Survey Pro Field Software

User Guide

From v6.6

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1.Definitions.

"**Affiliate**" shall mean any entity that directly or indirectly through one or more entities, controls, is controlled by, or is under common control with a Party. For purposes of this definition, the term "control" as applied to any entity, means the possession, directly or indirectly, of the power to direct or cause the direction of the management of that entity, whether through ownership of voting securities or otherwise.

"**Effective Date**" means the earlier of the date You sign an Order Form or the date on which the Software is first made available to You.

"**Order Form**" means any order which is entered into by us (or an authorized Spectra products distributor or reseller) and You under which You are provided the Software. Each Order Form for the Software shall be deemed a part of this Agreement. This Agreement is binding on You whether or not You executed an Order Form with us. Order Forms may not vary the terms of this Agreement. Only a written agreement, signed by us (not a Spectra products distributor or reseller) may vary the terms of this Agreement.

"**Software**" means the Spectra software product(s) provided in connection with this Agreement in object code form (or as otherwise specified in any related Order Form). "Software" shall also include any releases provided to or purchased by You under any separate support and maintenance agreement You may enter into with us. Unless otherwise noted, the Software and Documentation are referred to collectively herein as "Software".

"**Our**", "**we**" and "**us**" means Trimble Inc. (935 Stewart Drive, Sunnyvale, California 94085, U.S.A.) and/or its Affiliates, including, without limitation, Trimble Europe B.V. (Meerheide 45, 5521 DZ Eersel, The Netherlands);

"**Supplier**" means either us or an authorized distributor or reseller of Spectra products or services which has entered into an Order Form with You.

"**Third-Party Software**" means any third-party software that we provide to You under this Agreement or under separate terms and conditions.

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2.1.Grant of License. Subject to all of the terms and conditions of this Agreement, we grant You a non-transferable, non-sublicensable, non-exclusive license to use the Software in machine-readable form on any computer and operating system for which it was intended, but solely (a) for your own internal business purposes at the location specified in the applicable Order Form or otherwise agreed to by us (the "**Site**"); (b) in accordance with the Documentation; and (c) in accordance with any additional license term, subscription term or other user, seat, computer, field of use or other restrictions set forth in the applicable Order Form or otherwise specified by us.

2.2.Installation and Copies. We shall make available the Software and Documentation by disk, other media, or as embedded in a device, or make it available for download in electronic form. We shall also provide You with electronic passwords or other enabling mechanisms if necessary to permit the licensed usage of the Software. All licenses shall commence, and delivery shall be deemed to occur, as of the Effective Date (or, if later, such date on which the Software and license keys are first made available to You). If your Order Form is with a Spectra products distributor or reseller, that distributor or reseller (and not us) is solely responsible for delivery to You and we have no liability for any failure to deliver. If the Software requires license keys to operate as licensed to You, our applicable Supplier will deliver such license keys to You.

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2.4.License Restrictions.

2.4.1.You shall not (nor shall allow any third party to): (a) decompile, disassemble or otherwise reverse engineer the Software or attempt to reconstruct or discover any source code, underlying ideas, algorithms, file formats or programming interfaces of the Software by any means whatsoever (except and only to the extent that applicable law prohibits or restricts reverse engineering restrictions). To the extent any applicable mandatory laws give You the right to perform any of the aforementioned activities without our consent in order to gain certain information about the Software for purposes specified in the respective statutes (e.g., interoperability), You hereby agree that, before exercising any such rights, You shall first request such information from us in writing detailing the purpose for which You need the information. Only if and after we, at our sole discretion, partly or completely deny your request, may You exercise such statutory rights; (b) distribute, sell, sublicense, rent, lease or transfer the Software (or any portion thereof), nor use the Software (or any portion thereof) for time sharing, hosting, service provider or like purposes; (c) provide the Software to a third party on a temporary basis and/or use the Software for the benefit or purposes of a third party whether by means of lease, loan, data processing services (e.g. "fee for service") or otherwise, unless You are a reseller of Spectra products under separate written agreement with us and authorized by us to do so; (d) remove any product identification, proprietary, copyright, or other notices contained in the Software; (e) modify any part of the Software, create a derivative work of any part of the Software, or incorporate the Software into or with other software, except to the extent expressly authorized in writing by us; (f) attempt to circumvent or disable the security key mechanism that protects the Software against unauthorized use (except and only to the extent that applicable law prohibits or restricts such restrictions) and/or any licensing control features; or (g) publicly disseminate performance information or analysis (including, without limitation, benchmarks or comparison testing or analysis) from any source relating to the Software or disclose to any third-party or release any results thereof (all of which information shall be considered our confidential information) without our prior written consent.

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2.4.3 You agree to use all reasonable efforts to prevent unauthorized use and disclosure of the Software.

2.5.Evaluation Software. Subject to the terms and conditions of this Agreement and during its term, we may, in our discretion, provide You with pre-release, beta or other software on an evaluation basis ("**Evaluation Software**"). You may use Evaluation Software solely for internal evaluation purposes for thirty (30) days from receipt of the Evaluation Software (unless otherwise agreed with us in writing) (the "**Evaluation Period**"). Unless You pay the applicable license fee for the Software, the Evaluation Software may become inoperable and, in any event, your right to use the Evaluation Software automatically expires at the end of the Evaluation Period. Evaluation Software shall be subject to all restrictions on

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3.Payment. Unless a Software has been made available by us at no charge, You shall pay all fees associated with the Software licensed and any services purchased hereunder as set forth in the applicable Order Form. All payments shall be made in the currency specified in the applicable invoice within thirty (30) days of your receipt of such invoice, unless otherwise specified in writing by our Supplier. Except as expressly set forth herein, all fees are non-refundable once paid. You shall be responsible for all taxes, withholdings, duties and levies arising from the order (excluding taxes based on the net income of our Supplier). Any late payments shall be subject to a service charge equal to 1.5% per month of the amount due or the maximum amount allowed by law, whichever is less.

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4.1.Term. This Agreement is effective as of the Effective Date and expires at such time as all license and service subscriptions hereunder have expired in accordance with their own terms (the "**Term**"). Either Party may terminate this Agreement (including all related Order Forms) if the other Party: (a) fails to cure any material breach of this Agreement within thirty (30) days after written notice of such breach; (b) ceases operation without a successor; or (c) seeks protection under any bankruptcy, receivership, trust deed, creditors arrangement, composition or comparable proceeding, or if any such proceeding is instituted against such Party and not dismissed within sixty (60) days. If You have entered into a separate written agreement with us which governs the Software and that agreement is terminated, then this Agreement automatically terminates and You shall no longer have any right to use the Software. Termination is not an exclusive remedy and the exercise by either Party of any remedy under this Agreement will be without prejudice to any other remedies it may have under this Agreement, by law, or otherwise. For clarity, even if You have entered into an Order Form with a Spectra products distributor or reseller, we are a third party beneficiary to that Order Form and has the right to terminate this Agreement as set forth in this Section 4 (Term of Agreement).

If a Software has been made available by us at no charge, the license remains effective until terminated in accordance with subparagraphs (b) and (c) mentioned above; You decide to terminate this Agreement by ceasing all use of the Software and destroying or returning all copies; or, without prejudice as to any other rights, we decide to terminate this Agreement with or without notice if You fail to comply with the terms and conditions of this Agreement.

4.2.Termination. Upon any expiration or termination of this Agreement, You shall cease any and all use of any Software and Evaluation Software and destroy all copies thereof and so certify to us in writing.

4.3.Survival. Paragraph 2.4 (License Restrictions), Paragraph 2.7 (Ownership), Paragraph 2.8 (Copyright), Section 3 (Payment), Section 4 (Term of Agreement), Paragraph 5.3 (Disclaimer of Warranties), Section 8 (Limitation of Remedies and Damages), Section 9 (Confidential Information), Section 10 (Export Compliance) and Section 11 (General) shall survive any termination or expiration of this Agreement.

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5.3 Disclaimer of Warranties. THIS SECTION 5 IS A LIMITED WARRANTY AND, EXCEPT AS EXPRESSLY SET FORTH IN THIS SECTION 5, THE SOFTWARE AND ALL SERVICES ARE PROVIDED "AS IS." NEITHER WE NOR OUR SUPPLIERS MAKE ANY OTHER WARRANTIES, CONDITIONS OR UNDERTAKINGS, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING BUT NOT LIMITED TO WARRANTIES OF TITLE, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT. YOU MAY HAVE OTHER STATUTORY RIGHTS. HOWEVER, TO THE FULL EXTENT PERMITTED BY LAW, THE DURATION OF STATUTORILY REQUIRED WARRANTIES, IF ANY, SHALL BE LIMITED TO THE LIMITED WARRANTY PERIOD. YOU ASSUME THE ENTIRE RISK AS TO RESULTS AND PERFORMANCE OF THE SOFTWARE. IN ADDITION, WE MAKE NO WARRANTY, EXPRESSED OR IMPLIED, TO SOFTWARE PROVIDED TO YOU FREE OF CHARGE INCLUDING WITHOUT LIMITATION FOR ACCURACY, COMPLETENESS, SUITABILITY, PERFORMANCE OR USE. ANY SOFTWARE PROVIDED BY US AT NO COST IS PROVIDED "AS IS."; ALL IMPLIED WARRANTIES ARE IN SUCH CASE DISCLAIMED.

6.Support & Maintenance. We shall provide the support and maintenance services, if any, as separately purchased by You and specified in the applicable Order Form. Such support and maintenance shall be provided pursuant to our standard service terms which are available upon request to us. Our Suppliers may provide additional support services under separate written agreement, but we are not responsible for any such support unless being a contracting party.

7.Professional Services. Our Supplier shall provide the number of person-days, if any, of professional consulting services ("**Professional Services**") purchased in the applicable Order Form and related statement of work. If we are providing Professional Services, unless agreed in a separate written agreement, all Professional Services shall be provided pursuant to our standard service terms which are available upon request to us. If your Order Form is with our Supplier other than us, that party (and not us) is solely responsible for providing Professional Services and we, not being a contracting party, have no liability related to such services.

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8.2.NOTWITHSTANDING ANY OTHER PROVISION OF THIS AGREEMENT, WE AND OUR SUPPLIERS' ENTIRE LIABILITY TO YOU UNDER THIS AGREEMENT SHALL NOT EXCEED THE AMOUNT ACTUALLY PAID BY YOU TO US UNDER THIS AGREEMENT.

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8.4.The Parties agree that the limitations specified in this Section 8 will survive and apply even if any limited remedy specified in this Agreement is found to have failed of its essential purpose.

9.Confidential Information. Any software, Documentation or technical information provided by us (or our suppliers and agents) shall be deemed our "Confidential Information" without any marking or further designation. Except as expressly authorized herein, You will hold in confidence and not use or disclose any of our Confidential Information. Without limiting the foregoing, You acknowledge that the Software constitutes the valuable confidential information and trade secrets of us and, accordingly, You shall at all times, both during the term of this Agreement and thereafter keep in trust and confidence all the Software, and shall not disclose the same to any third party without our prior written consent. You acknowledge that disclosure of our Confidential Information would cause substantial harm to us that could not be remedied by the payment of damages alone and therefore that upon any such disclosure by You, we shall be entitled to appropriate equitable relief in addition to whatever remedies we might have at law.

10.Export Compliance. You agree to comply with all applicable laws and regulations of the United States of America ("U.S.") and of other jurisdictions (national, state, and local) to the extent that they may govern your use of the Software. In addition, You acknowledge that the Software may be subject to export restrictions by the U.S. government and by certain other governments. You shall not, and shall not allow any third party to, directly or indirectly, remove or export or allow the export or re-export of any part of the Software or any direct product thereof: (a) into (or to a national or resident of) any embargoed or terrorist-supporting country; (b) to anyone on the U.S. Commerce Department's Table of Denial Orders or U.S. Treasury Department's list of Specially Designated Nationals; (c) to any country to which such export or re-export is restricted or prohibited, or as to which the U.S. government or any agency thereof requires an export license or other governmental approval at the time of export or re-export without first obtaining such license or approval; or (d) otherwise in violation of any export or import restrictions, laws or regulations of any U.S. or foreign agency or authority laws, or in violation of any applicable export control laws in the country where the Software has been obtained or is used. You agree to the foregoing and warrant that You are not located in, under the control of, or a national or resident of any such prohibited country or on any such prohibited party list. The Software is further restricted from being used for the design or development of nuclear, chemical, or biological weapons or missile technology, or for terrorist activity.

11.General.

11.1.Assignment. This Agreement will bind and inure to the benefit of each Party's permitted successors and assigns. We may assign this Agreement to any Affiliate or in connection with a merger, reorganization, acquisition or other transfer of all or substantially all of our assets or voting securities. You may not assign or transfer this Agreement, in whole or in part, without our written consent. Any attempt to transfer or assign this Agreement without such written consent will be null and void. If You obtain such written consent from us, You shall permanently assign or transfer all of your rights under this Agreement, provided You retain no copies and You transfer all of the Software (including all component parts, the media and printed materials, any upgrades, and this Agreement), and the recipient agrees to the terms of this Agreement. If the Software portion is an upgrade, any assignment or transfer must include all prior versions of the Software.

11.2.Partial Invalidity. If any provision of this Agreement is held to be invalid, illegal or unenforceable to any extent, that provision shall, if possible, be construed as though more narrowly drawn, if a narrower construction would avoid such invalidity, illegality or unenforceability, or, if that is not possible, such provision shall, to the extent of such invalidity, illegality or unenforceability, be severed, and the remaining provisions of this Agreement shall remain in effect, provided, however, that the court shall have authority and jurisdiction to, and shall, add to this Agreement a provision as similar in terms and intended to effect to such severed provision as may be possible and be legal, valid and enforceable.

11.3.Governing Law; Jurisdiction and Venue.

11.3.1.If You obtained this Software in the U.S., this Agreement is governed by the laws of the State of California (state where Trimble Inc. is located) and the U.S. without regard to conflicts of laws provisions thereof, and without regard to the United Nations Convention on the International Sale of Goods ("UNCISG"). In such case the jurisdiction and venue for actions related to the subject matter hereof are the State of California and U.S. federal courts located in Santa Clara County, California, and both Parties hereby submit to the personal jurisdiction of such courts.

11.3.2.If You obtained this Software outside the U.S., this Agreement is governed by the laws of The Netherlands (country where Trimble Europe B.V. is located), excluding its rules governing conflicts of laws and without regard to the UNCISG. In such case each jurisdiction and venue for actions related to the subject matter hereof are the Dutch courts of the District of Oost-Brabant, The Netherlands, and both Parties hereby submit to the personal jurisdiction of such courts.

11.4.Attorneys' Fees and Costs. The prevailing Party in any action to enforce this Agreement will be entitled to recover its attorneys' fees and costs in connection with such action.

11.5.Notices and Reports. Any notice or report hereunder shall be in writing. If to us, such notice or report shall be sent to the attention of "General Counsel – Legal Notice – Spectra Products" to "Trimble Inc., 935 Stewart Drive, Sunnyvale, California 94085, U.S.A.". If to You, such notice or report shall be sent to the address You provided upon placing your order or at the time the Software has been first made available to You. Notices and reports shall be deemed given: (a) upon receipt if by personal delivery; (b) upon receipt if sent by certified or registered U.S. mail (return receipt requested); or (c) three (3) business days after being sent by a reputable international courier requiring signature for receipt, addresses to the Party at its notice address. Either Party may change its notice address by written notice to the other.

11.6.Amendments; Waivers. No supplement, modification, or amendment of this Agreement shall be binding, unless executed in writing by a duly authorized representative of each Party to this Agreement. No waiver will be implied from conduct or failure to enforce or exercise rights under this Agreement, nor will any waiver be effective unless in a writing signed by a duly authorized representative on behalf of the Party claimed to have waived.

11.7.Entire Agreement. This Agreement is the complete and exclusive statement of the mutual understanding of the Parties and supersedes and cancels all previous written and oral agreements and communications relating to the subject matter of this Agreement. No provision of any purchase order or in any other business form employed by You will supersede the terms and conditions of this Agreement, and any such document issued by a Party hereto relating to this Agreement shall be for administrative purposes only and shall have no legal effect. **Notwithstanding the foregoing, if You have entered into a separate written license agreement signed by us for use of the Software, the terms and conditions of such other agreement shall prevail over any conflicting terms or conditions in this Agreement**.

11.8.Independent Contractors. The Parties to this Agreement are independent contractors. There is no relationship of partnership, joint venture, employment, franchise or agency created hereby between the Parties. Neither Party will have the power to bind the other or incur obligations on the other Party's behalf without the other Party's prior written consent.

11.9.Force Majeure. Neither Party shall be liable to the other for any delay or failure to perform any obligation under this Agreement (except for a failure to pay fees) if the delay or failure is due to unforeseen events, which occur after the signing of this Agreement and which are beyond the reasonable control of the Parties, such as strikes, blockade, war, terrorism, riots, natural disasters, refusal of license by the government or other governmental agencies, in so far as such an event prevents or delays the affected Party from fulfilling its obligations and such Party is not able to prevent or remove the force majeure at reasonable cost.

11.10.Government End-Users. The Software is commercial computer software. If the user or licensee of the Software is an agency, department, or other entity of the U.S. Government, the use, duplication, reproduction, release, modification, disclosure, or transfer of the Software, or any related documentation of any kind, including technical data and manuals, is restricted by a license agreement or by the terms of this Agreement in accordance with Federal Acquisition Regulation 12.212 for civilian purposes and Defense Federal Acquisition Regulation Supplement 227.7202 for military purposes. The Software was developed fully at private expense. All other use is prohibited.

11.11.Third-Party Software. If designated in the Documentation, the Software may contain or be provided with certain Third-Party Software (including software which may be made available to You in source code form). Such Third-Party Software is not licensed hereunder and is licensed pursuant to the terms and conditions indicated in the Documentation and/or on the Third-Party Software conditions ("**Third-Party License**"). Except as may be set forth in the Third-Party License, neither we nor our Suppliers offer any warranty in connection with any Third-Party Software and neither we nor our Suppliers shall be liable to You for such Third-Party Software.

11.12.Official Language. The official language of this Agreement is English. For purposes of interpretation, or in the event of a conflict between English and versions of this Agreement in any other language, the English language version shall be controlling.

11.13.Reservation of Rights. We reserve all rights not expressly granted by this Agreement.

If an executed agreement exists between You and us at any time regarding the Software, the terms of that agreement shall supersede the terms of this Agreement in its entirety. Thus, if You enter into a separate written agreement with us regarding the Software, that agreement (not this one) will control your use of the Software; and further if that agreement is terminated, You will not have the right to use the Software under the terms of this Agreement after termination. Notwithstanding the foregoing, pre-printed terms and conditions on your Order form shall not supersede this Agreement.

Data Collector Warranty Program

Spectra would like to make you aware of the warranty program. A new data collector that has been purchased and is still under the one year factory warranty or under an extended warranty will be authorized for software updates. Data collectors that are not currently under a warranty plan are eligible to purchase an extended warranty. There are Survey Pro software only warranties that will authorize the data collector for software updates, and there are warranties that cover both the data collector hardware and Survey Pro software. The extended warranties are a good way to protect your investment in your equipment.

The Survey Pro installation program will use your internet connection to compare the data collector's serial number against a data base that contains the warranty status on all units. If the unit is under a valid warranty, the installation will proceed. If the unit is not covered under warranty, then a message will be displayed informing you of this and the installation will stop.

To receive Survey Pro minor improvement releases, identified by the version numbering system, you only need to be on the current version of the latest minor update. In other words, if you have version 5.0.x you are authorized for a version 5.0.5 improvement release automatically. For minor updates, 5.0 to 5.1 for example, it is now required that the data collector or Survey Pro software be on a current warranty plan.

The warranty plans are listed on Spectra price lists. Data collector serial numbers are required in order to generate the proper registration codes for your unit and to log the warranty plan into the database.

Changes to this User Guide from Survey Pro v6.5 to v6.6

This new guide includes the following changes, reflecting the latest enhancements made to Survey Pro:

- Traverse adjustment: A new section was added in chapter 5 to describe in more detail what traversing is, what the different field methods are and how a traverse can be adjusted.
- Customizable Map Context menu: When working from the map, a customizable context-sensitive menu now exists so that you can conveniently and quickly access the routines you most frequently use.
- Programmable hardware keys: Survey Pro now lets you program the function keys, if any, of the data collector you are using to run Survey Pro.
- Enhanced remote control for robotic total stations: Several speed modes now exist (low, fast, progressive) to turn the station, which you can now control either from the data collector keyboard or from its touch-sensitive screen.
- Other: A few screenshots in the guide were updated to show new icons (e.g. smart targets) or new symbols.

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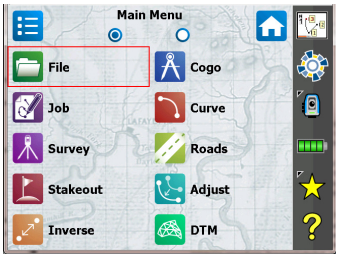
1. Welcome to Survey Pro



Congratulations on your decision to purchase a Spectra Precision product. Spectra Precision is serious about providing the best possible products to its customers and knows that you are serious about your tools. We are proud to welcome you to the Spectra Precision family.

Scope

This manual will guide you through your first steps using Survey Pro. Whether you are using optical or GNSS equipment, or whether you want to perform leveling fieldwork, you will find here key instructions and explanations for a successful start.

If you are new to Survey Pro, reading the first three sections will help you understand the organization and workflow of the software. Chapter 3 will also give all the details to understand what a "receiver profile" is and how it is used to easily connect to and configure a GNSS receiver for RTK and/or post-processing data collection.

The rest of the guide is dedicated to helping you start your field work.

- Station setup is an essential step when surveying with an optical instrument: this guide discusses the Known Point, Resection and Multiple Backsights routines, followed by a short description of a few standard surveying procedures (traverse/sideshot, repetition).
- Choosing the right coordinate system before starting a job with GNSS is also an essential step: the guide will take you through the different possible scenarios, followed by a short description of standard data collection procedures.
- Collecting elevations in level loops is explained in Chapter *7. Leveling on page 86*.
- Stakeout routines are functions common to optical and GNSS surveying. These are introduced in *8. Stakeout Routines on page 96*.
- The last section provides instructions specific to Survey Pro running on Nikon Nivo and Spectra Precision FOCUS total stations.

From your first successful experience with Survey Pro, based on the information provided in this guide, you will be able to extend your knowledge of the software to its many other functions, relying on your own experience as a surveyor and referring to the on-line Help whenever necessary.

Conventions Used

The following conventions are used:

- Text strings in **bold font** represent the names of software items such as fields, buttons, check boxes, tabs, messages, screens, menus, etc.
- The symbol ">" is placed between menus, tabs and/or buttons to indicate that you have to tap on these parts successively in that order.
- When referring to both optical instruments and GNSS receivers, the term "instruments" will be used to encompass the two types of equipment.

The following acronyms and abbreviations are used:

- BS: Backsight
- EDM: Electronic Distance Meter
- NEE: Northing, Easting, Elevation (grid coordinates)
- HA: Horizontal Angle
- LLH: Latitude, Longitude, Height (geodetic coordinates)
- PPM: Part Per Million
- SD: Slope Distance
- SS: Side Shot
- ZA: Zenith Angle

The following conventions are used when inputting or outputting angles:

- **Azimuths**, **latitudes**, **longitudes** are entered in degrees-minutes-seconds format and are represented as **DD.MMSSsss**, where:
  - **DD**: One or more digits representing the degrees
  - **MM**: Two digits representing the minutes
  - **SS**: Two digits representing the seconds
  - **sss**: Zero or more digits representing the decimal fraction part of the seconds.

  E.g.: 212.0805 would indicate 212 degrees, 8 minutes and 5 seconds.
- **Bearings** can be entered in either of the following formats:
  - S32.0805W to indicate South 32 degrees, 8 minutes, 5 seconds West.
  - 3 32.0805 to indicate 32 degrees, 8 minutes, 5 seconds in quadrant 3.

When a field accepts a time for its input, the time is entered in hours-minutes-seconds format, which is represented as **HH.MMSSsss**, where:

- **HH**: One or more digits representing the hours
- **MM**: Two digits representing the minutes
- **SS**: Two digits representing the seconds
- **sss**: Zero or more digits representing the decimal fraction part of the seconds.

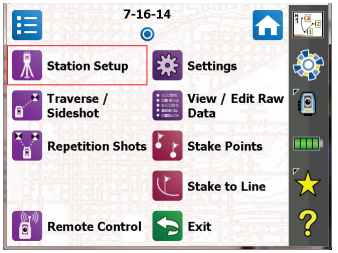
2. Introduction to the Survey Pro User Interface

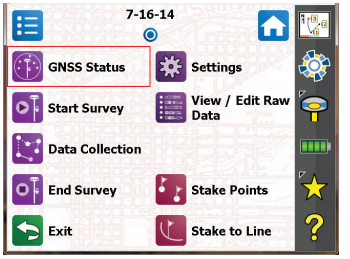
Home Screen and Main Menu

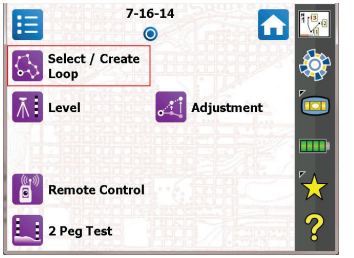
On launching Survey Pro, you will first be asked to open a job. When done, the software will open at the **Home screen**. The home screen shows a selection of the functions you will most frequently use in the field. You can customize the Home screen based on your needs.

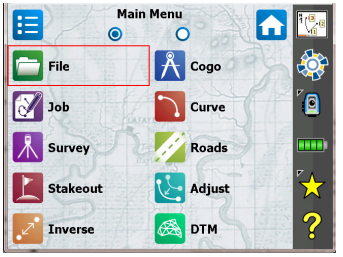
If this is your first time using Survey Pro, a message box will inform you how you can customize the items and layout of the functions on the Home screen (see *How to Customize the Home Screen on page 6*).

Because some of the available Survey Pro functions are mode dependent (optical, GNSS), there is a different Home screen for each mode. That also means there is a slightly different default Home screen depending on which instrument is used. See below, from left to right: Optical, GNSS, Leveling.









The functions available from the Home screen are taken from the **Main Menu**, which contains all the possible Survey Pro functions.

You can access the functions available from each submenu by tapping the corresponding submenu icon.

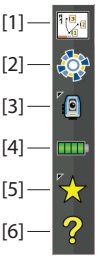
Each submenu, and all the functions attached to the submenu, are represented by icons of the same background color. For example the **File** submenu and its functions are all in green.

