. Press 5 [RCS (Remote) On/Off]. Make sure that [Remote control mode] is **off**.
5. To put the instrument in the [Measure and Record] screen, press F1 [Back] twice and then press F6 [Meas].

**Note** – You do not need to configure 2 [GeoCOM parameters], 4 [RCS parameters], and you do not need to put the instrument in [GeoCOM On-Line mode] or switch on RCS mode.

**Tip** – Trimble Survey Controller can only communicate with the instrument when the instrument is in the [Measure and Record] screen. To configure the instrument to start in the [Measure and Record] screen, select 5, 1, 04 from the main menu on the Leica instrument. Set the [Autoexec] to [Measure and record].

The Trimble Survey Controller software does not support the use of [ATR] mode during automated rounds. The [ATR] state is not updated during the round. Use [Lock] rather than [ATR] mode during automated rounds.

**Tip** – To use the Reflectorless technology of your instrument, configure the instrument to reflectorless. In Trimble Survey Controller, set the *Measurement mode* to *Instr. Default*. Alternatively, tap the Target icon in the status bar and select *Target DR* to switch to *Target DR* and automatically configure the instrument for reflectorless (DR) mode.

**Note** – Search does not work when the instrument is in reflectorless (DR) mode.

**Note** – The Leica TC/TPS1100 survey styles have been designed to operate specifically with the TPS1100 instruments. However, the TC/TPS1100 style may also be used to operate other Leica TPS instruments using the same protocol.

## Configuring a Leica TPS1100 instrument to record data to the Trimble Survey Controller software

You can configure a Leica TPS1100 instrument to trigger a measurement and then record the data to the Trimble Survey Controller software.

**Note** – Record mode is supported in the Trimble Survey Controller software only when using *Measure topo*.

To enable this function on the Leica instrument, you must [configure the format of the data](#) and then [configure where to send the data](#).

## Configuring the format of the data

To configure the Rec–Mask so that the correct information is sent to the Trimble Survey Controller software:

1. From the Main menu on the Leica TPS1100, press 5 [Configuration] and then press 1 [Instrument config].
2. Press 05 [Display and Record].
3. Press F4 [RMask].
4. In the [Define] field, select an appropriate [Rec–Mask] to configure.
5. Set the [Mask name] to something appropriate.
6. Set the [REC format] to [GSI16 (16 char)].
7. The [1st word] is set to [Point Id (11)]. You can not change this.
8. Set the [2nd word] to [Hz (21)].
9. Set the [3rd word] to [V (22)].
10. Set the [4th word] to [Slope Dist (31)].
11. Set the [5th word] to [/ (empty)].
12. Set the [6th word] to [Point Code (71)]. This step is optional.

When a point code is output from the instrument, it replaces the code in the code field in the *Measure topo* form.

To enter a Point code on the Leica instrument, you may need to configure the [Display mask](#).

13. Press [CONT] to continue.

On the [Main Display and Record] form the [REC–Mask] now appears with the name you gave the recording mask in step 5 above.

14. To return to the Main menu, press [CONT] / [BACK] / [BACK].

## Configuring where to send the data

To configure the instrument to send the REC–Mask data to the RS232 port:

1. From the Main menu on the Leica TPS1100, press F5 [SETUP].
2. Set the [Meas job] field to [RS232 RS].

The [REC–Mask] field appears with the name you gave the recording mask in step 5 above.

3. To return to the [Measure &Record] screen, ready to start measuring points, press F6 [MEAS].

The Leica TPS1100 instrument is now configured to measure and send the point name, code, and measurement details to the Trimble Survey Controller *Measure topo* screen when you use F1 [All] on the Leica TPS1100 instrument.

*Measure topo* is the only place in the Trimble Survey Controller software where you can trigger a measurement on the Leica instruments and have the data stored to the controller.

Depending on the model (and possibly the firmware) of your instrument, you may need to configure the Trimble Survey Controller software. Some models require an acknowledgement from the controller that they have received the data.

If the instrument reports a comms error [Comm. error : wrong response.], and fails to increment the point name on the instrument, then you need to send an acknowledgement to the instrument.

To send an acknowledgement, select the *Send record acknowledgement* option in the Leica style, or in *Measure topo / Options*.

**Note** – If you selected the *Send record acknowledgement* check box, the status line in the Trimble Survey Controller software is disabled and the target icon is not updated with Lock status information from the instrument. View the Lock status through the instrument panel.

In the Trimble Survey Controller software, configure the *View before storage* field as required:

- When *View before storage* is on, the measurement details appear, and you can change the code field before storing the observation.
- When *View before storage* off, the measurement details appear briefly on the large button before the observation is stored.

## Notes

- Records, 11, 21, 22, 31, and 71 (as described above) are the only records read by the Trimble Survey Controller software. All other records are ignored.
- The code field in the Leica software annotated [Point code] can be sent to the Trimble Survey Controller software.
- The code field in the Leica software annotated [Code] cannot be sent to the Trimble Survey Controller software.
- The point name must be defined in the Leica software and will always replace the point name in the *Measure topo* form. If *View before storage* is on, you do get the opportunity to change the point name.
- If the [Point code] has been defined in the Leica software it will always replace the Code in the *Measure topo* form.
- If the [Point code] is null in the Leica software it does not replace the code on the *Measure topo* form.
- If *View before storage* is on in the Trimble Survey Controller software, you can change the code before the observation is stored.
- When using *Auto F1/F2* the Trimble Survey Controller software does not increment the point name for the face 2 observation. This feature does not work if the point names are sent from the Leica instrument. For *Auto F1/F2* to work you must set the correct point names in the Leica instrument.

## Configuring the display mask

To configure the Display mask so that the [Point code] field is available on the instrument:

1. From the Main menu on the Leica TPS1100, press 5 [Configuration] and then press 1 [Instrument config].
2. Press 05 [Display and Record].

3. Press F3 [DMask].
4. In the [Define] field, select an appropriate [Displ.Mask] to configure.
5. Set the [Mask name] to something appropriate.
6. Set the [word] corresponding to the position that you want the point code field displayed to [Point code].
7. Set the other [word] values as required.
8. Press [CONT] to continue.

On the [Main Display and Record] form the [Displ.Mask] now appears with the name you gave the display mask in step 5 above.

9. To return to the Main menu, press [CONT] / [BACK] / [BACK].

## Laser Rangefinder

To measure points or distances using a laser rangefinder connected to the controller, first configure the laser rangefinder in your Survey Style.

1. From the main menu, select *Configuration / Survey styles*. Highlight a survey style and tap *Edit*.
2. Select *Laser rangefinder*.
3. Select one of the instruments in the *Type* field.
4. If necessary, configure the *Controller port* and *Baud rate* fields.  
The default value in the *Baud rate* field is the manufacturer's recommended setting. If the laser is a model with which the Trimble Survey Controller software can automatically take a measurement when you tap *Measure*, edit the *Auto measure* field.
5. If required, select the *Auto store* point check box.
6. Tap *Enter*. The precision fields contain the manufacturer's precision values for the laser. They are for information only.

Laser measurements can be displayed as vertical angles measured from the zenith or inclinations measured from horizontal. Select a display option in the Laser VA display field of the Units screen. For more information, see [System units](#).

Before using the laser with the controller, configure the laser options. The following table shows the configuration for each laser that is supported by Trimble Survey Controller.

Laser	Laser setting
Bosch DLE 150	When the Bosch DLE 150 is detected, an authentication request dialog appears. You must enter the PIN number set in the laser rangefinder.
LTI Criterion 300 or LTI Criterion 400	From the main menu, press the down arrow or up arrow key until the <i>Survey</i> menu appears and then tap <i>Enter</i> . Select <i>Basic measurements</i> and tap <i>Enter</i> . A screen showing the fields <i>HD</i> and <i>AZ</i> appears.
LTI Impulse	Set up the laser to operate in CR 400D format. Make sure that a small "d" is displayed on the screen. (If necessary, press the <b>Fire2</b> button on the laser).
Laser Atlanta Advantage	Set the <i>Range/Mode</i> option to <i>Standard (Averaged)</i> and the <i>Serial/Format</i>



	option to <i>Trimble Pro XL</i> .
LaserCraft Contour XLR	Set the LaserCraft mode in the laser. If you connect through Bluetooth wireless technology, you also need to change the baud rate setting on the laser rangefinder to 4800.
Leica Disto memo/pro	Set the unit to meters or feet, not feet and inches.
Leica Disto Plus	You must enable Bluetooth wireless technology on the Leica Disto Plus before you run a Bluetooth scan. If automeasure is switched off: 1. To take the measurement, press the [Dist] key on the laser rangefinder. 2. Press the [2nd] key. 3. To transfer the measurement to the controller, press one of the eight direction arrow keys.
MDL Generation II	No special settings are required.
MDL LaserAce	Set the <i>Data record</i> format to <i>Mode 1</i> . When you use the angle encoder, set the magnetic declination to zero in the Trimble Survey Controller software. The angle encoder in the LaserAce laser corrects for the magnetic declination. Set the baud rate to 4800.

**Note** – You must configure the laser rangefinder to update the inclinometer and slope distance readings after each measurement.

### Measuring laser points

During a survey, select *Measure laser points* from the *Survey* menu to measure laser points as offsets from a known point. Alternatively, to insert a distance into an *H.Dist* or a *Length* field, tap *Laser* from the pop-up menu and measure the distance with the laser.

If the *Auto measure* field in the survey style *Laser rangefinder* option is set to *Yes*, the Trimble Survey Controller software instructs the laser to take a measurement when you tap *Laser*.

If the Trimble Survey Controller software receives only a distance measurement from the laser, another screen is displayed with the measured distance in a *Slope distance* field. Enter a vertical angle if the measured distance was not horizontal.

**Note** – If you are using a laser without a compass, you must key in a magnetic azimuth before the Trimble Survey Controller software can store the point.

**Note** – Allow the laser to settle for a few seconds before you take a measurement with it. If you enter a value for magnetic declination in the laser, make sure the [Cogo setting](#) in the Trimble Survey Controller software is set to zero.

## Duplicate Point Tolerance

In a GPS survey, when you attempt to add a point name, the Trimble Survey Controller software warns you if a point of the same name already exists.

In a conventional survey, when you attempt to add a point name that already exists, no message appears to warn you that the point already exists. This is because you may want to regularly measure points on both faces.

In a real-time GPS survey, or a conventional survey, you can set the tolerance for a duplicate point warning.

- Specify the maximum distance that a new point can be from an existing point.

In a conventional survey, only duplicate points from two separate station setups can be automatically averaged. Duplicate points from a single station setup are meant to create an MTA record. To average conventional observations from one station setup, set low duplicate point tolerances and select *Average* when the duplicate point warning appears. Alternatively, average using *COGO / Compute average*.

If the new point is further from the original point than the tolerance specified, you can choose what to do with the new point when you store it.

The options are:

- Discard
- Rename
- Overwrite – Overwrite and delete the original point, and all other points of the same name and the same (or lower) search class.
- Store as check – Store with a lower classification.
- Store another – Store the point, which can then be averaged in the office software. The original point is used in preference to this point.
- Average – Store the point and then compute and store the averaged position.

**Note** – When you select the *Average* option, the current observation is stored and the computed average **grid** position appears, along with the computed standard deviations for the north, east, and elevation ordinates. If there are more than two positions for the point, a *Details* softkey appears. Tap *Details* to view the residuals from the average position to each individual position. You can use this residuals form to include or exclude specific positions from the average computation.

To configure the Duplicate point tolerance:

1. Select the *Survey Style*.
2. Select *Duplicate point tolerance*.
3. Specify the horizontal and vertical tolerances. If you set these distances to zero, a warning is always given.
4. To automatically compute and store the average position, select the *Auto average* within tolerance option.

**Note** – When the *Auto average* option is checked, and an observation to a duplicate point is within the specified duplicate point tolerances, the observation and the computed average position (using all the available point positions) are automatically stored.

**Note** – The Trimble Survey Controller software computes an averaged coordinate by averaging the grid coordinates computed from the underlying coordinates or observations. Observations that do not allow a grid coordinate to be resolved (for example, angles only observations) are not included in the average coordinate.

## Face 1 and Face 2 observations

When you carry out two-face observations in a conventional survey during *Station setup*, *Station Setup Plus*, *Resection*, or when measuring *Rounds*, the Trimble Survey Controller software checks that the Face 1 and the Face 2 observations to a point are within a preset tolerance.

If the observations are out of tolerance, the *Observation: Out of tolerance* screen appears. The screen displays the following options:

- Discard – discard the observation without storing.
- Rename – rename to a different point name.
- Store as check – store with a classification of Check.
- Store another – store the observation.
- Store and reorient – (This option only appears if you are observing a backsight point.) Store another observation that will provide a new orientation for subsequent points measured in the current station setup. Previous observations are not changed.

Once you have completed the *Station Setup Plus*, *Resection*, or *Round* measurements, the Trimble Survey Controller software saves the Mean Turned Angles to each of the observed points. The software does not check for duplicate points at this stage. Therefore, to use any of the observations to compute an average position for an observed point, you must select the [Compute average](#) option from the *Cogo* menu.

## Feature and Attribute Library

Use a predefined feature and attribute library in a survey, transfer one from Trimble Geomatics Office, or create a feature code list in the Trimble Survey Controller software. You can also transfer a data dictionary (.ddf) file using the Trimble Data Transfer utility.

To create a new feature code list:

1. From the main menu, select *Configuration / Feature and attribute libraries*.
2. Tap *New*.
3. Enter the name of the list.
4. Tap *Edit* to add, delete, or edit codes.

**Note** – Feature codes cannot contain more than 20 characters.

**Tip** – The *Code* and *Description* are both displayed when you use Feature and attribute libraries. Most recently used codes are displayed indented at the top of the list.

5. To set the display properties for the feature code, tap *Display*. If the *Display coded features* option is selected in the map options, the Trimble Survey Controller software draws lines between points based on the specified display properties.

Feature code names that contain spaces appear in the Trimble Survey Controller software with a small dot between the words, for example, Fire·Hydrant. These dots do not appear in the office software.

Some symbols are not supported in feature and attribute libraries, for example ! and [ ]. If you use unsupported symbols when creating a library in the office software, the Trimble Survey Controller software converts them to the underscore symbol "\_" when they are transferred.

## Control Commands

With feature codes, points that have the same code can be joined by lines or represented by symbols on a plan. In a topographical survey, for example, survey the center line of a road and give it the code CL. Then set up the office software that processes the feature codes so that all points with the code CL are joined together.

However, if you survey the centerline of two different roads, and the points all use the code CL, the two centerlines will be joined together. To prevent this, use the code CL START for the first point on the first center line. Observe a succession of points with the code CL, then use the code CL END for the final point on the first center line.

Set up the feature code library for the office software to recognize these start and end codes as control commands.

## Radios – for GPS

Radios are used for real-time surveys.

To connect a data link radio or cellular modem to the Trimble Survey Controller software, select the *Route through SC* check box. Real-time data between the receiver and the radio or cellular modem then passes through the Trimble Survey Controller software.

Specify the controller port that the radio or cellular modem is connected to, and the baud rate for communications.

A radio icon is displayed in the status bar when there is a radio link between the base and rover receivers. If there are fewer than 4 satellites, no position is computed and the radio icon disappears. If there is a problem, various messages appear in the status line to give you extra information about the radio.

Configure the *Rover radio* or *Base radio* type when you create or edit the *Survey Style*.

### Configuring a radio using the Trimble Survey Controller software

Use the Trimble Survey Controller software to:

- change the frequency of a radio.
- change the mode of a radio from a broadcasting/receiving radio to a repeater radio.
- change the wireless data rate.

To configure a radio:

1. Connect the controller, receiver, power, and radio. For more information, see the [diagram](#) on setting up the base receiver.

- Alternatively, use a Y-cable to connect the power and the controller directly to the radio.
2. On the controller, highlight your survey style and tap *Edit*.
  3. Select *Base radio* or *Rover radio* depending on which radio you are configuring.
  4. Set the *Type* field and, if connecting directly, the *Controller port* field.

If connecting through a receiver, set the *Receiver port* field.

5. Tap *Connect*.

**Note** – If the softkey is not displayed, you cannot configure the type of radio you have selected.

If you are configuring a radio other than the internal radio of a Trimble R8, R7, R6, 5800, 5700, 4800, or 4700 GPS receiver, the following message appears:

*Please confirm. Disconnect power from radio.*

6. Disconnect the power from the radio and then tap *OK*.

The following message appears: *Please confirm. Connect power to radio.*

7. Reconnect the power to the radio and tap *OK* (there is no need to tap *OK* for a Pacific Crest radio).

The second *Base radio* / *Rover radio* screen appears.

8. Change the settings in the *Frequency* field and the *Base radio mode* field, as required.

The radio firmware version is also displayed.

9. Tap *Enter* when the details are correct (there is no need to tap *Enter* for a Pacific Crest radio).

**Note** – In some countries it is illegal to change the frequency of a radio. The Trimble Survey Controller software uses the latest GPS position to see if you are in one of these countries. If you are, only the available frequencies are displayed in the *Frequency* field.

If your radio does not appear on the list, select *Custom radio* and then define the receiver port, baud rate, and parity.

If you select *Base radio* and set the *Type* field to *Custom radio* or *Cellular modem*, you can also enable *Clear To Send (CTS)*.

**Warning** – Do not enable CTS unless the receiver is connected to a radio that supports CTS.

The Trimble R8, R7, R6, 5800, 5700, 4800, and 4700 GPS receivers support RTS/CTS flow control when you enable CTS.

If you are using a 4700 or 4800 GPS receiver, use receiver firmware version 1.20 or later.

For more information on CTS support, refer to the documentation supplied with your receiver.

## Radio Solutions

Trimble provides a comprehensive range of radio solutions that have been tested and proven. TRIMTALK radios are powered by the receiver's power supply using a common data/power cable. This configuration simplifies battery issues, as the receiver and the radio use the same power source. The Trimble R7, 5700, 4800 and 4700 GPS receivers can use a TRIMMARK III, TRIMMARK IIe or a TRIMTALK 450S radio at the base, and an internal radio at the rover.

You can use a [cellular modem](#) at both the base and rover receivers. At the base, the cellular modem is connected to the receiver. At the rover, the cellular modem can be connected to the receiver or the controller.

**Note** – Cellular modems used with the Trimble Survey Controller software must support Hayes compatible AT commands.

Base receivers used with modems must support CTS flow control.

You can use the Trimble Survey Controller software to configure the radios. For more information, see [Configuring a radio using the Trimble Survey Controller software](#).

**Note** – The 450 MHz internal radio in a Trimble R8 or R6 receiver can also operate as a base radio if it is configured as a transceiver. This avoids having to use an external radio solution at the base receiver to broadcast base data.

## Radio considerations

Real-time survey methods rely on trouble-free radio transmission.

**Note** – The precision of measured points is not affected by radio performance.

To reduce the effects of interference from other base stations operating on the same frequency, use a transmission delay for your base station that does not coincide with others on the same frequency. For more information, see [Operating Several Base Stations on One Radio Frequency](#).

Sometimes the conditions or topography of a site adversely affect radio transmission, resulting in limited coverage.

To increase site coverage:

- Move the base stations to prominent points around the site.
- Erect the base radio antenna as high as possible.
- Use radio repeaters.

**Tip** – Double the height of the broadcast antenna to increase the coverage by approximately 40 %. To achieve the same effect, it would be necessary to quadruple the radio broadcast power.

## Radio Repeaters

Radio repeaters increase the broadcast range of a base radio by receiving the base transmission and then rebroadcasting it on the same frequency.

Trimble provides five radio solutions for use with the Trimble Survey Controller system.

You can use one repeater with the TRIMTALK 450S (12.5 kHz) radio, and one or two repeaters with the TRIMTALK 450S (25 kHz) radio. For details of the TRIMMARK 3, TRIMMARK II / IIe, TRIMCOMM, and Pacific Crest radios, please refer to the specific product documentation.

You can configure the R8/R6 Trimble Internal radio to repeat base data to other rovers while performing a rover survey. This is known as a roving repeater setup. The internal radio can repeat the base signal over its UHF communication link to other rovers while simultaneously performing a rover survey. This option is available in R8 and R6 receivers with internal radios that are configured as transceivers. Select this repeater mode when you connect to the R8/R6 internal radio from the *Rover radio options* screen in the Survey Style.

**Note** – To use any of these radios as repeaters, they must be configured as repeaters. To do this, follow the steps above to connect to the radio and then choose a repeater mode, which appears if the radio you are connected to supports being a repeater. Alternatively, if the radio has a front panel, use that to set the repeater mode.

## Cellular Modem – Overview

In a real-time survey, you can use an external cellular modem or Trimble Internal GSM/GPRS module as the corrections data link between the base and the rover receivers. You can also use an external cellular modem to connect to the Internet to exchange data and e-mail.

For information on connecting to an Internet Service Provider (ISP), refer to the Windows CE Help on the controller.

To perform an Internet real-time survey, use one of the following methods:

- Receive base data from a service provider, using a system such as GPSnet or GPSbase.
- Use your own remote base station that is also connected to the Internet by a cellular modem or Trimble Internal GSM/GPRS module. If you use this method, you must have a Trimble Survey Controller data collector connected at all times at the base.

If you use your own base station connected to the Internet, you can set up the base station to operate as a server that the rover will connect to, or to transfer the data to a distribution server. When the base operates as a server, the number of rover connections to that base is limited by the capacity of the base Internet connection. In some cases, only one rover connection may be possible. When the base transfers data to a distribution server, the distribution server can send the base data to many rovers.

To use a cellular modem or Trimble Internal GSM/GPRS module to connect the controller to the Internet, see [Connecting to the Internet](#).

To use a cellular modem or Trimble Internal GSM/GPRS module in an Internet real-time survey, [configure](#) the base and rover radio as an Internet connection when you create or edit a Survey Style. The cellular modem must support an Internet connection.

You can use a cellular modem in dial-up mode to receive base data from a service provider that uses a modem as the service data link, or from a remote base station that is also equipped with a cellular modem. When you use your own base station, the rover cellular modem dials directly to the base cellular modem. The

cellular modem can be connected to the receiver or to the controller. Alternatively, you can use the Trimble Internal GSM/GPRS module in a Trimble R8 receiver.

To use a cellular modem or Trimble Internal GSM/GPRS module in a dial-up real-time survey, [configure](#) the base and rover radio for a dial-up connection when you create or edit a Survey Style. The modem must support Hayes compatible AT commands.

## Dial Profiles

If you use a cellular modem as the corrections data link for a real-time survey, you can create and configure the Internet or dial-in connection from *Configuration / Dial profiles*.

To access the dial profiles when you [configure the base or rover modem](#), tap the field menu (right arrow) on the *Dial profile* field.

To add, edit, or delete entries in dial profiles, tap *Configuration / Dial profiles* from the main menu.

### Creating and configuring dial profiles

You can select a dial profile when you configure the rover radio for your survey style:

1. Create a survey style with one of the following rover radio types:
  - ◆ Cellular modem.
  - ◆ Internet connection.
  - ◆ Trimble internal – GPRS Internet.
  - ◆ Trimble internal – GSM dial-up.
2. In the *Dial profile* field that appears in the base/rover radio form, tap the field-menu (right arrow) button. The *Dial profiles* form appears.
3. Tap the required dial profile name.  
The profile is automatically entered in the *Dial profile* field.

### To create a new dial profile:

1. From the main menu, select *Configuration / Dial profiles*.
2. Tap *New*.
3. Enter the *Profile name* and *Profile type* and then enter all of the dial profile details. If you are using a Bluetooth modem, select one from the drop down list or tap *Config* to perform a Bluetooth scan.
4. Tap *Store*.

**Note** – You can also create and edit profiles by editing the [DialProfiles.xml] file that is stored in the Trimble Data folder. To do this this, copy the file to your computer using ActiveSync technology, edit the file and then load it back into the Trimble Data folder.

### To delete a dial profile:

1. From the main menu, select *Configuration / Dial profiles*.



2. Highlight the entry that is to be deleted.
3. Tap *Delete*.
4. When asked if you want to permanently delete the profile, tap *Yes*.

#### **To create an Internet connection using dial profiles:**

1. From the main menu, select *Configuration / Dial profiles*.
2. Highlight a dial profile that is configured for an Internet connection.
3. Tap the *Connect* button at the bottom of the *Dial profiles* form. An Internet connection is established and a check mark appears next to the profile to show that it is in use.
4. To end the Internet connection, highlight the dial profile and then tap *Hang up*.

If you start a GPRS survey after you establish an Internet connection in *Dial profiles*, then the Trimble Survey Controller software uses this connection for the GPRS survey.

## **Cellular Modem Dial-up Survey Configuration**

### **Configuring a Survey Style for a Cellular Modem Dial-up Real-Time Survey**

Before you start a survey using a cellular modem connected to the controller with Bluetooth, make sure that the phone is paired with the controller.

*Bluetooth pairing* must establish that both the controller and the modem have permission to communicate with each other.

To start the pairing process with a Bluetooth modem:

1. Make sure that the phone is turned on and that it is in *discoverable* mode.
2. Select *Configuration / Controller / Bluetooth* and then click on the *Config* button to bring up the Bluetooth configuration screen for the controller.

**Note** – If you are using a Trimble R8 or R6 receiver with an Internal GSM/GPRS module, you do not need to scan for the module separately from the receiver.

The Trimble R8/R6 receiver and the Internal GSM/GPRS module are recognized by a Bluetooth scan as being the same device but with serial port and dial-up networking capabilities.

To configure the base/rover radio for a cellular modem that uses a dial-up (circuit switched) connection to another modem:

1. From the main menu, select *Configuration / (Selected Survey Style) / Base/Rover radio*.
2. In the *Type* field, select *Cellular modem*.
3. If you are connecting the cellular modem directly to the controller using a cable or Bluetooth, select the *Route through SC* check box.
4. In the *Dial profile* field, select a profile.