Switching Between Home Screen and Main Menu

The table below lists the buttons allowing you to navigate between the Home screen and the Main Menu and its submenus.

Icon / Check boxes	Result
	Takes you to the Home screen from the Main Menu or any submenu.
	Takes you back to the Main Menu from the Home screen.
	Takes you back to the Main Menu from an open submenu.
	The default Home screen has only one page so there's only one blue dot (a radio button), and it is necessarily checked. When adding functions through customization, other pages may be created for the Home screen to accommodate all the added functions (see *How to Customize the Home Screen on page 6*). In that case, tap one of the radio buttons to display the desired page.

Command Bar Description



The command bar is that portion of the Survey Pro screen that remains always displayed whether the Home screen, the Main Menu or one of its submenus is displayed. The command bar contains the following items:

- **Map View [1]**: This button will access the map view of the current job when it is tapped. The map view is available from many screens (see *Map View on page 9*).
- **Central [2]**: This icon shows the status of the connection to the *Spectra Precision Central* cloud file synchronization service. It will be in one of the four states below.

Icon	Spectra Precision Central Status
	Not signed into *Spectra Precision Central*
	Signed into *Spectra Precision Central* and file sync state is normal, with no errors.
	Signed into *Spectra Precision Central*; file synchronization in progress.
	Signed into *Spectra Precision Central*, and there is some problem with the file sync state.

Tap this icon to sign in to your organization's cloud account, or to see more detailed information about the file sync state once you are signed in.

- **Instrument Used [3]**: The Instrument icon indicates the mode (optical, GNSS or leveling) that the software is in, and the type of instrument the software is currently associated with.

Icon	Current Instrument Selection
	Optical instrument
	GNSS receiver
	Leveling

This icon is also used to change the instrument and perform additional settings on this instrument. See *4. Choosing a Surveying Mode - Connecting Survey Pro to an Instrument on page 26*.

- **Battery Level [4]**: The battery icon displays the condition of the data collector's rechargeable battery. The icon has five variations depending on the level of charge remaining, and a sixth variation to indicate battery charging.

Icon	Meaning
	100% charge remaining
	75% charge remaining
	50% charge remaining
	25% charge remaining
	Less than 5% charge remaining
	Battery charging from AC adaptor

Tapping the battery icon is a shortcut to the Windows Mobile Power Settings screen.

- **Quick Pick [5]**: The Quick Pick button will open a customizable list of routines. To quickly access a routine, just tap on it (see *Quick Pick on page 127*).
- **Online Help [6]**: This button opens the online help, which allows you to access information for each screen.

How to Customize the Home Screen

A message is displayed right after opening or creating a job asking you to "**Tap and hold on menu items to manage the Home screen**". This message prompts you to customize the Home menu so that only the functions you will most frequently be using in the field will be made available from this screen.

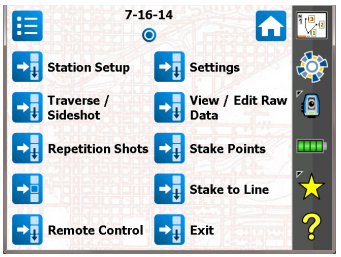
After you have become familiar with the customization process and next time you launch Survey Pro, you can dismiss the message by checking the **Don't show this again** prompt before tapping **OK** to close the message.

Adding a Function

This is a three-step procedure:

- Go to the Main Menu, then to the submenu containing the function you would like to add to the Home screen.
- Tap and hold the corresponding function item and select **Add to Home**. Survey Pro then shows the Home screen with all the possible free locations for the new function, all represented as unnamed icons. Note at this point that all the icons are shown with the same background color (see example).
- Tap on a free icon (an unnamed one) or on the icon of an existing function. The new function is inserted at the tapped location. Icon colors are then restored.

  If you tap on an existing function, this function and the next ones are shifted down by one location. Survey Pro will automatically create a new page of Home screen if the resulting number of functions on the screen is greater that what the screen can accommodate.



Removing a Function

On the Home screen, tap and hold the function you want to remove and select **Remove Item**. This instantly removes the function from the Home screen.

Moving a Function

- On the Home screen, tap and hold the function you want to move and select **Move Item**. Apart from the function you want to move, which keeps its original appearance, all other function items change color to blue.
- Tap on the location where you wish to move the function. This may be a free location, or the location of an existing function. If you tap on an existing function, the moved function will be inserted at the selected location and the function at that location and the ones that follow will be moved down.

Home Screen Pages

The default home screen consists of a single page. You may add up to three additional pages as part of the Home screen in order to make your many favorite functions accessible from this set of pages.

- Adding a page is done by tapping and holding any function on the Home screen and selecting **Insert Page Before** or **Insert Page After**.
- Switching from one page to the other is done by tapping on radio buttons at the top of the screen.
- Removing a page is done by tapping any location on that page and selecting **Remove Page**. This action requires user confirmation.

Programmable Function Keys For Data Controllers Equipped with Keyboards

(Such as Spectra Geospatial Ranger 3 or Ranger 7.)

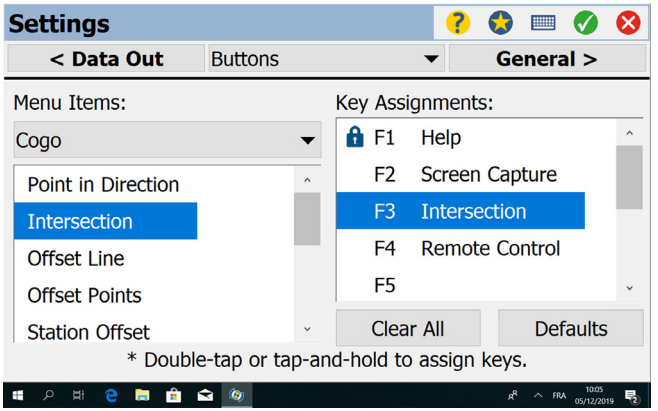
If Survey Pro is run on any such data controller, you can create shortcuts using their available function keys.

From Survey Pro's Home screen, tap **Settings**, then tap on the **Receiver Profiles** tab and select **Buttons**.

On the left, select the menu containing the function you want to assign to a function key. Then select the desired function. On the right, tap on the function key to which you want to assign the function.

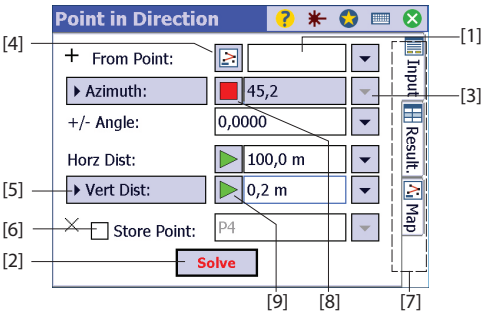
For example, in **Menu Items**, select **Cogo**. Then select **Intersection**.

On the right, double-tap on the key to which to assign the function. The name of this function then appears after the function key label (after "F3 in the example).



NOTE: On Ranger 3 and Ranger 7, there are only four hard functions keys. On Ranger 7 however, you can extend the number of function keys by hitting the **Fn** hardware key (next to Ctrl key) before hitting any of the existing function keys.

Screen Details The screen example below illustrates the different types of items you will usually encounter on the screen when using the different Survey Pro functions:



- Input Field **[1]**: An area where you can enter a specific value.
- Output Field: Only displays a value that cannot be changed.
- Simple Button **[2]**: Typically used to run the function described by its name. Just tap it to run the function. When the button name appears in red characters, you can alternately press the Enter key on the keypad to perform the same action.
- Power Button **[3]**: Typically used to provide context-sensitive functions to modify the corresponding field. Once you have tapped on it, a drop-down list will appear with several choices. Simply tap the desired choice from the drop-down list.
- Choose From Map Button **[4]**: Always associated with a field where an existing point is required. When the button is tapped, a map view is displayed. To select a point for the required field, just tap it from the map.

NOTE: If you tap a point from the map view that is located next to other points, another screen will open that displays all of the points in the area that was tapped. Tap the desired point from the list to select it.

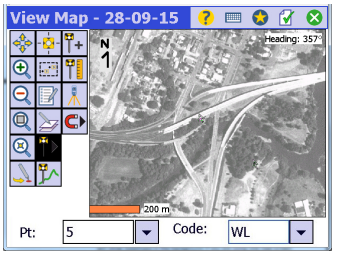
- Scroll buttons **[5]**: When a button label is preceded with the > symbol, it indicates that the button label can be changed by tapping it, thus changing the type of value that would be entered in the associated field. As you continue tapping a scroll button, the label will cycle through all the available choices.
- Check boxes **[6]**: Tap on these boxes to successively check or clear the corresponding option.

- Tabs **[7]**: Many screens show tabs, which look like the tabs on index cards. Tapping on a tab displays a subset of information part of the selected screen.
- A data field preceded by **[9]** means its value can freely be edited, whereas **[8]** indicates that the content of the field is locked to the current value. Toggling between **[8]** and **[9]** is simply achieved by tapping on the icon.

The following buttons will appear in the area usually occupied by the command bar.

Item	Function
	OK button. Accepts the changes made and closes the window.
	Cancels the changes made in the open window
	Closes the current window
	Quick access to the relevant Settings screen
	Quick access to the Help system
	Quick access to the Quick Pick list.

Map View



The *map view* is a graphical representation of the objects in the current job. It will show *basemaps* in the background if you are using one (see screen example).
Basemap files may be either raster images (such as a georeferenced TIFF file, or a JPG image with an associated world file), CAD drawings (DXF files) or Open Street Map files (OSM format).

There are different map views depending on how the map view is accessed. Each can display slightly different information, such as a vertical profile. A bar is shown at the bottom of every map view that indicates the scale. The buttons along the left edge of the screen allow you to change what is displayed in the map view.

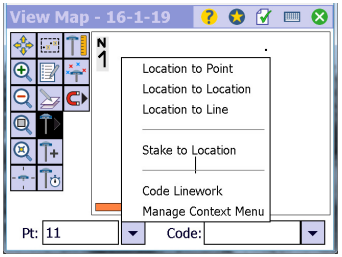
TIP: You can pan around your map by dragging your stylus across the screen.

The "main" map view is the one you get after tapping  in the command bar (from the Home screen or Main Menu).

From all those screens including a  button, you will also display a map view after tapping this button.

The "main" map view, as well as any map view accessible from a survey routine, will also function as an "active" map. That means you can perform several actions directly from the map. Tap and hold on the map to bring up a context menu of available actions. The actions available will depend on what you have selected at the tap-and-hold location.

If Optical or GNSS is selected, the main map can also function as an interface to collect measurements:



- . Tap  and hold in the toolbar onto the left of the main map and then choose **Set Survey Mode** to enable the Measurement interface.

  As a result, the content of the toolbar is extended to show all the available tools in that context:

  -  : Means the survey mode is active (optical).
  -  : Means the survey mode is active (GNSS; see on the left).

  (see screen example for GNSS).

When in **Survey Mode**, you can collect data from the main map by tapping on one of the available buttons (see table below).

You can also press the Enter key to trigger an observation. By default, the Enter key will trigger a "Topo" observation. You can change the Enter key to trigger a point observation by clearing the **Use Enter Button for Topo SS** prompt on the **Job > Settings > Surveying** tab.

Shortcut buttons are available to optimize your work. These are defined below:

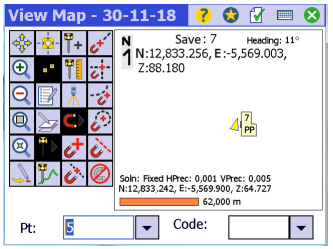
Optical	Function	GNSS	Function
	- Mechanical optical instrument: Triggers the instrument to take a shot in the current mode (fine or coarse). - Robotic optical instrument: Similar to GNSS, i.e. takes the latest tracking mode data and stores a point.		One-epoch point measurement
	- Mechanical optical instrument: Takes a fine mode observation. - Robotic optical instrument: Opens up the remote control screen where you will hit the **Take Shot** button to take a fine mode observation.		Multi-epoch point measurement (static occupation)
	Setting target height		Setting antenna height
	Station setup		GNSS status
	Means that the Survey Mode from the map view is ON.		Means that the Survey Mode from the map view is ON.
	(Robotics only) Tap this button and then tap a point on the map view to automatically turn the total station to that point.		When activated (icon blackened) the computed GNSS position is kept at the center of the map screen.
	When activated (icon blackened) the computed position of the prism is kept at the center of the map screen.		

The main map view includes two additional toolbars:

- The Zoom toolbar
- The Snap-To toolbar

These are described below.

- The Zoom toolbar is always shown.
- Tap  to show the Snap-To toolbar,  to hide it.



Displayed Coordinates

The last computed coordinates of the GNSS rover or rod (optical) are constantly displayed in the lower part of the active map screen as you move around in the working area. In addition, the name and coordinates of the last point saved (if any) will be displayed on top of the active map view.

Coordinates will all be expressed in either "NEZ", "ENZ", "XYZ" or "YXZ" coordinates, depending on your choice of **Coord. Order** in **Job** > **Settings** > **Units** tab.

Viewing coordinates on the active map view is activated by default. You can choose not to view coordinates by disabling the corresponding option:

- Tap  on the map view
- Clear the **Show Coordinate** check box.
- Tap to save your changes and close the **Map Display Options** window.

Zoom Toolbar

Button	Function
	**Zoom Extent** button: By default, will set the map view so that all the points in the current job can be seen. If the last button in this table has been activated then tapping this button will restore the zoom setting so the frame occupies the wole map view.
	Will zoom the current screen in by approximately 25%.
	Will zoom the current screen out by approximately 25%.
	Allows you to drag a box across the screen. When your finger or stylus leaves the screen, the map will zoom to the box that was drawn.
	Prompts you for a point name and then the map view will be centered to the specified point with the point label displayed in red.
	Use this button after you have adjusted the zoom at your convenience. Tapping this button will draw a frame with blue dotted lines around the whole area. As long as you keep this button active, and whatever the zoom out value you apply to the map, you will be able to identify this area with its blue frame surrounding it.

Snap-To Toolbar

Button	Function
	Snap to nearby point.
	Snap to the midpoint of the selected line segment.

Button	Function
	Snap to the nearest of the begin point or the end point of the selected line segment.
	Snap to the intersection of two straight line segments. You cannot snap to the intersection of line segments that are curves or spirals.
	Snap to the point of intersection (PI) of the selected curve segment.
	Snap to the radius point (RP) of the selected curve segment.
	Snap to the nearest point on the selected straight line or curve segment.
	Remove all of the Snap To temporary points created on this map.

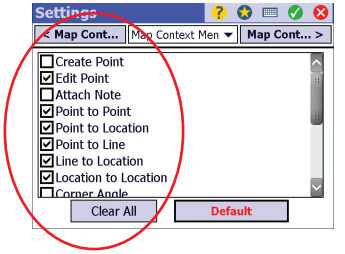
Manage Context Menu

This menu is accessible from the map screen by simply holding down a finger anywhere on the map until a menu opens in which you can select **Manage Context Menu** (last option in the scroll-down list).

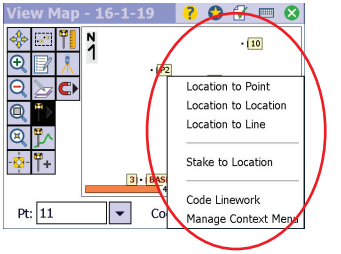
It is also available from the main menu by selecting successively **Job**, **Settings** and then by selecting **Map Context Menu** (last option in the scroll-down list attached to the central upper tab).

With this function, you can choose the functions (see [1] below) you wish to see visible from within the context-sensitive menu (see [2] below) attached to the active map screen.

[1]



[2]



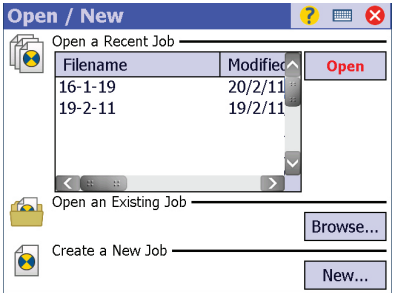
NOTE: This menu should not be confused with the Map Display Options screen, which you can open by tapping on the button below:

Survey Pro cannot start without a job being open. Upon launching Survey Pro, the **Welcome to Survey Pro** screen will guide you through the process of creating a new job or opening an existing job.

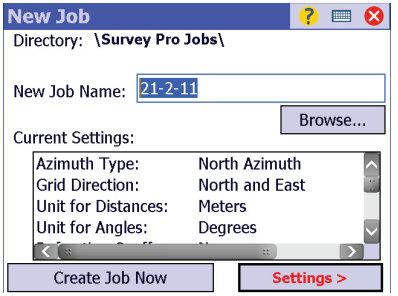
NOTE: Upon launching the onboard version of Survey Pro, the initial screen allows you take measurements without having to open a job. Refer to *10. Survey Pro's On-Board Version on page 112*.

- Tap the **New** button. The **New Job** screen opens, which prompts you for a job name where the current date is the default name.

1



2

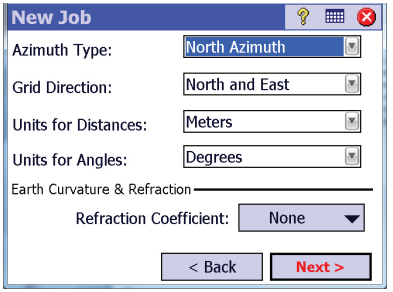


- Either type in a new job name or accept the default name.
- You can create the job in two different ways:
  1. Tap the **Create Job Now** button. The new job will be created with the current default settings (as listed at the bottom of the screen) and will be stored in the default directory (\Survey Pro Jobs\).
  2. Tap the **Settings** button to access the different job settings (see below). After you have gone through the different settings, tap the **Finish** button. This will create and store the new job.

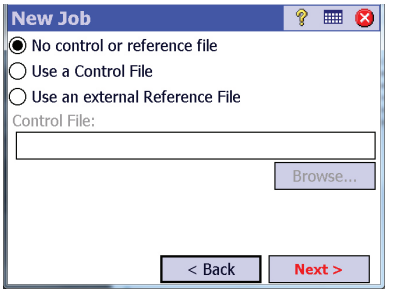
NOTE: The job names listed in the upper portion of the screen are those of the most recent jobs you opened in Survey Pro. This list does not necessarily reflect the list of jobs stored in your data collector. If you are looking for a job stored in your data collector, use the **Browse** button.

Job Settings The settings and values entered for a new job become the default values for any subsequent new jobs. A short description of the jobs settings is given below.

[1]



[2]



- **Units [1]**: When creating a new job, set all the desired units for the job. You can also enable the setting for **Earth Curvature and Refraction** correction for optical measurements.
- **Control/Reference File [2]**: Control points can optionally be imported from another existing job by checking the **Use a Control File** check box. After tapping **Finish** to create the job, a message will indicate the number of imported points. If you are using a control file, by default the coordinate system of this control file will be used for the new job. You can override this default setting on the coordinate system page. A control file can be imported from either a .Job or .Survey file.

  You can also use the points from a reference file (also a .Job or .Survey file) by checking the **Use an External Reference File** check box. Any of the points read from this file will be usable as a reference point in the new job.

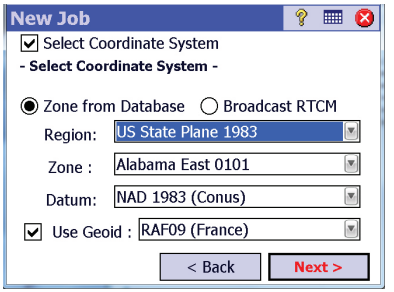
About Control Files and Reference Files: A control file contains a list of control points. When selecting a control file during the job creation phase, you allow Survey Pro to import all the control points from this file into the job file. For example if the selected control file contains 10 control points, the newly created job file will contain 10 points (+1 if you optionally defined a start point; see below).

A reference file contains a list of reference points. When selecting a reference file during the job creation phase, you allow Survey Pro to show all the reference points stored in this file from within the open job (reference points will show up on the map view and in the list of points), **but these points are not imported into the job file**. That's why they are not represented the same way as the other points (a different icon is used). But if you pick a reference point to be used as a setup point (whether in optical or GNSS), or for any reason that requires a point for calculations, this reference point – and only this one – will be imported into the job (and will change icon).

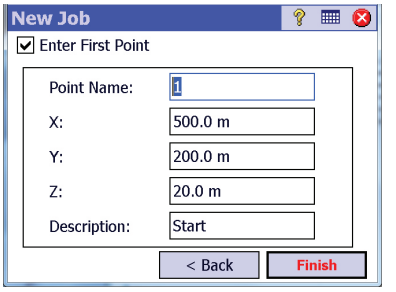
NOTE: Basically, a reference file is not different from a control file because control points and reference points are not different by nature; Both types can be any point of interest, which you consider to be useful to complete your survey.

If you don't need any points from another file for the job, select **No control or reference file** and tap **Next>**.

[3]

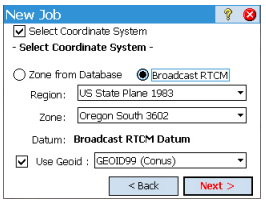


[4]



- **Select Coordinate System [3]**: When you are using a control file, you can start the job with the control file's coordinate system, or you can pick a different coordinate system from the database. If you don't have a control file, you need to choose the coordinate system for the job. To select the coordinate system for the new job:
  - Clear the check box when you are doing an optical survey with a ground scale factor of 1, or if you are doing a GNSS survey and there's no known projection or datum for your local grid coordinates.
  - Check this box when your local grid coordinates are defined by some known map projection and datum. In this case, select **Zone from Database** and specify the region (**Region**), zone (**Zone**) and datum (**Datum**) of your working area.

    In GNSS Survey only, the datum may be defined in a different way using RTCM messages 1021 and 1023 received from some NTRIP networks that broadcast these messages. In this case, check **Broadcast RTCM** and specify the region (**Region**) and zone (**Zone**) of your working area. The datum will be provided by the RTK network.



Understanding Scale Factor for your coordinate system:

- If your job has "no coordinate system", Survey Pro automatically sets the scale factor for optical measurements to "1.0". This means that the distance measured on the ground will be 1:1 to the distance on the grid. If

you start a GNSS survey, Survey Pro will use default **Ground Calibration** mode to calculate your grid coordinates from GNSS measurements.

– If your job is using a map projection and datum, Survey Pro will automatically calculate the correct scale factor for each station setup so the distance measured on the ground will properly be reduced to the coordinate grid. If you start a GNSS survey, Survey Pro will use the selected projection to calculate grid coordinates from GNSS measurements.

NOTE: You can modify the default optical scale factor settings in the **Job > Settings > Scale Factor** tab.

- **First Point [4]**: A default point name and coordinates are prompted to become the first point in the job. You can freely change the name and coordinates of this point before creating it. You may also clear the box if you do not want to create a new point at this stage.

You may start your measurements now if you don't need anything else in your job at this time. In that case, go directly to *4. Choosing a Surveying Mode - Connecting Survey Pro to an Instrument on page 26*.

If you need to add data (points, polylines, alignments, etc.) into your job before starting, the sections below will tell you how to import or create/edit data from within the open job. The last section lists the possible formats in which the data stored in the job can be exported.

Importing Data

Use the **File > Import** function to add points to the open job. The points may be imported from different file formats, using default importers:

- Survey Pro native formats (*.Survey, *.JOB, *.JXL, *.CR5). JXL is the extension for files in JobXML format, a Spectra Precision standard format for point, alignment, and measurement data.
- LandXML (*.XML), an industry standard format for point, alignment, and measurement data.
- Text format (*.TXT, *.CSV). An Import ASCII wizard will help you define the content of every TXT file you will import.

Data may also be imported form other formats (GDM, KOF, SFN, Surpac) using custom importers created in IXL (XML) format.

Survey Pro will parse and import all the known elements from the chosen file. These elements will be added to the current job as points, polylines and

alignments. See the definition of these elements in *Editing Points on page 19*, *Editing Polylines on page 22* and *Editing Alignments on page 23*.

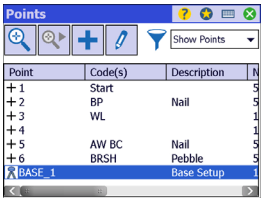
The **File > Import Control** function is used to import points onto the control layer of your job. Points on the control layer are protected from being modified. Control files should be in *.Survey or *.JOB format.

The **File > Reference File** function is used to add points to the current job without importing them into the job file. You see all of your reference points on the map and in point lists. You can use any reference point in Survey Pro as if it were a regular point stored in your job file.

Editing Points

A point in Survey Pro has coordinates and properties. A point's coordinates can be derived in one of two ways:

- *Key-in point*: The coordinates for this point were entered using the **Job > Points** function or this point was created by importing data to the job.
- *Observed point*: The coordinates for this point are calculated from measurements in the current job.



NOTE: To see the current coordinates and properties of a point, you can tap the point on the map. This will open the **Point Details** screen showing the **Origin** of the point, which describes how the point was created.

Managing Points

All points in a job file, whether keyed-in or computed from observations, can be viewed using the **Job** > **Points** function. Points in the job will be either active or deleted. Active points can be used in Survey Pro. Deleted points exist in the job file database, but must be undeleted before they can be used in Survey Pro.

The following icons are used to identify the different types of existing points:

Icon	Point type
	Design point
	Reference point
	Staked point
	Point (undifferentiated)
	Deleted point

The drop-down list available from the right-upper corner of the screen allows you to view all the active –i.e. non-deleted– points (select **Show Points**), the previously deleted points (select **Show Deleted**), only the design points (select

Design Pts. only), only the staked points (select **Staked Pts. Only**), both design and staked points (select **Design & Staked Pts. Only**), or all of them (select **Show All**).

Use the three or four buttons located at the top of the screen to manage your points:

-  : Allows you to search for the first point in the displayed list meeting the search criterion you define. You may define a criterion on the point name or the point description. You can also search by point code (FXL auto linework and code).

   : Will become active only after Survey Pro has found the first point in the list meeting your search criterion. Each new press on this button will view the next point in the list also meeting the search criterion.

-  : Allows you to insert a new point to the list. A name will be prompted by default for the new point, based on the name of the currently selected point. Entering the definition of a new point is organized into three different tabs (see *Creating a New Point on page 21*). Note that defining a point as a design or staked point can only be done using **Manage Design Points** on the **Stakeout** menu.

-  : Allows you to edit the selected point (see *Modifying a Point on page 22*).

Also, when you tap and hold a point in the **Show Points** list, a context-sensitive menu is displayed giving access to the following functions:

- **Delete Point**: Allows you to delete the selected point.