Do one of the following:

- From the *Dial profile* field, tap the field menu (right arrow) button to access the [dial profiles](#) form. Select a dial profile from the list or create a new dial profile.
  - ◆ If you are configuring a rover modem, enter the phone number of the base station modem in the dial profile.
  - ◆ If you are connecting to a modem through Bluetooth wireless technology, make sure that you select the Bluetooth modem you are using in dial profile.
- Enter the dial profile name for a profile that you have already configured.

## Configuring a Survey Style for a Trimble Internal GSM/GPRS Module Dial-up Real-Time Survey

Before you start a survey using a Trimble Internal GSM/GPRS module:

1. Connect the controller to the Trimble R8 or R6 receiver that has an Internal GSM/GPRS module with Bluetooth technology installed.
2. Select *Configuration / Controller / Bluetooth*. In the *Connect to GPS receiver / S Series* field, select the receiver.

To configure the base/rover radio for a Trimble Internal GSM/GPRS module that uses a dial-up (circuit switched) connection to another modem:

1. From the main menu, select *Configuration / (Selected Survey Style) / Base/Rover radio*.
2. In the *Type* field, select *Trimble Internal*.
3. In the *Method* field, select *GSM Dial-up*.
4. In the *Dial profile* field, select a profile.

Do one of the following:

- From the *Dial profile* field, tap the field menu (right arrow) button to access the [Dial profiles](#) form. Select a dial profile from the list or create a new dial profile.
  - ◆ Enter the phone number of the base station modem in the *Number to dial* field.
  - ◆ Select the name of the Trimble R8 receiver in the *Bluetooth modem* field.
- Enter the dial profile name for a profile that you have already configured.

When you start a survey using the Trimble Internal GSM/GPRS module, Trimble Survey Controller software dials the base station's modem and then begins the survey. For more information, see [Starting a Real time survey using a dial-up GSM connection](#).

The following table shows cellular modem commands and information that may be useful when completing a new *Dial profile*.

Field	Information required	Functions of command
Modem PIN (optional)	Number (4–8 digits).	Unlocks the cellular modem.
Init string (optional)	Command <b>Note</b> – For the base modem, the command must leave the modem in auto-answer mode. Alternatively, set the auto-answer mode separately, using a Terminal program.	Starts communication and sets up modem options.

Hang up	Command	Ends communication.
Dial prefix	Command	Command used to initiate dialing number.
Number to dial	Phone number of the base station modem. <b>Note</b> – Use a comma (,) to send a short delay, for example, to separate the area code from the number.	–
Dial suffix (optional)	Command	Software sends to the modem after it has dialled the number.
–	<b>Note</b> – The Dial prefix, Number to dial, and Dial suffix values are concatenated to send to the modem.	–
Post connect (optional)	Once the connection is established between the base and rover modems, information is sent from the rover to the base. This is usually the log-in name and password. <b>Note</b> – Use a caret (^) to send a carriage return and a 3-second delay to the base system. For example, use this to separate a log-in name from a password.	–

For information on starting a Real-time survey using a cellular modem, see:

[Starting the Base Receiver](#)

[Starting a Real-time Survey using a Cellular Modem](#)

[Starting a Wide-Area RTK Survey](#)

## Cellular Modem Internet Survey Configuration

### Configuring a Survey Style for an External Internet Real-Time Survey

To configure the base/rover radio to use an external Internet connection:

1. From the main menu, select *Configuration / (Selected Survey Style) / Base/Rover radio*.
2. In the *Type* field, select *Internet connection*.
3. In the *Dial profile* field, select a profile for the connection type.

Do one of the following:

- From the *Dial profile* field, tap the field menu (right arrow) button to access the [dial profiles](#) form. Select a dial profile from the list or create a new profile.
- Enter the dial profile name for a profile that you have already configured.

To configure a new dial profile to use an external Internet connection:

1. Do one of the following:

- If you are configuring a rover connection, enter the *IP Address* and *IP Port* number of the server you are connecting to as a source for base data into the *Edit dial profile* form.
- If you are configuring a base connection to operate as a server, enter the *IP Port* number the rover will connect to into the *Edit dial profile* form. Enter this same *IP Port* number when you configure the rover survey style.
- If you are configuring a base connection to upload to a remote server, enter the *IP Address* and *IP Port* of the remote server into the *Edit dial profile* form.

Obtain the IP address of the base from the Internet GPS correction data provider, or the IP address of the controller (if you are using a controller at the Internet base).

2. If the rover is to connect to the base through [NTRIP](#), select the *Use NTRIP* check box. If required, enter an NTRIP username and password. The proxy server check box appears when you select the NTRIP check box. If the rover is to connect to the proxy server, select the check box and then enter the proxy server address and port.
3. If the rover must supply identification information through regular NMEA messages to the base data server, select the *Send user identity info* check box. At the start of the survey, the software asks you to enter this information.
4. In the *Use connection* field, key in a network connection or select one from the pop up directory. To create a network connection, see [Connecting to the Internet](#).
5. In the *Connection type* field select the method your modem uses to connect to the Internet:
  - If your modem uses GPRS, select *GPRS*.
  - If your device is a CDPD modem, select *CDPD*.
  - If you are using a dial-up Internet connection where a phone number is used to dial your ISP, then select *Dial-up*.
6. If required, enter the *Modem PIN* and Access Point Name (APN) for the external modem.
7. If your GPRS provider requires a user name and password for a network connection, select the *Show connect dialogue* check box in your dial profile. The system prompts you to enter a user name and password before it establishes a network connection.

**Note** – If you are connecting to a cellphone through Bluetooth for an Internet connection, you must select the cellphone in the *Bluetooth modem* field of the *Edit dial profile* form.

### Configuring a Survey Style for a Trimble Internal GSM/GPRS Module Internet Real-Time Survey

**Note** – To use the Trimble Internal GSM/GPRS module for Internet real-time surveys, connect the controller to the receiver using Bluetooth.

To configure the base/rover radio of a Trimble Internal GSM/GPRS module to use an Internet connection:

1. From the main menu, select *Configuration/ (Selected Survey Style) / Base/Rover radio*.
2. In the *Type* field, select *Trimble internal*.
3. In the *Method* field, select *GPRS internet*.
4. In the *Dial profile* field, select a profile for the connection type.

Do one of the following:

- From the *Dial profile* field, tap the field menu (right arrow) button to access the [dial profiles](#) form. Select a dial profile from the list or create a new profile.
- Enter the dial profile name for a profile that you have already configured.

To configure a new dial profile to use a Trimble Internal Internet connection:

1. Do one of the following:

- If you are configuring a rover connection, enter the *IP Address* and *IP Port* of the server you are connecting to as a source for base data into the *Edit dial profile* form.
- If you are configuring a base connection to operate as a server, enter the *IP Port* number the rover will connect to into the *Edit dial profile* form. Enter this same *IP Port* number when you configure the rover Survey Style.
- If you are configuring a base connection to transfer to a remote server, enter the *IP Address* and *IP Port* of the remote server into the *Edit dial profile* form.

Obtain the IP address of the base from the Internet GPS correction data provider, or the IP address of the controller (if you are using a controller at the Internet base).

2. If required, enter the *Modem PIN* and Access Point Name (APN) for the external modem.
3. If the rover is to connect to the base through [NTRIP](#), select the *Use NTRIP* check box. If required, enter an NTRIP username and password. The proxy server check box appears when you select the NTRIP check box. If the rover is to connect to the proxy server, select the check box and then enter the proxy server address and port.
4. If the rover must supply identification information through regular NMEA messages to the base data server, select the *Send user identity info* check box. At the start of the survey, the software asks you to enter this information.
5. If your GPRS provider requires a username and password for a network connection, select the *Show connect dialogue* check box. The system prompts you to enter a username and password before it establishes a network connection.
6. In the *Use connection* field, key in a network connection or select one from the pop up directory. To create a network connection, see [Connecting to the Internet](#).

When you start the survey, Trimble Survey Controller establishes a network connection with the Trimble Internal GSM/GPRS module and then begins the survey. For more information, see [Starting a Real time survey using a GPRS internet connection](#).

**Note** – The *Access Point Name (APN)* that you key in provides network routing and connection information for the service being requested. You can obtain this information from your GPRS service provider.

**Note** – If the IP address of the base controller appears to be invalid, Trimble recommends that you perform a soft reset of the device before you connect to the Internet and start the base.

**Note** – If you are using the R8 or R6 Trimble Internal modem for an Internet connection and you are connected to the receiver through Bluetooth wireless technology, you must select the receiver in the *Bluetooth modem* field of the *Edit dial profile* form.

## Networked Transport of RTCM via Internet Protocol (NTRIP)

NTRIP uses the Internet to distribute real-time GPS base station data.

When the radio type is set to *Internet connection*, the *Use NTRIP* check box appears in the rover radio screen. In this screen, enter the IP address or the domain name and port number of the NTRIP server to connect to. If the Internet connection you are using at the rover requires a proxy server to access the Internet, select the *Use proxy server* check box and enter the name of that server and the proxy server port.

When this is correctly configured and you start the survey, a connection is established to the NTRIP server. In addition, a table appears showing the available sources of corrections from the server. These can be single station sources, or network sources (for example, VRS). The type of base station data that this "mount point" provides is shown in the source table. Select the source that you want to use. When you do this, a connection is made to that source, and base station data begins to stream through Trimble Survey Controller to the connected GPS receiver.

**Note** – To determine the closest source, tap the *Distance from here* heading to sort that column.

If authentication is required to connect to a particular mount point, the Trimble Survey Controller software displays a screen where you can enter your user name and password.

## Connecting to the Internet

To connect to the Internet, you need a cellular modem (typically, a cell phone). The cellular modem can be connected to the controller by Bluetooth wireless technology or by cable.

To connect by cable, use the cellular modem data cable connected to the serial port on the controller. Then create a [new dialing location](#) and [dial-up connection](#).

### To connect to the Internet using a Bluetooth cellular modem:

A Bluetooth cellular modem can connect to a Trimble ACU, or to a TSCe with a BlueCap using Bluetooth.

1. Make sure that Bluetooth is enabled, and that the cellular modem is paired and connected. For more information, see [Bluetooth](#).
2. On the controller, run the application [Bluetooth2Mobile] to associate your phone with Dial-up networking.
  - On the Trimble ACU and TSCe controllers, double-tap [My computer] and browse to \Disk\Program Files\Survey Controller\, then double-tap Bluetooth2Mobile.exe.
3. Select your cellular modem from the drop down list. Tap [Hide] to minimize the application to the toolbar. Then follow the remaining steps below.

**Note** – You cannot connect to the Internet using the Trimble Internal GSM / GPRS module unless the controller is running the Trimble Survey Controller software.

### **To create a new dialing location on a Trimble ACU or TSCe controller:**

1. On the controller, tap [Start / Settings / Control Panel / Dialing].
2. Tap [New]. Enter an appropriate name for the dialing location and then tap [OK].
3. Edit the [Dial patterns]:
  - On the Trimble ACU and TSCe, tap [Dial patterns].
4. Set the [Local], [Long distance], and [International calls] fields all to "g". Tap [OK].

This ensures that the controller does not add any automatic long distance or area codes to the number that it dials.

### **To create a new Dial-up Connection on a Trimble ACU or TSCe controller:**

1. On the controller, tap [Start / Settings / Control Panel / Network and Dial-up Connections].
2. Double tap [Make new Connection]. Enter a connection name.
3. Make sure that the connection type is set to [Dial-up Connection]. Tap [Next].
4. Do one of the following:

- ◆ If you are using Bluetooth wireless technology, select [BluetoothDUN].
- ◆ If you are using a cable, select either [Com1: Hayes Compatible] or [Com2: Hayes Compatible].

**Note** – Do not change the settings on the [Configure], [TCP/IP Settings] or [Security Settings] softkeys. The windows defaults are correct.

5. Tap [Next].
6. In the [Phone number] dialog, enter the number to dial:
  - ◆ If you are dialing a GSM provider (pay by the minute), enter the number to dial.
  - ◆ If you are dialing a GPRS provider (pay by volume of data transferred), enter \*99\*\*\*1#. The \*99\*\*\*1# is a standard access code for GPRS. If you are unable to connect using \*99\*\*\*1#, contact your GPRS provider.

### **To start the Internet connection on the Trimble ACU or TSCe controller:**

1. Make sure that the cellular modem is switched on and connected to the controller.
2. On the controller, tap [Start / Settings / Network/Dial-up Connections].
3. Double tap the new connection that you created earlier.
4. If necessary, enter the [User Name] and [Password] required by your GPRS provider to log onto their network. Many providers do not require a user name or password.
5. Tap [Connect].
6. When you are connected, tap [Hide].

**Tip** – To check that you are connected to the Internet, tap [Start / Programs / Internet Explorer] and visit a website, for example, [www.trimble.com](http://www.trimble.com)

To configure an Internet Real–Time Survey see [Configuring a Survey Style for an Internet Real–Time Survey](#).

## Bluetooth

You can configure a Trimble controller (Trimble ACU or TSCe with a BlueCap attachment) to connect to other devices using Bluetooth wireless technology.

On the controller, you can establish a connection to:

- Another Trimble controller (Trimble ACU or TSCe with a BlueCap)
- A Trimble R8, R6, or 5800 GPS receiver
- A Bluetooth capable PC

### To configure one controller to connect to another controller:

1. Switch on both controllers.
2. On both controllers, start the Trimble Survey Controller software and then select *Configuration / Controller / Bluetooth* from the main menu.
3. On both controllers, tap *Config*.
  - ◆ On a Trimble ACU or TSCe controller, make sure that the [Enable Bluetooth] check box is selected.
4. Start a scan on **one** controller:
  - ◆ On a Trimble ACU or TSCe controller, tap [Scan].  
(Do not use [Stop] – wait for the scan to complete.)

The Trimble Survey Controller software searches for other Bluetooth wireless technology devices within range.

Do not perform a scan on more than one controller at a time. A Bluetooth device cannot respond if it is scanning.

5. Once the scan is complete, highlight the Bluetooth device to connect to
  - ◆ On a Trimble ACU or TSCe controller, tap the → softkey to make it a Trusted device.

When connecting one controller to another controller, you do not need to Authenticate the device. When the authentication message appears, tap [No].

6. On both controllers, tap [OK] to return to the Trimble Survey Controller software.
7. On the controller that is **sending** the data, select the controller you are sending to in the *Send ASCII data to* field. Tap *Accept*.

The controllers are now configured to [send and receive](#) ASCII data.

**Note** – You can give your controller a unique name. This makes it easier to identify when searching for it in a Bluetooth scan. To do this:



- On a Trimble ACU or TSCe controller, go to [Start \ Settings \ Control Panel \ System]. Tap the [Device Name] tab and change the [Device name] field, and then tap [Ok]. To reset the controller, go to [Start \ Programs \ Utilities\Reset \ Soft Reset].

**Warning** – Bluetooth wireless connections are made between specific Bluetooth devices. If you swap one BlueCap attachment on a TSCe controller for another attachment, you must perform another Bluetooth Scan.

**To configure Trimble Survey Controller software to connect to a Trimble R8, R6, or 5800 GPS receiver:**

1. Switch on the receiver and the controller.
2. Start the Trimble Survey Controller software and then select [Configuration / Controller / Bluetooth] from the main menu.
3. Tap *Config* and ensure that the Bluetooth wireless technology is switched on:
  - ◆ On a Trimble ACU or TSCe controller, make sure that the [Enable Bluetooth] check box is selected.
4. Start a scan on the controller:
  - ◆ On a Trimble ACU or TSCe controller, tap [Scan].  
(Do not use [Stop] – wait for the scan to complete.)

The Trimble Survey Controller software searches for other Bluetooth devices within range. A Trimble R8, R6, or 5800 GPS receiver does not respond to a scan if it is already connected through Bluetooth wireless technology.

5. Once the scan is complete, highlight the Bluetooth device to connect to.
  - ◆ On a Trimble ACU or TSCe controller, tap the → softkey to make it a Trusted device.

When connecting a controller to a Trimble R8, R6, or 5800 GPS receiver, you do not need to Authenticate the device. When the authentication message appears, tap [No].

6. Tap [OK] to return to the Trimble Survey Controller software.
7. In the *Connect to GPS receiver / S Series* field, select the Trusted Bluetooth device to connect to and then tap *Accept*.  
The Trimble Survey Controller software automatically connects to the Trimble R8, R6, or 5800 GPS receiver within a few seconds.

**Note** – Unless you change the *Connect to GPS receiver / S Series* fields to None, you do not need to use the scan function again. The controller automatically connects to the receiver when you turn on both devices.

**Warning** – If you are using a TSCe controller, do not connect or remove the Bluecap when the controller is switched on. The connection to a Bluetooth device could break and you may need to perform a soft reset on the controller to reconnect.

**To configure Trimble Survey Controller software to connect to a Bluetooth cellular modem:**

1. Switch on the cellular modem and the controller.
2. On the cellular modem, select the option to make the cellular modem discoverable.

3. Start the Trimble Survey Controller software and then select [Configuration / Controller / Bluetooth] from the main menu.
4. Tap *Config* and make sure that the Bluetooth wireless technology is switched on:
  - ◆ On a Trimble ACU or TSCe controller, make sure that the [Enable Bluetooth] check box is selected.
5. Start a scan on the controller:
  - ◆ On a Trimble ACU or TSCe controller, tap [Scan].  
(Do not use [Stop] – wait for the scan to complete.)
6. Once the scan is complete, highlight the cellular modem in the list of devices.
  - ◆ On a Trimble ACU or TSCe controller, tap the → softkey to make it a Trusted device.

When prompted to authenticate the device, select [Yes].

When the [Enter Pin] dialog appears, enter a PIN of your choice, for example, 1234. Do not tap [OK] until you complete step 7.

7. On the cellular modem, select the appropriate option to accept a pairing request.  
For example, on the Sony Ericsson T68i, you need to select [Connect (8) | Bluetooth (4) | Paired Devices (2) | Add Device | Phone accepts (2)].

**Note** – The controller **must** become a paired/trusted device on the phone.

8. To complete pairing the devices:
  - ◆ On a Trimble ACU or TSCe controller, tap [OK] on the [Enter Pin] dialog.The cellular modem prompts you to add the controller as a paired device and allows you to enter the corresponding PIN you selected in step 8.

The controller is now listed as a paired device on the cellular modem, and the cellular modem is added to the list of trusted devices on the controller.

9. Tap [OK] to return to the Trimble Survey Controller software.

**Note** – If you use the Trimble Survey Controller software to dial a base station directly using a Bluetooth cellular phone, do not run [Bluetooth2Mobile.exe]. If you do, the software cannot connect to the modem; the error message *Connection failed* appears.

To connect to the Internet, you must create a dialing location and start a GPRS connection. For more information see [Connecting to the Internet](#).

To use a cellular modem for real-time surveying, see [Using cellular modems](#).

## Transferring files between controllers

To transfer files between controllers, you can use either the File Transfer application or Microsoft Windows Mobile Beam application. Within the application, and depending on the controllers that you are transferring files between, you can use Bluetooth wireless technology, Infrared (IrDA), a serial cable, or a network cable (TCP/IP).

The application and the connection types that you can use to transfer files between controllers are as follows:

\* = this feature is supported

– = this feature is not supported

From	To	Recommended application	Bluetooth	Infrared	Serial cable	Network
TSC2	TSC2	Beam	*	–	–	–
		File Transfer	*	–	*	–
	TCU	Beam	–	–	–	–
		File Transfer	*	–	*	–
	TSCe	Beam	–	–	–	–
		File Transfer	*	–	*	–
	ACU	Beam	–	–	–	–
		File Transfer	*	–	*	–
TCU	TSC2	File Transfer	*	–	*	–
	TCU	File Transfer	*	–	*	–
	TSCE	File Transfer	*	–	*	–
	ACU	File Transfer	*	–	*	–
TSCe	TSC2	File Transfer	*	–	*	–
	TCU	File Transfer	*	–	*	–
	TSCe	File Transfer	*	*	*	*
	ACU	File Transfer	*	–	*	*
ACU	TSC2	File Transfer	*	–	*	–
	TCU	File Transfer	*	–	*	–
	TSCe	File Transfer	*	–	*	*
	ACU	File Transfer	*	–	*	*

### Using the File Transfer Application to send files between controllers

You can use the File Transfer Application to transfer any type of file between controllers, using Bluetooth wireless technology, Infrared (IrDA), a serial cable, or a network cable (TCP/IP).

See the table [above](#) for details on the connection types supported between different controllers.

To configure the transfer method:

1. Start the Trimble Survey Controller software and then select *Files / Import/Export / File Transfer Application* from the main menu.

**Note** – You can also open the File Transfer Application from outside the Trimble Survey Controller software:

- ◆ On a TSC2 controller, open the application from [Start / Programs / File Transfer].
  - ◆ On a Trimble CU, ACU, or TSCE controller, open the application from [Start / Programs / Utilities/ File Transfer].
2. Tap [Settings].
  3. To be asked which transfer method to use each time you transfer a file, select [Always ask which transport to use].
  4. To use the same transfer method each time, select [Always connect using:], and use the [Choose] softkey to select your transfer method.
  5. Configure the other options as appropriate.

Before you can transfer files using Bluetooth, you must configure the Bluetooth devices:

1. Enable Bluetooth on both controllers:
  - ◆ On a TSC2 controller, tap [Start / Settings / Connections / Bluetooth]. Make sure that the [Turn on Bluetooth] and [Make this device discoverable to other devices] check boxes are selected.
  - ◆ On a Trimble CU, ACU, or TSCE controller, tap [Start / Settings / Control Panel / Bluetooth Device Properties]. make sure that the [Enable Bluetooth] check box is selected.
2. Start a scan on one controller:
  - ◆ On a TSC2 controller, tap the [Devices] tab and then tap [New Partnership...].
  - ◆ On a Trimble CU, ACU, or TSCE controller, tap [Scan].  
(Do not use [Stop] – wait for the scan to complete.)

Do not perform a scan on more than one controller at the same time. A Bluetooth device cannot respond if it is scanning.

4. Once the scan is complete, highlight the Bluetooth device to connect to.
  - ◆ On a TSC2 controller, tap the [Next] softkey.  
When connecting one controller to another controller, you do not need to enter a passkey. Tap [Next].  
Enter a display name for the device and then tap [Finish].
  - ◆ On a Trimble CU, ACU, or TSCE controller, tap the --> softkey to make it a Trusted device.  
When connecting one controller to another controller, you do not need to Authenticate the device. When the authentication message appears, tap [No].

To transfer files using the File Transfer Application and Bluetooth wireless technology:

**Note** – You can transfer only one file at a time with the File Transfer Application.

1. Use Bluetooth wireless technology to connect the controllers, as described above.
2. On both controllers, start the Trimble Survey Controller software and then select *Files / Import/Export / File Transfer Application* from the main menu.

**Note** – You cannot transfer files that are in use by the Trimble Survey Controller software. To make sure that files transfer successfully, close the software.

3. On the controller that is to **receive** the file, select [File / Receive]. If required, select the transport to use.
4. On the controller sending the file, highlight the file and select [File / Send to / File Transfer]. If required select the transport to use.
5. Select [OK].  
The file will be transferred.

### Using the Microsoft Windows Mobile Beam program to send files between controllers

You can use the Beam program on Microsoft Windows Mobile software for Pocket PCs to transfer any type of file between two TSC2 controllers, or from a TSC2 controller to an office computer using Bluetooth wireless technology.

**Note** – You can only transfer one file at a time with Beam.

To transfer files using Beam:

1. Enable Bluetooth wireless technology on the controller/s.
  - ◆ On a TSC2 controller, tap [Start / Settings / Connections / Bluetooth].  
Make sure that the [Turn on Bluetooth] and [Make this device discoverable to other devices] check boxes are selected.
2. Close the Trimble Survey Controller software. Otherwise, the file transfer may fail.
3. On the controller that is to **send** the file, select [Start / Programs / File Explorer].  
Browse to find the file to send.
4. Set up the device that will **receive** the file.
  - ◆ If you are sending to another TSC2 controller, browse to [Start / Settings / Connections / Beam] and make sure that the *Receive all incoming beams* check box is selected.
  - ◆ If you are sending to an office computer, you must initiate the computer to receive a file.
5. On the controller **sending** the file, tap and hold on the file and then tap [Beam File].
6. The controller scans for devices within range. Select the device that you want to send the file to.
7. On the receiving device, accept the file. The file is transferred.

For help with Bluetooth issues, go to [Troubleshooting](#).

You can use Bluetooth wireless technology to establish a connection between a Trimble CU and an office computer, and then you can transfer files using Bluetooth and the Trimble Data Transfer utility or Microsoft ActiveSync. For more information, see [Using Bluetooth to Connect a Trimble CU to an Office Computer](#).

# Instruments

## Instrument Menu

This menu provides information about the instrument connected to the Trimble Controller, and is used to configure the settings.

Available options depend on the instrument that is connected.

For more information on GPS instrument controls, see the following topics:

[Satellites](#)

[Receiver Files](#)

[Position](#)

[Receiver Status](#)

[GSM Status](#)

[Receiver settings](#)

[Navigate to Point](#)

[Network/Reference Station Status](#)

For more information on conventional instrument controls, see the following topics:

[Electronic Level](#)

[Direct Reflex](#)

[Turn to](#)

[Joystick](#)

[Tracklight](#)

[Autolock and Search Controls](#)

[Instrument Settings](#)

[Radio Settings](#)

[Adjust](#)

## Satellites

To see information about the satellites currently being tracked by the receiver, tap the satellite icon on the status bar or select *Instrument / Satellites* from the main menu.

A satellite is identified by the space vehicle (SV) number.

- GPS satellite numbers are prefixed with a "G".
- GLONASS satellite numbers are prefixed with an "R".

The satellite positions can be represented graphically with the sky plot or textually in a list.

### Sky Plot

To see a sky plot, tap *Plot*.

- Tap *Sun* to see the plot oriented towards the sun.
- Tap *North* to see the plot oriented towards north.
- The outside circle represents the horizon or 0° elevation.
- The inner, solid green, circle represents the elevation mask setting.
- The SV numbers on the diagram are placed in the position of that particular satellite.
- Satellites that are tracked but not used in the position solution appear in blue.
- The zenith (90° elevation) is the center of the circle.

Tap the SV number to view more information about that specific satellite.

### Satellite List

To see the list of satellites, tap *List*.

- In the list of satellites, each horizontal line of data relates to one satellite.
- Azimuth ( *Az* ) and elevation ( *Elev* ) define a satellite's position in the sky.
- The arrow displayed next to the elevation indicates whether the elevation is increasing or decreasing.
- The signal-to-noise ratios (SNR) indicate the strength of the respective satellite signals. The greater the number, the better the signal.
- If L1 or L2 are not being tracked, then a dashed line (-----) appears in the appropriate column.
- The check mark on the left of the screen indicates whether that satellite is in the current solution, as shown in the following table.

Situation	What a check mark indicates
-----------	-----------------------------

No survey is running	Satellite is being used in the current position solution
RTK survey is active	Satellite is common to the base and rover receivers
Postprocessed survey is running	Satellite for which one or more epochs of data have been collected

- To see more information about a particular satellite, tap the appropriate line.

You can also select the following options:

- To stop the receiver tracking a satellite, tap the satellite to display the satellite information and then tap *Disable*.

**Note** – If you disable a satellite, it remains disabled until you enable it again. Even when the receiver is switched off, it stores that a satellite is disabled.

- To change the [elevation](#) mask and the [PDOP](#) mask for the current survey, tap *Options*.
- In a real-time survey, tap *Base* to see which satellites are being tracked by the base receiver. No values appear in the *Az* and *Elev* columns, as this information is not included in the correction message broadcast by the base.
- In a postprocessed survey, the *L1* softkey appears in the *Satellites* dialog. Tap *L1* to display a list of cycles tracked on the L1 frequency for each satellite.

The value in the *CntL1* column is the number of cycles on the L1 frequency that have been tracked continuously for that satellite. The value in the *TotL1* column is the total number of cycles that have been tracked for that satellite since the start of the survey.

- With a dual-frequency receiver, the *L2* softkey appears in the *Satellites* dialog. Tap *L2* to display a list of cycles tracked on the L2 frequency for each satellite.

The *SNR* softkey appears. Tap *SNR* to return to the original screen and view information about the signal-to-noise ratio for each satellite.

## Enabling and Disabling WAAS and EGNOS satellites

When you start a WAAS or EGNOS survey with Trimble Survey Controller, the appropriate satellites are enabled in the receiver so that they can be tracked. Two WAAS satellites are enabled (numbers 122 and 134) and two EGNOS satellites are enabled (numbers 120 and 131).

To use an alternative WAAS or EGNOS satellite, disable the satellite(s) that you do not want to use, and enable the satellite that you want the receiver to track. To do this:

1. Start the survey with the WAAS/EGNOS enabled style.
2. Tap the satellite icon.
3. Tap *Info* and then enter the number of the satellite that you want to enable or disable.
4. Tap *Enable* or *Disable*.

The WAAS/EGNOS satellites remains enabled or disabled until the next time that you start a new survey with Trimble Survey Controller.



## Receiver Files

If the controller is connected to a receiver that supports this function, you can transfer files to and from the Trimble controller to the survey data card on the receiver.

The *Import from receiver* option is available when a Trimble R8, R7, R6, 5700, 4800, or 4700 receiver is in use. Use it to delete files in the connected receiver, or to copy files from the connected receiver to the controller.

The *Export to receiver* option is available when a Trimble R7 or 5700 receiver is in use and has a compact flash card inserted. Use it to copy files from the controller to the connected receiver.

You can transfer the following types of files: R00, T01, DAT, JOB, STY, CSV, TXT, DXF, TIN, CDG, and FAL.

To transfer files from the receiver to the controller:

1. From the main menu, select *Instrument / Receiver files / Import from receiver*.  
The list that appears shows all files stored in the receiver.
2. Tap the file(s) to transfer. A check mark appears next to the selected files.

**Note** – To see more information about a file, highlight the file name and tap *Info*. To delete a file, highlight the file name and tap *Delete*.

3. Tap *Import*. The *Copy file to Trimble Controller* screen appears.
4. Tap *Start*.

To transfer files from the controller to the receiver:

1. From the main menu, select *Instrument / Receiver files / Export to receiver*.  
The list that appears shows all files stored in the \Trimble Data folder in the controller.
2. Tap the file(s) to transfer. A check mark appears next to the selected files.
2. Tap *Export*.
3. Tap *Start*.

## Position

This function displays the current position of the base or rover GPS antenna.

A projection and datum transformation must be defined to view grid coordinates.

The precision of this position depends on which survey method is selected. Precisions are:

- +/- 10 m (no current survey)
- +/- 10 m (postprocessed survey)
- +/- 0.01 m (RTK survey)

To see the current position, from the main menu, select *Instrument / Position*.

If the antenna height is defined, the software calculates the position of the roving antenna. To view the position of the base antenna as well, tap *Base*.

Tap *Options* to find out whether the position is shown as WGS–84, local, or grid.

## Receiver Status

To view the power and memory status of the connected GPS receiver, the GPS time, and the GPS week, select *Instrument / Receiver status* from the main menu.

### GSM Status

To view the GSM signal strength and available network operators when using the R8 or R6 Trimble Internal GSM module, select *Instrument / GSM Status* from the Instrument menu.

Alternatively, tap the cellular modem icon in the status bar.

## Receiver Settings

To view the configuration of the connected GPS receiver, select *Instrument settings* from the main menu.

Alternatively, tap the receiver icon on the status bar.

## Navigate to Point

You can navigate to a point without using a radio link, or without a survey running. If there is no radio link, all positions are autonomous. If radio corrections are received but the receiver is not initialized, all positions are Float solutions. When you start the *Navigate to point* function, it uses the settings in the last GPS Survey Style that you used.

If you are using a GPS receiver that can track WAAS/EGNOS signals, when the radio link is down you can use WAAS/EGNOS positions instead of autonomous positions. To use WAAS/EGNOS positions, set the *Satellite differential field* in the survey style to WAAS or EGNOS.

To navigate to a point:

1. From the map, select the point you want to navigate to.
2. Tap and hold on the map and then select *Navigate to point* from the shortcut menu. Alternatively, select *Instrument / Navigate to point* from the main menu.
3. If you want to display cross-track information, set the *Navigate* field to *From fixed point* or *From start position*.
4. Fill in the other fields as required and then tap *Start*. The graphical display screen appears.

5. Use the arrow to navigate to the point, which is shown as a cross. When you are close to the point, the arrow disappears and a bull's-eye symbol appears.
6. When you are on the point, the bull's-eye symbol covers the cross.
7. Mark the point if required.

## Network / Reference Station Status

When you perform a real-time survey and the reference station or network server that you receive base station data from supports status messaging, the *Network/Reference Station Status* menu option appears. The screen for this menu option shows the reported status of the reference station server, the options the reference station supports (such as *RTK on Demand*), and also enables you to configure notification and storage of the status messages in the current job.

If you select the *Popup new Reference Station* messages check box, messages from the reference station or network server pop up on the screen.

If you select the *Store Reference Station* messages check box, messages from the reference station or network server are stored in the current job database.

## Station Setup Details

To view the instrument type and current station setup information when the controller is connected to a conventional instrument, select *Instrument / Station setup* details from the main menu.

Alternatively, if you are using a mechanical instrument (not a servo or robotic instrument), tap the Instrument icon on the status bar.

## Laser pointer

In a [Direct Reflex](#) survey, the laser pointer eliminates the need to look through the telescope when measuring DR points.

**Note** – When using a 5600 DR200+ instrument, the laser pointer is not coaxial with the telescope.

To turn on the laser:

1. To open the *Trimble Functions* screen, tap the Instrument icon in the status bar, or tap the Trimble key (if available) on the controller.
2. Click the Laser pointer button.

**Note** – If DR is not yet enabled, turning on the laser pointer enables it. If you turn off the laser pointer, the instrument remains in DR mode. However, if you turn off DR mode, the laser is automatically turned off.

To automatically measure to the laser pointer with a non-coaxial 5600 DR200+ or DR300+, configure the Laser alignment setting in *Instrument / Direct reflex*. For more information, see the section on [Laser](#)

alignment in Direct Reflex.

## Electronic Level

The electronic level is available when connected to Trimble S Series, 5600, and 3600 instruments.

### To level a Trimble S Series instrument electronically from startup:

1. Plumb the instrument.
2. Use the tripod legs and the tribrach bubble to roughly level the instrument.
3. Establish a connection between the controller and the instrument. The Electronic level screen appears as part of the connection process.

If the instrument is not level enough, you will get a tilt error. Roughly level the instrument with the tribrach circular bubble to bring the electronic level into range.

4. Turn the footscrews to center the bubbles for the sighting and trunnion axis.
5. To complete the leveling process, tap *Accept*.

### To level a Trimble 5600 instrument electronically from startup:

1. Plumb the instrument.
2. Use the tripod legs and the tribrach bubble to roughly level the instrument.
3. Establish a connection between the controller and the instrument. The Electronic level screen appears as part of the connection process.
4. Turn the footscrews to center the bubbles for the sighting and trunnion axis.
5. To complete the leveling process, tap *Accept*.

The instrument initializes the compensator (unless the *Disable compensator* check box is selected).

When Trimble Survey Controller connects to a Trimble 5600 instrument, the compensator is not reinitialized if it was initialized within the last 2 hours and if the instrument level has not changed by more than 30 seconds.

### To level an instrument electronically during a survey:

1. From the main menu, select *Instrument / Electronic level*.
2. Turn the footscrews to center the bubbles for the sighting and trunnion axis.

For the Trimble 3600 instrument only, the laser plummet is also activated while the Electronic level screen is open.

**Warning** – If accuracy is important, do not disable the compensator. If you do disable the compensator, horizontal and vertical angles in the instrument are not corrected for mis-levelment errors.

## Direct Reflex

When Trimble Survey Controller is connected to an instrument with Direct Reflex (DR), select *Instrument / Direct Reflex* to configure the DR settings.

**Tip**– For fast access to configure the DR settings, tap the instrument icon in the status bar or press the Trimble key, and tap and hold on the DR icon.

The following settings are available if supported by the instrument:

- To enable or disable direct reflex measurement, select *DR*.
- To enable or disable the laser, select *Laser*.
- To take a measurement to where the laser is pointing, set the Laser alignment to *Horizontal* or *Vertical* (depending on the surface you are measuring to). For more information see, [Laser alignment](#).
- To accept measurements at a lower accuracy (that is, below the normal instrument specification), enable weak signal.
- To define the acceptable accuracy of a DR measurement, enter a standard deviation value. When measuring to diffuse targets the standard deviation is displayed on the status line until the standard deviation satisfies the defined value. Once the standard deviation is satisfied, the DR measurement is accepted. To accept the DR measurement before the standard deviation is satisfied, tap *Enter* while the standard deviation is displayed on the status line.
- To restrict the DR measurement range, enter a minimum and maximum distance. Use this to avoid a result from a distant or intermittent object.

When using DR with a Trimble S Series, 5600, or 3600 instrument, Target DR is dedicated for DR use. You must configure the prism constant and target height appropriately.

When you turn on DR, Trimble Survey Controller automatically switches to Target DR.

When you turn off DR, the software returns to the last used non-DR target. If the last used target has been deleted, the software uses Target 1.

Alternatively, select *Target DR* to enable DR. Select *Target 1* to disable DR and return the instrument to its previous state.

Trimble Survey Controller supports up to six preconfigured targets, but only one DR target. For more information see, [Target details](#).

### Laser alignment

The laser pointer on a Trimble 5600 DR 200+ or DR 300+ instrument is not coaxial with the EDM. As a result, the location where the DR measurement is observed will not correspond to the location of the laser dot. To configure Trimble Survey Controller to measure to the laser dot, do the following:

1. Enable the laser pointer.
2. Select a laser alignment:
  - None – DR measurement is observed below the laser dot.

- Horizontal – DR measurement is observed at the location of the laser dot provided that the measurement is on a horizontal surface.
- Vertical – DR measurement is observed at the location of the laser dot provided that the measurement is on a vertical surface.

The instrument will turn to the location of the laser dot and perform the measurement. Once the observation is completed, the instrument will turn the laser dot back to the observed point.

For more information, see:

## Surface Scan

## Remote Object

# Turn to





If using a servo or [robotic instrument](#), you can use the *Turn to* options to control how the instrument moves.

To do this:

1. From the main menu, select *Instrument / Turn to*. Alternatively, tap the Instrument icon on the status bar and then click the **Turn to** button on the Trimble Functions screen.
2. Select an instrument control method to turn the instrument to a specified angle or point:
  - ♦ to a horizontal or vertical angle only, enter the angle in the *Turn to* field.
  - ♦ to a horizontal and vertical angle, enter the horizontal angle in the *Turn to HA* field, and the vertical angle in the *Turn to VA* field.
  - ♦ to a specified point, enter a point name in the *Point name* field.
  - ♦ by distance, enter the distance from your current position to the point where the instrument lost lock.
3. Tap *Turn*. The instrument turns to the angle(s) or point you entered.

To turn the instrument horizontally 90° to the right or left, or 180° use the appropriate softkey at the bottom of the screen.

**Tip** – Use the ACU keys to turn the instrument. For example, in *Stakeout*:

-  horizontally only
-  vertically only
-  horizontally and vertically
-  change face

To make the instrument locate and lock on to the target, tap *Search*.  
The message "Searching..." appears and the instrument starts searching for the target.

For information on other methods, see:

- [Joystick](#)
- [Robotic instrument](#)
- [Map of current job](#)

## Joystick









If you are operating a robotic instrument at the remote end (target), use the *Joystick* softkey to turn the instrument towards the target when lock has been lost.

To turn the instrument towards the target:







1. From the main menu, select *Instrument / Joystick*. Alternatively, tap the Instrument icon on the status bar and then tap *Joystick* button on the *Trimble Functions* screen.
2. Tap an arrow on the screen or press the up, down, left, or right arrow keys to turn the instrument. The instrument turns in the direction indicated by the solid/filled arrow.

**Note** – When the instrument is on Face 2, the up and down arrows are reversed. For example, if you press down the instrument turns upwards. If you press up it turns downwards.

3. When using a Trimble S Series, turn the instrument as shown in the following table.

Tap and hold this arrow	to turn the instrument
 or 	horizontally (left or right)
 or 	vertically (up or down)
 ,  ,  , or 	horizontally and vertically

### Notes

- ◆ To stop the instrument turning, release the arrow.
- ◆ To change the direction tap the change direction button (    ,    ).
  - ◇ When the instrument icon is to the left of the prism icon, the instrument turns as if you are standing behind the instrument.
  - ◇ When the instrument icon is to the right of the prism icon, the instrument turns as if you are standing at the pole.
- ◆ To increase or decrease the turning speed, tap the left (decrease) or right (increase) speed arrows.

4. When using a Trimble 5600, turn the instrument as shown in the following table.

Tap this arrow	to turn the instrument
first left or right	horizontally 12°
second left or right	horizontally 120°
first up or down	vertically 1°
second up or down	vertically 5°

Tap *Esc* or another arrow to stop the instrument from turning. The directional arrow becomes hollow. The instrument now points towards the target.

- When using a Leica TPS1100 series instrument, select the same direction to increase the instrument turning speed. The second directional arrow becomes solid. Select the same arrow again to decrease the speed.

Tap *Esc* or another arrow to stop the instrument from turning. The directional arrow becomes hollow. The instrument now points towards the target.

To make the instrument locate and lock on to the target, tap *Search*.

The message "Searching..." appears and the instrument starts searching for the target.

The search results appear in the status line as messages:

- Target Locked – indicates that the target has been located and tracking locked.
- No Target – indicates that the target was not located.

For information on other methods, see:

- [Turn to](#)
- [Robotic instrument](#)
- [Map of current job](#)

## Tracklight

When connected to a Trimble S Series instrument, operate the Tracklight as follows.

To set the speed of the guide-light:

- From the main menu, select *Instrument / Tracklight*.
- Select the *Enable tracklight* check box.
- From the drop down list in the *Speed* field, select *Slow*, *Fast*, or *Auto*.

**Tip** – When *Auto* is selected, the Tracklight flashes fast when the target is locked and slow if there is no target.

To switch on the tracklight or switch it off:



1. Tap the Trimble functions icon.
2. Tap *Tracklight* in the *Trimble Functions* screen.

When connected to a Trimble 3600 or 5600 instrument, operate the Tracklight as follows.

To set the intensity of the guide–light:

1. From the main menu, select *Instrument / Tracklight*.
2. Select the *Enable tracklight* check box.
3. From the drop down list in the *Intensity* field, select *Normal* or *High*.

To switch on the tracklight or switch it off:

1. Tap the Trimble functions icon.
2. Tap *Tracklight* in the *Trimble Functions* screen.


**Tip** – For fast access to configure the Tracklight, tap the instrument icon in the status bar or press the Trimble key, and tap and hold on the Tracklight icon.

**Note** – When *EDM power save* is enabled on a Trimble 5600 DR Standard instrument, the Tracklight is not available.

## Autolock

If Autolock is available on the instrument, use it to lock on to and track a remote target.

To enable/disable Autolock, do one of the following:

- Press the Autolock key  (ACU only).
- To open the *Trimble Functions* screen, tap the instrument icon on the status bar or tap the Trimble key (if available) on the controller.
- Select the Autolock icon.
- From the main menu, select *Instrument / Autolock and Search controls*.

A search is automatically performed if a measurement is initiated when Autolock is enabled but the instrument is not locked to the target.

**Tip**– For fast access to configure the Autolock and search settings, tap the instrument icon in the status bar or press the Trimble key, and tap and hold on the Search icon.

**Note** – Do not use Autolock during the collimation or Trunnion axis tilt tests. For more information, see [Instrument Adjustment](#).

This provides additional Autolock controls:

### Snap to target

This function was previously called *Advanced lock*.

*Snap to target* automatically locks on to a remote target if one is detected.

If you do not want to automatically lock onto a target, set the Autolock method to *Snap disabled*.

**Note** – *Snap to Target* does not check the Target ID.

### Autosearch

Select *Autosearch* to automatically perform a horizontal search when lock is lost to a remote target.

### Predictive Tracking Time

This feature enables you to pass behind a temporary obstruction and have the instrument continue to turn, based upon the target's horizontal trajectory, when lock to the prism is lost.

If the trajectory is consistent and the prism re–appears from behind the obstruction within the defined time interval, the instrument will be aimed directly at the prism and lock is automatically regained.

After the specified time interval, the Trimble Survey Controller software reports that the target is lost and then takes corrective actions based on the current settings.

The instrument turns to where the target was last seen and then acts as follows:

If <i>Autosearch</i> is ...	and <i>Snap to target</i> is <b>ENABLED</b> , the instrument ...	and <i>Snap to target</i> is <b>DISABLED</b> , the instrument ...
On	Locks on to any target in the field of view. If there is no target, a search starts based on your search window settings.	Ignores any visible targets and starts a search based on your search window settings
Off	Locks on to any target in the field of view or waits until a target comes into the field of view and then locks onto it.	Ignores any targets in the field of view and does not start any search until you prompt it to do so.

**Note** – The Trimble Survey Controller software defaults are *Snap to target* **ENABLED** and *Autosearch* **OFF**.

You can configure the Predictive tracking time as follows:

- For standard robotic usage, Trimble recommends the default setting (1s).

This enables you to pass behind anything small blocking the line of sight between the instrument and the target (for example, trees, electrical posts, or vehicles) and then automatically regain lock.

- In environments with a number of reflective objects, you could set the predictive tracking time to 0s. For optimal performance, use this setting with *Snap to target* **DISABLED**.

With these settings, you are immediately informed if the line of sight to the correct target is obstructed. You can then ensure that you regain lock to the correct target.

- In environments where your target may be blocked for a few seconds at a time, you can use settings of 2s or 3s.

This enables you to pass behind larger objects blocking the line of sight between the instrument and the target (for example, small buildings) and then automatically regain lock.

If the instrument fails to regain lock onto the moving target, it returns to the location where it first lost lock and the predictive tracking began.

To change the Predictive tracking time:

1. Do one of the following:
  - ◆ From the main menu, select *Instrument / Autolock and Search controls*.
  - ◆ From the *Trimble functions* form, tap and hold briefly on the **Autolock** or **Search** icon. When you release, the *Autolock and Search Controls* dialog appears.
2. Select the required time from the Predictive tracking time list.

### **Tiltable RMT** (Trimble 5600 only)

Enable *Tiltable RMT* when you use a remote target tilted towards the instrument. Disable *Tiltable RMT* when you use a fixed vertical target. When disabled, the vertical angle measurement will be corrected for the small offset distance between the RMT and the prism center.

### **Autocentered Search Window and Search Window Size**

When performing a search with the Autocentered search window selected, Trimble Survey Controller uses the current horizontal and vertical angle of the instrument to set the center of the search window, and the horizontal and vertical range to calculate the extents of the window. These extents are sent to the instrument each time it performs a search.

If you do not select the Autocentered search window, the search extents are not reset in the instrument.

To configure the top left and bottom right extents of the search window, point and measure with the instrument before starting the robotic survey. For more information, see [Prepare for a robotic survey](#).

### **Target tracking with the Trimble S Series**

If you use a Trimble S Series instrument with search capabilities and a Trimble S Series 360° prism or a Trimble MultiTrack target, you can configure the software to use an Active Target ID.

**Note** – If you use a Trimble S Series instrument with the Trimble MultiTrack target, you must upgrade the instrument to firmware version R7.0.35 or later. The Trimble S Series firmware is available on [www.trimble.com](http://www.trimble.com).

- When using the Trimble MultiTrack target, the **Tracking mode** can be set to *Passive* or *Active*. When the tracking mode is set to *Active*, you can configure the Target ID.
- When using the Trimble S Series 360° prism, the **Target ID** can be set to *Off*, *Search*, *Search and measure*, or *Always*. When the tracking mode is set to *Search*, *Search and measure*, or *Always*, you

can configure the Target ID.

From the following, select the target ID checking method that best suits the equipment you have and the environment that you are working in:

- **Active** – the instrument is always locked to the active target.
- **Search** – check the ID when a search is initiated.
- **Search and measure** – check the ID when a search is initiated, and when a measurement is initiated.
- **Always** – the ID is constantly being checked by the instrument.

#### **Tracking mode – Active**

- If you operate in a highly reflective environment, or on a site with many prisms, set the *Tracking mode* to *Active* to ensure that you maintain constant lock to the correct target.

#### **Check the target ID – Search**

- If you operate in an environment with few reflective surfaces, but you want to ensure that if you do a search you will lock to the correct target, set *Check target ID* to *Search*.
- When the *Check target ID* is set to *Search*, the Target ID is checked after a search is made to ensure that you are locked onto the correct target. If not, the Trimble Survey Controller software warns you and you can perform a new search for the correct target ID.
- If you enable *Snap to target* and the instrument automatically detects the target, the instrument does not perform a search or check the Target ID.
- The target ID must be carefully aimed towards the instrument when performing a search.

#### **Check the target ID – Search and measure**

- If you operate in an environment with few reflective surfaces, but you want additional assurance if you do a search or when you measure that you will lock to the correct target, set *Check target ID* to *Search and measure*.
- When the *Check target ID* is set to *Search and measure*, the Target is checked again before a measurement is made to ensure that the instrument is still locked onto the correct target. If not, the Trimble Survey Controller software warns you and you can then perform a new search for the correct target ID.
- The target ID must be carefully aimed towards the instrument when taking a measurement.

#### **Check the target ID – Always**

- If you operate in a highly reflective environment, or on a site with many prisms, set *Check target ID* to *Always* to ensure that you maintain constant lock to the correct target.
- When the *Check target ID* is set to *Always*, the Target ID is used to actively maintain horizontal lock. The prism is used to maintain the vertical lock.
- The Target ID has two "on" modes; on for 60 seconds, and on continuously. When *Check target ID* is set to *Always*, you must set the Target ID on the pole to "on continuously".
- The target ID must be carefully aimed towards the instrument at all times.

For more information on how to configure the target ID in the Trimble Survey Controller software, see [Target details](#).

For more information on how to configure the target ID on the Trimble pole, refer to the documentation for your instrument.

**Note** – *Target ID* can be used for rounds observations. For the Trimble MultiTrack target, set *Tracking mode* to *Active*. For the Trimble 360° prism, set the *Check target ID* to *Search and measure*. Also, make sure that each target in the rounds list can have a different target ID. These settings are retained for each individual target until the rounds observations are completed.

## Trimble MultiTrack Target

The Trimble MultiTrack target, together with the Trimble S Series, combines the advantages of both passive and active target tracking and the flexibility to instantly choose which method best fits the current task.

To obtain the most accurate measurements with the MultiTrack target ensure that:

- Line of site to the target is maintained during a measurement. When using a Trimble receiver in an integrated survey, ensure that the radio antenna from the receiver does not obstruct the target.
- Ensure that the correct prism type and mode is selected in the target form. This will ensure that the appropriate correction values are applied to the slope distance and vertical angle for geocentric offset and prism constant.
- The MultiTrack target should be used within the vertical angle tolerances shown in the following table:

Tracking mode	Vertical range
Active	+/- 15° from horizontal
Passive	+/- 30° from horizontal

Using the MultiTrack target outside these tolerances may degrade the accuracy of the measurement.