  A deleted point is marked with the () icon, placed before its name.
- **Delete Points**: Prompts you to make a multi-selection of points and then deletes all these points.
- **View Point Details**: Allows you to get a read-only view of the point origin, coordinates, properties and notes. The information is split into three different tabs: **Details**, **Derivation** and **Notes**.
- **View Raw**: Takes you to the **Raw Data** view on which the step during which the point was created is highlighted. The **Raw Data** view can also be selected from the main menu by tapping **Job** > **View / Edit Raw Data**.
- **View Map**: Takes you to the map screen where the selected point is shown at the center of the screen.

Double-clicking a point in the list is equivalent to selecting **View Point Details** in the context-sensitive menu.

When you tap and hold a point in the **Show Deleted** list, a context-sensitive menu is displayed giving access to the following functions:

- **Undelete Point**: Will take this deleted point back to the list of existing points. The undeleted point will recover its original icon.
- **View Point Details**: Same as above.
- **View Raw**: Same as above.

Creating a New Point

Select any point in the list and tap  to insert a new point:

- The **General** tab allows you to name the new point, add a description if necessary, assign a layer to the point and possibly attach a picture to it (using the built-in camera or by selecting an image file from the disk).
- The **Location** tab allows you to enter coordinates for the point. You can enter **Grid**, global geodetic (**WGS84 LLH**) or local geodetic (**Local LLH**) coordinates.
  - Grid: This point's local grid coordinates are the Northing, Easting, Elevation values that were keyed in or imported. This point's global geodetic coordinates will be calculated by transforming grid coordinates into latitude, longitude, height coordinates using the current projection.
  - Global geodetic: This point's WGS84 coordinates are the latitude, longitude and height values that were keyed in or imported. This point's local grid coordinates will be calculated by transforming geodetic coordinates into Northing, Easting, Elevation coordinates using the current projection.
  - Local geodetic: This point's local geodetic coordinates are the latitude, longitude and height values that were keyed in or imported. This point's grid and global geodetic coordinates will be calculated by transforming the local geodetic coordinates with the current projection.

  When there is no projection set or solved, there is no way to transform the keyed in values into grid or geodetic coordinates. You will see these coordinates are missing when you look at the point details.

  If the point originates from an observation, the **Position** tab will show this point's coordinates but will not allow you to change them.
- The **Code** tab allows you to associate one or more feature codes to the point. For more information on Descriptions, Layers, Codes and Notes, see *Point Properties on page 118*.

Modifying a Point

Select the point you want to modify and tap  .

- Survey Pro will show two additional tabs compared to when you inserted the point:
  - **Derivation**: This is a read-only tab indicating the type and origin of the point.
  - **Notes**: This tab allows you to add as many notes as needed to the point. Each note is date & time tagged.
  - The data shown on the **General**, **Code** and **Location** tabs can normally be modified.
- **Transforming a computed point into a key-in point**: Use the **Edit Location** button on the **Location** tab to change the two horizontal coordinates or/and the one vertical coordinate.

  For example, using a total station or GNSS, you observe a point and measure its three coordinates. This point is in addition a benchmark providing an elevation reference. You may want to fix the vertical coordinate to what is written on the benchmark sheet rather than keep the measured elevation. Using the **Edit Location** button, you can change the measured vertical coordinate to a keyed-in coordinate while keeping the horizontal coordinates as measured.

Multi-Point Selection

With a selection of multiple points, you can use the same button to modify the description and layer of the entire selection in one operation.

Selecting several points not in sequence is obtained by first activating the Control key and then tapping successively on the points to edit. The Control key is accessible from either the virtual keyboard (CTL key on Nomad, Recon or ProMark 220) or the real keyboard (CTRL key on Ranger). The Shift key can also be used to select several points in sequence.

Editing Polylines

A polyline in Survey Pro is a line connecting points together. Each vertex of the line is defined by an existing point, whether an observed or keyed in point. Points in polylines can be connected with either straight segments or horizontal curves.

You can use the polyline editor to modify polylines (go to **Job > Edit Polylines**). The polyline editor is described in the Online Help.

Editing Alignments

An alignment in Survey Pro is a line defined by vectors starting at a Point of Beginning (POB). The POB can be an existing point in the job, or just location coordinates. Alignments can have horizontal segments and optionally a vertical profile. Horizontal segments can be straight segments, circular curves or spiral curves. A vertical profile can be defined using a vertical curve and straight grade segments.

You can use the alignment editor to modify alignments (go to **Job > Edit Alignments**). The alignment editor is described in the Online Help.

You can import alignments for staking, using **Roads > Edit Roads** menu. Alignments imported using this function can be viewed in the alignment editor but cannot be modified.

Exporting Data

Use the **File > Export** function to export data from the open job to one of the supported file formats. For most formats (Survey, JOB, TXT, CSV, CR5 and DXF), you may select the portion of the current job you wish to export. For export to XML, Survey Pro 4.x (Job/RAW) or JobXML format, the entire job database will always be exported.

Generating Survey Reports

Survey Pro can generate a report of your survey based on the content of the currently open job and formatted according to the template you chose at the beginning of the process.

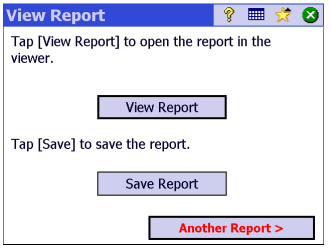
About 20 templates are available (see list below) and most of them are customizable.

- Complete Survey Report, in html format
- Report in fbk format
- Report in kof format
- GNSS Points report in csv format
- LevelLoopReport_doubleSpaced
- Google Earth report in kml format
- LisCAD report in fld format
- Report in Nikon RAW format
- Optical observation report in htm format
- Two different points reports in csv format
- Nine different stakeout reports in csv or htm format

To generate, view, and save a survey report for the open job, follow the instructions below:

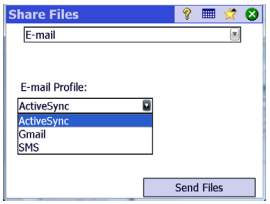
- Go to the Main Menu and tap **Job**, then **View Report**.
- Select the desired template, then tap **Next**.

- Whenever prompted, customize the report, then tap to let Survey Pro generate and then view the report.
- Depending on the chosen template, do the following to access the screen from which you will be able to save the report:
  - For html reports, tap , , then . You then get the screen below.
  - For Google Earth reports, in absence of an application capable of viewing the generated report, Survey Pro will take you directly to the screen below.
  - For all other types of reports, tap to access the screen below.



- Tap **Save Report** to save the report to the desired folder.
  (On the same screen, the **View Report** button would take you back to the survey report view, and the **Another Report** button would allow you to ask for a new report, based on the same or a different template.)

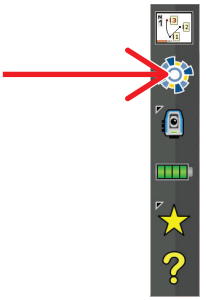
Sharing Files Over the Internet



Survey Pro allows you to share files over the Internet. This requires that you first set up an Internet connection on your data collector using Windows Mobile's **Settings** > **Connections** > **Connections** function.
After the Internet connection has been established, go to **File** > **Share** and set an e-mail profile. You can send emails to one or more recipients, with your files attached to your e-mails. If several files are selected to be attached to an e-mail, Survey Pro will automatically zip the files so there is always one single file attached to the email

Sending e-mails requires that you use an e-mail profile. You can set up your own e-mail account (e.g. Gmail) or use one of the default e-mail profiles (SMS, ActiveSync) set up by Windows Mobile. After you have set up your own e-mail account, it will appear as an additional option in the **E-mail Profile** list.

Connecting to Spectra Precision Central



Spectra Precision Central is a cloud file storage and synchronization service allowing an organization to synchronize files and folders across multiple desktop computers, data collectors running Survey Pro, and mobile devices.

Spectra Precision Central automatically keeps files synchronized across devices so that team members can easily exchange data, and everyone is always using the latest up to date copy of any data file.

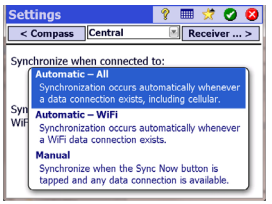
To access *Spectra Precision Central* from Survey Pro, you need to connect your data collector to the Internet using WiFi, the cellular modem connection, or by plugging it into Windows Mobile Device Center (ActiveSync).

To connect a data collector to *Spectra Precision Central*:

- Tap the icon in the command bar to open up the **Central** screen
- Type in your user name (**Username**), your company's organization name (**Organization**), and your user password (**Password**).
- Tap **Sign in**.

  When you are connected, the Central icon will change to 
- Once you are signed in to Central, the **Central** screen shows your sign-in status, as well as any current file sync activities going on in the background.

  You can then go to **Job** > **Settings** and select the **Central** tab to configure your file synchronization connection usage preferences:
  - **Automatic - All**: Files will get synchronized any time there is a data connection. This is for users who want the file synchronization to be continuous and don't care about mobile data bandwidth usage.
  - **Automatic - WiFi**: Files will get synchronized any time there is a data connection that is not cellular, for example, if you are using WiFi, or any time you plug into Windows Mobile Device Center (ActiveSync). This is for users who want automatic file synchronization any time, except when their data connection is using mobile data bandwidth.
  - **Manual**: Synchronization takes place only when the **Sync Now** button on the central screen is tapped.



Whenever the **Cloud** button () is shown on the screen, for example when you want to import files, you can tap on this button and select **Central**.

By doing this, you will be allowed to browse through the different folders on the cloud (and not only the subfolder specific to your data collector) so you can download a new file posted elsewhere in the cloud by your team.

After you will have saved this file to your data collector, the sync mechanism will in the background create a copy of this file to your specific data collector subfolder on the cloud.

4. Choosing a Surveying Mode – Connecting Survey Pro to an Instrument

Before you start taking new measurements with Survey Pro, you must configure and activate your instrument. You can activate an optical total station, a GNSS receiver, a digital automatic level, or you can specify to use manual input for three-wire leveling.

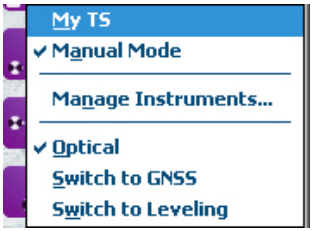
NOTE: Selecting an instrument only makes sense when Survey Pro is running on a data collector. If it's running in the instrument you are using (e.g. FOCUS 30), only this instrument can be used in Survey Pro.

Before you make this choice, power on the instrument. This will allow the data collector to detect it and establish a radio, Bluetooth or serial connection with it when asked to do so. Three-wire leveling using manual input does not require Survey Pro to be connected to an instrument.

With GNSS equipment, you may simply use a rover receiver, or both a base receiver and a rover receiver. In the latter case, it's good practice to start your survey having both receivers running side by side. This way, you can complete the setup of both receivers and ensure they are communicating on the data link, and you are getting a fixed position at the rover.

When using a serial connection to start a base and rover, the data collector must be connected to the base receiver first. Once the base is set, disconnect the cable from the base and connect it to the desired rover.

Instrument Icon and Options List



- Run Survey Pro.
- Open or create a job.
- Tap on the Instrument icon in the command bar.

  (This icon may look like any of the following:  ,  or ).

  This opens a list of options (see screen example).
- **Manage Instruments** provides access to various functions allowing you to declare a new instrument and make advanced settings for each instrument.
- The available options below the **Manage Instruments** button are for selecting the desired operating mode for Survey Pro:
  - **Optical** for optical instrument (the selected one in the example)
  - **GNSS** for GNSS receiver used in RTK or/and post-processing
  - **Leveling** allows Survey Pro to use the most accurate techniques for measuring elevations. Leveling can be done using an optical total station, a digital automatic level, or a manual automatic level.

NOTE: In surveying, the term "automatic level" refers to a level that can be accurately plumbed without having to be accurately leveled.

All levels built in the last 40 years or so have been automatic levels. They are automatic because the prism through which the light rays pass is suspended by a pendulum. Therefore, as long as the instrument is close to level (which can be achieved ± 60" using a bubble level), the pendulum mechanism ensures that the light rays are always passing through perpendicular to actual gravity, and they are very accurate.

This means that a digital instrument such as the Trimble Zeiss Dini level is called a digital automatic level, and a non-digital instrument, such as the Nikon AL2s, is also an automatic level.

- In the section above the **Manage Instruments** button is a list of all instruments that have been added to Survey Pro for the currently selected mode. The current active instrument is indicated with a check mark. An additional option is available ("Manual Mode" for optical and leveling; "Demo Mode" for GNSS) allowing you to use Survey Pro standalone.

  In optical, you choose "Manual Mode" to manually enter horizontal angle, vertical angle, and slope distance any time Survey Pro is triggered to take an observation. This is useful for training and learning the software, and it can also be used to enter survey measurement data into a job from written field notes.

  In GNSS, you can choose "Demo Mode" for demonstration and training purposes only. The "Demo Mode" has no use for handling actual survey measurements.

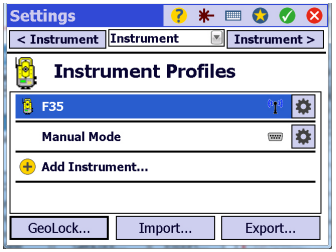
  In leveling, you must choose "Manual Mode" if you wish to do single-wire or three-wire leveling from rod readings.

  The "Manual Mode" and "Demo Mode" profiles cannot be deleted or renamed.

In summary, tapping the Instrument icon allows you to:

- Select Optical, GNSS or Leveling mode
- Quickly activate an instrument for use in the selected operating mode
- Quickly access the Instrument Settings screen
- Add a new instrument supported in the selected operating mode.

Optical Mode – Connecting Survey Pro to an Optical Instrument

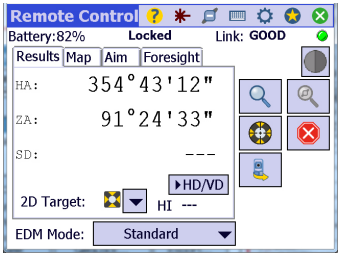


- Tap the Instrument icon and select **Switch to Optical**
- Tap the Instrument icon and select **Manage Instruments**. This opens the Settings screen listing all the current instrument profiles.
- Tap the **Add Instrument** button and define the new instrument: Choose its brand and model, and then name it.

  Depending on the model you select, additional settings may be required (connection, radio, etc.) and status is also provided (port, connection, level bubble, etc.). An **Instrument Settings** button is also available giving access to advanced settings (collimation, EDM, lights, etc.).
- Tap ✓ to create the new instrument and close the **Instrument Setup** screen. The new instrument is automatically selected in the list (the instrument name is highlighted in the list).
- Tap ✓ to close the **Settings** screen.

The **Settings** screen for optical instruments includes the following buttons:

- **Instrument Settings**: Gives quick access to the settings of the instrument selected in the list. The type and number of settings depend on the brand and model of the instrument selected. All instruments have a **Precision** tab through which you can read the expected precision values of the instrument (angles, distances, PPM). These values are used in the resection routine (see *page 46*) to weight the observations used in the computation process.
- **GeoLock**: Allows you to enable or disable GeoLock, a GPS-assisted target search function usable with some robotic instruments only.
- **Export** and **Import**: These buttons allow you to respectively save or load instrument profiles. Survey Pro saves instrument profiles as SPI files. Importing an SPI file is a quick way of adding a preset instrument in Survey Pro.



Remote Control Screen

If you are using a robotic total station, use the **Survey > Remote Control** function to control the total station from the data collector running Survey Pro.

In addition to providing the same level of control as Survey Pro's onboard version, the Remote Control screen constantly provides information about:

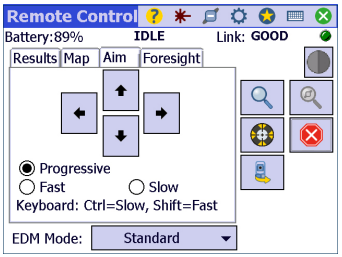
- The charge status of the battery used in the total station
- The operating status of the total station (IDLE/ MEASURING/Locked)
- The quality of the radio link between the robotic total station and the data collector.

The following buttons are also available from this screen to control the instrument:

- : Launches a GPS-assisted search for the prism (**GeoLock**)
- : Launches a search for the prism starting at the current instrument direction
- : Enables or disables the lock-and-go feature (**LockNGo**)
- : Stops the current turn or search operation
- : Opens up the "Turn To" screen where you can select a point or angles to turn the instrument to
- : Turns on or off the track light.

The following icons are made available next to the title bar:

Item	Function
	Visible laser pointer off. Tapping on this icon will turn the laser pointer on. Note: Standard safety precautions should be taken to ensure that persons do not look directly into the beam.
	Visible laser pointer on. Shown to indicate the visible laser is currently active. In the command bar, the instrument icon will then look like this: Tapping will turn the laser pointer off. Note: Standard safety precautions should be taken to ensure that persons do not look directly into the beam.
	Provides access to the Instrument settings screen.
	Shows or hides the on-screen keyboard.
	Provides access to Geolock activation, status and reset.



The arrow keys and radio buttons on the **Aim** tab of the Remote Control screen provides a very efficient way to control the way you turn your robotic total station:

- **Progressive**: If this option is selected, the total station will start turning slowly in the requested direction and will then gradually turn at a faster speed if you keep your finger on the button.
- **Fast**: If this option is selected, the total station will instantaneously turn at a fast and constant speed until you release the direction button.
- **Slow**: If this option is selected, the total station will instantaneously turn at a slow and constant speed until you release the direction key.

Alternately, if you are using a data collector fitted with a keyboard, you can obtain the same features in the way you turn the total station by using the arrow keys on the keyboard combined with one of the following keys (also on the keyboard):

- Control (Ctrl) key: Slow turn
- Shift key: Fast turn
- No other key held down: Progressive turn, gradually faster.

GNSS Mode – Connecting Survey Pro to a GNSS Receiver

Introduction to Receiver Profiles

Survey Pro connects to a GNSS receiver through a *receiver profile*, which is a convenient way of connecting to and configuring a GNSS receiver in one click, using information previously saved as a receiver profile.

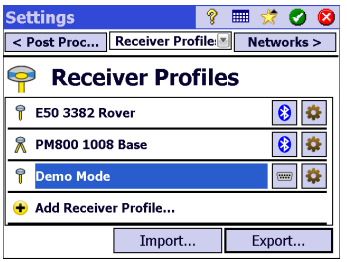
Receiver profiles allow you to use GNSS receivers for either RTK data collection, post-processing data collection, or both simultaneously.

There are two ways of adding a receiver profile into Survey Pro:

- Using **Spectra Auto-Configure**. This procedure can only be used with Spectra Precision receivers. Survey Pro uses Bluetooth to detect all the nearby Spectra Precision receivers. For each detected receiver, Survey Pro will offer to create a base, rover, and network rover profile using the default settings for that receiver type. You can then choose the receiver profiles you would like to create for the newly detected receivers.

  If the receiver has also RTX capability, be aware Survey Pro does not automatically create an RTX profile for a receiver. If you want to use the receiver in RTX mode, you can modify an existing profile, or add a new RTX profile to operate the receiver in this mode.
- Using **Manual Configuration**. This procedure allows you to connect to a single receiver either through a serial connection or over Bluetooth. This procedure is suitable for any of the supported manufacturers and models of GNSS receivers. Once the connection with the receiver is established, you have to define your receiver profile by yourself (see *Modifying a Receiver Profile on page 35* for more information). In the last step, you will name the receiver profile and save it.

Example of Receiver Profiles List



Later, when you start a survey, just select the desired receiver profile –and a *network profile* if you are working in a network; see also *Managing Network Profiles on page 37*– before you ask Survey Pro to connect to the receiver you are using. Survey pro will configure the receiver hardware according to the settings defined in the selected receiver profile.

When you are using Bluetooth to communicate with receivers, you will typically have a different profile for each receiver, since the Bluetooth address is part of the profile. However, you can change the receiver a profile connects to by changing the Bluetooth address.

You may have two or more different profiles for the same receiver. For example, if you use receiver "x" as a rover with a radio base on some days, and as a network rover with an NTRIP server on other days, then you would have two different profiles for this same receiver.

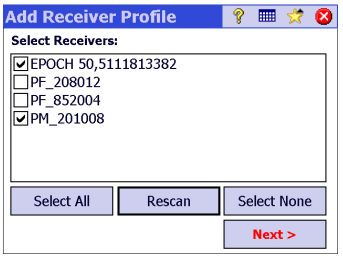
Receiver profiles can be imported or exported as SPR files allowing you to deploy consistent receiver profiles across your surveying crews.

Receiver profiles can be modified, renamed or deleted.

Adding Receiver Profiles

- Tap the Instrument icon and select **Switch to GNSS**.
- Tap the Instrument icon and select **Manage Instruments**. This opens the Settings screen listing the currently existing GNSS receiver profiles.
- Tap **Add Receiver Profile**, then use of the two procedures described below.

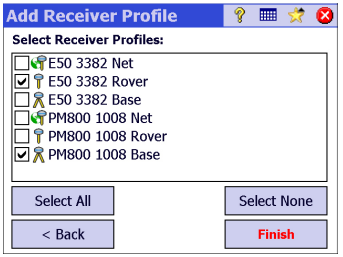
Example of Detected Receivers



Adding Receiver Profiles Using Spectra Auto-Configure:

- Tap on the **Start** button in the **Spectra Auto-Configure** pane. Survey Pro then scans automatically for new Spectra Precision GNSS receivers within Bluetooth range. After a while, the screen lists the names of all the detected receivers.
- Select each of the receiver for which you would like to add a receiver profile.

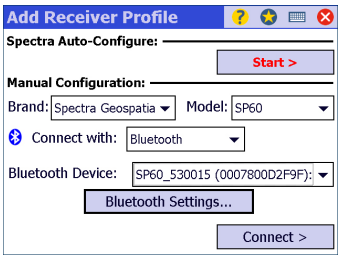
Example of Selected Standard Receiver Profiles



- Tap **Next**. Survey Pro will in sequence connect to each of the selected receivers and will then return a list of standard receiver profiles, each of them corresponding to a possible usable profile for that receiver.
- Check each of the receiver profiles you would like to add.
- Tap **Finish**. Survey Pro comes back to the Receiver Profiles screen on which you can now see the added profile(s). Receiver profiles may be imported or exported at this point (see *Managing Your Receiver Profiles on page 33* for more information).
- Tap ✓ to return to the Home screen.

Adding a Receiver Profile Using Manual Configuration:

Example of Bluetooth Connection



- In the **Manual Configuration** pane, do the following:
  - Select the brand of your GNSS receiver
  - Select the model of your GNSS receiver
  - Select the type of connection to the receiver.

    1) If it's a Bluetooth connection, select **Bluetooth** and then tap the **Bluetooth Settings** button. This button opens up the **Bluetooth Instruments** screen, from which you can scan for Bluetooth devices supporting a serial port service (or open up the Windows OS Bluetooth application).

    Tap **Start Scan** and let the utility search for all the devices. When the search is complete, select the device corresponding to your GNSS receiver. Then tap **Add Selected**, change the Bluetooth name if you wish, set the Bluetooth PIN if required, and tap ✓.

    Tap ✗ to return to the initial screen. The name of the chosen Bluetooth device now appears in the **Bluetooth Device** field.

NOTE: The **Bluetooth Device** field lists the names of the previously detected Bluetooth devices. Use this field when the receiver you want to connect to was detected beforehand, is still running nearby, or you know its Bluetooth name and this name is still listed in the drop-down menu. Only in that case can you directly select the Bluetooth name from that list and quickly establish a connection with the receiver.

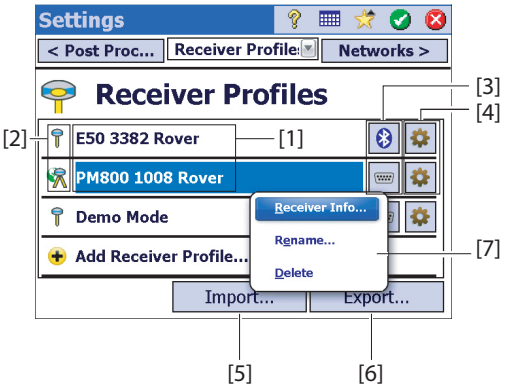
2) If it's a serial connection, check **Serial** and select the port used on the data collector side for this connection.

- Tap **Connect**. You can now define a receiver profile for use in the connected receiver. Complete the four tabs (**Survey**, **Modem**, **General**, **Reset**). See *Modifying a Receiver Profile on page 35* for more information on receiver profiles.
- Tap ✓ to save the new receiver profile. This profile is now available from the list of receiver profiles. Receiver profiles may be imported or exported at this point (see *Managing Your Receiver Profiles on page 33* for more information).
- Tap again ✓ to return to the Home screen.

Managing Your Receiver Profiles

Do the following to access the list of existing receiver profiles in Survey Pro:

- Tap the Instrument icon and select **Switch to GNSS**.
- Tap the Instrument icon and select **Manage Instruments**. Survey Pro lists the receiver profiles as detailed below.



- **[1]**: **Receiver profile name**. By default, the name includes the receiver model first, followed by its serial number (last four characters), then its survey function.

- **[2]**: **Survey function** icon: This may be one of the four icons below (see also *Modifying a Receiver Profile on page 35*).

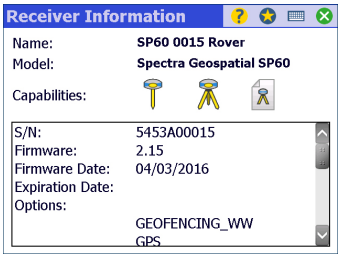
Icon	Meaning
	Rover.
	Base.
	Network Rover.
	Network base.
	RTX (prompted only if the receiver has RTX capability).

- **[3]**: **Connection** icon: This may be one of the two icons below.

Icon	Function
 or 	Shown when respectively a Bluetooth or cable connection has been set between Survey Pro and the receiver. If the Bluetooth icon is shown, tapping this icon will provide the receiver brand and model as well as the receiver Bluetooth name. If the Serial icon is shown, tapping this icon will provide the receiver brand and model as well as the serial line settings.

- **[4]**: **Settings** icon:  . Provides access to the receiver profile's **Survey**, **Modem**, **General** and **Reset** tabs. See *Modifying a Receiver Profile on page 35* for more information.
- **[5]**: **Import**. Tap on this button to import a receiver profile, then:
  - Select the SPR file you want to import.
  - Tap ✓. Survey Pro returns the name of the receiver profile contained in the file.
  - Select the profile name to continue.
  - Tap **Import** to complete the import sequence.
- **[6]**: **Export**. Tap on this button to export a receiver profile, then:
  - Select the receiver profile you want to export.
  - Tap **Export**.
  - Name the file, then tap ✓ to export the profile and save it as an SPR file in the chosen folder.