## Instrument Settings

When connected to a Trimble S Series, 5600, or 3600 instrument, select *Instruments / Instrument settings* from the main menu to access the *Instrument settings* dialog. Alternatively, tap and hold briefly on the instrument icon in the status bar and then release to enter *Instrument settings*.

Use this dialog to view and set specific controls on the instrument. Depending on the instrument that the controller is connected to, the following functions may be available:

- instrument name
- instrument model
- instrument firmware version
- reticle illumination
- target test

- face 2 backlight
- signal volume
- EDM power save mode
- long range mode

## **Instrument Name, Instrument Type, and Firmware Version**

In Trimble S Series instruments, tap *Name* to enter the instrument name. The instrument name is stored in the Trimble Survey Controller job file, and can be output to [Export custom format files](#) .

The instrument type and firmware version details are also stored in the Trimble Survey Controller job file and output to DC files and Custom ASCII files.

## **Target test**

The target test is used primarily in Trimble Survey Controller Basic when measuring a distance that is to be displayed as a dead record.

If the instrument is moved more than 30 cm from where the last measurement was observed, the HA and VA are updated but the SD reverts to "?" to avoid mistaking the next target's distance for the previously measured target's distance.

## **Face 2 Backlight** (Trimble S Series only)

To enable the face 2 backlight when Trimble Survey Controller is running, select *Face 2 backlight*.

## **Signal volume** (Trimble 5600 only)

A returned signal sounds if a prism is detected. However, if you have activated EDM power save, you will not hear a signal.

## **EDM power save** (Trimble 5600 DR Standard, and 3600 only)

The power save mode turns off the EDM when the instrument is not measuring a distance. The instrument icon appears without the EDM indicator (\*).

When the power save mode is off, the EDM is always turned on to receive a signal.

**Note** – If *EDM power save* is enabled on a Trimble 5600 DR Standard instrument, the tracklight is not available.

## **Long range** (Trimble S Series and 5600 DR Standard, and 3600 only)

Use the long range mode when a strong instrument signal is required for measuring to targets more than one kilometer (about 0.6 miles) away.

# Radio Settings

These settings are used with a conventional instrument in robotic mode.

The internal radio settings are set when Trimble Survey Controller connects to the instrument. The remote radio settings are set later when you start the rover survey.

You must configure the radio settings to the same values on the instrument and on the rover radios.

**Tip** – To configure the instrument Radio channel and Network ID without Trimble Survey Controller, select *Radio settings* on the Trimble S Series instrument through the *Face 2* menu display.

For more information, refer to the documentation for your instrument.

**Note** – Trimble Survey Controller cannot communicate with the Trimble S Series when the instruments onboard programs are being used. After using the onboard programs, select *Exit* from the *Setup* menu to return to the *Waiting for connection* menu.

**Tip**– For fast access to configure the Radio settings, tap the instrument icon in the status bar or press the Trimble key, and tap and hold on the Start Robotic icon.

## Radio Channel

To avoid conflicting with another user on the same Radio channel, give your instrument radio and rover radio a unique radio channel.

## Network ID

To avoid conflicting with another user on the same Network ID, give your instrument radio and rover radio a unique ID number.

## Station and Remote Address

To avoid conflicting with another user on the same radio channel, give your instrument and radio a unique address. Enter a station and a remote address between 0 and 99.

# Instrument Adjustment

Select *Instrument / Adjust* from the main menu to complete the following tests:

**HA VA Collimation**

**Trunnion axis tilt**

**Autolock collimation**

**Compensator calibration**

On a Trimble S Series instrument, you must perform the HA VA Collimation and the Trunnion axis tilt adjustments together. To start the adjustment wizard, select *Instrument / Adjust / Collimation & Trunnion axis tilt*.

**Note** – *Instrument / Adjust* is not available during a survey. End the current survey to perform an instrument adjustment.

The HA VA collimation, Trunnion axis tilt, and Autolock collimation instrument adjustments can be performed using Trimble Survey Controller, or on the Trimble S Series instrument through the Face 2 menu display. For more information, refer to the documentation for your instrument.

### **HA VA Collimation and Trunnion axis tilt adjustments**

1. Set up the instrument on a stable surface and follow the prompts to complete the test.

Current adjustment values appear for each test (Horizontal collimation, Vertical collimation, and Trunnion axis tilt). Press the keys lightly to avoid bumping the instrument.

2. Aim at the target and take the first measurement.
3. Turn the instrument away and then re-aim.
4. Take the second measurement.

**Note** – Do not use *Autolock* during Collimation or Trunnion axis tilt tests.

Position the instrument as follows:

1. Collimation – at least 100 m from the target.
2. Collimation – less than 4°30' (5 gon) from the horizontal plane.
3. Trunnion axis tilt – at least 13°30' (15 gon) from the horizontal plane (for the 5600) or from the VA measured during collimation (for the Trimble S Series).

You must take a minimum of one observation on each face.

Final collimation values must be within tolerance of standard values. If not, the instrument needs to be adjusted mechanically.

For more information, contact your local Trimble dealer.

### **Autolock collimation**

This option is available only for instruments with *Autolock*, and should be performed after the HA VA Collimation adjustment has been completed.

Set up the instrument on a stable surface and follow the prompts. Press the keys lightly to avoid bumping the instrument. Ensure that there are no obstructions between the instrument and the target, which should be at least 100 m apart.

### **Compensator calibration**



The dual axis compensator in the Trimble S Series and 3600 instruments does not require initialization every time the instrument is leveled. However, Trimble recommends that you calibrate the compensator periodically, especially before you take precise measurements.

On a Trimble S Series instrument, calibrate the compensator through the Face 2 menu display. The instrument handle must be **attached** and the Trimble CU must be **unattached**. For more information, refer to the documentation for your instrument.

To calibrate the compensator in a 3600 instrument:

1. Select *Instruments / Adjust / Compensator calibration*.
2. When prompted, turn the instrument 180° to 0°.
3. Tap *Accept*.

**Note** – This option is not available for the 5600 because the compensator is calibrated when the instrument is leveled.

## Trimble Survey Controller Basic

Trimble Survey Controller Basic is available when you connect a controller to a Trimble S Series, 3600, or 5600 instrument.

You can use it as follows:

- If a Trimble Survey Controller job was created with a station setup, then Trimble Survey Controller Basic can display raw data, and coordinates based on the station setup in the job.
- If a current station setup does not exist, you can:
  - ◆ Make simple distance or angular checks.
  - ◆ Define the Northing and Easting coordinates for the instrument point in Trimble Survey Controller Basic, set the horizontal circle and then display coordinates for points observed using Trimble Survey Controller Basic.
  - ◆ Key in the elevation for the instrument point and then display the elevation for points observed using Trimble Survey Controller Basic.
  - ◆ Observe to a point with a known reference elevation to compute the instrument elevation and then display the elevation for points observed using Trimble Survey Controller Basic.

To compute the instrument point elevation from a known reference point using Trimble Survey Controller Basic:

1. Ensure that a current station setup does not exist and then start Trimble Survey Controller Basic.
2. Tap *Set* and then enter the *Target height*, *Reference elevation*, and *Instrument height*.
3. If required, enter the *Horizontal angle* and instrument point *Northing* and *Easting*.
4. To measure the reference point, tap *Measure*. The instrument point *Elevation* is computed.
5. To return to Trimble Survey Controller Basic, tap *Accept*.

To change the view on the data displayed, tap the arrow button.

## Notes

- If the target height **or** instrument height is null, the Trimble Survey Controller software cannot calculate a VD.
- If target height and instrument height are **both** null, the Trimble Survey Controller software assumes zero for both and can compute the VD, but cannot compute the Elevation.
- If a station setup is computed using Trimble Survey Controller Basic, a scale only projection of 1.0 is used to calculate coordinates.

**Tip** – To quickly access SC Basic, from the Trimble functions screen, press **0**.

**Note** – You cannot store measurements in Trimble Survey Controller Basic.

The following table shows Trimble Survey Controller Basic functions.

Tap the ...	to ...
Trimble functions icon	access the <i>Trimble Functions</i> screen
Instrument icon on the status bar	
Target icon	set or modify the target height
Zero softkey	set the instrument horizontal circle to 0
Set softkey	set the horizontal circle
	set the target height
	set the reference elevation, and compute the instrument elevation
	set the instrument point coordinates, and instrument elevation
	set the instrument height
Options softkey	modify the correction values used in Trimble Survey Controller Basic
Clear softkey	reset the angles back to live and clear the slope distance after a measurement
Display view button	switch the display between HA, VA, SD and HA, HD, VD
Press the ...	to ...
Distance key (ACU only)	measure a distance and continually update the horizontal and vertical angles <b>Note</b> – The distance reverts to ? if target test is enabled and the instrument is turned more than 30 cm from the target.
Enter key	measure a distance and fix the horizontal and vertical angles

**Note** – When a survey is running you cannot change:

- the instrument's horizontal circle
- the instrument point coordinates
- [correction](#) values

# Trimble Functions

To access the *Trimble Functions* screen, do one of the following:

- tap the instrument icon on the controller screen
- tap the Trimble key (if available) on the controller
- select *Instrument / Trimble Functions* from the Trimble Survey Controller main menu

The *Trimble Functions* screen is available for conventional total stations. Use it to control commonly used instrument functions, and to change instrument settings. Depending on the instrument that the controller is connected to, the following functions may be available:

- STD (EDM Standard mode)
- FSTD (EDM Fast Standard mode)
- TRK (EDM Tracking mode)
- [Tracklight](#)
- [Laser](#) (Laser pointer for DR instruments)
- [DR \(Direct Reflex\)](#) mode
- [Electronic level](#)
- [Joystick](#)
- [Turn to](#)
- Change face
- [SC Basic](#)
- [Autolock](#)
- [Search](#)
- [Start Robotic](#)
- Disconnect

## Disconnect

The Disconnect function is available when the controller autoconnects to a Trimble S Series instrument in a robotic survey. To restart the survey and reconnect to the instrument, select *Station setup*. Autoconnect is temporarily disabled when you use *Disconnect*.

Once you begin a survey, this option changes to *End survey*.

## Trimble Functions shortcuts to the Instrument menu

Shortcuts to certain Instrument menu functions are available from *Trimble Functions*. In the *Trimble Functions* screen, tap and hold on the DR, Laser, Tracklight, Autolock, Search and Start Robotic icons to quickly access their Instrument menu configuration screens.

## Geodimeter users

Former Geodimeter users can enter a Geodimeter program number in the *Trimble Functions* screen to launch the corresponding Trimble Survey Controller function. For example, Geodimeter program 26 (Compute join) is the same as the Trimble function *Compute inverse*.

# GDM Data Output

Use GDM data output to stream horizontal angle, vertical angle, slope distance, northing, easting, elevation, date, and time data from a TSCe controller connection to a Trimble S Series instrument, or directly from the COM port of the Trimble S Series instrument.

To enable GDM streamed data output:

1. From the main menu select *Instrument / GDM data output*.
2. Set the *Streamed data* to either *After measurement* or *Continuous*.
3. Select the *Streamed format*.

If the *Streamed format* is set to *User defined*, configure the GDM labels.

4. If necessary, configure the *Port details*.

GDM data output remains enabled while the *GDM data output* form is open. To access other functions in the Trimble Survey Controller software and leave *GDM data output* running, use *Switch to* or *Menu*.

To stop GDM data output, tap *Stop*, or close the *GDM data output* form.

## Supported labels

Label	Text	Description
7	HA	Horizontal angle
8	VA	Vertical angle
9	SD	Slope distance
37	N	Northing
38	E	Easting
39	ELE	Elevation
51	Date	Date
52	Time	Time

## Notes

- If streamed output is on and no new distance is available, the HA and VA labels are sent rather than the user defined labels.
- The angle and distance units match the Trimble Survey Controller system settings.
- The northing, easting, and elevation units match the Trimble Survey Controller system setting.
- Before the system can output northing, easting, and elevation, you must complete a station setup. Otherwise, the system outputs 0, 0, 0.
- If you want to stream data from the COM port on the Trimble CU robotic holder, or the Trimble S Series instrument, you must connect the cable **before** you open the GDM data output form. Otherwise, the COM port is not available.

# Coordinate System

## Coordinate System

A coordinate system consists of a projection and datum transformation and, sometimes, additional horizontal and vertical adjustments.

When you create a job, select a coordinate system by one of the following methods:

- [Scale factor only](#)
- Select from library
- Key in parameters
- [No projection/ no datum](#)

If you need to perform a GPS site calibration, or change the parameters manually after selecting the coordinate system, select *Files / Properties of current job / Coord. sys.*

Where the job parameters are keyed in, or a calibration is used, the coordinate system settings are displayed as "Local site".

If you modify the coordinate system by calibration or by manually changing the parameters, you must do so before you compute offsets or intersection points, or stake out points in the local coordinate system.

To set up a [ground coordinate system](#) for the job, choose the *Select from library* or *Key in* parameters option.

To customize the coordinate systems available on the Trimble Survey Controller software, use the Coordinate System Manager software. For more information see [Customizing the Coordinate System Database](#).

## Customizing the Coordinate System Database

You can customize the coordinate system database used by the Trimble Survey Controller software. This enables you to:

- Reduce the number of coordinate systems available in the Trimble Survey Controller software so that it includes only the ones you need.
- Customize existing coordinate systems definitions or add new coordinate system definitions.
- Include GPS site calibrations in the coordinate system library.

You must use the Coordinate System Manager software to modify the Coordinate System Database (CSD) and then transfer the modified database to the /Trimble data folder on the Trimble controller. When a [custom.csd] file exists in the Trimble data folder, the Trimble Survey Controller software uses the custom.csd database instead of the coordinate system database built into the Trimble Survey Controller software.

**Note** – The Coordinate System Manager software is installed at the same time as your Trimble Office

software, for example, Trimble Geomatics Office.

There are a number of ways you can use the Coordinate System Manager software to customize the coordinate systems. From the following options, choose the one that best suits your needs.

**To reduce a coordinate system library to one or more coordinate systems, zones, and sites:**

1. Run the Coordinate System Manager software on your office computer.
2. Do one or more of the following to hide the required element:
  - ◆ **Coordinate system:** In the left pane of the *Coordinate Systems* tab, select the coordinate system(s) that you do not want, right click and then select *Hide*.
  - ◆ **Zone:** In the left pane of the *Coordinate Systems* tab, select a coordinate system, from the right pane, select the Zone(s) you do not want, right click and then select *Hide*.
  - ◆ **Site:** From the *Sites* tab, right click the site(s) you do not want and then select *Hide*.
3. Select *File / Save As*.
4. Name the file [custom.csd] and then click **Save**.

By default, the file is saved in [Program Files\Common Files\Trimble\GeoData] with the extension \*.csd.

**To export only User defined coordinate systems:**

1. Run the Coordinate System Manager software on your office computer.
2. Select *File / Export*.
3. Select *User-defined records only* and then click **OK**.
4. Name the file [custom] and then click **Save**.

By default, the file is saved in [Program Files\Common Files\Trimble\GeoData] with the extension \*.csw.

**Tips for using the Coordinate System Manager software**

- ◆ To make multiple selections, press **CTRL** or **SHIFT**.
- ◆ To hide records, right click the selection and then select *Hide*.
- ◆ To display hidden records, select *View / Hidden Records*. Hidden records are displayed with a dark red icon.
- ◆ To unhide hidden records, right click hidden record(s) and then clear the *Hide* check box.

For more information, see the Coordinate System Manager Help.

**Note** – If a GPS site calibration has been saved using your Trimble Office software, a site with the assigned name is added to the *Sites* tab and a Site group is created in the *Coordinate Systems* tab, if required. When you create a customized coordinate system that includes sites saved by the Trimble Office software, include those sites created in the *Sites* tab. The Site group in the *Coordinate Systems* tab contains the coordinate system details **referenced** by the sites saved in the *Sites* tab, but the calibration details are **only** stored in the site in the *Sites* tab.

**Transferring Customized Coordinate Systems**

You can transfer the file to the controller using the Trimble Data Transfer utility or Microsoft ActiveSync technology. The file must be called [custom.csd] for the Trimble Survey Controller software to access it.

A file transferred by the Data Transfer utility is automatically renamed and saved to the \Trimble data folder. If you transfer the file using ActiveSync technology, you must copy the file to the \Trimble data folder and then rename the file to [custom.csd].

For more information on transferring a file from a Trimble controller to an office computer, see [Connecting the controller to the office computer using Microsoft ActiveSync technology](#).

When the *Open* dialog appears, select *CSD Files (\*.csd)* or *CSD Files (\*.csw)* from the *Files of type* list.

#### To select a custom site in Trimble Survey Controller software:

1. From the main menu, select *Files / New job*.
2. Enter the *Job name*.
3. In the *Properties* group, tap the *Coord sys* button.
4. Choose *Select from library* and then tap *Next*, if required.
5. If this is a new custom.csd file, a warning appears. Tap *OK* to accept.
6. In the *System* field, select *[User sites]*.
7. In the *Site* field, select the required site.
8. If required, select a geoid model.
9. To return to the *New job* dialog, tap *Store*.
10. In the *New job* dialog, tap *Accept* to save the new job.

## Scale Factor Only

Use this projection type when you are doing a conventional–instrument only survey with a local scale factor. This option is useful for areas that use a local scale factor to reduce distances to the local coordinate system.

To choose a Scale factor only projection:

1. Create a new job.
2. Select *Scale factor only* from the *Select coordinate system* menu.
3. Enter a value in the *Scale* field and then tap *Store*.

## Projection

A projection is used to transform local geodetic coordinates into local grid coordinates.

**Note** – Enter an appropriate default height value for the Trimble Survey Controller software to correctly calculate a sea level correction and then apply it to the grid coordinate.

GPS coordinates are relative to the WGS–84 ellipsoid. To work in local grid coordinates, you must specify a projection and datum transformation.

You can specify a projection:

- when a job is created and you have to choose a coordinate system (select from a list, or key in)
- during a survey (you calculate values by performing a calibration)
- in the Trimble Geomatics Office software, when the data is transferred.

Do not change the coordinate system or calibration after you have staked out points, or computed offset or intersection points.

If a projection and datum transformation are specified, you can reduce any discrepancies between the WGS–84 coordinates and the local grid coordinates by performing a site calibration.

## Ground Coordinate System

If you require coordinates to be at ground level instead of projection level, use a ground coordinate system. When you select a ground coordinate system, grid distances equal ground distances.

To set up a ground coordinate system, when you create a job:

1. Specify a coordinate system by choosing the *Select from library*, or *Key in parameters* option.
2. To use ground coordinates with the selected coordinate system, tap the Page down button, and then from the *Coordinates* field, do one of the following:
  - ◆ To key in a scale factor, select *Ground (Keyed in scale factor)*.
  - ◆ To let the Trimble Survey Controller software calculate the scale factor, select *Ground (Calculated scale factor)*. Enter values in the *Project Location* group to compute the scale factor.

The computed scale factor allows for the projection scale factor at the Project Location in order to ensure that the combined factor (grid scale factor plus elevation factor) at the Project Location equals 1.

The Trimble Survey Controller software applies the ground scale factor to the projection.

3. To add offsets to the coordinates, enter a value in the *False northing offset* and *False easting offset* fields as required.

**Note** – When working with a ground coordinate system the reported ground distance may not be the same as the reported grid distance. The reported ground distance is simply the ellipsoid distance corrected for the average height above the ellipsoid. However the grid distance is computed between the ground coordinates of the points, and is therefore based on a coordinate system that provides a combined scale factor of 1 at the Project Location.

**Note** – Use offsets to differentiate ground coordinates from unmodified grid coordinates.



## Project Height

The project height can be defined as part of the coordinate system definition when creating a new job. To find it, select *Files / Properties of current job* for a coordinate system in either the *Library* or *Key in projection* dialogs.

If a point has no elevation, the Trimble Survey Controller software uses the project height in Cogo calculations. If you combine GPS and 2D conventional observations, set the *Project height* field to approximate the height of the site. This height is used with 2D points to calculate grid and ellipsoid distances from measured ground distances.

In 2D surveys where a projection has been defined, enter a value for the project height that approximates the height of the site. You need this value to reduce measured ground distances to ellipsoid distance, and to compute coordinates.

If you edit the project height (or any other local site parameter) after calibrating, the calibration becomes invalid and must be reapplied.

## No Projection / No Datum

To select a coordinate system with an undefined projection and datum, when you create a job:

1. Tap the *Coord. sys* button and select *No projection/no datum*.
2. Set the *Coordinates* field to *Ground*, and enter a value (average site height) in the *Project height* field to use ground coordinates after a site calibration. Alternatively, set the *Coordinates* field to *Grid*.
3. Select the *Use geoid model* check box, and select a geoid model to calculate a Geoid/Inclined plane vertical adjustment after a site calibration.

Any points measured using GPS are displayed only as WGS84 coordinates. Any points measured using a conventional instrument are displayed with null (?) coordinates.

The Trimble Survey Controller software performs a calibration that calculates a Transverse Mercator projection and a Molodensky three-parameter datum transformation, using the supplied control points. The project height is used to compute a scale factor for the projection so that ground coordinates can be computed at elevation.

## Horizontal Adjustment

A horizontal adjustment is a least-squares adjustment that is applied to minimize the differences between transformed grid coordinates and local control points.

Horizontal and vertical adjustments are calculated if you perform a calibration when a projection and datum transformation are defined.

Trimble recommends that you use a minimum of four control points to compute a horizontal and vertical adjustment.

Alternatively, you can key in horizontal adjustment parameters when you start a new job.

## Vertical Adjustment

This is a least-squares adjustment that is applied to convert (ellipsoid) heights to elevation. It is computed when you do a calibration. A minimum of one point is required to compute the adjustment. If more points are used, an inclined plane adjustment can be calculated.

If you have a geoid model selected, you can choose to use only the geoid model, or to use the geoid model and do an inclined plane adjustment. Trimble recommends that you use a geoid model to obtain more accurate orthometric heights from your GPS measurements.

You can specify the type of vertical adjustment when you create a job. Set this parameter when you choose the coordinate system. You can also key in the parameters when you create a job.

To change the parameters for the current job, from the main menu select *Files / Properties of current job*, tap *Coord sys* and then select *Key in parameters / Vertical adjustment*.

**Note** – When the Projection is set to *Scale factor only*, the *Datum transformation*, *Horizontal adjustment*, and *Vertical adjustment* options are not available. Select a non *Scale factor only* projection to access the other parameters.

## Coordinate Systems

Before starting a GPS survey, decide which coordinate system to use. This topic discusses some things to consider when making this decision.

[Choosing a Coordinate System for a Conventional Survey](#)

[Choosing a Coordinate System for a GPS Survey](#)

[GPS Coordinate System](#)

[Local Coordinate Systems](#)

[Calibration](#)

[Using a Datum Grid File](#)

[Using a Geoid Model](#)

[Working with Ground Coordinates](#)

If you intend to combine conventional observations with GPS measurements, read the whole of this topic. To make only conventional observations, see [Choosing a Coordinate System for a Conventional Survey](#).

## Choosing a Coordinate System for a Conventional Survey

When surveying using conventional equipment, it is important to choose a suitable coordinate system.

For example, if a job is to combine GPS measurements with conventional observations, choose a coordinate system that lets you view GPS observations as grid points. This means that you must define a projection and a datum transformation. For more information, see [Creating a job](#).

**Note** – You can complete the field work for a combined survey without defining a projection and a datum transformation, but you will not be able to view the GPS observations as grid coordinates.

If you want to combine GPS measurements with two-dimensional conventional observations, specify a project height for the job. For more information, see [Project Height](#).

If a job is to contain conventional observations only, select one of the following when you create the job:

- A typical coordinate system and zone that provide mapping plane coordinates. For example, State Plane coordinates.
- Scale factor only.

In a conventional survey, measurements are made at ground level. To compute coordinates for these measurements, observations are reduced to grid level. The specified scale factor is applied to measured distances to reduce them from ground to grid.

The *Scale factor only* option is useful for areas that use a local scale factor to reduce distances to grid.

**Tip** – If you are not sure what coordinate system to use, select the *Scale factor only* projection and enter a scale factor of 1.000.

## Choosing a Coordinate System for a GPS Survey

When you create a new job, the Trimble Survey Controller software prompts you to define the coordinate system you are using. You can select a system from the library, key in the parameters, select *Scale factor only*, or select *No projection / no datum* transformation. For more information, see [Creating a job](#).

The most rigorous coordinate system consists of four parts:

- datum transformation
- map projection
- horizontal adjustment
- vertical adjustment

**Note** – To conduct a realtime survey in terms of local grid coordinates, define the datum transformation and map projection before starting the survey.

**Tip** – In the *Coordinate view* field, select *Local* to display local geodetic coordinates. Select *Grid* to display local grid coordinates.

When WGS84 coordinates are transformed onto the local ellipsoid, using a datum transformation, local geodetic coordinates result. Local geodetic coordinates are transformed into local grid coordinates using the map projection. The result is Northing and Easting coordinates on the local grid. If a horizontal adjustment is defined, it is applied next, followed by the vertical adjustment.

## GPS Coordinate System

GPS measurements are referenced to the 1984 World Geodetic System reference ellipsoid, known as WGS84. However, for most survey tasks, results in terms of WGS84 have little value. It is better to display and store results in terms of a local coordinate system. Before you start a survey, choose a coordinate system. Depending on the requirements of the survey, you can choose to give the results in the national coordinate system, a local coordinate grid system, or as local geodetic coordinates.

When you have chosen a coordinate system, search your survey archives for any horizontal and vertical control points in that coordinate system that are in the area to be surveyed. You can use these to calibrate a GPS survey. For more information, see [Calibration](#).

## Local Coordinate Systems

A local coordinate system simply transforms measurements from a curved surface (the earth) onto a flat surface (a map or plan). Four important elements constitute a local coordinate system:

- local datum
- datum transformation
- map projection
- calibration (horizontal and vertical adjustments)

When you survey using GPS, consider each of these.

### Local Datum

Because an exact model of the earth's surface cannot be created mathematically, localized ellipsoids (mathematical surfaces) have been derived to best represent specific areas. These ellipsoids are sometimes referred to as local datums. NAD83, GRS80, and AGD66 are examples of local datums.

### Datum Transformation

GPS is based on the WGS84 ellipsoid, which is sized and positioned to best represent the entire earth.

To survey in a local coordinate system, the WGS84 GPS positions must first be transformed onto the local ellipsoid using a datum transformation. Three types of datum transformation are commonly used. Alternatively, you can choose not to use a transformation at all.

The datum transformations are as follows:

- three-parameter – This assumes that the rotational axis of the local datum is parallel with the rotational axis of WGS84. The three-parameter transformation involves three simple translations in X, Y, and Z. The three-parameter transformation that the Trimble Survey Controller software uses is a Molodensky transformation, so there may also be a change in ellipsoid radius and flattening.

**Note** – Positions on a local datum are commonly called "local geodetic coordinates". The Trimble Survey Controller software abbreviates this to "Local".

- Seven-parameter – This is the most complex transformation. It applies translations **and** rotations in X, Y, and Z, as well as a scale factor.
- Datum grid – This uses a gridded data set of standard datum shifts. By interpolation, it provides an estimated value for a datum transformation at any point on that grid. The accuracy of a datum grid depends on the accuracy of the gridded data set it uses. For more information, see [Using a Datum Grid File](#).

## Map Projection

Local geodetic coordinates are transformed into local grid coordinates using a map projection (a mathematical model). Transverse Mercator and Lambert are examples of common map projections.

**Note** – Positions on a map projection are commonly called "local grid coordinates". The Trimble Survey Controller software abbreviates this to "Grid".

## Horizontal and Vertical Adjustments

If published datum transformation parameters are used, slight discrepancies can exist between local control and GPS-derived coordinates. These discrepancies can be reduced using minor adjustments. The Trimble Survey Controller software calculates these adjustments when you use the *Site calibration* function. They are called horizontal and vertical adjustments.

## Calibration

Calibration is the process of adjusting projected (grid) coordinates to fit the local control. You can key in a calibration, or let the Trimble Survey Controller software calculate it. You should calculate and apply a calibration before:

- staking out points
- computing offset or intersection points

The rest of this section describes how to perform a calibration using the Trimble Survey Controller software. To key in a calibration, see [Creating a job](#).

## Calibration Calculations

Use the Trimble Survey Controller software system to perform a calibration in one of two ways. Each method results in the computation of different components, but the overall result is the same if enough reliable control points (coordinates in your local system) are used. The two methods are:

- If you use published datum transformation parameters and map projection details when creating a job, and if you provide enough control points, the Trimble Survey Controller software performs a calibration that computes horizontal and vertical adjustments. Horizontal control points allow scale error anomalies in the map projection to be removed. Vertical control allows local ellipsoid heights to be transformed into useful orthometric heights.

**Tip** – Always use published parameters if they exist.

- If you do not know the map projection and datum transformation parameters when creating the job and defining the local coordinate system, specify *No projection / no datum*.

Then specify whether grid or ground coordinates are required after a site calibration. When ground coordinates are required, you must specify the project height. In this case, the Trimble Survey Controller software performs a calibration that calculates a Transverse Mercator projection and a Molodensky three-parameter datum transformation using the supplied control points. The project height is used to compute a ground scale factor for the projection so that ground coordinates are computed at that height.

The following table shows the output of a calibration when various data is supplied.

Projection	Datum transformation	Calibration output
Yes	Yes	Horizontal and vertical adjustment
Yes	No	Datum transformation, horizontal and vertical adjustment
No	Yes	Transverse Mercator projection, horizontal and vertical adjustment
No	No	Transverse Mercator projection, zero datum transformation, horizontal and vertical adjustment

### Local Control for Calibration

Trimble recommends that you observe and use a minimum of four local control points for the calibration calculation. For best results, local control points should be evenly distributed over the job area as well as extending beyond the perimeter of the site (assuming that the control is free of errors).

**Tip** – Apply the same principles as you would when placing control for photogrammetric jobs. Make sure that the local control points are evenly distributed to the extent of the job area.

### Why Calibrations Are Needed

If you calibrate a project and then survey in real time, the Trimble Survey Controller software gives real-time solutions in terms of the local coordinate system and control points.

### Operations That Require Calibration

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

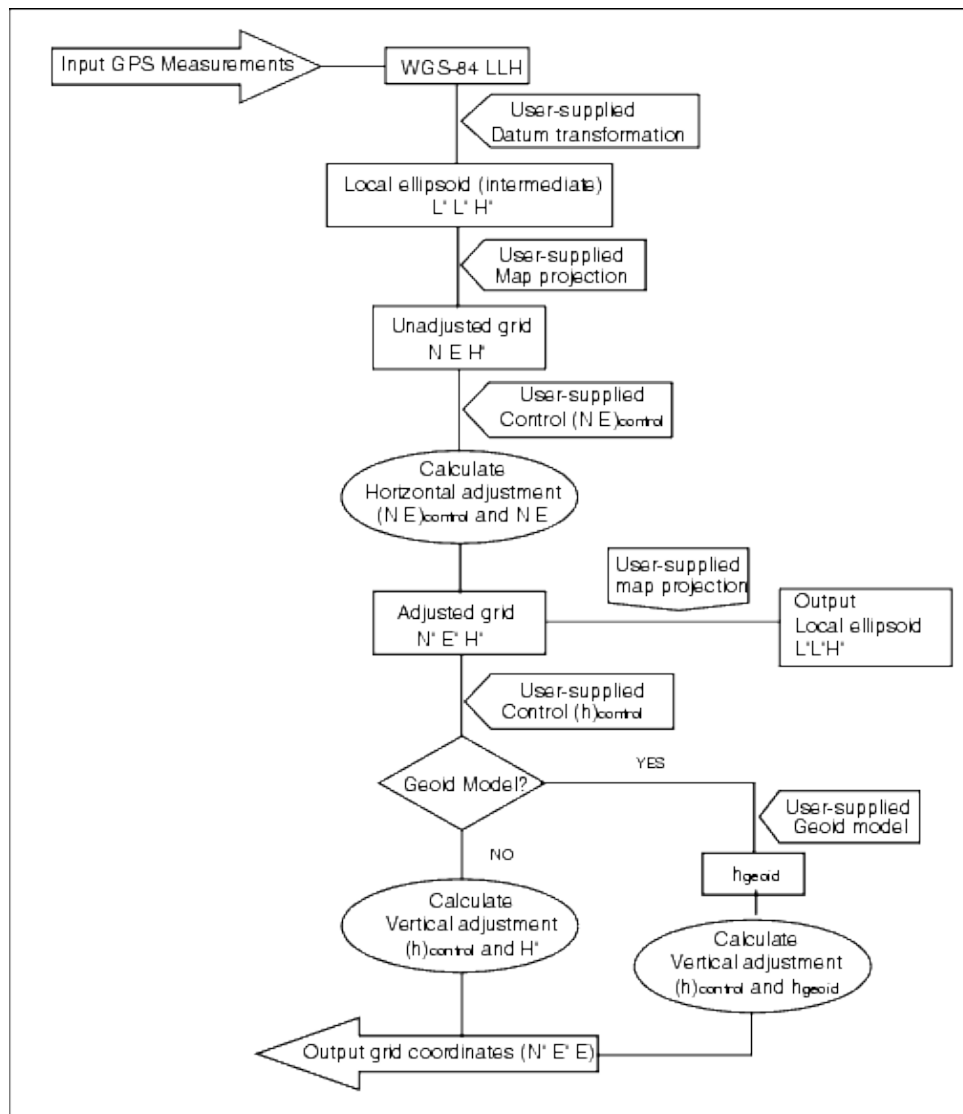
If no datum and no projection are defined, you can only stake out lines and points that have WGS84 coordinates. Displayed bearings and distances are in terms of WGS84.

Specify a projection before staking out arcs, roads, and DTMs. The Trimble Survey Controller software does not assume that WGS84 is the local ellipsoid, so you must also define a datum.

Without a datum transformation, you can only start a real-time base survey with a WGS84 point.

For information on how to perform a calibration, see [Calibration](#).

The following diagram shows the order of calculations performed when a calibration is calculated.



## Copying Calibrations

You can copy a calibration from a previous job if the new job is completely encompassed by that initial

calibration. If a portion of the new job lies outside the initial project area, introduce additional control to cover the unknown area. Survey these new points and compute a new calibration. Use this as the calibration for the job.

**Tip** – To copy the calibration from an existing job to a new job, make sure that the **current** job you want to copy has the calibration that you require in the new job. Then create the new job. A new job uses the default values from the previous job. Use the softkeys on the Job properties screen to change the defaults.

## Using a Datum Grid File

A datum grid transformation uses interpolative methods to estimate the value of the datum transformation at any point in the area covered by the datum grid files. Two gridded datum files are required for this interpolation—a latitude datum grid file and a longitude datum grid file. When you export a datum grid using the Trimble Geomatics Office software, the two datum grid files associated with the current project are combined into a single file for use in the Trimble Survey Controller software.

## Selecting a Datum Grid File

To select a datum grid file when creating a job, do one of the following:

- Select a coordinate system from the library provided in the Trimble Survey Controller software. Select the *Use datum grid* check box. In the *Datum grid* field, select the file that you want to use.
- Key in the coordinate system parameters. Select *Datum transformation* and set the *Type* field to Datum grid. In the *Datum grid* field, select the file that you want to use.

**Note** – The U.S. State Plane 1927 and the U.S. State Plane 1983 coordinate systems in the Trimble Survey Controller software use three-parameter transformations.

To select a datum grid file for use in the current job:

1. From the main menu, select *Files / Properties of current job – Coord. Sys.*
2. Do one of the following:
  - ◆ If *Key in parameters* is selected, select *Next*. Select *Datum transformation* and set the *Type* field to Datum grid. In the *Datum grid* field, select the file that you want to use.
  - ◆ If *Select coordinate system* is selected, select *Next*. Select the *Use datum grid* check box. In the *Datum grid* field, select the file that you want to use.

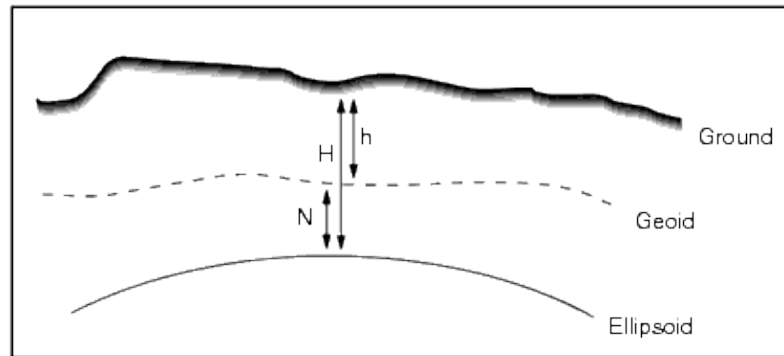
The semi-major axis and flattening values for the selected datum grid file are displayed. These details overwrite any already provided by a specified projection.

## Using a Geoid Model

The geoid is a surface of constant gravitational potential that approximates mean sea level. A geoid model or Geoid Grid file (\*.ggf) is a table of geoid–ellipsoid separations that is used with the GPS ellipsoid height observations to provide an estimate of elevation.

The geoid–ellipsoid separation value (N) is obtained from the geoid model and is subtracted from the ellipsoid height (H) for a particular point. The elevation (h) of the point above mean sea level (the geoid) is the result. This is illustrated in the following diagram.





**Note** – For correct results, the ellipsoid height (H) must be based on the WGS–84 ellipsoid.

When you select geoid model as the vertical adjustment type, the Trimble Survey Controller software takes the geoid–ellipsoid separations from the geoid file chosen, and uses them to display elevations on the screen.

The benefit of this function is that you can display elevations without having to calibrate on elevation benchmarks. This is useful when local control or benchmarks are not available, as it makes it possible to work "on the ground" rather than on the ellipsoid.

**Note** – If you are using a geoid model in a Trimble Geomatics Office project, make sure you transfer that geoid file (or the relevant part of it) when transferring the job into a Trimble controller.

### Selecting a Geoid File

To select a geoid file when creating a job, do one of the following:

- Select a coordinate system from the library provided in the Trimble Survey Controller software. Select the *Use geoid model* check box. In the *Geoid model* field, select the file to be used.
- Key in the coordinate system parameters. Select *Vertical adjustment* and set the *Type* field to *Geoid model* or *Geoid/Inclined plane* as required. (Select *Geoid/Inclined plane* if you intend to key in the inclined plane adjustment parameters.)

To select a geoid file for the current job:

1. From the main menu select *Files / Properties of current job – Coord. Sys.*
2. Do one of the following:
  - ◆ If the *Key in parameters* screen is selected, select *Next*. Select *Vertical adjustment* and set the *Type* field to *Geoid model* or *Geoid/Inclined plane* as required. (If you intend to key in the inclined plane adjustment parameters, select *Geoid/Inclined plane*.)
  - ◆ If the *Select coordinate system* screen is selected, select *Next*. Select the *Use geoid model* check box. In the *Geoid model* field, select the file to be used.

### Working with Ground Coordinates

If you need coordinates to be at ground level instead of projection level (for example, in areas of high elevation), use a ground coordinate system.

When you select a ground coordinate system, grid distances equal ground distances.

## Setting up a Ground Coordinate System

When you set up a ground coordinate system in a Trimble Survey Controller job, the software applies a ground scale factor to the coordinate system projection definition.

To set up a ground coordinate system when creating a job:

1. Define the coordinate system for the job. Do one of the following:
  - ◆ Choose the *Select from library* option to select a coordinate system from the library provided in the Trimble Survey Controller software. Tap *Next*.
  - ◆ Choose the *Key in parameters* option to key in the coordinate system parameters. Tap *Next* and then select *Projection*.
2. In the *Coordinates* field, choose an option to define the ground scale factor.

Additional fields appear below the *Coordinates* field.

3. If you select the *Ground (keyed in scale factor)* option, enter a value in the *Ground scale factor* field.
4. In the *Project location* group, enter values in the fields as required. Tap *Here* to enter the current autonomous position derived by the GPS receiver. The autonomous position is displayed in terms of WGS-84.

The project height is used with 2D points to reduce ground distances in Cogo calculations. For more information, see [Project Height](#). If you select the *Ground (calculated scale factor)* option, the fields are used to calculate the ground scale factor. When the fields are completed, the computed ground scale factor is displayed in the *Ground scale factor* field.

5. To add offsets to the coordinates, enter a value in the *False northing offset* and *False easting offset* field, as required.

**Note** – Use offsets to differentiate ground coordinates from unmodified grid coordinates.

To configure a ground coordinate system for the current job:

1. From the main menu, select *Files / Properties of current job – Coord.Sys*.
2. Do one of the following:
  - ◆ If the *Key in parameters* screen is selected, tap *Next* and then select *Projection*. Select an option from the *Coordinates* field. Complete the fields below as required.
  - ◆ If the *Select coordinate system* screen is selected, tap *Next*. Select an option from the *Coordinates* field and then complete the fields below as required.

## Options Softkey

This softkey appears in only some screens. It allows you to change the configuration for the task being performed.

If you make changes using the *Options* softkey, they only apply to the current survey or calculation. The

changes do not affect the current Survey Style or the job configuration.

### Distances setting options

The computed area varies according to the *Distance* display setting. The following table shows the effect of the distance setting on the area calculated.

Distances setting	Computed area
Ground	At the average ground elevation
Ellipsoid	On the ellipsoid surface
Grid	Directly off the grid coordinates

### Traverse Options

Use these options to specify how a traverse calculation is adjusted.

Field	Option	What it does
Adjustment method	Compass	Adjusts the traverse by distributing the errors in proportion to the distance between traverse points
	Transit	Adjusts the traverse by distributing the errors in proportion to the northing and easting ordinates of the traverse points
<b>Error distribution</b>		
Angular	Proportional to distance	Distributes the angular error among the angles in the traverse based on the sum of the inverses of the distances between traverse points
	Equal proportions	Distributes the angular error evenly among the angles in the traverse
	None	Does not distribute the angular error
Elevation	Proportional to distance	Distributes the elevation error in proportion to the distance between traverse points
	Equal proportions	Distributes the elevation error evenly among the traverse points
	None	Does not distribute the elevation error

**Note** – The *Compass* option is the same as the Bowditch method of adjustment.

For information about calculating and adjusting a traverse, see [Traverses](#).

### Measure Display

Use the *Measure display* field to configure how the observations are displayed on the controller.

See the [Conventional Instrument – Corrections](#) table for a description of the measure display options and the corrections that are applied.

### Subdivide Pts Code

When you subdivide a line or an arc, a number of points are created. Use the *Subdivide pts code* field to specify the code that the new points will be allocated. Choose from the name or the code of the line or arc that

is to be subdivided.

## Coordinate View Settings

To change the *Coordinate view* setting (when reviewing a job) for a point that you want to view:

1. When reviewing the database, highlight the point record and tap *Enter*.
2. Tap *Options* and set the *Coordinate view* field as required.

If the coordinate value for a point is *?*, one of the following situations may have occurred:

- The point may be stored as a GPS point but with the *Coordinate view* field set to *Local* or *Grid* and a datum transformation and projection not defined. To correct this, change the *Coordinate view* setting to *WGS-84*, define a datum transformation and/or projection, or calibrate the job.
- The point may be stored as a polar vector from a point which has been deleted. To correct this, restore the point.
- In a 2D survey, a projection may have been defined with the project height at null. To correct this, set the *Project height* to approximate the site elevation.

## Projection Grids

Use a projection grid to handle projection types that are not directly supported by the Trimble coordinate system routines. A projection grid file stores local latitude and longitude values that correspond to regular northing/easting positions. Depending on the direction of the conversion, either projection or local latitude/longitude positions are interpolated from the grid data for points within the grid extents.

Use the Coordinate System manager to generate the defined projection grid (\*.pjt) file.

For more information, refer to the *Coordinate System Manager Help*.

Use the Data Transfer utility or Microsoft ActiveSync technology to transfer the \*.pjt file to the controller. For more information, refer to the Trimble Survey Controller [File Transfer Help](#), Data Transfer Help or Microsoft ActiveSync Help.

To use the projection grid in Trimble Survey Controller:

1. From the main menu, select *Files / New job*.
2. Enter the *Job name*.
3. In the *Properties* group, tap the *Coord sys* button.
4. Select *Key in parameters*, if required, tap *Next*.
5. In the *Key in parameters* dialog, select *Projection*.
6. In the *Type* field, select *Projection grid* from the drop-down list.
7. In the *Projection grid file* field, select the required grid file.
8. If required, select the *Use shift grid* check box.
9. Tap *Accept* twice, to return to the *New job* dialog.

10. In the *New job* dialog, tap *Accept* to save the new job.

## Shift Grids

Initial projection coordinates are projections that are computed using specified projection routines. Some countries use shift grids to apply corrections to these coordinates. The corrections are generally used to fit the initial coordinates to local distortions in the survey framework, and so cannot be modelled by a simple transformation. You can apply a shift grid to any type of projection definition. Coordinate systems that use shift grids include the Netherlands RD zone, and the United Kingdom OS National Grid zones.

**Note** – The OS National Grid zones are currently used as a specific projection type but can also be used as a Transverse Mercator projection plus shift grid.  
For more information, contact your local Trimble dealer.

Use the Coordinate System manager to generate a shift grid (\*.sgf) file. For more information, refer to the *Coordinate System Manager Help*.

Use the Trimble Data Transfer utility or Microsoft ActiveSync technology to transfer the shift grid (\*.sgf) file to the controller. The file is stored in [\\Trimble Data].  
For more information, refer to the Trimble Data Transfer Help or Microsoft ActiveSync Help.

To apply a shift grid to a [projection definition](#):

1. In the *Projection* dialog, select the *Use shift grid* check box.
2. In the *Shift grid file* field that appears, select the required file from the drop-down list.

# File Transfer

## Import / Export menu

This menu lets you send and receive data to and from another device, export and import fixed format files, export and import custom format files and transfer files between controllers.

For more information, see:

[Send and Receive data to and from another device](#)

[Export Fixed Format Files](#)

[Import Fixed Format Files](#)

[Export Custom Format Files](#)

[Import Custom Format Files](#)

[File Transfer Application](#)

## Transferring Files between the Controller and the Office Computer

This topic describes how to transfer data between a Trimble controller and an office computer. It lists the types of files that can be transferred, and shows how to connect the equipment for transfer.

For more information, see:

[File transfer between a Trimble controller and the office computer](#)

[Connecting the controller to the office computer using Microsoft ActiveSync technology](#)

[Using the Trimble Data Transfer Utility](#)

[Using Microsoft Explorer with the Microsoft ActiveSync technology enabled](#)

[File conversion](#)

[Transferring a Geodimeter \(GDM\) job file](#)

[Transferring a Zeiss M5 file](#)

[AutoCAD Land Desktop software](#)

## File transfer between a Trimble controller and the office computer

You can transfer various types of files between a Trimble controller and the office computer, including data collector (.dc) files, feature code files, digital terrain models (DTM), and language files. The file transfer process on the Trimble controller is controlled by the office computer software, once you have established a connection between the controller and office computer using the Microsoft ActiveSync technology.

You can transfer files using:

- The Trimble Data Transfer utility with Microsoft ActiveSync technology enabled
- Microsoft Explorer with the Microsoft ActiveSync technology enabled

To use the Microsoft ActiveSync technology, you must first install it from the Trimble Survey Controller software CD.

You can also transfer data to and from a Trimble controller using other Trimble software packages. For more information, refer to the help provided with the Trimble office software.

### Connecting the controller to the office computer using Microsoft ActiveSync technology

To transfer Trimble Survey Controller files between the Trimble Survey Controller software and the office computer, you must use Microsoft ActiveSync technology on either a Guest or Partnership connection.

**Note** – To connect using a LAN (Local Area Network), you must create a partnership. However, you cannot create a partnership on a LAN connection. To create a partnership, you must connect the controller to the office computer using a serial cable, USB, or infrared connection.

To establish the connection:

1. Make sure that the Trimble controller and office computer are switched on.  
Disconnect any devices that are communicating with the controller, and close down any applications to ensure that the communications ports are available.
2. On the office computer, select *Start / Programs / Microsoft ActiveSync* to start the ActiveSync technology.

You only need to do this the first time to configure the connection settings. Subsequent connections start Microsoft ActiveSync technology automatically.

3. In Microsoft ActiveSync, select *File / Connection Settings* to configure the connection method. Select the appropriate option for *Serial/Infrared* and specify the communications port, USB, or Network.
4. Connect the Trimble controller to the office computer. Use one of the following methods:
  - ◆ Serial cable
  - ◆ USB cable (using the Multiport adaptor)
  - ◆ Network (Ethernet) card (using the Multiport adaptor)
  - ◆ Infrared (if your controller supports it)
5. The Microsoft ActiveSync icon on your Windows taskbar will start spinning and the Trimble controller prompts you with the message, "Connect to desktop". Tap *Yes*.

6. If the message does not appear on the Trimble controller and the Microsoft ActiveSync icon does not spin, there is a connection problem. Check that the connection settings in the Microsoft ActiveSync technology are correct and that there are no applications using the COM port on the Trimble controller.

If the controller fails to connect, a message may appear to advise that the connection is busy. Alternatively, an Error 678 message may appear to advise that the connection is not established. Remove the cable connected to the controller, perform a soft reset, and then reconnect the cable. When the cable is reconnected the [Connect to desktop] message appears, select [Yes] to connect.

For more information on how to perform a soft reset, see [Perform a soft reset](#).

If you have not already created a partnership between this computer and the controller, the Microsoft ActiveSync connection wizard prompts you to do so during the connection process. Creating a partnership is not essential, but it does have some advantages, as shown in the following table.

Connection Type	Advantages	Disadvantages
Guest	Fewer questions to answer on initial connection  Safer (because synchronization cannot adversely impact data either on your controller or your PC)  For use on borrowed or shared computers	Slower subsequent connections (one more step per connection that requests for partnership)  LAN connection is not possible
Partnership	Fast subsequent connections (one fewer step per connection)  Once a partnership is established, you can connect to the office computer through a LAN (the fastest connection)  The controller clock is set to match the office computer clock	More questions to answer on initial connection  Synchronization is not supported on the controller  If the clock on the office computer is wrong, it will make the clock on the controller wrong  Partnership is deleted when you perform a hard reset on the controller

To create a Partnership:

1. On the [New Partnership] dialog select [Yes] then [Next].
2. To allow only one partnership with this controller, select [Yes] then [Next].
3. Select the synchronization settings, we recommend clearing all check boxes. Select [Next] to continue.
4. The setup is now complete, select [Finish] to exit the wizard. You have now completed the ActiveSync connection process and formed a partnership.



To transfer Trimble Survey Controller files using Trimble Data Transfer, see [Using the Trimble Data Transfer Utility](#).

For more information, refer to the Microsoft ActiveSync Help. On the office computer, click *Start / Programs / Microsoft ActiveSync*.

**Note** – When the Microsoft ActiveSync technology is enabled, it takes control of the communication ports on the computer. This makes them unavailable to other applications. To transfer files to and from earlier versions of the Trimble Survey Controller software or Trimble GPS receivers, you must reconfigure the *Connection Settings* in Microsoft ActiveSync to make the required communication port available. Then use the Trimble Data Transfer utility directly.

### Using the Trimble Data Transfer Utility

Use the Trimble Data Transfer utility to transfer files between Trimble Survey Controller and the office computer.