Example of Receiver Information



- **[7]**: This menu is displayed after you tap and hold a receiver profile in the list. From this menu you can do the following:
  - **Receiver Info**: Use this function to view more information on the receiver connected to Survey Pro through this profile (see example). The possible capabilities of a receiver (shown as icons) are identified below.

Icon	Capability
	The receiver has rover capability.
	The receiver has base capability.
	The receiver has data collection capability (for post processing).

  - **Rename**: Used to rename the selected receiver profile.
  - **Delete**: Used to delete the selected receiver profile. Then tap **Yes** to confirm that you really want to delete the profile.

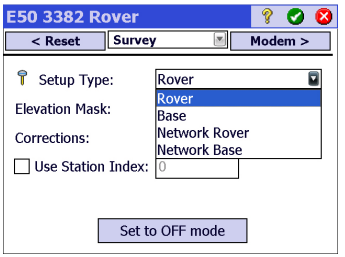
Modifying a Receiver Profile

Tap on the corresponding  button in the receiver profiles list to make changes to a receiver profile. The receiver profile is described on four different tabs, the content of which is receiver-dependent.

IMPORTANT! All changes you make to a receiver profile will be effective only if a receiver is connected to Survey Pro through this profile. In addition, the changes made to a receiver profile will not be effective immediately in the connected receiver, but only next time you start a survey using the modified receiver profile to connect to and configure the receiver.

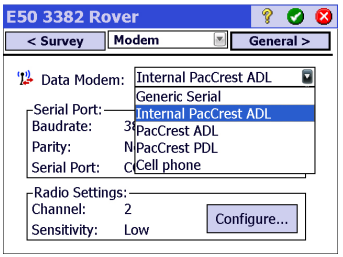
- The Survey tab is primarily used to define the following RTK survey parameters:
  - **Setup Type**: Used to assign one of the four functions to the receiver:
    1) **Rover**: Corrections received via radio.
    2) **Base**: Corrections broadcast via radio.
    3) **Network Rover**: Corrections received via modem.
    4) **Network Base**: Corrections sent to an IP address.
    5) **RTX**: RTX corrections received via modem (IP) or L band.
  - **Elevation Mask**: Limits the use of satellites to those that are high enough in the sky, seen from the receiver antenna. All satellites located under this zenith angle will be rejected (default: 10°).
  - **Corrections**: Used to set the format of corrections received (rover) or broadcast (base). This setting is not used for rover receivers that support automatic detection of correction format.

Epoch 50's Survey tab



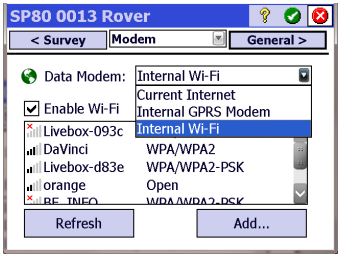
- **Use Station Index**: Used to assign a station ID to a base, or identify the base a rover is expected to use.
- **Set to Off mode**: Sets the receiver idle, i.e. no more corrections are sent out if the receiver is a base –or network base– or the receiver stops listening for corrections if it's a rover or network rover. There is an exception with ProMark receivers, which in all cases will keep on operating as rovers.

Epoch 50's Modem tab



- The Modem tab allows you to configure the RTK data link.
  - If **Setup Type** = **Rover** or **Base**, allows you to enter the UHF radio settings (i.e. baud rate, frequency channel and sensitivity for most radio models).

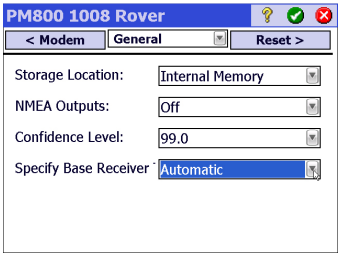
SP80's Modem tab



  - If **Setup Type** = **Network Rover**, **Network Base**, or **RTX**, allows you to set the cell modem used, either the one internal to the data collector (**Current Internet** or **Windows Networking** option), the one internal to the receiver (**Internal GPRS Modem** option), or an external cell phone (**IP Modem** option).

    Setting a cell modem mainly implies entering the service provider information (APN) and your connection profile (username & password).

ProMark 800's General tab



- The **General** tab allows you to configure settings that are specific to the brand and model of this receiver profile. For more information on brand- and model-specific settings, see the online help.

- The **Reset** tab provides additional control over the connected receiver. Three buttons may be available:
  - **Set Rx. to OFF mode**: Same as Set to Off mode above.
  - **Soft Reset**: Will reboot the receiver with its current settings.
  - **Hard Reset**: Will reboot the receiver with its default settings (depends on the model of receiver used).

SP80's Anti-Theft tab

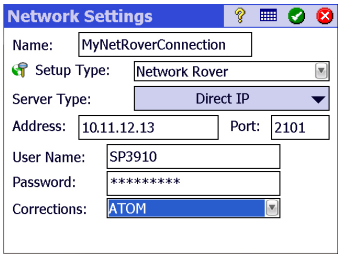
- For some Spectra Precision GNSS receivers, more tabs are available: When made visible, the **Anti-Theft** and **Alerts** tab can be used to protect a remote base receiver from theft and/or to authorize only certified users to operate the receiver at power up.

Managing Network Profiles

Network profiles are managed the same way as receiver profiles. Network profiles are required:

- To specify the source of RTK corrections a GNSS receiver acquires when it is set as a network rover.
- To specify the destination of the RTK corrections a GNSS receiver will generate when it is set as a network base.

Example of Network Profile



To add a new network profile:

- Tap the Instrument icon and select **Switch to GNSS**.
- Tap the Instrument icon and select **Manage Instruments**. This opens the Settings screen listing the currently existing GNSS receiver profiles.
- Tap on the **Networks** tab
- Tap **Add Network**. Enter your network parameters (see below), then tap ✔.

A network profile is defined by the following parameters:

- **Name**: Enter a name for your network profile.
- **Setup Type**: Tell whether the network profile is to be used by a base (choose **Network Base**) or a rover (choose **Network Rover**).
- **Server Type**: Depending on the selected **Setup Type**, define the type of IP connection used:

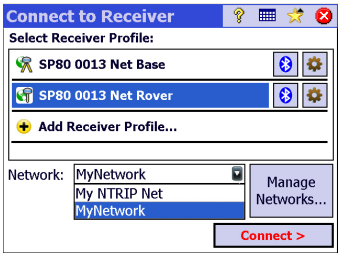
  For a network rover:

  - **Automatic**: Make this choice if you want Survey Pro to determine the type of connection and server from which the rover will acquire corrections (recommended).
  - **NTRIP**: Make this choice if you want your rover to acquire corrections from an NTRIP server.
  - **Direct IP**: Make this choice if you want your rover to connect directly to a Direct IP single base server or to a static IP base.

  For a network base:

  - **Direct Connect**: Make this choice for your base if you want the rover to connect directly to that base over the Internet.
  - **TCP/IP Forwarding**: Make this choice if you want the base to forward its corrections to a TCP/IP server.
  - **NTRIP Forwarding**: Make this choice if you want the base to forward its corrections to an NTRIP server.

- **Address**: IP address of the server that the receiver connects to for sending or acquiring corrections. With **Direct Connect** chosen for a network base, the IP address is assigned dynamically by the network provider. That's why in that case, the **Address** field reads "**Dynamic"** and is read-only.



- **Port**: IP port of the server that the receiver connects to for sending or acquiring corrections.
- **User Name** and **Password**: Credentials required to be allowed to access the server.
- **Mount Point**: (for a network base in **NTRIP Forwarding** only) Enter the mount point where to send corrections to.
- **Force NTRIP password** (for a network rover in **Automatic** or **NTRIP** setup type). With this option enabled, you will be prompted for user name and password for every NTRIP mount point, even if the NTRIP table specifies that they are not required. This option is to deal with poorly formatted NTRIP tables, where the source table says that password is not required, but the selected mount point actually requires one.
- **Corrections**: Whenever required, specify the format of corrections (ATOM, CMR, RTCM) the receiver should generate (base) or receive (rover).

When later starting a survey, you will be requested to specify the network profile your receiver will work with. Choose the name of that network profile.

At this point, the **Manage Networks** button allows you to return to the list of existing network profiles to make changes if necessary. In the networks list, an icon placed ahead of each network profile name tells you the type of receiver the network profile is intended for:

- : Network base profile
- : Network rover profile

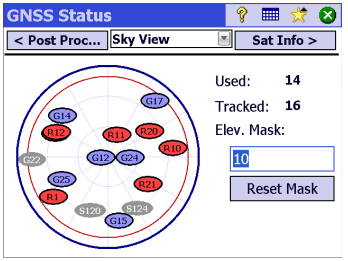
Checking the GNSS Status

Checking the GNSS status of the connected receiver is recommended before starting a job. This implies that the GNSS receiver is in real conditions of use, preferably in an open sky environment.

Use the **GNSS Status** function on the **Survey** menu to read this information. The GNSS status is split into six different tabs:

- **Receiver**: Provides additional information describing the position solution computed by the receiver. In RTK, the **Reset Ambiguities** button allows you to re-initialize the computation of the position. For more information, see *6. GNSS Surveying on page 65*.
- **Data Link**: Describes how a rover is provided with RTK corrections, or the type of RTK corrections generated by a base. For more information, see *6. GNSS Surveying on page 65*.
- **Post Process**: This tab shows the data recording status (Yes/No), the recording interval (1 or 2 sec), the name of the point on which data recording takes place (only when static) and the time elapsed since data recording was started. Additionally, this tab shows the receiver's battery and memory

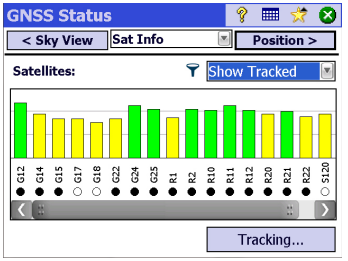
statuses (plus remaining, estimated recording time for some receivers). When there is no data recording in progress, most of these fields are left empty.



- **Sky View**: Provides a polar view of the sky showing the location and type of each satellite being tracked and the total number being used in position solutions (see example). You may change the value of the elevation mask on this screen. This will update the value read on the **General** tab as well (see *Managing Your Receiver Profiles on page 33*).

  Color code and letter code used for the different constellations:

Color	Gray	Blue	Red	Green	Yellow	Magenta	Cyan
Satellites used in position	Not used	GPS	GLONASS	BeiDou	Galileo	QZSS	SBAS
Sat label ("xx"= Sat PRN)	-	Gxx	Rxx	Cxx	Exx	Jxx	Sxx



- **Sat Info**: For each visible satellite, provides the satellite identifier (e.g. G8), the current status (Used/not Used) and the L1 signal strength (SNR) as a color-coded vertical bar. See table below.

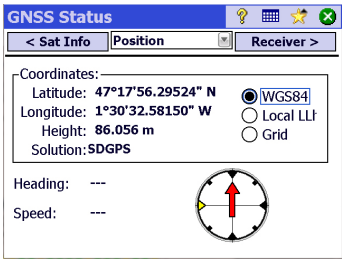
Vertical Bar	L1 Signal Strength
Green	Very Good
Yellow	Good
Red	Poor

Used/Not Used Indicator	Status
Solid dot	Used
Hollow Dot	Not Used

  The **Tracking** button allows you to enable or disable each of the constellations the receiver can track.

  Depending on the receiver used, you may be given the ability to reject some satellites through a context-sensitive menu attached to each vertical bar (you may want to not use a satellite because the signal received from it is too weak, or because it is officially declared unhealthy). In this case, a filter is also available on this screen allowing you to show all the visible satellites or only those that are currently tracked.

  (NOTE: The same satellite labels as on the **Sky View** above are shown on this screen.)



- **Position**: Provides the three coordinates of the position solution currently computed by the GNSS receiver, the solution status, as well as heading and speed if the receiver is currently moving. The position may be expressed in WGS84 (always possible), in a local coordinate system (if selected and solved) or as grid coordinates (if the grid is selected and solved).

Before going any further in your work, you should check that at least 6 satellites are received and used, each satellite providing a good signal level, and the receiver delivers a 3D position solution.

During your survey, should your GNSS receiver raise some alerts (loss of RTK position status, low memory or low battery), Survey Pro will automatically forward them to you in the form of message boxes. This is to make sure you get this information in a timely manner as some GNSS receivers may not be able to warn you directly.

Leveling Mode – Getting Ready for Leveling

Leveling can be performed using one of two techniques:

- *Automatic leveling*: An automatic level is used to take readings on a graduated level rod. This is the traditional leveling technique for surveying. It can be performed by manually reading the rod, or by using a digital automatic level such as the DiNi to electronically read the rod.
- T*rigonometric leveling*: An optical total station is used to measure zenith angle and slope distance to a prism on a pole. This alternative leveling can be performed with a total station and a prism on a fixed height pole.

Depending on the technique you wish to use, you must configure your instrument and possibly select a leveling method.

Auto/Manual Leveling Methods

Survey Pro supports the following leveling methods:

- *Three Wire*: An automatic level is used and the operator observes the leveling rod at the upper, middle, and lower wire of the level stadia. This method is used with the "Manual Mode" instrument profile.
- *Single Wire*: Same as three-wire leveling, except that only the middle wire is read and entered using the "Manual Mode" instrument profile.
- *Electronic*: An electronic automatic level is used to digitally observe a bar-coded level rod. This method is used with one of the supported electronic level instrument profiles.
- *Trigonometric*: An optical total station is used to observe a prism on a prism pole to measure vertical distance. This method is used with any electronic total station instrument profile. It can also be used with the "Manual Mode" instrument profile if you wish to hand enter zenith and slope distance observations from a field book.

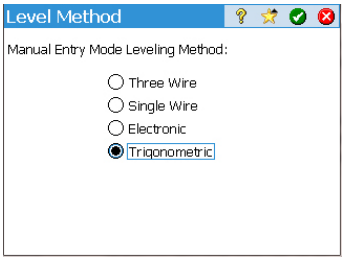
NOTE: Trigonometric leveling (trig leveling) is a different survey technique than performing a 3D optical survey with a total station.

In trig leveling, you do not set up the optical total station on a known point, and you do not measure the height of the instrument or the height of the rod at any time during the survey.

Trig leveling is more like traditional leveling in that you set up the instrument in between the points in each turn, you observe the rod at the backsight to establish the height of the instrument, then you observe the rod at the foresight to establish the foresight elevation. Because the foresight observation is subtracted from the backsight observation, the height of the rod, which must be kept constant between the backsight and foresight of each turn, cancels out. Therefore, in trig leveling, you never need to enter the height of the rod. The height of the instrument above the ground at each location is also not used in this procedure.

Choosing Leveling Mode

1. If your active instrument is an electronic automatic level, then Survey Pro will automatically use Electronic leveling method.
2. If your active instrument is an optical total station, then Survey Pro will automatically use the Trigonometric leveling method. Creating and activating either an electronic level instrument profile or an optical total station profile is the same procedure used to create an instrument profile in optical surveying mode (see *Optical Mode - Connecting Survey Pro to an Optical Instrument on page 28*).
3. If your active instrument is the "Manual Mode" profile, then you must choose your leveling method:
   - Tap the Instrument icon and select **Switch to Leveling**.
   - Tap the Instrument icon again and select **Manage Instruments**. This opens the **Settings** screen.
   - Select **Manual Mode** and then tap **Instrument Settings**. This opens the **Level Method** screen.
   - Select the desired leveling method among the four possible,
   - Tap ✔ to validate your choice. As a result, you can see that **Manual Mode** in the list of instruments has now been activated automatically.
   - Tap ✔ to close the **Settings** screen. Survey Pro is now ready to perform manual leveling.



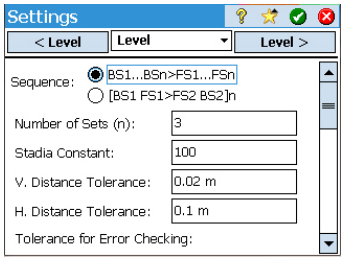
Level Settings

- Now that you have selected the **Leveling** mode, go back to the main menu and select **Job** > **Settings**. This opens the **Settings** screen
- Select **Level** from the upper tab. This screen allows you to set the shooting sequence (**BS1...BSn>FS1...FSn** or **[BS1 FS1>FS2BS2]n**), the number of sets (n) and a few leveling tolerances (vertical distance, horizontal distance, etc.) Survey Pro will be using in Leveling mode.

  The **Load FGCS Defaults** button allows you to specify a particular order and class for the level loop. This will automatically fill in all the tolerances on the **Settings** screen with the default FGCS values.

  Setting tolerances allows Survey Pro to issue warning messages when tolerances are not met. It's up to you to determine if the level loop meets the criteria for a particular standard.

- Tap ✔ to enter all your settings and close the **Settings** screen.
- Go to the main menu and select **Survey** to start your leveling work. Refer to Section *7. Leveling on page 86* for more information.



What you have done already:

- You have set up the optical instrument on a tripod over a point of your choice and measured the instrument height.
- You have selected **Optical** from the instrument icon located on the Home screen or Main Menu.
- You have activated the instrument for use with Survey Pro. See *Optical Mode - Connecting Survey Pro to an Optical Instrument on page 28*.
- You have configured the proper settings in the **Job > Settings > Surveying** tab. This tab allows you to configure:
  - **Earth Curvature & Refraction** correction: To adjust measured zenith angles for the effects of earth curvature and refraction.
  - **PPM**: To adjust the measured slope distances for the atmospheric effects on the EDM.
  - **Survey with True Azimuths**: Automatically sets the Circle on the instrument to match the BS Azimuth that is set when pointed at the backsight.

What you should do now: You have to position and orient the total station in your local coordinate system before you start measuring points. This can be done using one of the methods below, by choosing whichever is most appropriate:

- **Known Point**: Station setup on a point with known coordinates.
- **Unknown Point /Resection**: Station setup on an unknown point using the resection method to determine the position of the point.
- **Multiple Backsights**: Station setup on a known point using several backsight points to determine the orientation.
- **Use Last Setup**: This method is made available only after a station has been set up in the current job. Use it only if you are certain the tripod is still exactly at the same location as when the last setup was performed, and the same BS and Circle are being used.

The first three methods are described below. The point or points used should have previously been stored in or imported into the job.

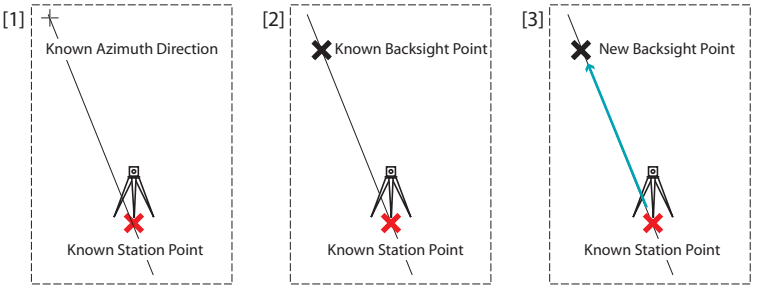
Station Setup on a Known Point

The name and coordinates of the known point where the station is set up can be picked from within the open job. This method offers three different scenarios:

- **BS Azimuth** [1]: Backsight azimuth. The station location will be set from the coordinates of the known point. The backsight azimuth will be the value you enter in the **BS Azimuth** field.

  Typically, this is an "assumed" backsight and the value will be 0 or North. The backsight circle orientation will be set to 0°00'00" automatically.
- **BS Point** [2]: Backsight point. The station location will be set from the coordinates of the known point. The backsight circle orientation will also be set to 0°00'00" in that case.
- **New Point** [3]: This is a variant of backsight azimuth in which the azimuth is given to a new point you would like to measure and add to the job.

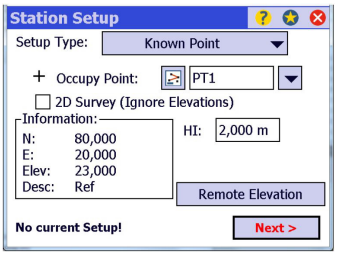
The diagram below illustrates the three possible scenarios.



NOTE 1: A variant to this procedure exists (whatever the scenario used) if the **Survey with True Azimuths** setting is enabled (see **Job** > **Settings** > **Surveying** tab). In this case, the backsight circle will always be set automatically to the true azimuth, either the entered one (**BS Azimuth** then renamed "**True Azimuth**" scenario and **New Point** scenario) or the calculated one (**BS Point** scenario).

NOTE 2: Whatever the method used, you can refine the station setup by making more measurements. This is done by activating the **Perform Backsight Repetition Set** check box allowing you to perform direct and reverse measurements. Before you tap on the **Finish** button to end the station setup, you can use the **Backsight Sets** button to perform additional measurements.

The three scenarios are detailed below with the **Survey with True Azimuths** option disabled.

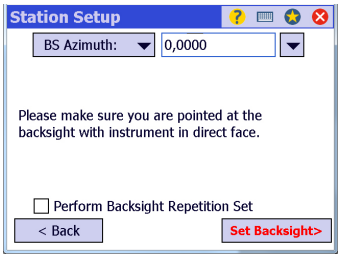


Start the station setup as follows:

- Go to the Main Menu, then tap **Survey** > **Station Setup**.
- Choose **Setup Type**= **Known Point**.
- Enter the name of the station setup point in the **Occupy Point** field. The point name can be entered directly, picked from the map or point list. These options can be selected from the button attached to the **Occupy Point** field. In MAX+ configuration (GNSS + Robotics), the point may have been collected using a GNSS receiver just before setting the base.
- If you wish to ignore elevations in your job, check the **2D Survey** box. You will otherwise enter the height of instrument in the **HI** field.
- Tap **Next**.

Then, of the three possible options, choose the one that is suitable for your job:

1. If you choose **BS Azimuth**:
   - Aim the instrument in the direction of a known or assumed azimuth.
   - Enter the known or assumed value of azimuth in the **BS Azimuth** field.
   - Tap **Set Backsight**. The screen provides a summary of what you have just done and prompts you to check the setup.



NOTE: If the equipment used is unable to set the backsight circle, the button is labeled "**Read Backsight**" instead of "**Set Backsight**".

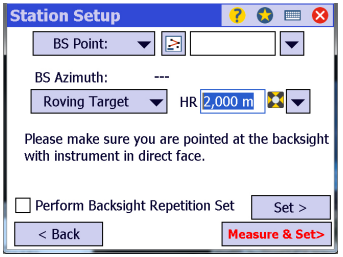
Check the Setup:

a. If you choose the **By Angle** option, just make sure the instrument is still aimed in the direction of known azimuth, then tap **Check**. You should read the previously set backsight circle.

b. If you choose the **By Point** option, enter the name of the point used for checking, specify the target used on that point, correct the target height if necessary and tap **Check**. A measurement is then made. Check the delta values reported on the screen, which should be as close as possible to zero.

c. You cannot use the **By Distance** option in this case.

- If you are satisfied with the read values, tap **Finish**. You can now start measuring new points.



2. If you choose **BS Point**:
   - Enter the name of the backsight point. It can also be picked from the map or the list of points. The resulting backsight azimuth is then calculated and displayed just underneath the **BS Point** field.
   - Specify the type of target used at the backsight point (**Fixed Target** or **Roving Target**).

     A "roving target" is when you measure to the backsight with the same rod and prism you will be using for your subsequent data collection.

     A "fixed target" is when you have a tripod and prism that will remain at the backsight and that will be different from the rod and prism you will be using for subsequent data collection. See also *Managing Smart Targets on page 125* for more information on the Survey Pro target database and the fixed backsight target.
   - Using ▾, select the name of this target. As a result, the **HR** (height of rod) field is updated to provide the height of this target.
   - Aim the instrument at the known backsight point.
   - Two actions are then possible:

     1) Tap **Set**. The screen provides a summary of what you have just done and prompts you to check the setup. Note that the backsight circle has been set to 0°00'00".

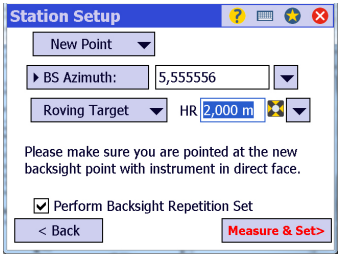
     NOTE: If the equipment used is unable to set the backsight circle, the button is labeled "**Read Backsight**" instead of "**Set Backsight**".

     As previously explained for **BS Azimuth**, you can in the same way check the setup either **By Angle** or **By Point** (see **Check the Setup** above).

     You can also use the **By Distance** option. Just make sure the instrument is still aimed in the direction of the backsight point and tap **Check**. The measured horizontal and vertical distance errors are reported on the screen. They should be as close a possible to zero.

     or 2) Tap **Measure & Set**: This option sets the backsight circle to 0°00'00" and also takes a measurement to the point, with the measurement results displayed in the next screen.
   - Whether you used the first or second option, if you are satisfied with the read values, tap **Finish**. You can now start measuring new points.

3. If you choose **New Point**:
   - Place a target at the unknown (new) backsight point.



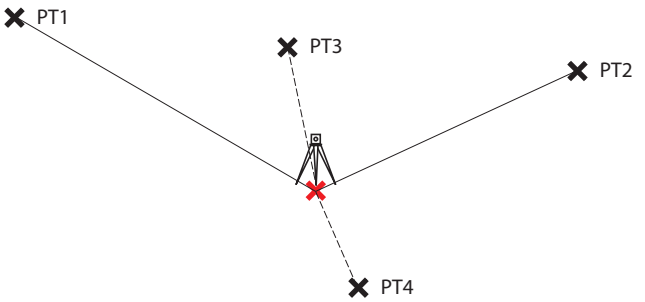
- Aim the instrument at this point.
- Enter the known or an assumed value of azimuth along this direction.
- Specify the type of target used at the backsight point (**Fixed Target** or **Roving Target**).
- Using ▼, select the name of this target. As a result, the **HR** field is updated to provide the height of this target. Update the height value if necessary.
- Tap **Measure & Set** to measure the new point and set the backsight.

NOTE: If the equipment used is unable to set the backsight circle, the button is labeled "**Measure & Read**" instead of "**Measure & Set**".

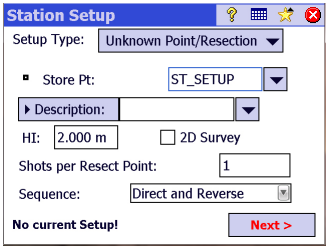
- Enter a name and description for the new backsight point.
- Tap ✓ to store the point.
- Review the summary of the station setup, as shown on the screen. If it's not as expected, tap **Back** and resume the setup.
- If the setup is fine, tap **Finish**. You can now start measuring new points.

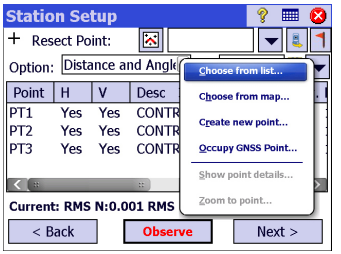
Station Setup on Unknown Point, Resection Method

The resection method is illustrated below.



At least two known points should be observed to solve the station setup (e.g. PT1, PT2). Other known points (PT3, PT4,..) may be added to refine the computation.





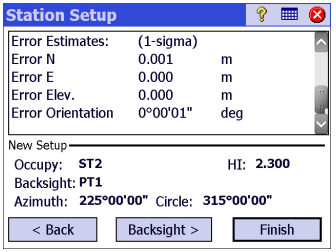
- Go to the Main Menu, then tap **Survey** > **Station Setup**.
- Choose **Setup Type**= **Unknown Point/Resection**.
- Use the **Store Pt** and **Code** or **Description** fields to enter respectively the name and code or description of the point where the instrument is set up. (This is a new point, with unknown coordinates.)
- If you will ignore elevations in your job, check the **2D Survey** box. You will otherwise enter the height of instrument in the **HI** field.
- You can take one or more shots of each point. Enter the desired number of shots in the **Shots per Resect Point** field.
- You may want the instrument to perform either **Direct and Reverse** measurements (recommended for station setup) or a **Direct Only** measurement. Use the **Sequence** field to make this choice.
- Tap **Next**. This opens the **Station Setup** screen on which you should define the following parameters:
  - **Resect Point**: Enter the name of the first point used (PT1 for example). This name can be entered directly, or picked from the map or point list.

    These options can be selected from the ▾ button attached to the **Resect Point** field.

    In MAX+ configuration (GNSS + Robotics), you may use the **Occupy GNSS Point** option to collect the point on which your GNSS receiver is standing. Once the point has been logged and named, it can be used as a resection point.
  - **Option**: Define the type of measurement you will perform on the point (**Distance and Angle** or **Angle Only**).
  - Define the type of target used and its height (**HR**).
- Tap **Observe** then **Take Shot** to start a measurement. You are then taken back to the **Station Setup** screen where the measured point is listed as the first point involved in the station setup.
- Repeat the previous two steps for the next point (PT2 for example), and then for additional points (PT3, PT4, etc.) for data redundancy.

  As you get new points, Survey Pro tries to compute a solution for the station location.

  When a solution is available, the RMS values of the solution are shown in the lower part of the screen.



You may reject the horizontal or vertical contribution of a point by tapping on the corresponding "Yes" which will then be changed into a blank field. Again, you will immediately see the impact of this change on the quality of the solution.

At this stage (i.e. a solution is now available), you may take measurements to as many other points as necessary to refine the station location (these points must all be stored in the job). Survey Pro can guide you (or the rodman) to each of these points if you don't know where they are:

- In the **Resect Point** field, enter the name of the first of these points (or select it from the map or list as you would usually do).
- Tap 
- Use this new screen to find the point. Take several shots and each time, follow the guidance instructions until the point is found.
- Then tap  , to return to the previous screen, and tap **Observe** to add a measurement to the solution.
- Add other points if necessary using the same procedure.

Also at this stage, if you are using a robotic instrument, you may add a measurement to another known point of your choice by first asking Survey Pro to turn the instrument to that point:

- Use the **Resect Point** field to select the name of the desired point.
- Tap  to rotate the instrument in the direction of the point
- Take a measurement to the point
- Add other points if necessary using the same procedure.

- When you are satisfied with the results, tap **Next**. The screen then shows the properties of the station setup. If you scroll down the list of results, you will see the components of the final error ellipse for the solved point.

  On this screen, Survey Pro defines one of the control points you have just used in the resection method as a backsight point.
- At this stage, you can tap **Finish** to complete the station setup. The instrument circle used for this setup will be the direct circle reading on the first resection point used in the setup, unless you are surveying in true azimuth mode.

  In true azimuth mode, the instrument circle will be adjusted so that your circle will now read the true azimuth when pointed at the first resection point used in the setup.

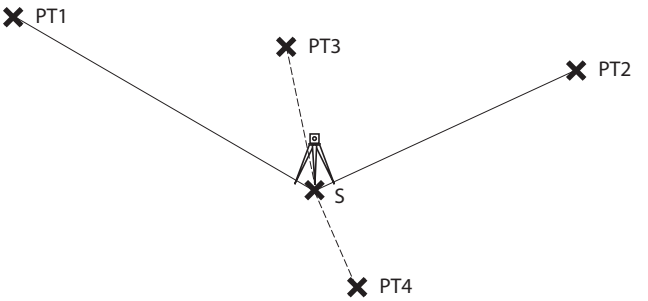
  Alternatively, you can tap **Backsight** to proceed to the normal backsight setup, with your newly calculated station point as the setup point, and your last resection point as the backsight point. It is a good practice to do a

backsight check after a resection to ensure the instrument circle is oriented as you expected.

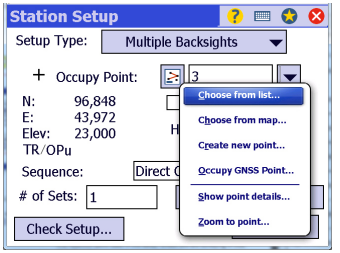
When this is done, tap **Finish**. You can now start measuring new points.

Station Setup Using Multiple Backsights

The multiple backsights method is illustrated below.



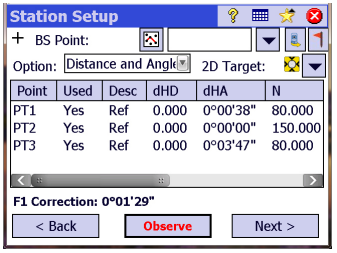
S, where the station is set up, is a known point. At least one known point should be observed to determine the orientation of the instrument and correct it accordingly. Other known points (PT3, PT4,..) may be added to refine the computation of the correction angle.



- Go to the Main Menu, then tap **Survey** > **Station Setup**.
- Choose **Setup Type**= **Multiple Backsights**.
- Use the **Occupy Point** field to enter the name of the point where the instrument is set up. (This is a known point, i.e. with known coordinates.) The point name can be entered directly, picked from the map or point list. These options can be selected from the ▼ button attached to the **Occupy Point** field.
- If you will ignore elevations in your job, check the **2D Survey** box. You will otherwise enter the height of instrument in the **HI** field.
- You may want the instrument to perform either **Direct and Reverse** measurements (recommended for station setup) or a **Direct Only** measurement. Use the **Sequence** field to make this choice.
- You can take one or more shots of each point. Enter the desired number of shots in the **# of Sets** field.
- Tap **Next**. This opens the **Station Setup** screen on which you should define the following parameters:
  - **BS Point**: Enter the name of the first backsight point used (PT1 for example).

In MAX+ configuration (GNSS + Robotics), you may use the **Occupy GNSS Point** option to collect the point on which your GNSS receiver is standing. Once the point has been logged and named, it can be used as a backsight point.

- **Option**: Define the type of measurement you will perform on the point (**Distance and Angle** or **Angle Only**).
- Define the type of target used, and possibly its height (**HR**).



- Tap **Observe** then **Take Shot** to start a measurement. You are then taken back to the **Station Setup** screen where the measured point is listed as the first point involved in the station setup.

  Survey Pro indicates the correction angle needed to the instrument orientation so this instrument can accurately measure the azimuth angle to this point. This angle is called **F1 correction**. It is positive for an anticlockwise correction, negative for a clockwise correction.

- You may repeat the previous two steps using additional points (PT2, PT3, PT4, etc.) for data redundancy.

  You may reject the contribution of a point by tapping on the corresponding "Yes" which will then be changed into a blank field. You will immediately see the impact of this change on the correction value.

  When a solution is available, you may take measurements to as many other points as necessary to refine the station location (these points must all be stored in the job). Survey Pro can guide you (or the rodman) to each of these points if you don't know where they are:

  - In the **BS Point** field, enter the name of the first of these points (or select it from the map or list as you would usually do).
  - Tap 
  - Use this new screen to find the point. Take several shots and each time, follow the guidance instructions until the point is found.
  - Then tap  , to return to the previous screen, and tap **Observe** to add a measurement to the solution.
  - Add other points if necessary using the same procedure.

  Also at this stage, if you are using a robotic instrument, you may add a measurement to another known point of your choice by first asking Survey Pro to turn the instrument to that point:

  - Use the **BS Point** field to select the name of the desired point.
  - Tap  to rotate the instrument in the direction of the point
  - Take a measurement to the point
  - Add other points if necessary using the same procedure.

- To accept the computed correction value, tap **Next>**. Survey Pro suggests you use the first point measured as the backsight. If you agree, just tap **Finish** to complete the Station Setup.

Variant to the Basic Station Setup Procedures

There is a variant to the basic step-by-step procedures described above, related to your current job settings (in **Job** > **Settings** > **Surveying** tab):

- **PPM Correction**: By default, the PPM will not show up in the station setup routine. But, if you check the box for **Prompt for PPM during Station Setup**, the PPM will become the first step in your station setup routine.

  The PPM correction is applied to all measured slope distances. This may be achieved in one of two different ways:

  1. You enter the PPM in the instrument which in return will provide Survey Pro with slope distances corrected for the PPM.
  2. Or you enter the PPM in Survey Pro, in which case the instrument will return uncorrected slope distances (make sure the PPM is set to "0" in the instrument). Survey Pro will apply the PPM correction to any slope distances that will be used in further calculations.

NOTE: With some instruments (e.g. FOCUS 30 and S6), the PPM correction can only be set using the second method.

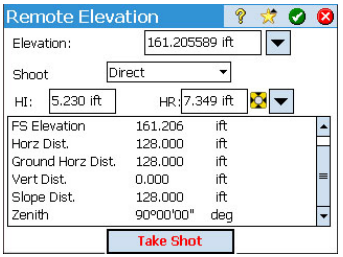
For any station setup, you can also set the elevation of the station point independently using the Remote Elevation routine (see *Remote Elevation on page 52*).

Remote Elevation

This routine will set the elevation coordinate of the station from a point with known elevation. It is accessible from within the first station setup screen by tapping the **Remote Elevation** button (provided the **2D Survey** box is unchecked).

The known elevation is either that of:

- A point stored in the job. You will select this point from the map or from the list of points.
- A point not stored in the job, but its elevation is known, perhaps through past results, by calculation, or printed on a data sheet.

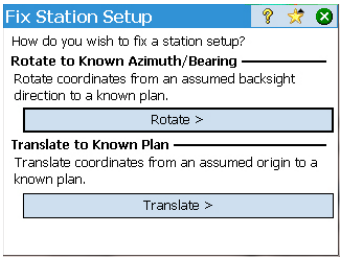


Step-by-step procedure:

- Have a target set up on the point.
- Aim the instrument at the point.
- Go to **Station Setup** and then tap the **Remote Elevation** button.
- Enter the elevation according to the suitable method.
- Check the **HI** value.
- Select the target and check the **HR** value.
- Tap **Take Shot**. The results of the shot then appears in the lower part of the screen.
- Tap ✓ to return to the Station Setup screen and complete the setup according to the method you chose.

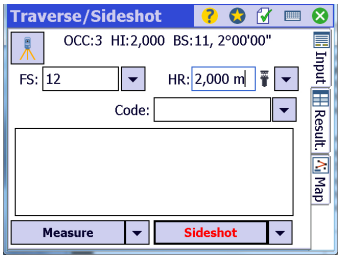
Fixing Station Setup

You may need to apply corrections to all the measured points sharing the same station setup. This can be done using the **Fix Station Setup** function in the **Adjust** menu.



Two types of transformation can be done:

- *Rotation*, based on a known azimuth between two points sharing the same station setup. You need to specify the value of known azimuth and the two point names. When applying the change, all the concerned points will be rotated the same way. The original backsight azimuth will be updated as well to achieve the desired result (which **Adjust** > **Rotate** would not do).
- *Translation*, based on two points that you specify. The first one is an observed point that you would like to translate to another location, and the second one is a key-in point created with the coordinates that you would like to assign to the first point. When applying the change, all the concerned points will be translated the same way. The original occupy point will be moved accordingly to achieve the desired results (which **Adjust** > **Translate** would not do).



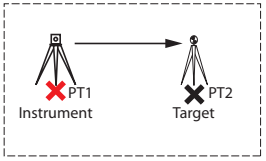
Introduction to Traverse / Sideshot

- Tap **Survey > Traverse / Sideshot**. This screen allows you to make traverse and sideshot measurements. The current setup is summarized at the top of the screen.
- Enter the name (**Foresight**) and description (**Desc.**) or feature (**Feat.**) of the point you will now be measuring, as well as the type and height (**HR**) of the target used on that point.
- The next step is choosing between sideshot or traverse (**Sideshot** is the default option for the button; tap on the down-arrow if you want to select **Traverse**).

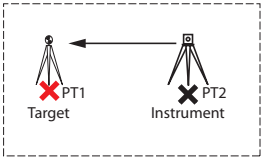
  Choosing "Sideshot" means you simply want to take a measurement of the point. (See *Sideshot on page 53*.)

  Choosing "Traverse" (see illustration below) means you are expected to move the instrument to that point either immediately or after measuring other points (sideshot).

[1]



[2]



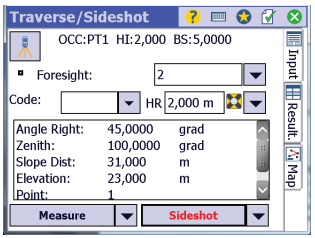
  This implies a new station setup is required after moving the instrument. (See *Traverse on page 54*.)

  You may want just to perform a measurement, and not store it as a point. In this case, use the **Measure** (or associated **Angles Only Measure**) button rather than the **Sideshot** button.

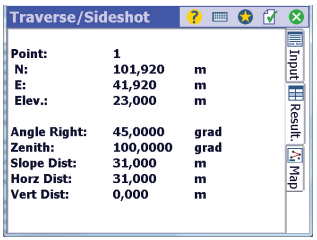
Sideshot

- Be sure the instrument is pointed at the target placed over the point.
- Tap **Sideshot**. Survey Pro returns the results of the measurement in the lower portion of the screen (**[1]**). The point name is automatically incremented for the next measurement. Tapping on the **Result** tab will provide more information on the measurement made (**[2]**).

[1]



[2]



Point: Point name

N: Point coordinate Y

E: Point coordinate X

Elev.: Point coordinate Z

Description: Point description

Angle Right: Azimuth angle measured from the occupy point to the foresight point (measured in a horizontal plane)

Zenith: Zenith angle measured from the occupy point to the foresight point (Zenith is measured in the vertical plane, relative to gravity, where 0 is pointing straight up, parallel to gravity, and 90 is pointing straight ahead, orthogonal to gravity.)

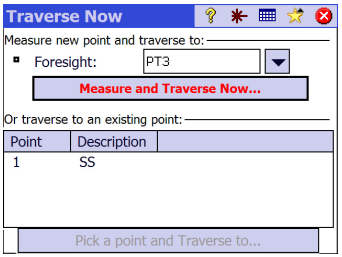
Slope Dist: Slope distance measured from the occupy point to the target

Horz Dist: Horizontal distance calculated from the occupy point to the target

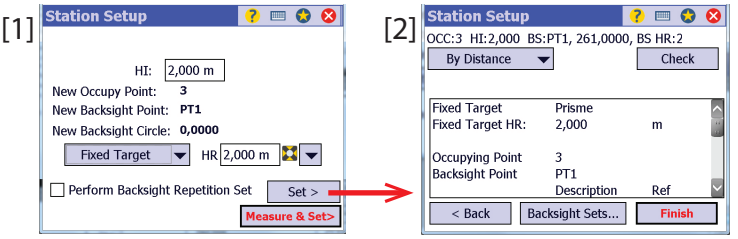
Vert Dist: Vertical distance measured from the occupy point to the target.

- Repeat the above two steps until all your points have been measured.

Traverse



- Be sure the instrument is pointed at the target placed over the point.
- Tap on the down-arrow by the **Sideshot** button and select **Traverse**. The screen prompts you to measure a new point, or to pick a point that was previously measured from the current station setup (Survey Pro will display a list of appropriate points), and then move the instrument to that point. If you create a new point to traverse to, you will then be asked to enter the description of the point before measuring it.
- After the measurement is done or the point selected, Survey Pro provides a summary of what the new station setup will be (see **[1]** below).
- Move the instrument to the new station point and level it on its tripod.
- Measure the new instrument height and enter the measured value (**HI**).
- Aim the instrument in the direction of the point you came from (now the backsight point).
- Enter the type and height (**HR**) of the target used on the backsight point (see **[1]**).



The **New Backsight Circle** will be preset to zero, unless you are surveying with true azimuths.

In the true azimuth case, the circle will be the azimuth from the new location occupied by the station back to its previous location, which is now your backsight point.

- Two actions are then possible:

  1) Tap **Set** and complete the station setup (see **[2]**). You have the capability to perform several measurements after activating the **Perform Backsight Repetition Set** check box, or by adding new measurements using the **Backsight Sets** button just before tapping on the **Finish** button to end the station setup.

  or 2) Tap **Measure & Set**: This option sets the backsight circle to 0°00'00" and also takes a measurement to the point, with the measurement results displayed in the next screen. Tap **Finish** to complete the measurement.

NOTE: The **Station Setup** routine can be used at any point to occupy any existing point in the job at any time. It is up to you to determine if and when this is appropriate.

Measure

If you wish to perform just a measurement, and not necessarily store the measurement results, use the **Measure** (or **Angles Only Measure**) button rather than the **Sideshot** button. You can however save the results in a text file by tapping and holding your finger within the results frame on the screen and selecting **Save Results**.

After a measurement has been made, you can however change your mind and store the measurement as a point using the **Store** button (which then replaces the **Sideshot** button).

Repetition Shots

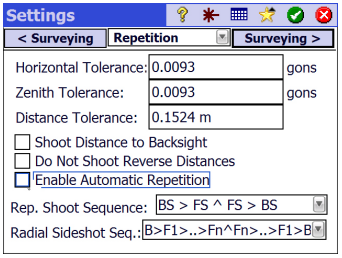
The Repetition shots function allows you to perform sideshots or traverse shots using any number (between 1 and 99) of repeated measurements ("Sets").

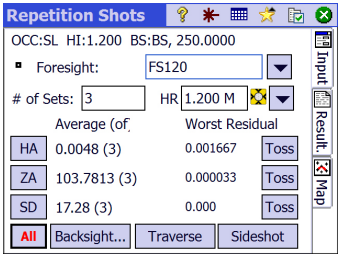
- Go to the **Survey** menu and tap **Repetition Shots**.
- Tap in the command bar to access the job settings relating to repetition shots (equivalent to navigating to the **Job > Settings > Repetition** tab).
- Tap the **Repetition** tab. The **Rep Shoot Sequence** field allows you to choose the desired sequence of repetitions (7 available):
  - "FS" stands for "Foresight":
  - "BS" stands for "Backsight"
  - The ">" symbol is used to denote the next shot coming in the sequence using the same face of the instrument (direct or reverse).
  - The "^" symbol is used to denote when in the sequence you will flip the instrument to take observations in the opposite face.

  The other parameters on this screen are self-explanatory. Set them to meet your application. The **Radial Sideshot Seq** field allows you to specify the sequence of observations to be taken in the Radial Side Shot routine. This setting is NOT used for either regular repetition shots or multiple side shots.
- Tap to return to the **Repetition Shots** window.
- Use the **Foresight** field to enter a name for the point you will measure through repetition shots.
- Enter the number of Sets you want the sequence to be repeated.
- Select the type and enter the height (**HR**) of the target used on the foresight point.
- Start the sequence by tapping either **HA**, **ZA**, **SD** or **All**, whichever is appropriate in your case. Depending on the instrument used, run the series of measurements manually or let the instrument do this automatically. Results are displayed at the end of the sequence (see illustrated).
  - **Average of**: Shows the average angle or distance to the point from all the shots taken. The number in parenthesis is the total number of repetitions performed.
  - **Worst Residual**: Displays the worst residual calculated from all the sets of the selected measurement type.

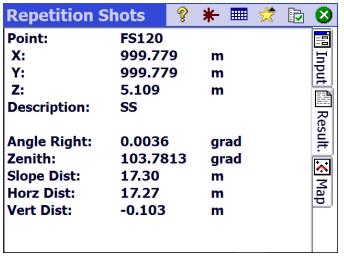
  You may use one or more of the **Toss** buttons to remove from the solution the set of measurements that provided the worst residual. A **Toss** button can only be used if three or more sets have been collected.

  When you tap **HA**, **ZA**, **SD** or **All**, Survey Pro will collect an additional observation of that type (or all of them) and add it to the sets already collected.





EXAMPLE: If you had three complete sets, then selected to toss the worst HA, you would now have two HA sets, three ZA sets and three SD sets. If you tapped HA, you would collect an additional set of horizontal angles only, and on return to this screen, you would now have three HA, three ZA, and three SD sets. If you hit HA again, on return to this screen you would have four HA, three ZA and three SD sets.



- Additionally from this screen, you can either traverse to the point (tap **Traverse** and then follow the usual traverse procedure) or tap **Sideshot** to store a measurement of the point, based on all the data gathered during the repetition shots, to store the point with the measurements taken.

NOTE: The **Sideshot** or **Traverse** buttons will not become active unless at least one observation for each type of measurement (HA, ZA, SD) has been performed.

If you tapped **Sideshot**, the observation is used to store a new point, and you view the results (see example). If you tapped **Traverse**, the traverse prompt will open and you will be guided through moving and setting the instrument on the new occupy station point. The traverse procedure is described above (see *Traverse on page 54*).

Tap **Sideshot** if you plan to occupy the measured point at a later time. You can use the **Traverse** button later to initiate moving the instrument to any point measured from the current station.

Tap ⊗ to quit the Repetition Shots function.

Reminder on Traversing

When you move your total station forward to any new foresight point, and you backsight the previously occupied point, this is called "traversing".

An important practice is to "close" all the traverses you do. Closing a traverse means coming back around the first point in the traverse, observe a known point, and then compare your measurement with the known point location.

Once you have closed a traverse, you can check the precision and make sure it meets your tolerance specifications. Then you need to adjust the traverse so that it closes perfectly. By doing this, the measurement error is distributed evenly between the different points of the traverse.

Adjusting a traverse therefore consists of:

- **Adjusting the angle misclosure**: The error is distributed evenly among the different points occupied by the station.
- **Adjusting the distance misclosure** (also known as *Compass Rule* or *Bowditch method*): The error is distributed between the different points occupied by the station, proportionally to the segment length (traverse legs with longer distances get more proportion of error).

Following the adjustment of a traverse, the coordinates of all the side shots taken along the way are corrected accordingly, both in rotation (angle) and translation (distance).

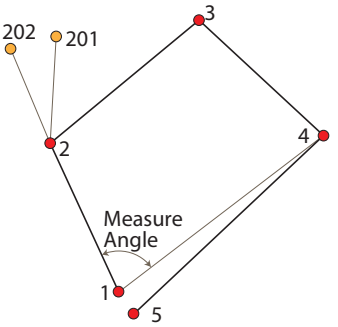
IMPORTANT: After adjusting a traverse, the points collected in the traverse become key in points, which means Survey Pro does not keep track of the vector measurements that linked these points together. However, Survey Pro automatically creates an archive of the job file as it was before the traverse adjustment so you can come back to it if necessary.

Field Methods

Traversing with Survey Pro can be done using one of the following three field methods:

- Closed traverse
- Open traverse closed to known points
- Close traverse to a known point.

The three sub-sections below describe the field steps for each of these methods and explain in each case how the traverse you have collected can be adjusted.



Closed Traverse

Field Steps:

The simplest method to do a closed traverse is to do a self-contained closed loop.

In the traverse example shown on the left, you would proceed that way:

- Start on point 1, sight point 2 from point 1 with an initial, assumed azimuth angle.
- Traverse to point 2, take side shots to points 201 and 202, then traverse to point 3, and finally traverse to point 4.
- From point 4, observe back to point 1 and store it as a new point (point 5).
- To finish closing the traverse, occupy point 1, backsight to point 4, and then turn the instrument to collect the "closing angle" formed by points 4, 1 and 2.

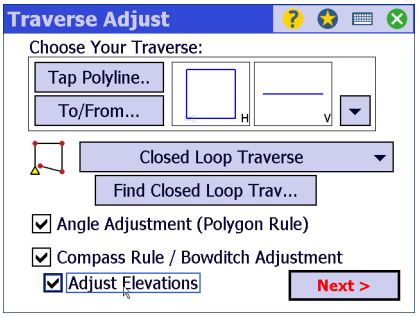
The traverse angle closure is derived from the geometry of a closed polygon, where the sum of the interior angles should always be 180 x (N-2) where N is the number of segments in the traverse polygon.

In the case of a four-sided polygon, the difference between the measured interior angles and the value 360° is the angle misclosure. The traverse distance closure is the coordinate difference between point 1 and point 5.

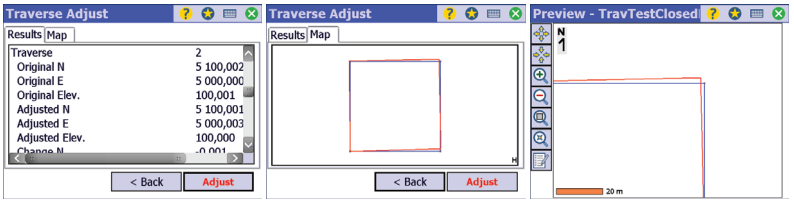
Adjusting a Closed Traverse:

- From the main menu, select **Adjust** > **Traverse Adjust**.
- Tap on the scroll-down list in the middle of the screen and select **Closed Loop Traverse**.
- Tap on the **Find Closed Loop Trav...** button. The traverse may be found either by specifying its first and last points (choose **By Traverse Points** and specify those two points) or by asking Survey Pro to find automatically all the existing closed loop traverses, based on the HD (Horizontal Deviation) tolerance between the detected first and last points (select **By HD Tolerance** and specify what the HD tolerance should be; 1.0 m by default).
- Tap ✓. The matching closed loop traverse or traverses found in the job are listed.
- Select the traverse you want to adjust and then tap ✓.

- Indicate which corrections should be calculated: angle and/or distance (Compass Rule/Bowditch adjustment and possibly elevations).



- Tap **Next>**. Survey Pro then warns you of the interdependency of all the points.
- Just tap ✔. If angle adjustment is requested, and as prompted, enter the closing angle if you have measured it, otherwise keep the prompted value for this angle.
- Tap **Next>**. Survey Pro then calculates the field measurement error. This is then presented in two different tabs: **Results** ([1]) and **Map** ([2]). The **Results** tab gives all the details of the calculation. If you open the **Map** tab, you can zoom in on the view after tapping anywhere on the map.