To transfer files using Trimble Data Transfer:

1. To transfer files to Trimble Survey Controller, you must first connect the controller to the office computer using the Microsoft ActiveSync technology, for more information see [Connecting the controller to the office computer using the Microsoft ActiveSync technology](#).
2. On the office computer, start the Data Transfer utility.
3. Ensure that the Device setting in Data Transfer is set correctly, for example, **Trimble Survey Controller on ActiveSync** and select the **Connect** button to connect.  
When the default device is set correctly, this connection process is automatic.
4. Select the *Receive* or *Send* tab as appropriate.
5. Select *Add*.
6. In the *Open* dialog, set the appropriate options for the file type, and select the file to transfer.
7. Select *Transfer All* to start the file transfer.

For more information on using Data Transfer, refer to the Data Transfer Help.

### Using Microsoft Explorer with the Microsoft ActiveSync Technology Enabled

You can use the Microsoft Explorer and ActiveSync technology to move or copy files to or from the Trimble controller. Use the software to transfer files that do not require [conversion](#) by Data Transfer (for example, comma delimited (.csv) files). See the table below.

To transfer files to Trimble Survey Controller, you must first connect the controller to the office computer using the Microsoft ActiveSync technology. For more information, see [Connecting the controller to the office computer using Microsoft ActiveSync](#).

When connected, from the Microsoft ActiveSync window:

1. Click **Explore** to move or copy files between the office computer and the Trimble controller for sharing information. Alternatively, use Windows Explorer to move or copy files.
2. Click **Tools** to backup and restore files.

For more information on using Microsoft ActiveSync technology to transfer files, refer to the Microsoft ActiveSync Help.

## File Conversion

When data is transferred to and from the Trimble Survey Controller software, some files are converted for use in the Trimble software.

The following table lists the files that are used in the Trimble Survey Controller software and the file types they are converted to when transferred to and from Trimble office software.

PC	Controller	Description	Data Transfer	MS Explorer / ActiveSync
.dc	.job	Trimble Survey Controller job files	Y	N
.csv	.csv	Comma Delimited (CSV) files	Y	Y
.txt	.txt	Comma Delimited (TXT) files	Y	Y
.dtx	.dtm	Digital Terrain Model files	Y	N
.ttm	.ttm	Triangulated Terrain Model files	Y	Y
.fcl	.fal	Feature and Attribute Library files	Y	N
.ddf	.fal	Data Dictionary files	Y	N
.ggf	.ggf	Geoid Grid files	Y	Y
.cdg	.cdg	Combined Datum Grid files	Y	Y
.pjpg	.pjpg	Projection grid files	Y	N
.sgf	.sgf	Shift grid files	Y	N
.pgf	.pgf	UK National Grid files	Y	Y
.dxf	.dxf	Map files	Y	Y
.shp	.shp	ESRI map shape files	Y	Y
.ini	.dat	Antenna files	Y	N
.lng	.lng	Language files	Y	Y
.wav	.wav	Sound files	Y	Y
.dat	.dat	GPS data files	Y	Y
.crd .inp .mos	.crd .inp .mos	GENIO road files	Y	Y
.xml	.xml	LandXML road files or XML Documents	Y	Y
.jxl	.jxl	JobXML files	Y	Y
.xsl	.xsl	XSLT Stylesheet files	Y	Y
.sss	.sss	XLST Stakeout Stylesheet files	Y	Y
.mcd	.mcd	Measure Codes Database files	Y	Y
.dc	.rxl	Trimble road file	Y	N
.csd .csw	.csd	Coordinate System Database files	Y	N

N = No. Use Data Transfer to convert the file.

When a .dc file is transferred to the Trimble Geomatics Office software, any GPS data files associated with that file are also transferred. Information about the .dc file format is available from the Trimble website ([www.trimble.com](http://www.trimble.com)). For more information, contact your local Trimble dealer.

**Note** – If a Trimble Geomatics Office project uses a geoid model, remember to also transfer the geoid file (or the subgridded part of it) when transferring the job into the Trimble Survey Controller software.

### Transferring a Geodimeter (GDM) job file

To create a GDM Job on the controller, or on a computer using ASCII File Generator, see [Creating Custom ASCII Files](#). Custom ASCII File uses XSLT style sheets that you can modify as required to generate new formats.

To transfer a GDM .job file from a Trimble controller to an office computer, use the Data Transfer utility, as described [above](#).

When the *Open* dialog appears, select GDM Job files from the *Files of type* list.

The GDM job files transferred using this option contain the terrestrial observation data collected on the Trimble controller.

**Note** – When you transfer a Geodimeter job file, for example test.job, from a Trimble controller, the software generates two files:

- test.job (the backup of the Trimble Survey Controller job file)
- testGDM.job (the actual GDM .job file)

### Special functionality when creating GDM job files

So that you can collect several user data items for a point in Trimble Survey Controller and then output the point attributes through a GDM job file as standard user label items, the following function is supported. While the GDM job file is being created from Trimble Survey Controller data, the point attributes are processed as follows. If you have assigned point attributes named 90 through 99 (GDM labels that can you can define), and assigned values to the attributes, then these attributes will automatically be output as labels 90= through 99=.

Similarly, if a point attribute is named 4, and it has a value assigned to it, then the attribute will be output as the point code (label 4=) instead of the original code assigned to the point.

**Note** – Before you can use this function, you must create a feature and attribute library that defines features with appropriately named attributes (for example, 4, and 90 through 99). You must also transfer this feature and attribute library to the Trimble Survey Controller and assign it to the Trimble Survey Controller job. A sample feature and attribute library is available on the Trimble Survey Controller CD in the *[Trimble Survey Controller\Utilities]* folder.

### Transferring a Zeiss M5 file

To create a Zeiss M5 file on the controller, or on a computer using ASCII File Generator, see [Export custom format files](#). The M5 coordinates file that was created using Export custom format files lets you create files using the 3300 or the 3600 default markings. Export custom format files uses XSLT style sheets that you can modify as required to generate new formats.

To transfer a Zeiss M5 file from a Trimble controller to an office computer, use the Data Transfer utility, as described [above](#).

When the *Open* dialog appears, select M5 Files from the *Files of type* list.

The M5 files transferred using this option contain the terrestrial observation data collected on the controller. The M5 file also includes coordinates for observed points.

### **AutoCAD Land Desktop software**

Use the Trimble Link software to transfer data between the Trimble Survey Controller software and Autodesk AutoCAD Land Desktop software.

When job data is transferred from the Trimble Survey Controller software to the AutoCAD Land Desktop software, a .tic file is created.

## **Sending and Receiving ASCII Data Between External Devices**

This section describes how to use the [Send data to another device](#) and [Receive data from another device](#) function in the Trimble Survey Controller software. Use these functions to transfer point names, point codes, and grid coordinates in ASCII format between the Trimble controllers and a variety of conventional instruments, data collectors, and office computers.

In addition, you can transfer ASCII files directly to the office computer using third-party download software, such as HyperTerminal.

**Note** – Only points with grid coordinates are transferred when you use the ASCII data transfer function. If the job does not have a projection and datum transformation specified, GPS points cannot be transferred. Furthermore, deleted points, and any points stored as polar vectors from a deleted point, cannot be transferred.

### [Transferring ASCII data to and from an external device](#)

#### [Send data to another device](#)

#### [Receive data from another device](#)

### **Transferring ASCII Data to and from an external device**

You can transfer ASCII data to and from an external device or office computer in the following formats:

- Trimble GDM (Area)
- Comma delimited (\*.csv, \*.txt)

- SDR33 coordinates
- SDR33 DC
- TDS CR5
- Topcon (FC–5)
- Topcon (GTS–7)
- Trimble DC v10.7
- Trimble DC v10.0
- SC Exchange
- Trimble Zeiss M5

**Note** – To use some of the formats listed above to create ASCII files in the / Disk / Trimble Data folder, select *Files / Import / Export / Export fixed format files*. (In previous versions of Trimble Survey Controller, this was done through *Files / Import / Export / Send data to another device*.)

The next sections describe how to connect a Trimble controller, and how to send and receive data to and from the Trimble Survey Controller software.

### Send data to another device

**Warning** – When sending data to a device that does not include a units setting as part of its file, make sure that the Trimble Survey Controller file uses the units setting of that device.

If you are not sure whether the device file includes a units setting, set the Trimble Survey Controller file to the same units as the device.

To send ASCII data to an external device:

1. Select *Files / Import / Export / Send data to another device*.
2. Use the *File format* field to specify the type of file to send.
3. Set the transfer parameters:
  - a. Set the *Controller port* field to the Trimble controller port you are using for the transfer.

**Note** – Set the controller port to Bluetooth to send Comma Delimited, Trimble DC v10.0, Trimble DC v10.70 and SC Exchange formats to another controller using Bluetooth. Before sending files using Bluetooth, you must configure the Bluetooth connection. For more information see, [Bluetooth configuration](#).

- b. Set the *Baud rate* and *Parity* fields to match the corresponding parameters on the device that you are communicating with.

**Note** – If the *File format* field is set to Comma Delimited (\*.CSV, \*.TXT), set the baud rate correctly on the external device. If appropriate, also set the flow control (xon/xoff).

- c. If you are transferring a SDR33 .dc file, and you want the Trimble Survey Controller software to include a checksum when the file is transferred, select *On* in the *Checksum* field.

**Note** – For the Trimble GDM (Area), SDR33, TDS CR5, Topcon (GTS–7), Topcon (FC–5), and Trimble Zeiss M5 output options, you must select the appropriate format on the external

device.

**Note** – The Trimble Zeiss M5 output option uses the default Markings for the Trimble 3300 instrument in the coordinate file that is transferred. Markings refers to the layout of the 27 character field used for the point number and code details in the M5 format file. The Markings in the transferred file are as follow:

- ◇ Characters 1 – 11 are unused and are output as spaces.
- ◇ Characters 12 – 15 hold numeric point codes (right justified within these characters). Any non-numeric characters in point codes are not output to the file.
- ◇ Characters 16 – 27 hold numeric point names assigned by the Trimble Survey Controller on export (right justified within these characters).

Make sure that the Markings settings on a 3300 instrument, and the PI1 Markings on a 3600 instrument, are configured as above when transferring ASCII files to and from Trimble Survey Controller.

4. Set the file parameters:

- a. If the *File format* field is set to *SDR33 coordinates* or *TDS CR5*, the *Job name* field appears. Enter a name for the file that is created when the data is transferred.
- b. Set the *Point name* field to *Unchanged* or *Auto-generate*. Unchanged sends the point names as they appear on the Trimble controller. Auto-generate adds two extra fields:
  - ◇ Use the *Start point name* field to specify the name of the first point to be transferred.
  - ◇ Use the *Auto point step size* field to define the amount by which the *Start point* value is incremented or decremented when the Trimble Survey Controller software generates point names for subsequently transferred points.

**Note** – If the *File format* field is set to TDS CR5 and the *Point name* field is set to Unchanged, a point will only be transferred if the point name is less than eight characters long and contains numeric characters only.

- c. Use the *Point code* field to specify what is sent to the external device selected in the *Code* field:
  - ◇ Select *Use point code* to send the point code.
  - ◇ Select *Use point name* to send the point name.

**Note** – If you have used long codes (up to 42 characters) in the Trimble Survey Controller software, and the file format you are transferring to does not support long codes, the codes will be shortened.

- d. If the *File format* field is set to *SDR33 coordinates*, there is an *Output notes* check box. Select this to output all user-entered notes with the point data. The notes are output in SDR33 record 13NM format.
- e. If the Comma Delimited (\*.CSV, \*.TXT) option is selected, you can specify the format of the data that is received. Five fields appear: *Point name*, *Point code*, *Northing*, *Easting*, and *Elevation*.  
Using the options provided, select a position for each field. Select *Unused* if a particular value is not present in the file being received. For example:

*Point name* Field 1

*Point code* Unused

*Northing* Field 2

*Easting* Field 3

*Elevation* Field 4

5. Transfer the files:

- a. When the format details are complete, tap *Send*.
- b. If you are sending points (not a .dc file), the *Select points* screen appears. Select the points to send.  
The procedure is similar to that to create a *Stake out points* list. For more information, see [Stakeout points](#).
- c. The Trimble Survey Controller software prompts you to initiate receiving on the instrument that you are sending data to. For more information about receiving data, refer to the manual for the receiving device.  
When the other device is ready to receive, tap *Yes* to send the data. The data is transferred.

### Notes

- When sending ASCII data from a Trimble controller to an external device, it is important to follow on-screen instructions. The cable must not be connected until you are prompted to do so. If you connect the cables at the wrong time, the transfer will fail.
- In an SC Exchange .dc file, all observations are reduced to WGS84 positions and grid positions (coordinates). Use this file format to transfer .dc files between different versions of the Trimble Survey Controller software.
- Trimble Survey Controller outputs the latest version SC Exchange DC file that the software knows about.  
When importing SC Exchange files, Trimble Survey Controller reads all records it knows about. If importing a new version SC Exchange file into an older version of Trimble Survey Controller, the software does not read new records that it does not understand.
- The Trimble GDM (Area) and Trimble Zeiss M5 formats created using the Trimble Survey Controller *Send data to another device* option are designed for data transfer to terrestrial instruments. The file format used is different from the GDM job and M5 files downloaded using Data Transfer.

### Receive data from another device

**Warning** – When receiving data from a device that does not include a units setting as part of its file, make sure that the Trimble Survey Controller file uses the units setting of that device. If you are not sure whether the device file includes a units setting, set the Trimble Survey Controller file to the same units as the device.

To receive ASCII data from an external device:

1. Select *Files / Import / Export / Receive data from another device*.
2. Use the *File format* field to specify the type of file to receive.
3. Set the transfer parameters:

- a. In the *Port details / Controller port* field, select the Trimble Controller port used for the transfer.

**Note** – Set the controller port to Bluetooth to receive Comma Delimited, Trimble DC v10.0, Trimble DC v10.70 and SC Exchange formats to another controller using Bluetooth. Before receiving files using Bluetooth, you must configure the Bluetooth connection. For more information see, [Bluetooth configuration](#).

- b. Set the *Baud rate* and *Parity* fields to match the corresponding parameters on the device that the Trimble Survey Controller software is communicating with.

**Note** – If the *File format* field is set to Comma Delimited (\*.CSV, \*.TXT), set the baud rate correctly on the external device. If appropriate, also set the flow control (xon/xoff).

If you are transferring a SDR33 .dc file, and you want the Trimble Survey Controller software to validate the checksum when the file is transferred, select *On* in the *Checksum* field.

4. The option in the *File format* field determines what you do next:

- ◆ If you select one of the following options, you must choose the appropriate output format on the external device:
  - ◇ Comma delimited (\*.csv, \*.txt)
  - ◇ SDR33 coordinates
  - ◇ SDR33 DC
  - ◇ TDS CR5
  - ◇ Topcon (FC–5)
  - ◇ Topcon (GTS–7)
  - ◇ Trimble DC v10.7
  - ◇ Trimble DC v10.0
  - ◇ SC Exchange
  - ◇ Trimble Zeiss M5

Use the *Point name* field to define how the point names in the data are received.

**Note** – In the case of the Trimble Zeiss M5 format the Markings (organization of the 27 character point number and code field) must conform to the following definitions:

- ◇ Characters 12 – 15 holding the point code
- ◇ Characters 16 – 27 holding the point name

**Note** – Trimble Survey Controller point names have a maximum of 16 characters, but some points received from other devices can exceed this. If point names have 16 characters or more, choose either Truncate left or Truncate right.

- ◆ If the Comma Delimited (\*.CSV, \*.TXT) option is selected, you can specify the format of the data that is received. Five fields appear: *Point name*, *Point code*, *Northing*, *Easting*, and *Elevation*.

Using the options provided, select a position for each field. Select *Unused* if a particular value is not present in the file being received. For example:

*Point name* Field 1



*Point code* Unused

*Northing* Field 2

*Easting* Field 3

*Elevation* Field 4

5. Store the files:

- a. When the format details are complete and the external device is ready to send, connect the cables and tap *Receive*.

The Trimble Survey Controller software prompts you to initiate sending on the external device. For more information about sending data, refer to the manual for the sending device.

When sending is initiated, the Trimble Survey Controller software starts to receive data, and a progress bar appears.

When the transfer is complete, the Trimble Survey Controller software automatically terminates the operation and saves the received data.

- b. If it is clear that the transfer is complete but the operation has not been terminated, tap *Esc*. The following message appears:

Transmission interrupted. What would you like to do now? Do one of the following:

- ◆ Tap *Continue* to return the Trimble Survey Controller software to receive mode.
- ◆ Tap *Finish* to terminate the operation and save any received data to the current job.
- ◆ Tap *Cancel* to terminate the operation and discard any received data.

**Note** – When receiving ASCII data from an external device to a Trimble controller, you must follow the on-screen instructions. Do not connect the cable until you are prompted to do so, otherwise the transfer will fail.

## Import and Export Fixed Format Files

Use these functions to:

- Import a fixed format file and convert it to a new Trimble job file
- Export a fixed format file from a Trimble job file and create a new file

The following formats are available:

- Comma delimited (\*.csv, \*.txt)
- SDR33 DC
- Trimble DC v10.7
- Trimble DC v10.0
- SC Exchange

- Trimble JobXML

The new file is saved to `\Disk\Trimble Data`.

If the Comma Delimited (\*.CSV, \*.TXT) option is selected, you can specify the format of the data that is received. Five fields appear: *Point name*, *Point code*, *Northing*, *Easting*, and *Elevation*.

Using the options provided, select a position for each field. Select *Unused* if a particular value is not present in the file being received. For example:

*Point name* Field 1

*Point code* Unused

*Northing* Field 2

*Easting* Field 3

*Elevation* Field 4

## Notes

- In an SC Exchange .dc file, all observations are reduced to WGS84 positions and grid positions (coordinates). Use this file format to transfer .dc files between different versions of the Trimble Survey Controller software running on the ACU and TSCe controllers.
- The Trimble Survey Controller software outputs the latest version SC Exchange DC file that the software knows about.  
When importing SC Exchange files, the Trimble Survey Controller software reads all records it knows about. If importing a new version SC Exchange file into an older version of the Trimble Survey Controller software, the software does not read new records that it does not understand.

To learn more about customizing your own ASCII format, see [Export custom format files](#).

## Export Custom Format Files

Use this menu to create custom ASCII files on the controller while in the field. Use the predefined formats or create your own custom formats. With custom formats, you can create files of almost any description. Use these files to check data in the field, or to produce reports, which you can e-mail from the field to your client or to the office for further processing with the office software.

The predefined ASCII export formats available on the controller include:

- Check shot report
- Comma delimited with attributes
- GDM area
- GDM job

- M5 coordinates
- Road–line–arc stakeout report
- Stakeout report

These custom ASCII formats are defined by the XSLT style sheet (\*.xsl) definition files in the \ *Disk* \ *Trimble Data* folder.

You can modify a predefined format to meet your specific requirements, or use it as a template to create a completely new custom ASCII export format.

In addition, the following predefined formats are available on the Trimble Survey Controller CD. To copy the files to the controller, use Trimble Data Transfer or the Microsoft ActiveSync technology.

- CMM coordinates
- CMM elevations
- KOF
- SDMS

#### **To create a custom ASCII file using a predefined XSLT style sheet:**

1. Open the job that contains the data to export.
2. From the main menu, select *Files / Import/Export / Export custom format files*.
3. In the *File format* field, specify the type of file to create.
4. Enter a filename.

By default, the *File name* field shows the name of the current job. The filename extension is defined in the XSLT style sheet. Change the file name and extension as required.

5. If more fields are displayed, complete them.

You can use the XSLT style sheets to generate files and reports based on parameters that you define. For example, when generating a Stakeout report, the *Stakeout horizontal tolerance* and the *Stakeout vertical tolerance* fields define acceptable stakeout tolerances. When generating the report you can stipulate the tolerances, then any stakeout delta greater than the defined tolerances appears in colour in the generated report.

6. To automatically view the file after you create it, select the *View created file* check box.
7. To create the file, tap *Accept*.

The file is saved in the \ *Disk* \ *Trimble Data* \ *Export* folder.

**Note** – When the selected XSLT style sheet is applied to create the custom export file, the processing is all carried out in the program memory available on the device. If there is not enough memory to enable the creation of the export file, an error message will be displayed and no export file will be created.

The maximum program memory the controller operating system has available for this process is 32 MB.

Four factors will affect whether the export file can be created

1. The amount of program memory available to the device.
2. The size of the job being exported.
3. The complexity of the style sheet being used to create the export file.
4. The amount of data being written to the export file.

If it is not possible to create the export file on the controller, download the job as a JobXML file to a computer.

To create the export file from the downloaded JobXML file using the same XSLT style sheet, use the ASCII File Generator utility program (available on the Trimble Survey Controller CD).

### **Creating XSLT Style Sheets to define Custom ASCII Formats**

You can use any text editor, such as Microsoft Notepad, to make minor changes to the predefined formats. However, to create a completely new custom ASCII format, you need some basic programming knowledge.

You cannot easily modify or create a style sheet on the controller. To successfully develop new style sheet definitions, work on an office computer using a suitable XML file utility program.

The predefined formats on the controller are available on the CD. You can edit them and then transfer them to the controller using Microsoft ActiveSync technology. To retain the existing formats, save the modified formats with a new XSLT filename.

To develop your own XSLT style sheets, you need:

- An office computer.
- Basic programming skills.
- An XML file utility program with good debugging facilities.
- The JobXML file schema definition that provides the details of the JobXML format required to create a new XSLT style sheet.
- A Trimble Survey Controller Job or JobXML file that contains the source data.

The predefined XSLT style sheets and JobXML file schema are available under the *[Trimble Survey Controller\Utilities]* folder on the Trimble Survey Controller CD.

You can install the ASCII File Generator utility from the Trimble Survey Controller CD. For information on using this utility, refer to the ASCII File Generator Help.

The basic steps are:

1. Source a Job file or JobXML file from your Trimble controller. Use one of the following methods:
  - Transfer a Job file from the controller using Microsoft ActiveSync technology or Data Transfer and then use the job file directly with the ASCII File Generator.
  - Transfer a Job file from the controller using Microsoft ActiveSync technology or Data Transfer and then use the ASCII File Generator to create a JobXML file.
  - Create a JobXML file on the controller. From the *Import/Export / Create ASCII file* menu, set the *File format* field to *Trimble JobXML*. Transfer the JobXML file using Microsoft ActiveSync technology.

- Create and transfer a JobXML file using Data Transfer. Make sure that the *Files of type* field is set to *JobXML Files*.
2. Create the new format using a predefined XSLT style sheet as a starting point and the JobXML schema as a guide.
  3. To create the new custom ASCII file on the office computer, use the ASCII File Generator utility to apply the XSLT style sheet to the Trimble Job or JobXML file.
  4. To create the custom ASCII files on the controller, copy the file to the `\Disk\Trimble data` folder on the controller using Microsoft ActiveSync technology.

## Notes

- XSLT style sheet definition files are XML format files.
- The predefined style sheet definitions are provided in English. Modify these files as required to your own language.
- Style sheets must be created according to the XSLT standards as defined by the World Wide Web Consortium (W3C). For details, go to <http://www.w3.org>.
- The Trimble JobXML file schema definition provides details of the JobXML file format.

## Import Custom Format Files

Use this menu to import custom ASCII files into your current job. You can use the predefined formats or create your own custom format to import fixed-width or delimited ASCII files. You can import the following data using this option:

- Point name
- Code
- Description 1 and Description 2
- Notes attached to points
- Grid coordinates
- WGS84 geographic coordinates (degrees minutes and seconds, or decimal degrees)  
To be successfully imported, points must have a height.
- Local geographic coordinates (degrees minutes and seconds, or decimal degrees)  
To be successfully imported, points must have a height
- Line definitions  
Before you import, line start and end points must exist in the database.

Line definitions include the following information: start point name, end point name, start station, station interval, azimuth, and length.

The predefined ASCII import formats available in the controller include:

- CSV Grid points E–N  
Point Name, Easting, Northing, Elevation, Code
- CSV Grid points N–E  
Point Name, Northing, Easting, Elevation, Code

- CSV Lines  
Start Point Name, End Point Name, Start Station, Station Interval
- CSV WGS–84 Lat–long points  
Point Name, Latitude, Longitude Height, Code

To import an ASCII file using a predefined file format:

1. Transfer the file to be imported into the Trimble Data folder on your controller.
  2. Open or create the job that you want to import the data into.
  3. From the main menu, select *Files/ Import/Export / Import custom format files*.
  4. In the *File format* field, specify the type of file to import.
  5. In the *File name* field, select the file to import. All files in Trimble Data with the file extension specified in the format file (by default CSV) appear in the list.
  6. If you are importing points, select or clear, as required, the *Import points as control* check box to specify if the imported points should be control points.
  7. To import the file, tap *Accept*.
- After import, a summary box shows how many items were imported and how many were discarded.

### **Creating custom ASCII import format files**

Custom ASCII import format files are stored on the controller in the Trimble Data folder, with the extension \*.ixl. You can make simple edits to existing format files on the controller using Microsoft Pocket Word software. If you have majors edits or you want to create new format files, use a text editor on a desktop computer. Use ActiveSync technology to transfer the new or edited format files to the Trimble data folder on the controller.

For information on how to create your own import formats, refer to the Import Custom Format Files document available on the Trimble Survey Controller CD in the [*Trimble Survey Controller\Utilities\Import Definitions*] folder.

# Database Search Rules

## Database Search Rules

This topic explains the database search rules relevant to the Trimble Survey Controller database.

- [Dynamic Database](#)
- [Search Rules](#)
  - ◆ [order in the database](#)
  - ◆ [search class](#)
- [Exceptions to the search rules](#)
- [Linked files and their Search Rules](#)
- [Finding the best point in the database](#)
- [The Overwriting rules](#)
- [Store another does not change the best point](#)
- [Assigning control class to a point](#)
- [Using low class points as backsights](#)

**Note** – If your job does not contain points of the same name, then the Search rules are not used.

### Dynamic Database

The Trimble Survey Controller software includes a dynamic database. This stores networks of connected vectors during RTK and conventional surveys, making the positions of some points dependent on the positions of others. If you change the coordinates of a point that has dependent vectors (for example, an instrument station, a backsight point, or a GPS base station), this affects the coordinates of all points that depend on it.