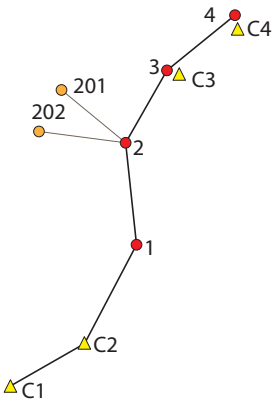


[1] [2] [3]

You then have access to the zoom-in setting ([3]) if you wish to see more visual details of the results.

Just tap ✖ to close the map and return to the **Map** tab.

- If you agree with the results of the correction suggested by Survey Pro, tap **Adjust** to apply the correction to the traverse.



Open Traverse Closed to Known Points

Field Steps:

Another method to do a closed traverse is to start on a pair of known points and finish on another pair of known points. This method is common when you have access to ground control points.

For example, you can use GNSS equipment to measure a pair of points on one side of a wooded area and another pair of points on the other side of the wooded area, and then use optical equipment to measure through the woods between them. In the traverse example shown on the left, you would proceed that way:

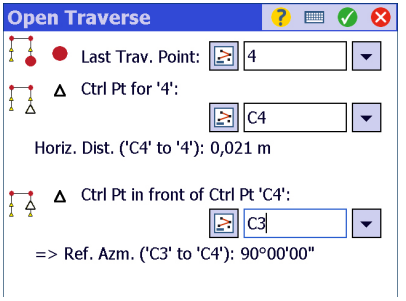
- Set up the station on the second control point (C2) and backsight the first control point (C1).
- Traverse to point 1 and then to point 2.
- With the station set up on point 2, traverse to the third control point (C3) and store the measurement as a new point (point 3). You can also take side shots to points 201 and 202.
- With the station set up on point 3, observe the fourth control point (C4) and store the measurement as a new point (point 4).

The traverse angle closure is derived from the difference in bearing between measured points 3-4 and control points C3-C4.

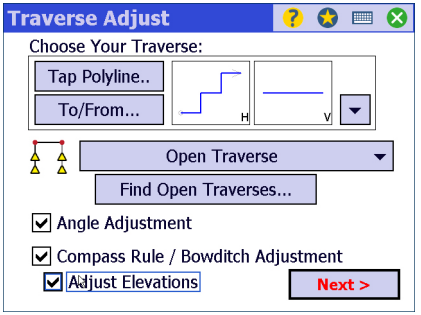
The traverse distance closure is the coordinate difference between point 3 and point C3. Adjustments for traverse points and side shots are then applied as in the case of the closed loop.

Adjusting an Open Traverse Closed to Known Points:

- From the main menu, select **Adjust** > **Traverse Adjust**.
- Tap on the scroll-down list in the middle of the screen and select **Open Traverse**.
- Tap on the **Find Open Traverses...** button.
- Enter the name of your last traverse point (4) and that of the control point (C4) that matches this observation. Also select the second to last control point (C3).



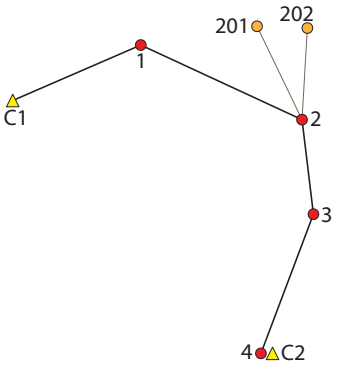
- Tap ✓. Survey Pro may find more than one matching traverse. In this case, select the traverse that includes all the points starting at C1.
- Tap ✓ again.
- Indicate which corrections should be calculated: angle and/or distance (Compass Rule/Bowditch adjustment and possibly elevations).



- Tap **Next>**. Survey Pro then warns you of the interdependency of all the points.
- Just tap ✓. Survey Pro indicates the resulting closing angle (a read-only value).
- Tap **Next>** again. Survey Pro then calculates the field measurement error. This is then presented in two different tabs: **Results** and **Map** (same as in Adjusting a *Closed Loop Traverse*).
- If you agree with the results of the correction suggested by Survey Pro, tap **Adjust** to apply the correction to the traverse.

Closed Traverse to Known Point

Field Steps:

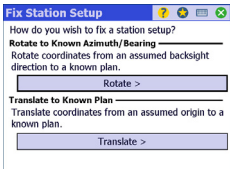


This is a special case of traverse closure where you can only do a compass rule adjustment, because you do not have enough measurements to know what the angular misclosure is.

In the traverse example shown on the left, you would proceed that way:

- Start with the station set up on the first control point (C1), usually with an arbitrary direction (as read on a compass) for the first orientation, since there is no azimuth mark visible to sight from point C1.
- Traverse to points 1 and 2, take some side shots (points 201 and 202), then traverse to point 3.
- With the station set up on point 3, observe the second control point (C2) and store the measurement as a new point (point 4).

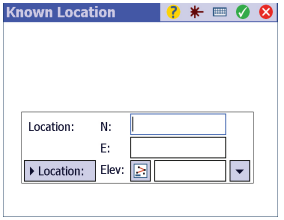
The traverse distance misclosure is the difference between the coordinates of point 4 and point C2.

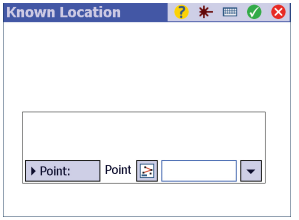


NOTE: It is important that you fix the orientation bias caused by starting from an assumed bearing. This is accomplished by the **Adjust** > **Fix Station Setup** routine, and choosing to fix rotation. This step should be done before attempting to adjust the traverse started with an assumed orientation.

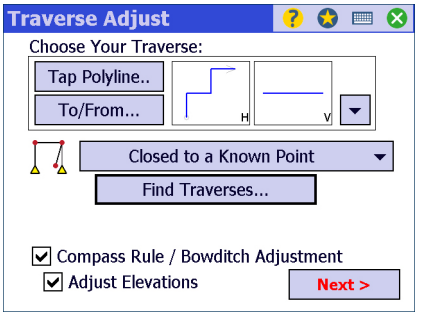
Adjusting a Traverse Closed to Known Point:

- From the main menu, select **Adjust** > **Traverse Adjust**.
- Tap on the scroll-down list in the middle of the screen and select **Closed to a Known Point**.
- Tap on the **Find Traverses** button. This opens the **Known Location** screen. The known location may be entered as a point name (this is the case in our example) or directly as the coordinates of the known location. To toggle between **Point** and **Location**, just tap on this field.

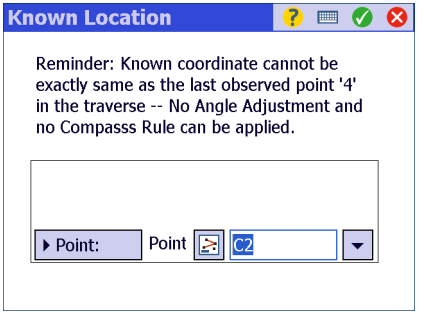




- After defining the field as "**Point**", enter the name of the point you observed and stored as a new point corresponding to the ending control point (point 4 in the example).
- Tap ✓.
- Select the traverse that starts at your control point and then tap ✓.
- Indicate which corrections should be calculated: Compass Rule/Bowditch Adjustment and possibly elevations:



- Tap **Next>**. Survey Pro then warns you of the interdependency of all the points.
- Just tap . You are prompted to enter the name of the control point (in our example: C2) corresponding to the point you measured as the closing point (point 4) of the traverse.



- Tap . Survey Pro then calculates the field measurement error. This is then presented in two different tabs: **Results** and **Map** (same as in Adjusting a *Closed Loop Traverse*)
- If you agree with the results of the suggested correction, tap **Adjust** to apply the correction to the traverse.

Canceling a Traverse Adjustment

There is no straightforward way to cancel a traverse adjustment. You can however do one of the following, to respectively recover all your points before adjustment, or keep a record of what your points were before the adjustment:

- When you accept to adjust a traverse, Survey Pro automatically creates an archive of the job file such as it was before the adjustment. So by using the **File** > **Backup / Restore** function, you have the possibility to restore the job file such as it was before the traverse adjustment.
- By anticipation, you can also save the results of the preview report just before adjusting the traverse.

Starting an RTK Base

NOTE: You don't need to set up a base if you are working in a network. Just make sure your rover is configured to receive network corrections, and actually receives them before you start taking measurements in your job. See *Starting an RTK Rover on page 67*.

What you have done already:

- You have set up the base GNSS receiver on a tripod over a point of your choice and measured the antenna height.
- You have selected **GNSS** from the instrument icon located on the Home screen or Main Menu.
- You have created a receiver profile that matches the use of your receiver as a base (or network base) and the receiver has been reported as being "base" capable. See *GNSS Mode - Connecting Survey Pro to a GNSS Receiver on page 31*.
- You have made sure the GNSS status is correct at the location where the base is to be operated. See *Checking the GNSS Status on page 38*.

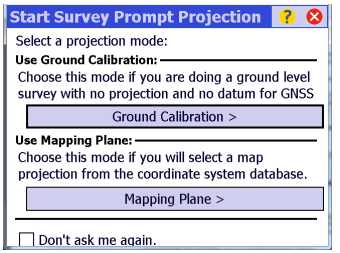
What you should do now:

- Go to the **Survey** menu and tap **Start Survey**. You may also find the **Start Survey** function on your Home screen.
- Unless already done, highlight the name of the receiver profile you intend to use for operating your base.

  For a "network base", select the network to which the base will deliver its corrections by selecting the relevant network profile name. For a "base", there may be additional settings required using the **Configure Modem** button (the radio settings provided by the selected receiver profile may not match your case of use).
- Tap **Connect**.

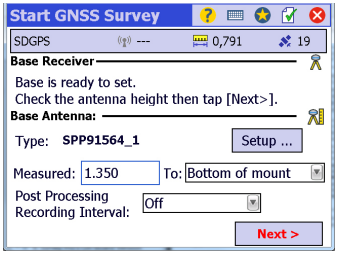
  When creating a job, if you decided not to choose a coordinate system, you will be asked to reconsider this choice when starting the base. The **Start Survey Prompt Projection** screen will appear at this time with two possible options:

  1. **Ground Calibration**: Choose this option if there is no known projection or datum to relate your local grid coordinates to geodetic coordinates (through this choice, you confirm your decision to use local control to set up a coordinate system). The selection of a geoid is possible after making that choice.
  2. **Mapping Plane**: Tap on this button if you now wish to use a coordinate system (i.e. known origin and type of projection + known datum or



broadcast RTCM datum) that can either be keyed in or picked from Survey Pro's coordinate system database. For more information on the projection mode, refer to *Introduction to Calibration on page 79*.

NOTE: If you always start your GNSS surveys with the same type of projection mode, then you can tap **Don't ask me again** at this prompt, and Survey Pro will start the GNSS survey with the settings you used to create the job.



- Survey Pro will poll for the base position. While Survey Pro does this, enter the antenna height you measured previously (**Measured** field) and how you measured it (**To** field).

  You may ask the base to log raw data (for post-processing) by just specifying a recording interval in the **Post Processing Recording Interval** field. When you start a rover, by default it will automatically use the same recording interval as the base you set. Set the recording interval to "Off" if you do not want to record raw data.
- Tap **Next**. Survey Pro searches the point database for a location that matches the current base position (the one that was checked on the previous screen). If a matching point is found in the job, or else in the reference station database (see *Managing Reference Stations on page 84*), then Survey Pro offers this as the default base point. Tap **Change** to choose a different point or to create a new point for the base setup.
- Tap **Next**. The base is now started. Survey Pro prompts you to start the rover (tap **Set Rover**) (as if you had tapped **Start Survey** on the Home screen). Underneath the GNSS receiver profiles list, the name of the modem for the selected profile is displayed).

NOTE: if you only want to set the base at this time, tap **Finish Base Setup**. Survey Pro will then exit the Start Survey wizard and open the GNSS status page connected to the base.

Starting an RTK Rover

This section describes how to configure and start an RTK rover.

What you have done already:

- You have set up the GNSS receiver on a pole and measured the antenna height.
- You have selected **GNSS** from the instrument icon located on the Home screen or Main Menu.
- You have created a receiver profile that matches the use of your receiver as a rover (or network rover) and the receiver has been reported as being "rover" capable. See *GNSS Mode - Connecting Survey Pro to a GNSS Receiver on page 31*.
- You have made sure the GNSS status is correct where you start your survey. See *Checking the GNSS Status on page 38*.

What you should do now:

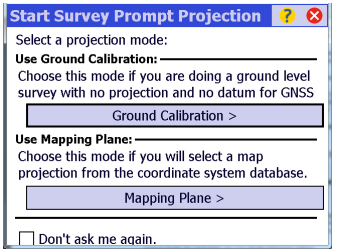
- Go to the **Survey** menu and tap **Start Survey**. You may also find the **Start Survey** function on your Home screen.
- Unless already done, highlight the name of the receiver profile you intend to use for operating your rover.

  For a "network rover", select the network from which the rover will receive corrections by selecting the relevant network profile name. For a "rover", there may be additional settings required using the **Configure Modem** button (the radio settings provided by the selected receiver profile may not match your case of use).

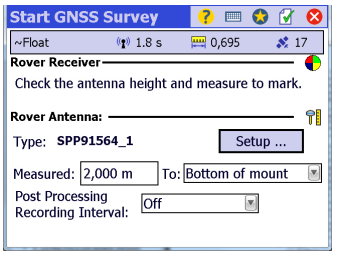
  For an "RTX" rover, no additional settings are required.
- Tap **Connect**. If your receiver operates in RTX, refer to *RTX Correction Service on page 128* to read about the additional steps that take place at this point.

  When creating a job, if you decided not to choose a coordinate system, you will be asked to reconsider this choice when starting the survey (unless you started your own base and you were already prompted to make a choice at that time). The **Start Survey Prompt Projection** screen will appear at this time with two possible options:

  1. **Ground Calibration**: Choose this option if there is no known projection or datum to relate your local grid coordinates to geodetic coordinates (through this choice, you confirm that you will be using a local coordinate system defined by existing control points). The selection of a geoid is possible after making that choice.
  2. **Mapping Plane**: Tap on this button if you wish to use a coordinate system (i.e. known origin and type of projection + known datum or broadcast RTCM datum) that can either be keyed in or picked from Survey Pro's coordinate system database. For more information on the projection mode, refer to *Introduction to Calibration on page 79*.



NOTE: If you always start your GNSS surveys with the same type of projection mode, then you can tap **Don't ask me again** at this prompt, and Survey Pro will start the GNSS survey with the settings you used to create the job.



- While the rover receives data (corrections and position) from the base, enter the rover antenna height you measured previously (**Measured** field) and how you measured it (**To** field).

  You may ask the rover to log raw data (for post-processing) by just specifying a recording interval in the **Post Processing Recording Interval** field. If you earlier set up a base doing the same, then make sure you are using the same recording interval for both receivers. Select "Off" if data logging is not required.
- Tap **Next**.
- Confirm or change the point where the base is located.

  For most receivers, the height of the base antenna is broadcast over the data link, so you do not need to change the base antenna height displayed on this page.

NOTE: The broadcast height will be reduced to the antenna phase center, and will show as an "Unknown" antenna brand.

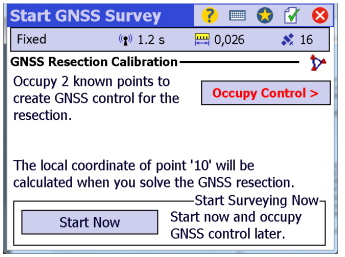
If your rover receiver does not get the base antenna height from the data link (**Measured**= "0.000", **Base Brand**= "Unknown" and **Antenna Type**= "Unknown Broadcast"), you need to specify the antenna brand and type used at the base, enter the measured height and specify the mark used to measure the height (tap on the **Change** button to access the base's **Antenna Height** definition screen).

NOTE: Next time you run your rover, Survey Pro will automatically query the Base Info list (see *Managing Reference Stations on page 84*) for the suitable base to use with the rover, thus skipping the base location selection step described here.

If both the base location and antenna type match, Survey Pro will automatically use the antenna parameters stored in the Base Info list for that base, and not the antenna parameters broadcast by the base.

The message **Rover is ready to set with reference station "x"**. will indicate that the base was picked from the reference station data base, whereas the message **Rover is ready to start a survey with base point 'x'.** will indicate it was found in the survey file.

Any time a VRS (Virtual Reference Station) survey is started, excluding a PRS (Physical Reference Station) in a VRS survey, automatic base selection will be done as well. The message **Rover is ready to start a survey with virtual base 'x'** will be displayed in this case.



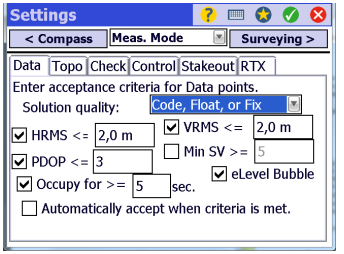
- If the **Finish** button is displayed, this means the coordinate system is fully solved, and you are ready to collect data.
  If the **Next** button is displayed instead, this means you are working in Default Ground mode, where a calibration is always required, or you are working in mapping plane mode but you started your base on a new point with a new autonomous position. Tap this button. You will see a new screen asking for occupation of control points (see screen example).
  For the sake of clarity, calibration is discussed in a separate section (see *Solving Calibration on page 79*).

NOTE: Solving the calibration is optional when your coordinate system is a known map projection and datum, and your base was setup on a known point.

At this stage, you may tap **Start Now** to begin surveying with a temporary calibration solution, which will solve your translation, but the scale and orientation parameters will remain unknown. You can collect data points; their local coordinates will be calculated with this temporary calibration.

At any time during the survey, you can collect the required number of GNSS control points and solve the proper calibration for your site. After you solve the calibration, any data collected points will automatically be recalculated using the latest solution of coordinate system.

Some routines, such as point stakeout or offset points, cannot be run until the calibration is properly solved.



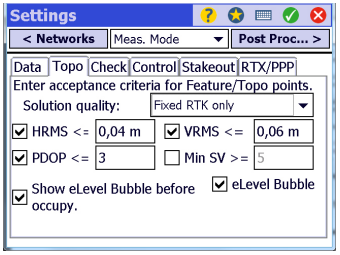
- Before starting data collection, tap  in the command bar. This directly opens the **Meas. Mode** tab (part of the **Job Settings** screen) where you can set the acceptance criteria for different types of point collection:
  - On the **Data** tab, define the criteria for all the points you will collect using **Point** from the **Data Collection** screen or from the active survey map.
  - On the **Topo** tab, define the criteria for all the points you will collect using **Topo SS** from any measurement screen or from the active survey map. Topo criteria are also used for feature collection.
  - On the **Check** tab, define the criteria for all the points you will collect after tapping successively **Control** (on the **Data Collection** screen), then **Check**.
  - On the **Control** tab, define the criteria for all the points you will collect after tapping successively **Control** (on the **Data Collection** screen), then **Control**.
  - On the **Stakeout** tab, define the criteria for all the points you will collect through any stakeout routine.

- On the **RTX** tab, define the criteria for all the points you will collect if you have selected "RTX" as the survey function for your receiver (if the receiver allows it). See also **Setup Type** field in *Modifying a Receiver Profile on page 35* or *Managing Your Receiver Profiles on page 33*.

  If you collect a topo point in RTX, the **Occupy for** and **Automatically accept when criteria is met** fields on the **RTX** tab are simply ignored.

  The value you choose in the **HRMS** field is used to test RTX convergence for the computed position. If no HRMS value is specified (the check button is cleared), a default value of 5 centimeters will be used to test the convergence.

Independently for each type, you can set the following criteria:



- **Solution quality**: "Fixed RTK only" or "Code, Float or Fix"
- Max. tolerated **HRMS** and **VRMS** values
- Max. tolerated **PDOP** value
- Minimum number of satellites required (**Min SV**).
- **eLevel Bubble**: Some models of GNSS receiver models are fitted with a built-in electronic tiltmeter providing level information directly on the screen. Check this option if you want to use it. This option will not appear if the connected GNSS receiver does not incorporate a tiltmeter.
- Minimum position averaging time, in seconds (**Occupy for**)
- Automatically accept data collection or not when criteria are met.

NOTE: The last two criteria make sense when the receiver is set to static to give the best averaged position. Since in **Topo SS** point collection Survey Pro is allowed to store a point using the single latest epoch of data, these two criteria are irrelevant in that case (compare the two screen examples on the left).

If you enabled raw data logging for post processing, the **Post Process** tab is also accessible through which you will set the **RTK autonomous points** field as follows:

- **Allow in PPK Survey**: Choose this option to allow Survey Pro to store an autonomous solution for a data point. This will happen during an RTK survey in case of intermittent or prolonged data link failure. By doing this, you will be able, after the survey and through post-processing, to calculate a precise solution for the point using the data from the GNSS raw data file (PPK logging file).
- **Do Not Store**: No autonomous point will be stored.

On the **Post Process** tab, you can also set an alarm to warn you if the number of satellites, or the remaining free memory size drops below a preset threshold, or if the HDOP exceeds a preset limit.

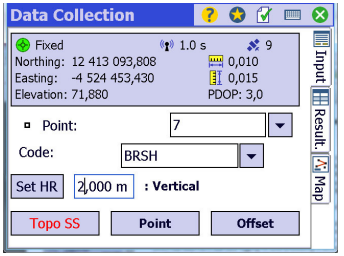
- Tap ✔ to save your settings. Survey Pro displays the **Data Collection** screen.

Collecting Data

Standard data collection routines are presented below. Keep in mind that you may have to solve the calibration before your measured GNSS coordinates are properly transformed into your local grid (see *Solving Calibration on page 79*).

Remember also that you can access the data collection functions from the active map after you have tapped and held on the map and selected **Survey Mode** from the popup menu.

From the **Data Collection** screen, you can perform several types of point collection:



- **Point**: Tap this button to collect the averaged position of a point after a timed, static occupation on that point. The acceptance criteria defined on the **Data** tab will apply. (The corresponding markers will be inserted into the GNSS raw data file if raw data logging for post-processing is activated.)
- **Topo SS**: Tap this button to collect the "instant" position solution of a point. The acceptance criteria defined on the **Topo** tab will apply.

In its upper part, this screen provides detailed, real-time GNSS status information:

- Type of computed position (Fixed, Float, RTX,..) preceded by a green icon if it complies with the current accuracy requirements (else red)
- Age of corrections (in seconds)
- Number of satellites used
- Coordinates of the last computed position, expressed in the chosen coordinate system
- PDOP
- VRMS (estimated vertical accuracy) and HRMS (estimated horizontal accuracy), represented respectively by small vertical and horizontal rulers.

Collecting Points

Place the pole in vertical position over the point to be surveyed and tap **Point**. to start collecting data on this point.

The workflow of this routine will depend on the choice you made for the following acceptance criteria:

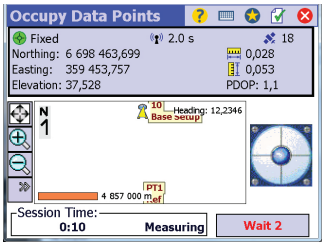
- **Occupy for** checked and a minimum averaging time (in seconds) requested: After tapping **Point**, you will see screen type **[1]** on which the lower-left button label will show Survey Pro counting down from the requested averaging time (**Wait xx**). After that time, **Accept** is restored as the button

label so you can decide on what to do: Accept the point collection now or wait more time for an even better averaged position.

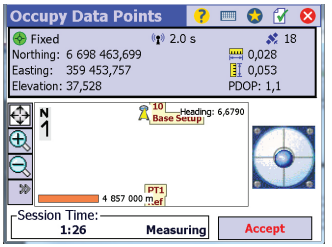
NOTE: You can tap the **Wait xx** button to accept the point before the minimum duration has expired. You will in return be informed that the minimum duration is not yet met, at which point you can discard the warning by tapping **Accept anyway**.

- **Occupy for** cleared: Screen type **[2]** will be displayed for an unlimited period of time, until you tap **Accept**. Point collection is then complete, unless some other acceptance criteria are not met in which case you will see screen type **[3]** after you tap **Accept**. You can also choose to accept the point before the wait time expires. Still with this option cleared, you can spend some time checking GNSS reception: This is done by pressing the **GNSS Status** button on screen type **[2]**. Closing the GNSS status screen will take you back directly to screen type **[2]**.
- **Automatically accept when criteria is met** checked: The use of this parameter makes sense when it is combined with **Occupy for** checked. Survey Pro will automatically store the point at the end of the averaging time, unless some other acceptance criteria are not met. In that case, at the end of the count down, the **Accept** button will be restored on the screen and when you tap on it, you will see screen type **[3]**.

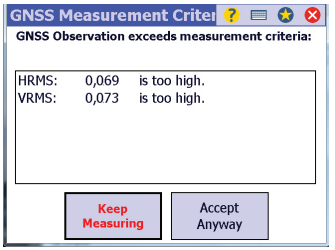
[1]



[2]



[3]



When screen type **[3]** is displayed, you can either ignore the warning message (tap **Accept Anyway**), or ask for more data collection on the point (tap **Keep**

Measuring) until you are satisfied with the collected data (you will then tap **Accept** to end the point collection).

NOTES: On-screen eLevel information is available only for those receivers fitted with an embedded electronic tiltmeter, and provided you enabled its use (see *page 70*). The **View Map**/**View Data** button allows you to choose the view that is the most convenient to you when logging points.

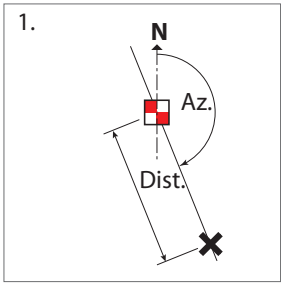
Collecting Topo SS Points

This is the simplest way of collecting a point. Just tap on the **Topo SS** button when you are physically on the point and you have previously named and described the point (see **Name** and **Description** fields). Survey Pro will save the point position right away (no position averaging), assigning the last computed position to the point. A new position being computed every second, the best possible accuracy for the point is achieved if you wait about 1 second, once physically on the point, before tapping on the **Topo SS** button. The **Point** field is then automatically incremented, ready for storing a new point.

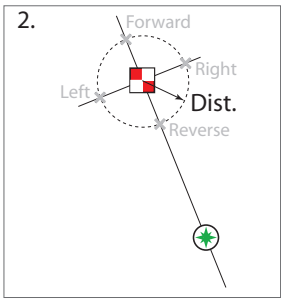
Collecting Offset Points

When GNSS reception is poor on a point of interest, you may resort to the Offset Point method to collect it.

To select this function, go to the **Survey** menu and tap on **Collect Offset**. This function is also available from the **Data Collection** screen. Offset points may be collected in one of three ways:

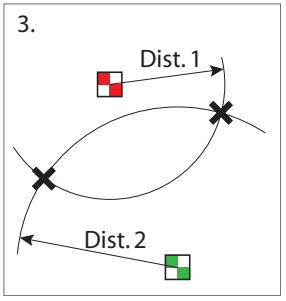


1. *By azimuth and distance* (**Az./Dist.**): You choose a nearby reference point ( ) where you know GNSS reception is good and from this point, you measure the azimuth and distance to the offset point (✕) using any means other than GNSS. You stand on the reference point and collect it, then you enter the measured azimuth and distance ( ) to the offset point. Then you store the offset point under a new point name (the point is therefore defined by the coordinates of the reference point and the measured azimuth and distance).



2. *By 2-point azimuth and distance* (**2-Point Az.**): You choose two nearby points (reference point: , azimuth point:) where you know GNSS reception is good. You measure the distance from the offset point (✕) to the reference point using any means other than GNSS. This distance is measured in one of four possible directions compared to the reference point, thus determining the location of the offset point compared to the other two points:

Direction	Offset Point Location
Forward	Aligned with, and beyond Az-to-Ref vector
Left	To the left of the Az-to-Ref vector, on a line perpendicular to this vector passing through the reference point.
Right	To the right of the Az-to-Ref vector, on a line perpendicular to this vector passing through the reference point.
Reverse	Somewhere on the Az-Ref segment.

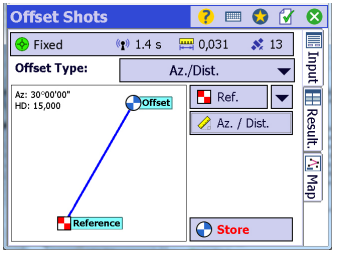


One after the other and in any order, you stand on each of these points and collect them, then you enter the measured distance and tell Survey Pro where the offset point is located compared to the direction from the azimuth to the reference point ("**Forward**", "**Left**", "**Right**" or "**Reverse**"). Then you store the offset point under a new point name.

3. *By distance/distance intersection* (**Dist. /Dist.**): You choose two nearby points (reference point 1: and reference point 2:) where you know GNSS reception is good and from each of these points you measure the distance to the offset point (✕). You stand on each of these points and collect them. Then you enter the distance from each of these points to the offset point. Survey Pro will in return view the possible solutions for the offset point. Choose the one that suits with what you see in the field and then store the offset point under a new point name.

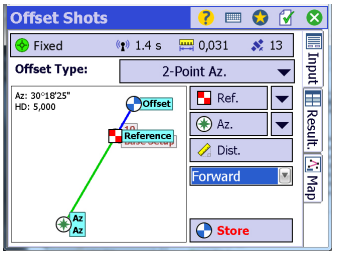
NOTE: In all three methods presented below, the reference and azimuth points are assumed to be new points that you have to collect. But be aware these points may also be existing points selected from either the list of points or from the map view.

Collecting an Offset Point by Azimuth & Distance



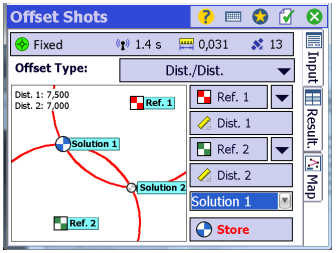
- Choose **Offset Type**= **Az./Dist.**
- Stand on the reference point then tap on the **Ref.** button to collect this point. This delivers an instant or averaged position solution for the point, depending on the choice made from the down arrow attached to this button.
- Using appropriate tools, measure the distance and azimuth from this point to the offset point, then tap **Az./Dist.** and type in the measured values. You may need to type in the heights of the instruments used if appropriate.
- Tap to validate these measurements, then tap **Store** to name and log the offset point.

Collecting an Offset Point by 2-Point Azimuth & Distance



- Choose **Offset Type**= **2-Point Az.**
- Stand on the reference point then tap on the **Ref.** button to collect this point. This provides an instant or averaged position solution for the point, depending on the choice made from the down arrow attached to this button.
- Go to and occupy the azimuth point then tap on the **Az.** button to collect this point. This provides an instant or averaged position solution for the point, depending on the choice made from the down arrow attached to this button.
- Using an appropriate tool, measure the distance from the offset point to the reference point. Then tap **Dist.** and type in the measured value.
- Tap to validate this measurement.
- Take a look at the map on the screen to deduce where the offset point would be on the screen compared to the two collected points, based on what you've done in the field. Choose between "**Forward**", "**Left**", "**Right**" or "**Reverse**" to qualify this location (see explanations further above).

  NOTE: The two collected points may be swapped using the scroll-down menu attached to either the **Ref.** or **Az.** button.
- Tap **Store** to name and log the offset point.



Collecting an Offset Point by Distance/distance Intersection

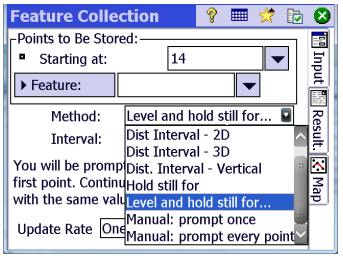
- Choose **Offset Type**= **Dist./Dist.**
- Stand on the first reference point then tap on the **Ref. 1** button to collect this point. This provides an instant or averaged position solution for the point, depending on the choice made from the down arrow attached to this button.
- Using an appropriate tool, measure the distance from the collected point to the offset point. Then tap **Dist. 1** and type in the measured value. Tap to validate this measurement
- Go to and occupy the second reference point then tap on the **Ref. 2** button to collect this point. This provides an instant or averaged position solution for the point, depending on the choice made from the down arrow attached to this button.
- Again, measure the distance from the collected point to the offset point.

  Then tap **Dist. 2** and type in the measured value. Tap to validate this measurement
- Take a look at the map on the screen and see which solutions Survey Pro suggests for the offset point. Choose the one corresponding to what you see in the field (**Solution 1** or **Solution 2**).

  If no solution is available, that means the two circles do not intersect. Please double-check the distances measured and/or the distance values you typed in.

  NOTE: The two collected points may be swapped using the scroll-down menu attached to either the **Ref. 1** or **Ref. 2** button.
- Tap **Store** to name and log the offset point.

Collecting Features



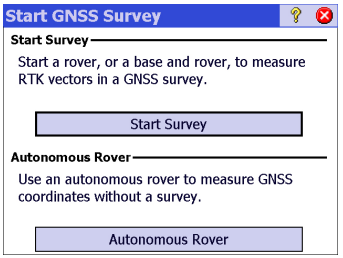
Go to the **Survey** menu and tap on **Collect Feature**. Features can be collected using one of the methods below. In all methods, each new point name is incremented automatically to the next available name.

- **Time Interval**: After accepting the first point, additional points will automatically be stored after the specified time interval (in seconds) has elapsed.
- **Dist Interval - 2D** or **3D**: After accepting the first point, additional points will automatically be stored after traveling the specified 2D or 3D distance.
- **Dist. Interval - Vertical**: After accepting the first point, additional points will automatically be stored after traveling the specified vertical distance.
- **Hold Still For**: After accepting the first point, additional points are automatically stored when the pole is held in the same spot for the specified interval of time (in seconds).
- **Level and hold still for**: Same as the previous option but you are required to set the range pole vertical, by watching the e-level reading, before Survey Pro starts down-counting the specified interval of time (in seconds) and log the point automatically when time is up.
- **Manual: Prompt Once**: Will store points in the same way as **Topo SS** from the **Data collection** screen, incrementing the point name automatically after each stored point.
- **Manual: Prompt Every Point**: Same as **Manual: Prompt Once** except that you are prompted for a new description, layer and attribute with each point stored.

When shown, **Interval** is the field where you should enter the time or distance interval used for continuous data collection.

Use the **Update Rate** field to set the speed at which the rover receiver should deliver position solutions. When **Five Hz** is selected, the receiver will compute positions five times a second minimizing the measurement latency.

Collecting Data Out of a Survey



If you tap **Data Collection** on the **Survey** menu to work with the selected GNSS receiver but without having first started a survey, Survey Pro will invite you to choose between two options:

- Start the survey first, then collect data (this is the recommended way of using Survey Pro).
- Start collecting data right away (and possibly running any stakeout routines) using your receiver in *Autonomous Rover* mode, that is, with the receiver only capable of delivering autonomous position solutions. You will need to confirm this choice.

  Working in this mode means you will collect LLH coordinates in the open job regardless of the chosen acceptance criteria in the Data Collection function.

NOTE: Most receiver models will provide autonomous position solutions in that mode. However some may keep the ability to deliver more accurate solutions (i.e. DGPS, Float or Fixed).

If you are using such a receiver, to remind you at all times that you are working with no survey started, position solutions will be reported with a tilde character (~) placed before the position status if better than Autonomous (e.g. "~Float" instead of "Float", "~Fixed" instead of "Fixed", "~RTX" instead of "RTX").

Solving Calibration

Introduction to Calibration

A GNSS calibration is a 2D similarity transformation. The GNSS LLH coordinates are transformed using a map projection into XY mapping plane coordinates. The XY mapping plane coordinates are then translated, scaled and rotated into your local grid using the calibration.

Your choice of projection mode will determine the mapping plane used for this procedure:

1. If you started your job with no coordinate system, then there is no projection and no datum available to relate the LLH coordinates to the local grid coordinates. In this case, Survey Pro will initialize a default map projection when you collect your first GNSS control point. This default projection will be created to give ground distances at the height of the first control point.

   Because the orientation of your local grid relative to geodetic North is unknown, you must collect **at least two GNSS control points** to solve the scale, rotation, and translation between the default map projection and your local grid coordinates.

2. If you started your job with a map projection and datum, then the measured LLH coordinates can be transformed into local coordinates using this selected map projection. In this case, because the scale and orientation is defined by the map projection, you need only to solve for the translation parameter.

   If you set your base on a known point, then no calibration will be required. If you set your base on a new autonomous point, then you must collect **at least one GNSS control point** to solve the translation parameter.

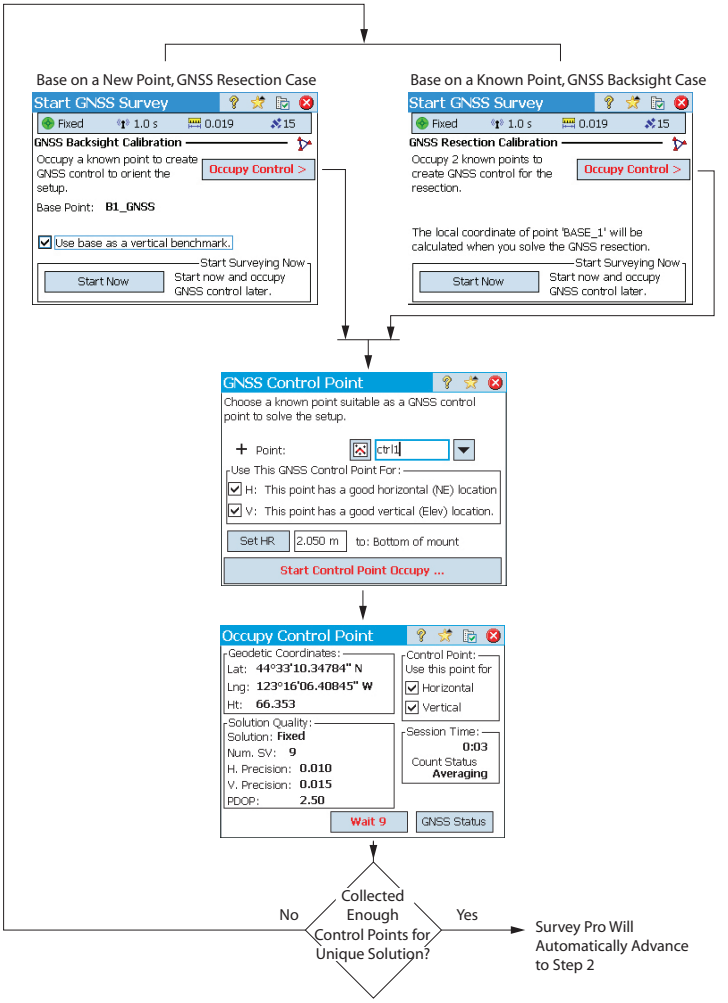
   A calibration with multiple points can still be performed to give extra redundancy to the calibration solution.

A calibration is solved by collecting GNSS control points. A GNSS control point is a point with an accurate local grid coordinate that you occupy with the GNSS rover. The LLH from the GNSS measurement is combined with the accurate grid point to form a calibration point pair. The calibration is then solved from these control points to give you the best fit between your GNSS measurements and the local ENE grid coordinate system.

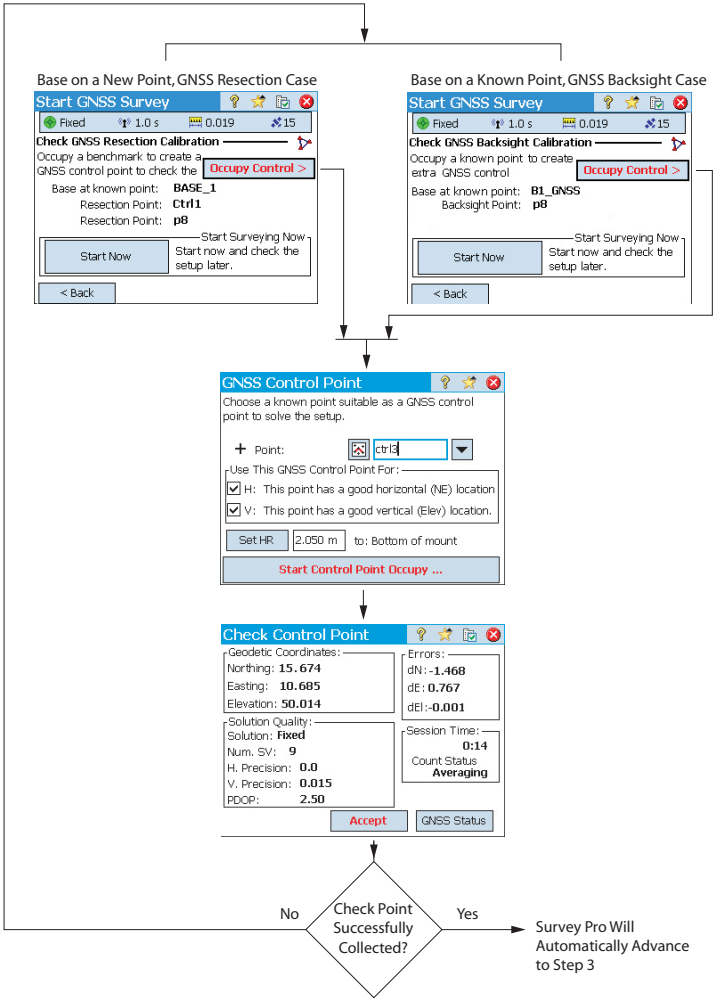
Calibration Procedure, Illustrated

The calibration procedure can be split into three distinct steps. These are described below as flowcharts:

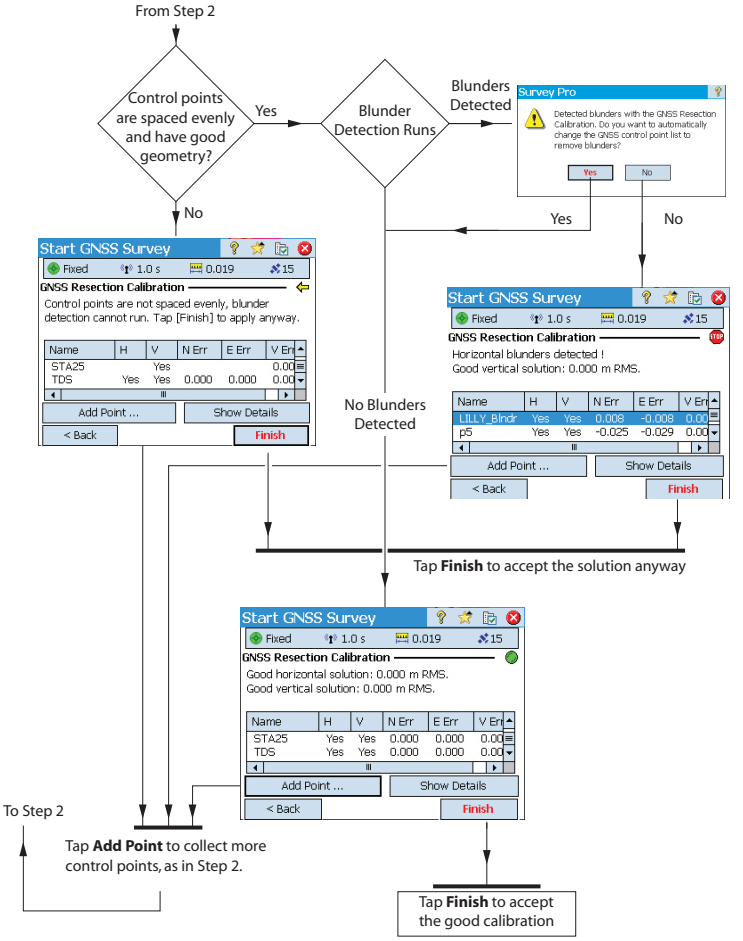
- **Step 1**: When you start a survey, Survey Pro will report the need for calibration on the Calibration Status page, which will guide you through the process of collecting the minimum amount of control points required for a unique solution of the calibration.



- **Step 2**: The Calibration check page will guide you through the process of collecting an additional GNSS control point to check the solution, and to provide redundancy for the best fit least squares solution.



- **Step 3**: The calibration results page will solve the calibration and display the results.



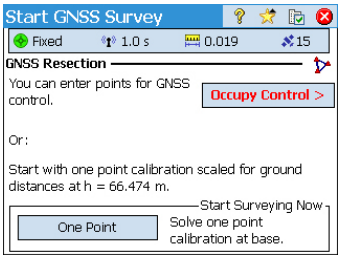
You can change the contribution of your control points to the calibration solution by tapping on the columns next to each point name in the list:

- Tap in the **H** column to deselect or select a point to be used in the horizontal calibration.
- Tap in the **V** column to deselect or select a point to be used in the vertical calibration.

Any time you change the contribution of a control point, the **Finish** button will change to a **Re-Solve** button. Tap this button to re-solve the calibration using the new contribution of that control point.

After you have solved the calibration as part of the Start Survey wizard, you can use the **Survey > Control > Control** routine, or the **Survey > Projection > Solve Calibration > Add Point** routine to add additional GNSS control points, re-solve the calibration, and have all the collected points updated with the latest calculation.

Special Case of One-Point Calibration



When you are using the Default Ground Calibration projection mode, and you have started a new job with no points, or only one point in it, you have the option of doing a one-point calibration to create the coordinate system for your job. If these conditions are met, the screen will look as illustrated.

You can tap **One Point** to set up the calibration for a ground level survey at the reference height displayed on this screen. Since there is only one point in the job to start, the orientation is not fixed by the local grid coordinates, so only the translation needs to be solved, which is possible from a single point.

How Survey Pro Deals With Base Location

With no known coordinate system used:

- If you set up the base on a known point, a geodetic point will be created for the base location, using the autonomous LLH coordinates from the GNSS receiver as the geodetic position for the base.

  EXAMPLE: Base location "B1" will have for geodetic counterpart a point named "B1_GNSS" with description "B1".

  This point will automatically become a GNSS control point, with the known grid location of the base paired with its new geodetic coordinates.
- If you set up the base on an unknown point, Survey Pro will create a default point named "BASE_1" using the autonomous LLH coordinates from the GNSS receiver as the geodetic position for the base. This point is not eligible as a GNSS control point, because the grid coordinates are not known until they can be calculated with a calibration solution. Until the calibration is available, the grid coordinates of this point will be "-- -- --".

NOTE: You can set only one new autonomous base position in each job.

With a known coordinate system used:

- If you set up the base on a known point, the selection of a known coordinate system will allow Survey Pro to compute and attach the equivalent geodetic (LLH) coordinates to that point.
- If you set up the base on an unknown point: Same as with no coordinate system used.

Detected Change of Base

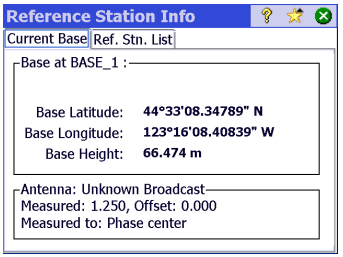
If the rover receives the coordinates of a new base station (through the broadcast corrections message), a warning message will then be displayed. This may occur when the receiver switches to a new network cell, or when using a radio link and another operator is also broadcasting on the same radio channel.

In this case, tap **OK** to acknowledge the warning message. This will take you to the **Start GNSS Survey** screen. From that screen, you can verify and validate the new base.

Managing Reference Stations

Survey Pro keeps up to date a list of reference stations that the software uses to enhance the search for base points when starting a survey. To view this list:

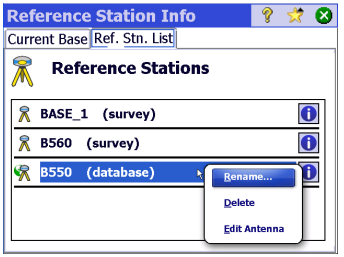
- Go to the Main Menu.
- Tap **Survey**, then **Base Info**.



The **Current Base** tab shows the properties of the base point currently used in the survey.

The **Ref Stn List** tab lists all the base points Survey Pro has been using so far. The list includes:

- Base point names followed by the term "(database)": These are read from the *reference station database*. By default, any NTRIP station set up in a survey – whether a single base, or a PRS in a VRS survey– is automatically saved to that database (in addition to being part of the survey). This is done because it is assumed that these stations are likely to be re-used in other survey jobs to provide the required base points.



- Base point names followed by the term "(survey)": These are read from the current survey and so belong to the survey file. These are considered to be temporary base points (reference stations using radios) not likely to be re-used. That's why they are not by default saved to the reference station database. You may however do so if you wish (see below).

From the **Ref Stn List** tab, you can:

- Tap  to view all the properties of any reference station: base point name, geodetic location, antenna used, and if applicable, additional information about the NTRIP mount point used.
- For a "re-usable" reference station (*<base point name> (database)*), you can use the context menu (tap and hold the base point name) to either rename or delete the reference station, or edit the properties of its antenna.
- For a "temporary" reference point (*<base point name> (survey)*), you can use the context menu to save the reference point to the *reference station database*.

Ending a Survey

Go to the Home screen and tap **End Survey**. Confirm the end of survey by tapping **End**.

A survey in progress implies that either a base or a rover or both are running. You will need to end the currently running survey if you wish to reset the base or rover.

Opening an existing job or creating a new one while a survey is in progress will automatically end the current survey.

When an RTK rover or/and an RTK base is used in a survey, then ending this survey will cause the rover to stop listening for corrections, and/or the base to stop sending out corrections. (ProMark will however continue to operate as rovers.)

7. Leveling

Introduction

What Leveling Is

Leveling is a surveying method that allows the most accurate measurement of vertical distances between points. Using a starting point with known elevation, the leveling survey method allows you to transfer the elevation to new points by measuring vertical distance differences between the known elevation and the position of the level instrument.

Leveling data collection is organized into *level loops*. A *level loop* is a sequence of measurements that starts and ends on a point of known elevation. Many level loops start and end on the same point, hence the name "loop". However, you can start and end a level loop on different points, provided the elevation is known for both points.

NOTE: Collecting and storing points in a level loop is different than optical or GNSS surveying in that for leveling, you often need to take many measurements before you reach the point of interest in the survey where you want to store a new elevation.

The procedure for leveling with Survey Pro is almost the same no matter which leveling method you are using. The main difference for each method is the type of information that is collected with each shot taken.

You should have now selected a leveling method and possibly connected an instrument to Survey Pro (if you are using an electronic level or an electronic total station for trig leveling). See *Leveling Mode - Getting Ready for Leveling on page 40* for more information.

It's a good idea, in the current job, to create the point from which your first level loop will start. This point, which must have an accurate elevation, can also be created when creating the level loop.

Other Definitions

- A *level loop* is a series of level measurements that start with a backsight measurement on a known point with a valid elevation. This point is referred to as the *opening Control Benchmark* (or *opening CBM*). The elevation of the opening CBM will NOT be modified by the elevation measurements you will collect in the loop.

  A level loop is closed by taking a measurement to a point with a valid elevation. This point is referred to as the *closing Control Benchmark* (or *closing CBM*). Often, the closing CBM is the same point as the one where you started the level loop, but it can also be any known point with an accurate elevation.

A level loop can have two states: *open* or *closed*. Once a new loop is created, it is automatically opened. It will remain open until you decide to close the loop. A level loop is closed after shots are taken to the closing CBM.

Level loops are stored within the current Survey file, which can contain any number of level loops.

Any level loop can be selected from the current job as the active loop for data collection. Once a loop is closed, it cannot be re-opened for data collection. It can only be viewed or adjusted. Only closed loops can be adjusted.

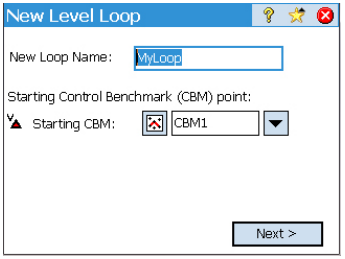
- A *level turn* represents the set of backsight-foresight observations collected from a given location where your instrument is set up. Each *level turn* calculates the elevation of the point in the loop for which the foresight observation is made. A *level loop* typically consists of many *level turns* between each level benchmark point stored.
- A *benchmark* is a point in your level loop for which you will store the elevation as a point record in Survey Pro. A benchmark is usually a permanent mark, such as a brass survey disk or a stable iron rod in the ground, that can be reoccupied at a later date.
- A *turning point* is an intermediate point used to connect two benchmarks. Because a *level turn* is usually short (typically less than 50 meters), many turning points are often needed to make the connection between two consecutive benchmarks.

  As opposed to benchmarks, turning points are not permanent marks on the ground and are not stored in the job. They only exist while the rod occupies them during the foresight/backsight measurements.
- A *sideshot point* is a point of interest for which you will store the elevation as a point record in Survey Pro. Unlike benchmarks, you do not turn through sideshot points in the level loop, they are spur observations to the loop.
- A *stakeout point* is like a sideshot point in that you do not turn through these points. They are spurs to your loop. A stakeout point is used to display the cut/fill information from the level observation and some design elevation.

Creating or Selecting a Level Loop

- From the main menu, tap **Survey** > **Select/Create Loop**.