The Trimble Survey Controller software uses database search rules to resolve the coordinates of dependent points, based on the new coordinates for a point they depend on. If the coordinates of a point with dependent points move by a certain amount, the dependent points are shifted by the same amount.

When two points of the same name exist, the Trimble Survey Controller software uses search rules to determine the best point.

### Search Rules

The Trimble Survey Controller software lets multiple points with the same point name (point ID) exist in the same job.

To distinguish between points of the same name and to decide how these points are to be used, the Trimble Survey Controller software applies a set of search rules. When you ask for the coordinates of a point in order to perform a function or calculation, these search rules examine the database according to:

- the order in which the point records were written to the database
- the classification (search class) given to each point

## Order in the Database

A database search starts at the beginning of the job database and works down to the end of the job, looking for a point with the specified name.

The Trimble Survey Controller software finds the first occurrence of a point of that name. It then searches the rest of the database for points of the same name.

**Note** – The database search changed for version 7.50 and later of the Trimble Survey Controller software. Previously the software searched from the end of the job database and worked up.

The rules generally followed by the software are:

- ◆ If two or more points have the same class and the same name, it uses the first point.
- ◆ If two or more points have the same name but different classes, it uses the point of higher class, even if this is not the first occurrence of the point.
- ◆ If two or more points (one from the job database and one from an attached linked file) have the same name, the software uses the point in the job database, regardless of the classification of the point in the linked file. For more information see, [Linked files and their Search Rules](#).

## Search Class

The Trimble Survey Controller software gives most **Coordinates** and **Observations** a classification. It uses this classification to determine the relative importance of points and observations stored in the job database.

Coordinates have priority over Observations. If a Coordinate and an Observation of the same name have the same class, the Coordinate will be used regardless of its order in the database.

The **Coordinate Classes** are arranged in a descending hierarchy, as follows:

- ◆ Control – (the highest class) can only be set when a point is keyed in or transferred.
- ◆ Averaged – is given to grid positions stored as a result of an average position computation.
- ◆ Adjusted – is given to points that are adjusted in a traverse computation.
- ◆ Normal – is given to keyed-in and copied points.
- ◆ Construction – is given to all points measured using Fastfix, which are typically used in the computation of another point.
- ◆ Deleted – is given to points that have been overwritten, where the original point had the same (or a lower) search class than the new point.  
Deleted points are not displayed in point lists and they are not used in calculations. However, they do remain in the database.

### Control class

Control class is used in preference to other classes. It can only be set by you. Use control class for points that you want to use in preference to points of the same name in the same job database. For more information, see [Assigning control class to a point](#).



**Note** – You cannot overwrite a control class point with a measured point, or use a control class point in an average position computation.

The **Observation Classes** are arranged in a descending hierarchy, as follows:

- ◆ Mean Turned Angle (MTA)
- ◆ Normal
- ◆ Backsight
- ◆ Construction
- ◆ Stakeout
- ◆ Check
- ◆ Deleted

Deleted observations are not displayed in point lists and they are not used in calculations. However, they do remain in the database.

### Example

If a point named "1000" is entered as the start point when calculating a from-a-baseline offset, the Trimble Survey Controller software searches for the first occurrence of point "1000". It then searches the rest of the database for any point named "1000", under the following rules:

- ◆ If no other point of this name is found, it uses the one it has to calculate the offset.
- ◆ If another point "1000" is found, the software compares the classes of the two points. It uses the point "1000" that has the highest classification. Remember that a Coordinate class point (for example, keyed-in) is higher than an Observation class point. For example, if both points were keyed in, one was given a normal classification and the other a control classification, Trimble Survey Controller uses the control class point to calculate the offset, regardless of which record the search finds first. If one point was keyed in and one was observed, Trimble Survey Controller uses the keyed-in point.
- ◆ If the points are of the same class, Trimble Survey Controller uses the first one. For example, if both points named "1000" were keyed in, and both were given a normal classification, the first one is used.

### Exceptions to the search rules

Normal search rules are not used in the following situations:

#### Exceptions to the search rules for GPS surveys:

- **In a GPS calibration**

Calibration searches for the highest class point stored as grid coordinates. This grid point is used as one of a pair of calibration points. The Trimble Survey Controller software then searches for the highest class GPS point stored as WGS84 coordinates or as a WGS84 vector. This point is used as the GPS part of the point pair.

- **When starting an RTK rover**

When you start a rover survey, if the broadcast base point is called, for example, "BASE001", choosing *Start survey* causes the Trimble Survey Controller software to search for the highest class GPS (WGS–84) point of that name. If no GPS point with the name "BASE001" exists, but "BASE001" exists with grid or local coordinates, the Trimble Survey Controller software converts the grid or local coordinates of the point into a GPS (WGS–84) point. It uses the projection, datum transformation, and current calibration to calculate the point. It is then stored, as "BASE001", with WGS–84 coordinates and is given a check class classification so that the original grid or local coordinates will still be used in calculations.

**Note** – The WGS–84 coordinates of the base point in the Trimble Survey Controller database are the coordinates from which GPS vectors are solved.

If there is no base point in the database, the position broadcast by the base receiver is stored as a normal class point and it is used as the base coordinates.

#### **Exceptions to the search rules for conventional surveys:**

- **F1 or F2 from one station setup and an MTA from another station setup**

If you observe a point on more than one face, an F1 observation and an F2 observation are combined to create an MTA record. In this situation, the MTA is used to coordinate the point. However, if there is an observation to a point on F1 or F2 only, from an earlier station setup, and later a station setup (that could be at the same station as the first) to that same point creates a new MTA, then the MTA is deemed to be of the same class as the earlier F1 or F2 observation. In this situation, the order in the database rule is invoked, and the first point in the database is deemed the best point.

- **Observations that coordinate a point are better than those that do not**

An angles and distance observation that coordinates the point, is better than an angles–only observation that does not coordinate a point. This rule applies even when the angles–only observation is earlier in the database, and is of a higher class, for example, an MTA.

#### **Linked files and their Search Rules**

Comma Delimited (\*.csv or \*.txt) files or Trimble Survey Controller (job) files can be linked to the current Trimble Survey Controller job to access external data. For more information, see [Linked files](#).

The Trimble Survey Controller search rules do not operate across linked files. Points in the current job are **always** used in preference to a point of the same name in the linked file, regardless of the classification. For example, if point 1000 in the current job has an As–staked classification, and point 1000 in a linked job file has a Normal coordinate classification, then the search rules will select the As–staked class point in preference to the Normal class point.

If both points were in the current job, then the search rules would select the Normal class point.

When points of the same name exist in a single CSV file, the Trimble Survey Controller software uses the first point.

When points of the same name exist in multiple CSV files, the Trimble Survey Controller software uses the point in the first CSV file. The first CSV file is the first one in the file selection list. To change the order of the CSV files, tap the tabs at the top of the file selection screen. If you change the order of the CSV files, this may change the order in which files are selected.

When you accept a CSV file selection, and you then go back and select more CSV files, all subsequent files are appended to the initial selection, using the rules. This assumes that the original selection is not altered.

Trimble recommends that you do not use multiple CSV files that contain points of the same name.

### Finding the best point in the database

To find the point with the highest classification, use the [Point manager](#). In the *Point manager*, the highest class point always appears at the first level in the tree structure. If there is more than one point of the same name, the tree structure has a second level, which contains all points of the same name. The point with the highest classification appears at the top, followed by the other points of the same name, in the order in which they were observed.

### Duplicate points and overwriting

Duplicate point tolerances compare the coordinates of a point to be stored with a point of the same name that already exists in the database. If the coordinates are outside the duplicate point tolerances defined in the survey style, the *Duplicate point out of tolerance* dialog appears. Select *Overwrite* to store the new point and delete all existing points of the same class or below.

Of the options displayed, *Overwrite* and *Average* are the only two options that might result in a point being 'promoted' – thus changing the coordinates for the best point.

**Note** – This warning only appears if the new point is out of tolerance with the original point. If you have changed the tolerance values, the message may not appear. For more information see, [Duplicate point tolerance](#).

In a conventional survey, observations from one station setup to the same point are combined to create an MTA record. You do not see the "duplicate point out of tolerance" warning.

If you store a face 2 observation to a point that already has a face 1 observation, the face 2 observation is checked to see if it is within tolerance of the face 1 observation and then stored. For more information about face 1 and face 2 observations, see [Measuring a point in two faces](#).

**Warning** – The duplicate point warning could indicate that you are about to overwrite a point that has dependent vectors. If you continue, the coordinates of the dependent vectors could change.

### The Overwrite rules

Overwrite deletes points, and results in a change to the coordinates of the best point.

**Note** – Deleted points remain in the database and have a search class of Deleted. For more information, see [Search Class](#).

If the *Overwrite* option does not appear in the Trimble Survey Controller software, this means that an overwrite would not result in changes to the coordinates of the best point.

### **General Observation and Coordinate overwrite rules:**

- ◆ Observations can overwrite and therefore delete Observations.
- ◆ Coordinates can overwrite and therefore delete Coordinates.
- ◆ Observations cannot overwrite Coordinates.
- ◆ Coordinates cannot overwrite Observations.

One exception to these rules is when a Rotate, Scale or Translation is performed. When one of these transformations is applied, the original observations are deleted and replaced by the translated points.

That does not mean that all Observations can overwrite all other Observations of the same name, and all Coordinates can overwrite all Coordinates of the same name. The [Search Class](#) rules still apply.

### **Some Examples**

- ◆ If you measure a point with a name that already exists in the database, you can choose to overwrite it when you store the new one. All previous Observations of the same name, and with the same or a lower search class, are deleted.  
If a point stored as a Coordinate existed, then overwrite would not have been an option, because overwriting the observations would not have changed the best point.
- ◆ If you key in a point with a name that already exists in the database, you can choose to overwrite it when you store the new one. All previous points stored as Coordinates, of the same name, and with the same or a lower search class, are deleted.  
Points of the same name stored as Observations are not affected.

### **Store another does not change the best point**

If you measure or key in a point with a name that already exists in the database, you can choose to store both points in the database, and both are transferred with the job. The Trimble Survey Controller search rules ensure that the point with the highest class is used for calculations. If there are two points of the same class, the **first** is used.

### **Averaging overwrites another average**

If you measure a point and use a name that already exists in the current job, you can choose to average all points of that name. To store the observation and an averaged grid coordinate, select *Average*. Where an averaged position of that name already exists, the new averaged position will overwrite the existing averaged position. Averaged points have a coordinate classification. Coordinates have a higher classification than observations, so the stored averaged position is used in preference to any observations. You can also choose to Auto-average when the point is within tolerance. For more information, see [Averaging](#).

### **Assigning control class to a point**

Control class is the highest classification that you can give to a point. Any high-accuracy point that you use as a fixed standard in a job can be a control point.

If you specify control search class when you key in the coordinates for a point, you can be sure that those coordinates will not change until you key in another point of the same name and the same search class (control) and choose to overwrite the first point.

The Trimble Survey Controller software never elevates measured points to control class. This is because measured points have measurement errors and may change or be measured again during the course of the job. If the keyed-in point "CONTROL29" is control class, generally you would not want the coordinates of that point to change. A control class point is held fixed for the job.

The Trimble Survey Controller software can measure **observed** control points, but it does not give them control classification. This is because, in calibration, the measured point often has the same name as the keyed-in control point. This makes it easier to set up the calibration. It also makes it easier to manage your data, for example, if you know that all references to point "CONTROL29" on the ground are also references to point "CONTROL29" in the database.

### Using low class points as backsights

If you use a low class point, such as an 'As-staked' or 'Check' class point for a backsight, the following message appears:

"Backsight point has a low classification. Before continuing, key in a backsight coordinate to ensure that coordinates can be calculated."

The Search rules resolve the coordinates of dependant points, and then determine the best point. While these rules work extremely well in most situations, occasionally a loop in the search rules can occur that results in observations failing to produce coordinates when expected.

This can occur when an 'As-staked' observation class point, or a 'Check' observation class point is used as a backsight point.

The Trimble Survey Controller software then warns you that a low class point is being used as a backsight. You can ignore this message, and your data should still process correctly in the office software. However, you may not be able to view coordinates for subsequent observations, and you may not be able to see the points in the map.

To avoid this problem, enter a Keyed-in coordinate for the backsight point **before** completing the station setup:

1. Tap *Key in / Points*.
2. Enter the name for the backsight point. When a message appears saying that the point already exists, tap *OK*.
3. The coordinates for the point appear. Tap *Store*.
4. In the *Duplicate point* form that appears, set the *Action* to *Store another* and then tap *Enter*.

A coordinated keyed-in point for the backsight has now been stored. Coordinates have a higher class than observations, so your backsight point no longer has a low class, and all observations from this station are now coordinated.

# Appendix A

## Calculations performed by the Trimble Survey Controller software

### Introduction

This appendix outlines some of the calculations performed by the Trimble Survey Controller software.

- [Transformations applied to GPS positions](#)
- [Ellipsoid calculations](#)
- [Conventional instrument calculations](#)
- [Area calculations](#)

## Transformations applied to GPS positions

For RTK surveying, coordinate transformations are required so that one set of coordinates (GPS positions) can be represented in terms of another (grid positions), and vice versa.

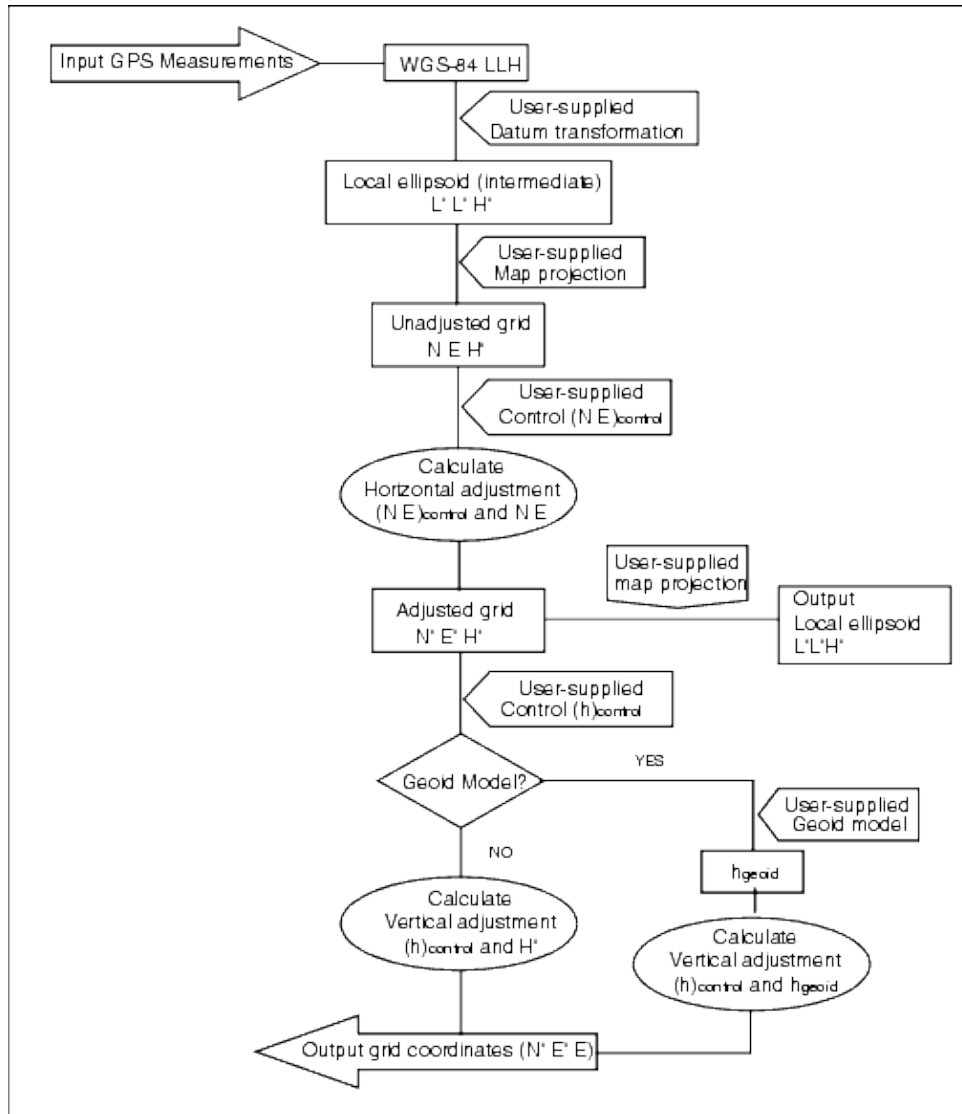
**Tip** – To see an example of converting measurements to grid coordinates using the Trimble Survey Controller software, click [here](#) and then select the *Calibration* section.

This section provides an overview of the management and application of coordinate transformations using the Trimble Survey Controller software. It describes how to apply a datum transformation and map projection, and horizontal and vertical adjustments.

With the Trimble Survey Controller software, the site calibration process defines transformation parameters derived from a set of points. This set of points is coordinated in terms of two systems:

- WGS–84 Latitude, Longitude, Height (LLH) geodetic coordinates
- A local system with project–specific Northing, Easting, Elevation (NEE) grid coordinates

The following diagram shows the order of calculations performed when a calibration is calculated.



The formulae used in the above flow diagram are detailed below.

### Transforming WGS-84 ECEF to WGS-84 LLH

When GPS signals are processed by a receiver, they yield Earth-Centered-Earth-Fixed (X, Y, Z) coordinates, which must then be transformed to more meaningful geodetic coordinates (  $\phi$  ,  $\lambda$  , H).

Here,  $\phi$  represents the geodetic latitude,  $\lambda$  is the longitude, and H is the perpendicular height above the WGS-84 ellipsoid.

First we define:

$$e^2 = 2f - f^2$$

$$N = \frac{r}{\sqrt{1 - e^2 \sin^2(\phi)}}$$

where  $f$  is the flattening value for the source ellipse and  $r$  is the semi-major axis.

The values of the ECEF coordinates are:

- $X = (N + H) \cdot \cos(\phi) \cdot \cos(\lambda)$
- $Y = (N + H) \cdot \cos(\phi) \cdot \sin(\lambda)$
- $Z = [N(1 - e^2) + H] \cdot \sin(\phi)$

The inverse problem (that of transforming ECEF coordinates to  $\phi$ ,  $\lambda$ , and  $H$ ) is solved by using an iterative procedure. The values of  $e^2$  and  $N$  now use the destination ellipsoid flattening and semi-major axis values:

$$\phi = \tan^{-1} \left( \frac{Z}{\sqrt{X^2 + Y^2}} (1 - e^2) \right)$$

then iterate

$$\phi = \tan^{-1} \left( \frac{Z + e^2 N \sin(\phi)}{\sqrt{X^2 + Y^2}} \right)$$

$$\lambda = \tan^{-1} \left( \frac{Y}{X} \right)$$

if  $45^\circ\text{S} < \phi < 45^\circ\text{N}$

$$H = \frac{\sqrt{X^2 + Y^2}}{\cos(\phi)} - N$$

or if  $\phi > 45^\circ\text{N}$  or  $\phi < 45^\circ\text{S}$

$$H = \frac{Z}{\sin(\phi)} - N(1 + e^2)$$

## Datum Transformation

A datum transformation provides the necessary parameters for converting from one geodetic coordinate system to another.

The Trimble Survey Controller software can apply a predefined three- or seven-parameter datum transformation. It can also calculate a three-parameter datum transformation given points coordinated in WGS-84 and local L'L'H'.

$$X = T + kRX'$$

where  $X'$  is a matrix of 3-D Cartesian ECEF coordinates or Cartesian local coordinates,  $T$  is a matrix of translation parameters,  $k$  is a scalar, and  $R$  is a rotation matrix. In most cases,  $X'$  is measured and  $T$ ,  $k$ , and  $R$  are user-specified.

To calculate a three-parameter datum transformation, pairs of WGS-84 LLH and local L'L'H' coordinates are needed.



In the trivial one point case, the three translation parameters are just the vector components of the ECEF vector that connect the ECEF pair derived from the WGS–84 LLH and the local L'L'H'.

In the non-trivial case, the translation parameters are the vector components of the average vector. This is represented as:

$$AX + W = 0$$

where the solution

$$X = \begin{bmatrix} \Delta X \\ \Delta Y \\ \Delta Z \end{bmatrix}$$

and

$$W = \begin{bmatrix} X_1 - X_1^s \\ Y_1 - Y_1^s \\ Z_1 - Z_1^s \\ X_2 - X_2^s \\ Y_2 - Y_2^s \\ Z_2 - Z_2^s \\ \vdots \end{bmatrix}$$

where  $X_n$  is the value of the ECEF coordinate derived from the local L'L'H' of the nth 3-D point in the list, and  $X_n^s$  is the X value of the ECEF coordinate derived from the WGS–84 LLH of the nth 3-D point and

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ \vdots & \vdots & \vdots \end{bmatrix}$$

is called the Molodensky matrix.

For more information, refer to *GPS Satellite Surveying* by A. Leick (John Wiley & Sons, 1995).

## Map Projection

A map projection defines the relationship between the local ellipsoidal surface (L'L'H') and a plane. Generally, map projection parameters are based on a local conformal mapping model.

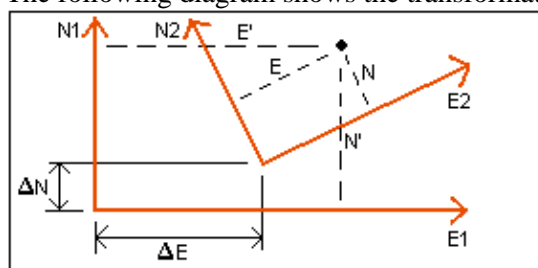
For more information about map projections, please refer to the *Map Projections—A Working Manual* by J.P. Snyder (U.S. Geological Survey Professional Paper 1295, U.S. Government Printing Office, Washington, 1987).

For nearly all projection types used in the Trimble Survey Controller software, the height component of a projected coordinate is just the height above or below the datum at that point. For a plane projection, however, the definition includes an ellipsoidal height and a projected surface elevation at the origin point.

## Horizontal Adjustment

It may be necessary to minimize the discrepancy between local fixed control coordinates (NE<sub>control</sub>) and projected grid coordinates (N'E'). The horizontal adjustment solves parameter translations in north and east ( $\Delta N$ ,  $\Delta E$ ), a rotation  $\phi$ , and a scale factor  $k$  using two different sets of plane coordinates—one converted from measurements in the field, and the other from a control list. Where the Trimble Survey Controller software generates its own three-parameter datum transformation, it is necessary to provide for scaling and rotation. This is done by a horizontal adjustment.

The following diagram shows the transformation between two coordinate systems.



## Coordinate systems for a horizontal adjustment

The Trimble Survey Controller software minimizes the discrepancy between local NE control and NE values derived using GPS observations and a datum transformation and map projection. It does this by performing a plane horizontal least-squares adjustment with no weighting.

In the trivial one point case, the translation parameters are just the Northing and Easting components of the vector between the two coordinated values. The scale factor is one, and the rotation value is zero.

For two or more points, calculation of horizontal adjustment uses a simple four-parameter transformation. This solves for two translations ( $\Delta N$ ,  $\Delta E$ ), a rotation ( $\phi$ ), and a scale factor ( $k$ ) between coordinate pairs.

The geometry between the two coordinate systems results in two transformation equations:

- $N' = aN + bE + \Delta N$
- $E' = -bN + aE + \Delta E$

where  $a = k \cos \phi$  and  $b = k \sin \phi$  are used to simplify the matrix representation, and  $\Delta N$  and  $\Delta E$  represent the shifts of the  $N$  and  $E$  axis in the  $N'$  and  $E'$  system.

Common points in both coordinate systems are used in a least-squares adjustment to solve the four unknown parameters ( $a$ ,  $b$ ,  $\Delta E$ , and  $\Delta N$ ).

Once estimates of  $a$  and  $b$  are determined, the rotation and scale between the two systems is calculated by:

$$\phi = \tan^{-1}\left(\frac{a}{b}\right) \text{ and } k = \sqrt{a^2 + b^2}$$

For more information about horizontal adjustment, please refer to *Observations and Least Squares* by E. Mikhail (John Wiley & Sons, 1982).

## Vertical Adjustment

The Trimble Survey Controller software determines a vertical adjustment using least-squares with no weighting. This adjustment requires measured WGS–84 heights and control elevations.

In the trivial one-point case, the adjustment consists of a constant height shift only. For two or more points, a tilt in north and east are also computed.

The inclined plane parameters are determined by solving the matrix equation:

$$AX = B$$

where the solution

$$X = \begin{bmatrix} \Delta H \\ \Delta E \\ \Delta N \end{bmatrix}$$

the components being the constant height shift and tilt east and north (in terms of a height shift per unit distance east or north), and the design matrix

$$A = \begin{bmatrix} 1 & E_1 - E_1 & N_1 - N_1 \\ 1 & E_2 - E_1 & N_2 - N_1 \\ \vdots & \vdots & \vdots \\ 1 & E_n - E_1 & N_n - N_1 \end{bmatrix}$$

where  $E_n$   $N_n$  are the coordinates of the nth point as derived from the WGS–84 data set.

$E_1$   $N_1$  are the coordinates of the origin point of the adjustment. (The origin point can be any one of the n points.)

$$B = \begin{bmatrix} H'_1 - H_1 \\ H'_2 - H_2 \\ \vdots \\ H'_n - H_n \end{bmatrix}$$

where  $H'_n - H_n$  is the difference in elevation between the keyed in value for the nth point and the value derived from the WGS–84 data set.

## Ground Scale Factor

In the Trimble Survey Controller software, you can define a *Project height* when you create a *No*

*projection/no datum* job. The project height is used after you perform a site calibration to compute a scale factor for the projection, so that ground coordinates are computed at elevation.

The projection scale factor is calculated as follows:

$$SF = \frac{R+h}{R}$$

and

$$R = \frac{a}{\sqrt{1 - e^2 \sin^2(\phi)}}$$

where:

SF	scale factor of projection
R	ellipsoidal radius
h	average elevation (reference elevation)
a	semimajor axis
e <sup>2</sup>	eccentricity <sup>2</sup>
φ	origin latitude of projection

## Geoid Model

The Trimble Survey Controller software can use a geoid model to provide orthometric heights from measured (by GPS) WGS–84 heights.

Geoid model is one of the options in the *Vertical adjustment* field. (The other options in this field are *No adjustment*, *Inclined plane*, *Geoid model/Inclined plane*.)

If you select Geoid model and you do not perform an in–field calibration, the elevation values displayed by the Trimble Survey Controller software represent the unadjusted elevation above the defined geoid using the relationship:

$$h_{\text{geoid}} = H - N$$

where:

h <sub>geoid</sub>	the unadjusted elevation above the geoid
H	the measured GPS height above the ellipsoid
N	the geoid ellipsoidal separation, derived from a geoid model

If you select *Geoid model* and then perform an in–field calibration, the Trimble Survey Controller software computes the calibration parameters using h<sub>control</sub> and h<sub>geoid</sub> as inputs, so that the geoid model is inclined to fit the local control elevations. The method of vertical adjustment becomes *Geoid/Inclined plane*.

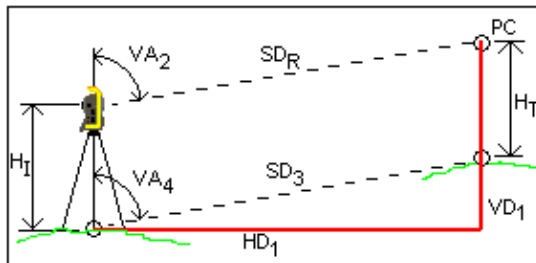
## Ellipsoid Calculations

The ground and ellipsoid distances in the Trimble Survey Controller software are calculated parallel to the ellipsoid. The equations used for these calculations are based on the Robbins ellipsoid geometry formulas. These formulas (by Dr A.R. Robbins) are in the *Empire Survey Review* No. 125, 1962. They are accurate to better than 20 mm over distances of 1,500 km. The errors can reach 16 meters at 4,500 km and more than 2,000 meters at 9,000 km.

## Conventional Instrument Calculations

The following diagram labels the observations and corrections that are applied when you use the Trimble Survey Controller software with a conventional instrument.

**Note** – Interim corrections are not shown in the diagram. They are enclosed in square brackets in the table that follows.



### Correction variables used in conventional instrument calculations

Where:

$VA_2$	Vertical angle from conventional instrument. The Trimble Survey Controller software assumes that the conventional instrument applies any corrections for collimation and tilt.
$[VA_3]$	Vertical angle corrected for curvature and refraction
$VA_4$	Vertical angle corrected for curvature and refraction, instrument and target heights
$SD_R$	Slope distance from EDM
$[SD_1]$	Slope distance corrected for prism constant (PC)
$[SD_2]$	Slope distance corrected for prism constant and PPM
$SD_3$	Slope distance corrected for prism constant, PPM, instrument and target heights
$HD_1$	Horizontal distance between instrument point and target point
$VD_1$	Vertical distance between instrument point and target point
$H_I$	Height of instrument
$H_T$	Height of target
PC	Prism constant

## Prism Constant Correction

The prism constant is applied to all slope distances. It is usually negative, but can be positive.

$$SD_I = SD_R + PC$$

where:

$SD_R$	measured (raw) slope distance
$SD_I$	resultant slope distance
PC	prism constant

## PPM Correction

The parts per million (PPM) correction is applied to the slope distance after being corrected for the prism constant (see above). PPM depends on pressure and temperature.

$$D_2(P, T) = SD_I \left[ J - \frac{N \cdot P}{273.16 + T} \right] \cdot 10^{-6}$$

where:

P	air pressure in millibars
T	temperature in °C
J & N	constants <i>supplied by the EDM manufacturer</i>

The following table lists some manufacturers of conventional instruments, and the J and N constants that the Trimble Survey Controller software uses to compute the PPM correction for those instruments.

### PPM Constants for Conventional Instruments

Manufacturer of conventional instruments	J constant	N constant
Trimble S Series	from instrument	from instrument
Trimble 5600	274.41	79.39
Trimble 3300/3600	278.77	80.653
Trimble TTS300/500	270.0	79.167
Sokkia SET	279.0	79.400
Topcon	279.7	79.600
Geotronics 400/600	275.0	79.550
Leica	282.0	79.400
Zeiss Elta2/Elta3/Elta4	255.0	79.100
Zeiss Elta C	281.8	79.391
Pentax	279.0	79.400

Nikon	275.0	79.5065
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**Note** – The Trimble S Series instrument J and N constants that are read from the instrument can be viewed in an exported JobXML file.

**Note** – The J constant value is the refractive index of the instrument. The N constant value is for use with pressure measurements in millibars. In the .dc file, the value is converted to one that can be used with pressure measurements in mmHg.

### Curvature and Refraction Correction

The curvature and refraction correction is applied to vertical angles according to the coefficient of refraction that you set.

$$VA_3 = VA_2 - \left[ \frac{(1-k)SD_3}{2R} \right] \cdot \frac{180}{\pi} \text{ (Curvature and refraction correction)}$$

where:

k	coefficient of terrestrial refraction, selected in the <i>Corrections</i> field in the survey style
R	approximate spheroid radius = 6378137m. (WGS-84 semi-major axis)
SD <sub>3</sub>	slope distance, from equation – <a href="#">Point to point slope distance</a>
VA <sub>2</sub>	vertical angle, from instrument
VA <sub>3</sub>	corrected vertical angle

### Instrument and Target Height Reduction

The corrected vertical angle (VA<sub>4</sub>) from the instrument to the target is:

$$VA_4 = \tan^{-1} \left[ \frac{SD_2 \sin VA}{SD_2 \cos VA_3 + H_I - H_T} \right]$$

where:

H <sub>I</sub>	instrument height
H <sub>T</sub>	target height
SD <sub>2</sub>	slope distance
VA <sub>3</sub>	vertical angle, from equation – <a href="#">Curvature and refraction correction</a>
VA <sub>4</sub>	corrected vertical angle

The slope distance from source point to target point (SD<sub>3</sub>) is given by the following:

$$SD_3 = \frac{SD_2 \sin VA_3}{\sin VA_4} \text{ (Point to point slope distance)}$$

## Face 1/Face 2 Determination

This section describes how the Trimble Survey Controller software reduces Face 2 readings to Face 1 readings in order to perform calculations. It does this automatically.

The observed raw vertical angle is used to determine whether an observation is Face 1 or Face 2:

- If the vertical angle is not present the observation is assumed to be Face 1.
- If the vertical angle is in the range  $0^\circ$  to  $180^\circ$ , the observation is Face 1.
- If the vertical angle is in the range  $180^\circ$ – $360^\circ$ , the observation is Face 2.

## Orientation Correction

To orient circle readings so that they become azimuths, an orientation correction is applied. The orientation correction is the difference between the backsight circle reading and the backsight azimuth. This term is applied to all the other observations (circle readings) at a station.

The formula is:

$$Az_x = HA_x + (Az_B - HA_B) \text{ (Orientation correction)}$$

where:

$Az_x$	azimuth to any point X
$HA_x$	horizontal observation to any point X
$Az_B$	actual backsight azimuth ('reference azimuth')
$HA_B$	observed backsight circle reading

## Slope Reduction

The horizontal and vertical components of an observation ( $HD_1$  and  $VD_1$ ) are found from the vertical angle and slope distances by:

$$HD_1 = SD_3 \sin VA_4$$

$$VD_1 = SD_3 \cos VA_4$$

where:

$HD_1$	horizontal distance
$VD_1$	vertical distance
$VA_4$	zenith angle
$SD_3$	slope distance

## Coordinate Calculation



Coordinates of a target point are calculated from observations and the coordinates of the instrument point using:

$$N_2 = N_1 + HD_1 \cos Az_1$$

$$E_2 = E_1 + HD_1 \sin Az_1$$

$$Z_2 = Z_1 + VD_1$$

where:

$N_1, E_1, Z_1$	Northing, Easting, Elevation of instrument point
$N_2, E_2, Z_2$	Northing, Easting, Elevation of target point
$HD_1$	horizontal distance
$VD_1$	vertical distance
$Az_1$	from equation – <a href="#">Orientation correction</a> .

### Mean Turned Angle Calculations

When the software calculates the mean turned angle and the mean distance for a point, it also calculates standard errors as follows:

For the angles, the standard error of the mean of a set of measurements formula is used:

$$\sigma = \sqrt{\frac{\Sigma v^2}{n(n-1)}}$$

For distances, the standard error of the set of measurements formula is used:

$$\sigma = \sqrt{\frac{\Sigma v^2}{(n-1)}}$$

### Resection Calculation

The resection calculation is a least-squares calculation that uses all available data.

Observations to the same point taken on different faces are treated as separate observations. However, the results are the same as those gained from using meaned (averaged) observations.

The residuals are given for each *point*, not each observation.

The formula used for the standard errors is as follows:

$$\sigma = \frac{(\sqrt{\Sigma v^2})}{(n-1)}$$

## Traverse Calculation

This section shows the formulae that the software uses when it calculates a traverse.

### Compass adjustment

The Compass adjustment distributes the error in proportion to the length of the traverse lines. The formulae are as follows:

$$\text{Northing adjustment} = \frac{D}{\sum D} \times \text{Northing misclosure}$$

where:

D	horizontal distance
$\sum D$	sum of the horizontal distances in the traverse

$$\text{Easting adjustment} = \frac{D}{\sum D} \times \text{Easting misclosure}$$

where:

D	horizontal distance
$\sum D$	sum of the horizontal distances in the traverse

### Transit adjustment

The Transit adjustment distributes the error in proportion to the northing and easting of each traverse point.

$$\text{Northing adjustment} = \frac{\Delta N}{\sum \Delta N} \times \text{Northing misclosure}$$

where:

$\Delta N$	change in northing for the traverse line
$\sum \Delta N$	sum of the changes in northings of all the traverse lines

$$\text{Easting adjustment} = \frac{\Delta E}{\sum \Delta E} \times \text{Easting misclosure}$$

where:

$\Delta E$	change in easting for the traverse line
$\sum \Delta E$	sum of the changes in eastings of all the traverse lines

### Angular adjustments

There are three options for distributing the angular error in a traverse:

- Proportional to distance—the error is distributed among the angles based on the sum of the inverses of the forward and back traverse distances for each point. The formula used is as follows:

$$A_a = \frac{\frac{1}{\text{to dist}} + \frac{1}{\text{from dist}}}{\sum \left( \frac{1}{\text{to dist}} + \frac{1}{\text{from dist}} \right)} \times A_m$$

where:

A <sub>a</sub>	Angular adjustment
A <sub>m</sub>	Angular misclose

- Equal proportions—the error is distributed evenly among the angles in the traverse.
- None—the error is not distributed.

### Elevation adjustments

There are three options for distributing the elevation error in a traverse:

- Proportional to distance—the error is distributed in proportion to the length of the traverse line to the point.
- Equal proportions—the error is distributed evenly among the traverse lines.
- None—the error is not distributed.

## Standard Errors Recorded With Conventional Observations

Each conventional observation that is recorded in the job file has standard errors associated with it. The standard errors that are recorded with the observations are determined as follow:

- For a single observation to a point (for example, Measure topo) the standard error values assigned to the observation are the instrument standard error values (a-priori values). This is because there is nothing else that the standard errors can be determined from.
- For an averaged observation, the standard deviations that are reported during the measurement process indicate the precision of the instrument, but do not indicate its accuracy. If the standard deviation of any of the measurement components (a-posteriori value) exceeds the equivalent instrument standard error value, then this standard deviation value is recorded with the observation. However, any standard deviation values that are below the instrument standard error value are replaced by the instrument standard error (a-priori) value when the observation is stored. This ensures that the recorded standard errors indicate the instrument accuracy rather than the precision of a given observation.
- For rounds measurements (Rounds, Resection, and Station Setup Plus), the MTA (Mean Turned Angle  $\angle$ ) observations record the a-posteriori standard errors computed from the individual observations that contribute to the MTA.

## Area Calculations

The area in *Cogo / Compute area*, is calculated at the average elevation of all the points when the *Distances* field is set to Ground. Average elevation is calculated as follows:

calculate

$$\bar{h} = \frac{\sum h_i}{N}$$

then

$$\left(\frac{\bar{h} + R}{R}\right)^2 \times \text{area at sea level}$$

where:

N	number of stations
$\bar{h}$	average elevation
R	ellipsoidal radius

# Glossary

## Glossary

This topic explains some of the terms used in this Help.

almanac	Data, transmitted by a GPS satellite, that includes orbit information on all the satellites, clock correction, and atmospheric delay parameters. The almanac facilitates rapid SV acquisition. The orbit information is a subset of the ephemeris data with reduced precision.
Angles and distance	Measurement of horizontal and vertical angles and a slope distance.
Angles only	Measurement of horizontal and vertical angles.
Anti-Spoofing (AS)	A feature that allows the U.S. Department of Defense to transmit an encrypted Y-code in place of P-code. Y-code is intended to be useful only to authorized (primarily military) users. Anti-Spoofing is used with Selective Availability to deny the full precision of GPS to civilian users.
Autolock	The ability to lock onto and track a target.
automated rounds	The process of automatically measuring a multiple observations to observed points.
autonomous positioning	The least precise form of positioning that a GPS receiver can produce. The position fix is calculated by one receiver from satellite data alone.
azimuth	Horizontal direction relative to a defined coordinate system.
Backsight	Point with known coordinates or known azimuth from the instrument point that is used to orientate the instrument during station setup.
base station	In a GPS survey, you observe and compute baselines (the position of one receiver relative to another). The base station acts as the position from which all unknown positions are derived. A base station is an antenna and receiver set up on a known location specifically to collect data to be used in differentially correcting rover files.
baud	A unit of data transfer speed (from one binary digital device to another) used in describing serial communications; generally one bit per second.
C/A (Coarse Acquisition) code	A pseudorandom noise (PRN) code modulated onto an L1 signal. This code helps the receiver compute the distance from the satellite.
change face	Turn a servo instrument from the face 1 observing face to face 2.
CMR	Compact Measurement Record. A satellite measurement message that is broadcast by the base receiver and used by RTK surveys to calculate an accurate baseline vector from the base to the rover.
constellation	A specific set of satellites used in calculating positions: three satellites for 2D fixes, four satellites for 3D fixes. All satellites visible to a GPS receiver at one time. The optimum constellation is the constellation with the lowest PDOP. See also <a href="#">PDOP</a> .
construction offsets	A specified horizontal and/or vertical offset distance to enable equipment

	to operate without disturbing construction stakes.
Construction point	A point that is measured using the "quick fix" option in COGO.
curvature and refraction	Correction to the measured vertical angle for the curvature of the earth and the refraction caused by the earth's atmosphere.
data message	A message, included in the GPS signal, that reports on the location and health of the satellites as well as any clock correction. It includes information about the health of other satellites as well as their approximate position.
datum	See geodetic datum.
design code	The code name given to the design point.
design name	The name given to the design point.
Differential Positioning	Precise measurement of the relative position of two receivers tracking the same satellites simultaneously.
Direct Reflex (DR)	Type of EDM that can measure to non reflective targets.
DOP (Dilution of Precision)	An indicator of the quality of a GPS position. DOP takes into account the location of each satellite relative to other satellites in the constellation, as well as their geometry relative to the GPS receiver. A low DOP value indicates a higher probability of accuracy. Standard DOPs for GPS applications are: – PDOP – Position (three coordinates) – RDOP – Relative (Position, averaged over time) – HDOP – Horizontal (two horizontal coordinates) – VDOP – Vertical (height only) – TDOP – Time (clock offset only)
Doppler shift	The apparent change in frequency of a signal caused by the relative motion of satellites and the receiver.
DTM	Digital Terrain Model. An electronic representation of terrain in three dimensions.
dual–frequency	GPS receiver that uses both L1 and L2 signals from GPS satellites. A dual–frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions because it compensates for ionospheric delays.
Dual–prism offset	Measurement of horizontal and vertical angles and a slope distance to two prisms located on one prism pole for the purpose of positioning an obstructed point.
Earth–Centered–Earth–Fixed (ECEF)	A cartesian coordinate system used by the WGS–84 reference frame. In this coordinate system, the center of the system is at the earth's center of mass. The z axis is coincident with the mean rotational axis of the earth and the x axis passes through 0° N and 0° E. The y axis is perpendicular to the plane of the x and z axes.
eccentric object	Measurement of horizontal and vertical angles and a slope distance to the face of a radial object (for example, power pole). An additional horizontal angle is observed to the side of the object to calculate the radius and thus position the center of the object.
EGNOS	European Global Navigation Overlay Service . A satellite–based system that broadcasts GPS correction information.

elevation	Height above mean sea level. Vertical distance above the geoid.
elevation mask	The angle below which Trimble recommends that you do not track satellites. Normally set to 10 degrees to avoid interference from buildings and trees as well as ground multipath errors.
ellipsoid	A mathematical model of the earth formed by rotating an ellipse around its minor axis.
ephemeris	The current satellite position predictions, transmitted in the data message.
epoch	The measurement interval of a GPS receiver. The epoch varies according to the survey type: – for real-time surveys it is set at one second – for postprocessed surveys it can be set to a rate of between one second and one minute
Face 1 (F1)	Observing position of an instrument where the vertical circle is commonly on the left hand side of the telescope.
Face 2 (F2)	Observing position of an instrument where the vertical circle is commonly on the right hand side of the telescope.
feature codes	Simple descriptive words or abbreviations that describe the features of a point. For more information, refer to the Help
fixed solution	Indicates that the integer ambiguities have been resolved and a survey is initialized. This is the most precise type of solution.
float solution	Indicates that the integer ambiguities have not been resolved, and that the survey is not initialized.
FSTD (fast standard)	The method of measuring one distance and one angle to coordinate a point.
GDOP	Geometric Dilution of Precision. The relationship between errors in user position and time, and errors in satellite range. See also <a href="#">DOP</a> .
GENIO	GENeric Input Output file exported by a number of road design software packages that defines a road as a series of strings. See also String.
geodetic datum	A mathematical model designed to fit part or all of the geoid (the physical earth's surface).
geoid	The surface of gravitational equipotential that closely approximates mean sea level.
GPS	Global Positioning System. Based on a constellation of 24 operational satellites orbiting the earth at a high altitude.
GPS time	A measure of time used by the NAVSTAR GPS system.
H. Angle offset	Measurement of vertical angle and slope distance. Horizontal angle is then measured separately, usually to an obstructed point.
H. Angle only	Measurement of horizontal angle.
HDOP	Horizontal Dilution of Precision. See also <a href="#">DOP</a> .
Helmert adjustment	The Helmert adjustment provides an alternative method for computing a resection setup. The Helmert adjustment is essentially the same adjustment as that used to compute a horizontal adjustment in a GPS calibration.
horizontal circle	Graduated or digital disc from which the horizontal angle is measured

instrument height	Height of the instrument above the instrument point.
instrument point	Point that the instrument is occupying.
integer ambiguity	The whole number of cycles in a carrier phase pseudorange between the GPS satellite and the GPS receiver.
ionosphere	The band of charged particles 80 to 120 miles above the earth's surface. The ionosphere affects the accuracy of GPS measurements if you measure long baselines using single-frequency receivers.
K factor	The K factor is a constant defining a vertical curve in a road definition. $K = L/A$ , where: L is the length of the curve A is the algebraic difference between the incoming and outgoing slopes in %
L1	The primary L-band carrier used by GPS satellites to transmit satellite data. The frequency is 1575.42 MHz. It is modulated by C/A code, Pcode, or Y-code, and a 50 bit/second navigation message.
L2	The secondary L-band carrier used by GPS satellites to transmit satellite data. The frequency is 1227.6 MHz. It is modulated by Pcode or Y-code, and a 50 bit/second navigation message. Block IIR-M and later GPS satellites will transmit an additional signal on L2 called L2C.
measurement modes: Standard (STD), Fast Standard (FSTD), Tracking (TRK)	Angles are measured and averaged as one distance is measured. STD mode is indicated by an S next to the instrument icon on the status bar. One angle and one distance are measured. FSTD mode is indicated by an F next to the instrument icon on the status bar. Angles and distances are continually measured. TRK mode is indicated by a T next to the instrument icon on the status bar.
multipath	Interference, similar to ghosting on a television screen. Multipath occurs when GPS signals traverse different paths before arriving at the antenna.
Neighborhood Adjustment	A coordinate adjustment that is applied to conventional surveys with multiple backsights or jobs with a GPS site calibration. During station setup plus, resection or GPS site calibration, residuals are calculated for each observed control point. The calculated distances from each new point to the control points used in the station setup or calibration are used to determine the coordinate adjustment to be applied to the new point.
NMEA	A standard, established by the National Marine Electronics Association (NMEA), that defines electrical signals, data transmission protocol, timing, and sentence formats for communicating navigation data between marine navigation instruments.
NTRIP	Networked Transport of RTCM via Internet Protocol
P-code	The 'precise' code transmitted by the GPS satellites. Each satellite has a unique code that is modulated onto both the L1 and L2 carrier waves.
parity	A form of error checking used in binary digital data storage and transfer. Options for parity checking include Even, Odd, or None.
PDOP	Position Dilution of Precision, a unitless figure of merit expressing the relationship between the error in user position and the error in satellite position.



PDOP mask	The highest PDOP value at which a receiver will compute positions.
postprocess	To process satellite data on a computer after it has been collected.
PPM	Parts per million correction that is applied to measured slope distances to correct for the affects of the earth's atmosphere. PPM is determined using observed pressure and temperature readings together with specific instrument constants.
Prism constant	Distance offset between the center of a prism and the point being measured.
projection	Used to create flat maps that represent the surface of the earth or parts of that surface.
QC records	Quality Control records. With precise positioning applications, this receiver option lets you process RTCM104 corrections and satellite data in real time to provide position precision statistics.
ratio	During initialization, the receiver determines the integer number of wavelengths between each satellite and the GPS antenna phase center. For a particular set of integers, it works out the probability that this is the correct set. The receiver then calculates the ratio of the probability of correctness of the currently–best set of integers to the probability of correctness of the next–best set. A high ratio indicates that the best set of integers is much better than any other set. (This gives us confidence that it is correct.) The ratio must be above 5 for New Point and OTF initializations.
RDOP	Relative Dilution of Precision. See also <a href="#">DOP</a> .
reference station	See <b>base station</b> .
refline	The process of establishing the position of an occupied point relative to a baseline by taking measurements to two known or unknown points.
resection	The process of establishing the position of an occupied point by taking measurements to two or more known points.
RMS	Root Mean Square. This is used to express the accuracy of point measurement. It is the radius of the error circle within which approximately 70% of position fixes are to be found.
RMT	Remote target
rounds	Conventional observation method of multiple observations to multiple points.
rover	Any mobile GPS receiver and field computer collecting data in the field. The position of a roving receiver can be differentially corrected relative to a stationary base GPS receiver.
RTCM	Radio Technical Commission for Maritime Services, a commission established to define a differential data link for the real–time differential correction of roving GPS receivers. There are two types of RTCM differential correction messages, but all Trimble GPS receivers use the newer Type 2 RTCM protocol.
RTK	Real–time kinematic, a type of GPS survey.
single–frequency	

	A type of receiver that only uses the L1 GPS signal. There is no compensation for ionospheric effects.
Single dist. Offset	Measurement of horizontal and vertical angles and a slope distance. Plus additional offset distances to position obstructed points.
SNR	Signal-to-Noise Ratio, a measure of the strength of a satellite signal. SNR ranges from 0 (no signal) to around 35.
Station setup	The process of defining the instrument occupation point and setting the orientation of the instrument to a backsight point or points.
stationing	The distance or interval along a line, arc or road.
String	A string is a series of 3D points joined together. Each string represents a single feature such as a curb line or the centerline of a road.
SV	Satellite Vehicle (or Space Vehicle).
target height	Height of prism above the point being measured.
TDOP	Time Dilution of Precision. See also <a href="#">DOP</a> .
TOW	Time of Week in seconds, from midnight Saturday night/Sunday morning GPS time.
tracking	The process of receiving and recognizing signals from a satellite.
Tracklight	A visible light that guides the prism operator on the correct bearing.
TRK	Tracking mode. Used to measure towards moving targets.
UTC	Universal Time Coordinated. A time standard based on local solar mean time at the Greenwich meridian. See also GPS time.
VDOP	Vertical Dilution of Precision. See also <a href="#">DOP</a> .
vertical circle	Graduated or digital disc from which the vertical angle is measured.
VPI	Vertical Point of Intersection
WAAS	Wide Area Augmentation System. A satellite-based system that broadcasts GPS correction information.
Weight exponent	The Weight exponent is used in the Neighborhood adjustment calculation. When the coordinate adjustment to be applied to a new point is calculated, the calculated distances from each new point to the control points used in the station setup are weighted according to the Weight exponent.
WGS-84	World Geodetic System (1984), the mathematical ellipsoid used by GPS since January 1987. See also <a href="#">ellipsoid</a> .
Y-code	An encrypted form of the information contained in the Pcode. Satellites transmit Y-code in place of Pcode when Anti-Spoofing is in effect.