NOTE: Survey Pro will list all the level loops that haven't been closed yet. You may select one of them and tap **Activate Selected Loop** to choose to work in this level loop.



- To create a new level loop, tap on the **New Loop** button. This opens the **New Level Loop** screen.
- Enter a name for the new level loop (e.g. MyLoop).
- Tap on ▼ to define the opening CBM. The point may be selected from either the map or the list of points. You may also create the opening CBM at this stage.

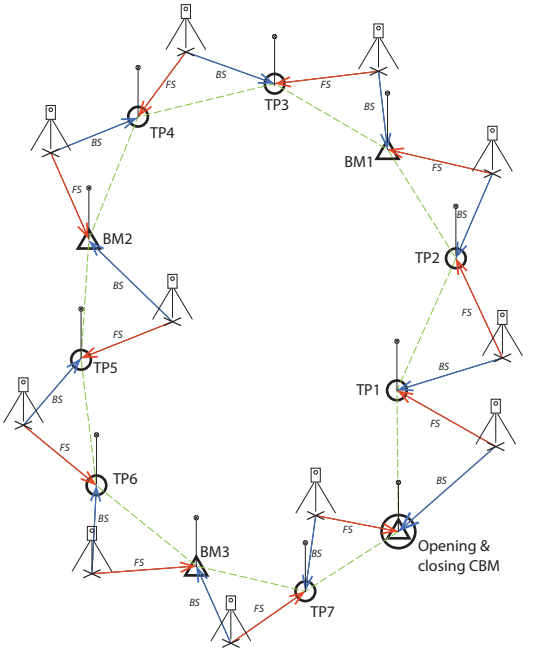
NOTE: The opening CBM must be a point in the job with a user-entered, keyed-in elevation. You cannot select points derived from measurements for your opening CBM.

- Tap **Next**.
- Use the **Desc** field to enter a description for the level loop (e.g. "Boundaries"). Below this field, the current definition of the level loop you want to create is displayed. You may tap **Back** if you wish to modify this definition.
- When the definition of the level loop is complete, tap the **Create Loop** button. A message is then displayed prompting you to proceed with level measurements in the loop.
- Tap **OK** to close the message. This automatically opens the screen from which you can start collecting elevations in the level loop. (This screen can also be accessed from the main menu by tapping **Survey** then **Level**.)

Collecting Elevations in an Open Level Loop

Description of a Simple Level Loop

A simple level loop is illustrated below.



Collecting elevations in a simple level loop consists of the following:

1. In every level loop, you will start with a backsight observation to the opening CBM.
2. You will observe some number of turning points next. Turning points are not stored in the survey file. They are used as intermediate points to transfer the elevation between benchmarks.
3. After some number of turning points, you will reach a point you wish to store an elevation for. You will observe this point as a benchmark. You can observe a brand new point as a benchmark, in which case a new point with only an elevation coordinate will be created. You can observe an existing point as a benchmark, in which case you will have the option of updating only the elevation of the existing point, and its horizontal coordinate will remain unchanged.
4. After some number of turning points and benchmarks stored, you will reach the end of your level loop. You will close the loop by collecting a foresight observation to the closing CBM. This can be either your starting point, or it can be another point of known elevation.

In practice, the sequence of observations will be as follows:

1. The instrument is set up somewhere close to the maximum allowable sight distance (typically 30 meters) away from the opening CBM. A backsight observation is taken to the opening CBM.
2. A foresight observation is made to the first turning point. This turning point should be chosen in such a way that the instrument is located midway between the opening CBM and that turning point.

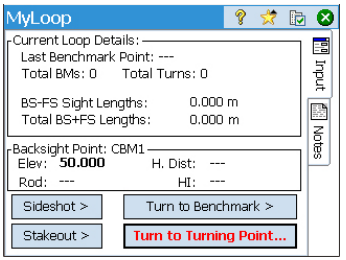
   Steps 1 and 2 are called *the first turn*, and are indicated as BS and FS in the above diagram.

NOTE: A usually observed tolerance is that the foresight and backsight distances for each turn should not be different from each other by more than ± 5 meters, or some similar value. Refer to *Level Settings on page 41* to set this tolerance.

---

3. The instrument is set up midway between the first turning point (TP1) and the second turning point (TP2). A backsight observation is made to TP1 and a foresight observation is made to TP2. These observations constitute the second turn.
4. The instrument is set up midway between the second turning point (TP2) and the first point of interest (BM1). A backsight observation is made to TP2 and a foresight observation is made to BM1. These observations constitute the third level turn.
5. Make the same types of observations for the next level turns (TP3-BM1, TP4-TP3, BM2-TP4, TP5-BM2, TP6-TP5, BM3-TP6, TP7-BM3).
6. In the last level turn, a backsight observation is made to TP7 and a foresight observation is made to the closing CBM, which here is the same point as the opening CBM (it could be a different one as long as it has accurate elevation).

There may be variants to this simple level loop. You can for example shoot sideshot points or stakeout points as you go along the level loop. This is explained in *Collecting Elevations for Sideshot and Stakeout Points on page 93*.



Collecting Elevations in a Simple Level Loop

After creating/selecting a loop, Survey Pro prompts you to start collecting elevations in the loop. A new screen is displayed providing the list of possible actions. The name of the open level loop is indicated in the upper bar.

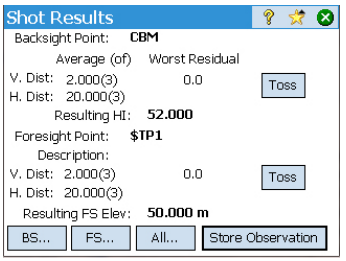
NOTE: The button provides access to the level settings (see *Level Settings on page 41*).

Follow the procedure below to complete a typical level loop:

1. Set up your instrument midway between the opening CBM and the first turning point and have your rods ready for backsight and foresight observations.
2. Unless already done, select **Survey** from the main menu, then **Level**.
3. Tap **Turn to Turning Point**. Based on the shooting sequence you have chosen, Survey Pro will prompt you successively to take all the necessary direct and reverse shots to the backsight point (the opening CBM) and the foresight point (the first turning point in the level loop).

   If in manual leveling, you will be requested to enter the following parameters measured with your standalone instrument:

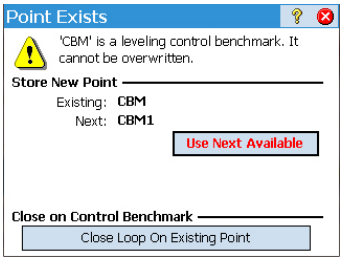
Measurements: / Leveling Method:	Upper Wire	Center Wire	Lower Wire	Vert. Dist.	Hor. Dist.	Zenith	Slope Dist.
Three Wire	•	•	•				
Single Wire		•					
Electronic				•	•		
Trigonometric						•	•

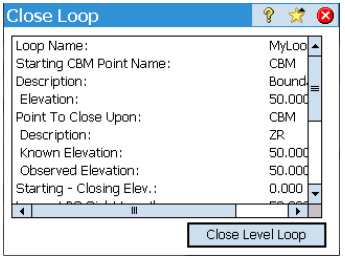


4. After completing the shooting sequence, Survey Pro will show the results. Tap **Store Observation** if you are satisfied with the results. If these are of poor quality you can remove some of them (use the **Toss** button) or add new backsight (**BS**) and/or foresight (**FS**) observations.
5. After you have tapped **Store Observation**, thus accepting the results, Survey Pro will prompt you to start a second level turn.

NOTE: As you move along the loop, at the end of each level turn, Survey Pro provides an up-to-date summary of the measurements made so far (total number of level turns made, etc.)

If you tap on the **Notes** vertical tab, you will see a summary of all the measurements made so far.



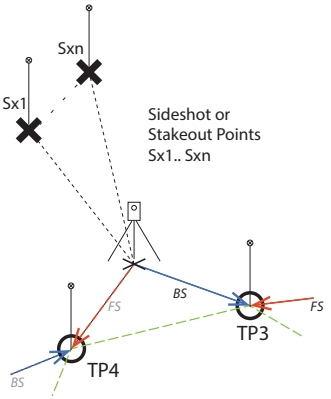


6. Move the instrument for the next level turn and then start a new shooting sequence.

   If the foresight point is a turning point, tap **Turn to Turning Point** again. If the foresight point is a point of interest (i.e. a benchmark), tap **Turn to Benchmark**. In both cases, proceed as explained above.

   Again, Survey Pro will provide results at the end of the second level turn that you will need to accept by tapping **Store Observation**. Additionally for a benchmark, you will need to enter a name and description for that point. This may be an existing point in the job (select it from the list or the map), in which case Survey Pro will prompt you to update its elevation, or a new point, in which case Survey Pro will create this point with just its elevation. Tap ✓ to continue.
7. For the last level turn, tap **Turn to Benchmark** when you are ready for the shooting sequence. Proceed in the same way as for any benchmark.

   The difference is when you name the point once the observation is accepted, you will have to select the closing CBM from the list of existing points. In our example, this point is also the opening CBM, a point named "CBM". Survey Pro will then alert you that this point cannot be modified but will give you the option to close the level loop (see screen example).
8. Tap **Close Loop on Existing Point**. Survey Pro will then provide a report on the level loop you are about to close.
9. Tap **Close Level Loop**. A message informs you that the loop has been closed successfully.
10. Tap **OK**. Survey Pro goes back to the loop summary screen from which you will notice that no more action can be taken for the loop.
11. Tap ⊗ to return to the home screen.



Collecting Elevations for Sideshot and Stakeout Points

For some level turn, you have made your backsight measurement to the previous turning point or benchmark. At this stage, the elevation of the instrument is known.

Before completing the turn with a foresight measurement to the next benchmark or turning point, you can shoot any number of sideshot or stakeout points. These points are spurs to the loop, as they are never used in any backsight measurements. They are stored in the job file.

Typically with stakeout points, you will want to compare the measured elevations to design points so you can compute cut/fill values.

Follow the instructions below to collect elevations of sideshot or stakeout points in an open loop:

- For the next level turn, instead of tapping **Turn to Turning Point** or **Turn to Benchmark**, tap **Sideshot** or **Stakeout**.
- Have your instrument and rods set up accordingly.
- Start the shooting sequence: First make a backsight measurement to the last measured benchmark or turning point, then shoot the sideshot or stakeout point. For a stakeout point, you will need to specify which point you want to measure. This may be an already existing point or a point you create on the spot.
- If your measurements are all good, tap **Store Observation**.
- Name the point and tap ✔.

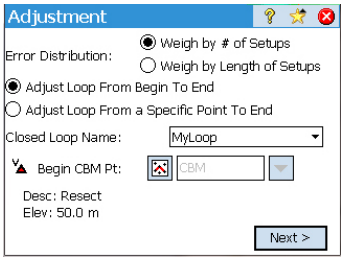
  For a sideshot point, you just need to name the point (**Point** field).

  For a stakeout point, Survey Pro will ask you to name the as-staked point (**Point** field) and will suggest to add a default description for this point in the form "pt<stakeout_point_name>" (**Description** field).

NOTE: If you wish to collect a series of sideshot or stakeout points from the same instrument setup, Survey Pro will ask you to perform foresight measurements directly to the second and next points (no backsight measurements need to be repeated in this case as Survey Pro has already collected these measurements for the first of these points).

- When you are finished with the collection of your sideshot or stakeout points, tap **Turn to Turning Point** or **Turn to Benchmark** to complete the level turn. Once again, you will just have to perform foresight measurements to this point, the backsight measurements having been already made.
- Start a new level turn.

Adjusting a Closed Loop



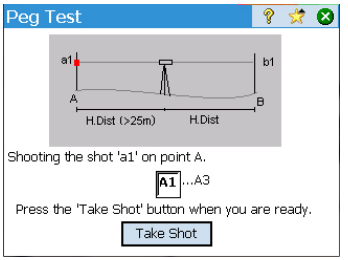
Adjustment may be used to remove the error computed from any existing closed loop. This is a simple arithmetic adjustment where the computed error can be either distributed equally among each instrument setup in the loop, or a weighted adjustment can be applied where the error is distributed based on the length of the backsight and foresight distance of each turn.

1. From the main menu, tap **Survey** > **Adjustment**
2. Choose how you want Survey Pro to distribute errors. **Weigh by # of Setups** divides the computed error equally among each instrument setup selected in the loop. **Weigh by length of Setups** distributes the error where each instrument setup is adjusted by an error proportional to the length between them, so that instrument setups that are farther apart will carry a larger portion of the error adjustment than those closer together.
3. Choose the portion of the loop you want to adjust. **Adjust Loop from Begin to End** will include every instrument setup of the selected level loop in the error adjustment. **Adjust Loop From a Specific Point to End** will only adjust the turning points and benchmarks starting from an alternative benchmark (that you need to specify in the **Begin CBM Pt** field) to the end of the loop.
4. Use the **Closed Loop Name** drop-down list to select the name of the loop you want to adjust. Only closed loops are listed here.
5. Tap **Next** to access the **Adjustment Preview** screen.
6. Tap **Adjust** to start the adjustment. At the end of this process, a message will inform you that the job file has been backed up and this backup file includes the archive of the adjustment.
7. Tap **OK** to close the message and read the results of the adjustment.
8. Tap ⊗ to close the results screen.

Running the 2 Peg Test

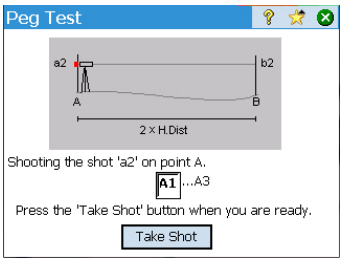
The *2 Peg test* is used to check the collimation error of an automatic level instrument. This test can be used for electronic automatic levels and manual automatic levels. The test will compute the error, which can then be used to adjust the horizontal cross-hair of the instrument.

1. Position two rods 50 to 90 meters apart (165 to 300 feet).
2. Pace off the distance between the rods and set up the level midway between them. (The placement of the rod over Point B can be adjusted after shooting Point A.)
3. Carefully level the instrument. You should be able to rotate the instrument 180° around its vertical axis without the bubble moving away from the center.
4. From the main menu, tap **Survey** > **2 Peg Test**.



5. Tap **Take Shot**. You are now prompted to take each set of shots to the rod over Point A. Once each shot is completed for the number of sets entered in the **Level Settings** screen, you will return to the **Peg Test** screen.
6. Turn the instrument to the rod over Point B.
7. You can optionally tap **Check H Dist** to verify the instrument is centered between the two rods.

   The distance to Point B will be measured and compared to the horizontal distances previously measured to Point A and a come/go distance will be provided so the rod at Point B can be moved to equal the horizontal distance to Point A prior to taking the shots that will be used to compute the error.



8. Tap **Take Shot**. You are now prompted to take the required shots to the rod over Point B. Once completed, the Peg Test screen will open with a new graphic showing the next instrument setup.
9. Move the instrument as close as possible to the rod over Point A where a shot can still be taken to it. This is typically about 3 meters (10 feet) from the rod.
10. Tap **Take Shot**. You can now take the required shots to Point A from the new instrument setup.
11. Once complete, turn to Point B and take the required shots to that point.
12. After the final shot is taken, the **Peg Test Results** screen will open showing the details of the shots taken and the computed error.
13. Tap ⊗ to close the results screen.

This section introduces the basic stakeout routines with optical and GNSS instruments. When you become familiar with these routines, you will be able to extend your knowledge on more specific stakeout routines, such as stake to line, slope staking, etc.

What you should have done already:

- You should have now completed the station setup with your optical instrument.
- You should have now solved the calibration with your GNSS receiver.
- If the points to stake are not in your job, you can use the **File > Import** function to import your points to the job (see *Importing Data on page 18*).

The built-in electronic compass (if there is one in your data collector) may be a valuable tool during the guidance phase as its activation will translate into accurate N/S indications on the stakeout screen (see *Electronic Compass on page 126* for more information).

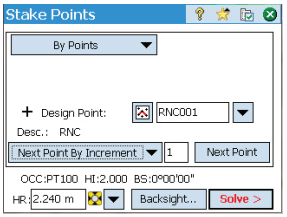
Selecting Points to Be Staked, "Next Point" Scenario

Whether you are working in GNSS or optical, Survey Pro offers two different ways of selecting points for stakeout work:

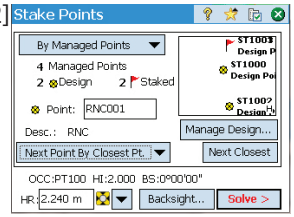
- **By Points** method (see screen **[1]** below): This is the simplest method. You just select the point, from the open job, from either the list of points or the map view, and then you stake it out. Icons assigned to points remain the same (+) at every step of the stakeout procedure.
- **By Managed Points** method (see screen **[2]** below): This method gives better control over the whole stakeout process. You need to create a list of design points. Icons assigned to these points are distinct from other points and later will change after the points have been staked. See *"By Managed Points" Method on page 97* for more information on this method.

To choose one of the two methods, go to **Stakeout** > **Stake Points** and use the button located in the upper-left corner (see diagram below).

[1]



[2]



"Next Point" Scenario. After you have staked out a point, Survey Pro may help you select the next point to be staked. This may be:

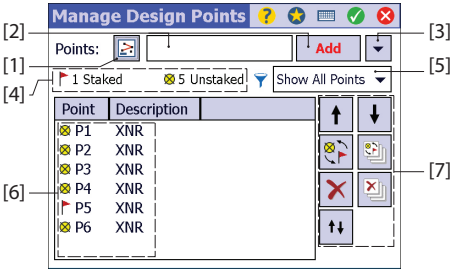
- Next Point by Increment: The point whose name matches the increment you specify (see screen [1] above). Available in **By Points** method only.

  e.g. "ST101" first staked and Increment= 2, then next point will be "ST103".

- Next Point by Closest Point: The point the closest to the one you have just staked (see screen [2] above). If the **By Managed Points** method is used, Survey Pro will search for and prompt the closest **design** point, ignoring all the other types of points. With the **By Points** method, Survey Pro will search for the closest point, regardless of its type (unstaked, staked or undifferentiated).
- Next Point in Order: The next point in the list of managed points. Available in **By Managed Points** method only.

"By Managed Points" Method

- Tap **Stakeout** > **Manage Design Points** (or tap **Stakeout** > **Stake Points** and then tap on the **Manage Design** button).
- All points are necessarily picked from the open job. For more details, see screen and instructions below.



  - **[1]**: Used to select points from the map.
  - **[2]**: Used to select points by specifying a point name (e.g. "ST100") or a range of point names (e.g. "ST200-ST300". Then tap **Add** or the Enter key to add the point or range of points to the list **[6]**.
  - **[3]**: Used to select points using another selection criterion (non-control points, distance, description, code or layer).
  - **[4]**: Indicates the current number of staked and unstaked points.
  - **[5]**: Used to choose which type of points to view in the list (all, unstaked points only, or staked points only)
  - **[6]**: Current list of managed points, according to viewing option **[5]**.
  - **[7]**: Set of seven buttons allowing you to make these changes to the list of managed points:

: Moves the selected point by one position to the top of the list.

: Moves the selected point by one position to the bottom of the list.

: Changes the selected point from staked to unstaked point, or vice versa.

: Changes all points in the list from staked to unstaked points, or vice versa.

: Deletes the selected point from the list (but the point still exists in the job).

: Deletes all points from the list (but the points still exist in the job).

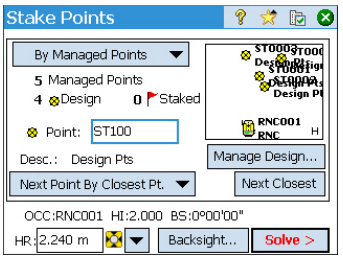
: Reverses the order of the points in the list (e.g. "P1, P2, P3" to "P3, P2, P1").

NOTE: You cannot add the same point twice to the list.

- When the list is complete, tap to save all the changes made to the list. (Tapping would cancel all those changes.) You can then start staking out the first point.

NOTE: The icon of an unstaked point will change from to only if you store the measured position as a new point in the job (which will be assigned a (+) icon).

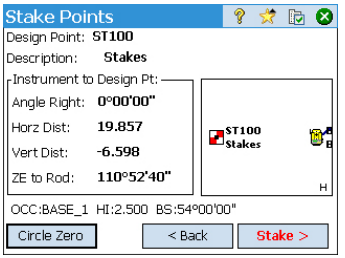
Staking Points With a Mechanical Optical Instrument



- Go to the **Stakeout** menu and tap **Stake Points**.
- Select the point to be staked using one of the two possible methods, as well as the criterion allowing Survey Pro to prompt the next point to be staked (see *Selecting Points to Be Staked, "Next Point" Scenario on page 96*).
- Choose the type of target used and set the height of the rod (**HR** field). The information underneath describes the current station setup.

  (You may use the **Backsight** button to check the station setup or start a new setup.)
- Tap **Solve**. The **Stake Points** screen now indicates the angle and distances the instrument should measure with the target placed exactly over the design point.

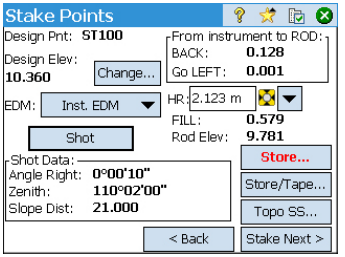
  It may be convenient at this point to change the circle setting so that it reads zero when the total station is facing toward the design point. This can be done by tapping the **Circle Zero** button. The first time you tap this button during a stakeout session, a message will warn that the original backsight reference will be lost.



The following appears when zeroing the circle:

- A new backsight circle value is computed, sent to the instrument and stored in the raw data.
- The **Angle Right** value is changed to zero to reflect the change (see example). **The instrument now needs to be turned horizontally to zero to face the design point**.
- To prevent errors, the backsight setup is invalidated when exiting the **Stakeout** function. You will need to reset your backsight circle to the proper reference after exiting stakeout before collecting any new data.

- Whatever your choice about the circle setting, orient the instrument as requested so the instrument is facing the target.
- Tap **Stake** then **Shot** to take a measurement. The screen returns the results of the measurement, providing information to adjust the position of the target (see screen example):
  - **FORWARD** / **BACK**: Indicates if the rod must move forward (toward the instrument) or backward (away from the instrument).
  - **Go RIGHT** / **Go LEFT**: Indicates if the rod must move to the right or left from the instrument's point of view.

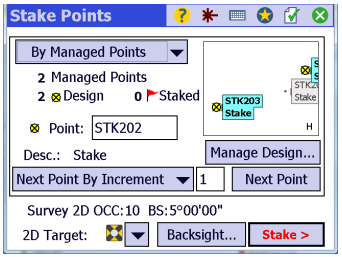


NOTE: You can also get the reverse indication (i.e. displaying directions from the rod's viewpoint) by clearing the **View From Instrument to Rod (non-remote)** option in **Job > Settings > Stakeout** tab.

  - **CUT / FILL**: Displays the required amount of cut or fill to bring the stake point to the design point's elevation.
  - **Rod Elev**: Displays the elevation at the rod's location computed from the last shot.

- When you are satisfied with the location of the target, stake the point and then do one of the following:
  1. Before moving on to the next point, you may want to store the location of the as-staked point: While still standing on the target, tap **Store**, name and describe the point (the default description prompted by Survey Pro is in the form "ST<*name_of_point_you have_just staked*>), then tap ✔ to collect the point. This point will be marked with a + icon.
  2. Or If you wish to stake the next point without storing the results of this staked point, tap **Stake Next**.

Staking Points With a Robotic Optical Instrument



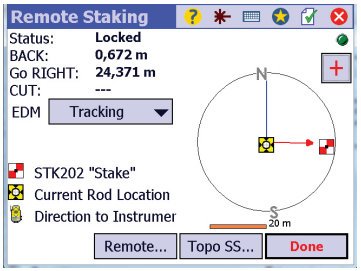
- Go to the **Stakeout** menu and tap **Stake Points**.
- Select the point to be staked using one of the two possible methods, as well as the criterion allowing Survey Pro to prompt the next point to be staked (see *Selecting Points to Be Staked, "Next Point" Scenario on page 96*).
- Choose the type of target used and set the height of the rod (**HR** field). The information underneath describes the current station setup.

  (You may use the **Backsight** button to check the station setup or start a new setup.)
- Tap **Stake**. This opens the **Remote Staking** screen.

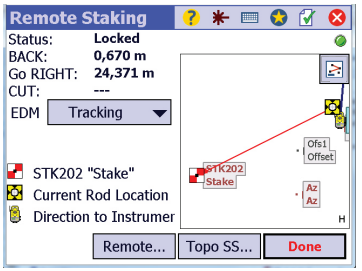
  If the status on that screen indicates that robotic tracking is not locked on, you can tap the **Remote** button to open up the **Remote Control** screen, where you can initiate a search for the target. Then tap ⊗ to close this screen.

  The **Remote Staking** screen (illustrated) will guide you to the design point. Survey Pro offers two different navigation modes to help you walk to the design point:

[1]



[2]



Tap on the button in the upper-right corner to change the navigation mode:

-  : When this button is displayed, the top of the screen shows the direction to the total station (**[1]**).
-  : When this button is displayed, you see a copy of the map view on this screen (**[2]**), including background maps, if any made visible. You may tap within this area to switch to the complete map view.

In both navigation modes, the screen provides information on how far you are from the design point:

- **FORWARD** / **BACK**: Indicates if the rod must move forward (toward the instrument) or backward (away from the instrument).
- **Go RIGHT** / **Go LEFT**: Indicates if the rod must move to the right or left from the rod's point of view. This requires that you have cleared the **View From Instrument to Rod (remote)** option in **Job > Settings > Stakeout** tab,

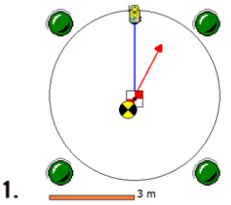
otherwise you will get the reverse indication, i.e. directions from the instrument's viewpoint.

- **CUT / FILL**: Displays the required amount of cut or fill to bring the stake point to the design point's elevation.
- **Rod Elev**: Displays the elevation at the rod's location computed from the last shot.

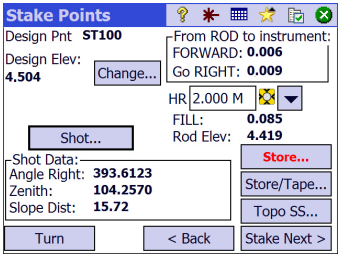
- Walk toward the design point following the instructions on the screen:

Symbol	Meaning
	Design point location.
	Your current location.
	Instrument location.
 10 m	Scale used on the graphic. Represents the circle radius.
FORWARD/BACK: xxx Go LEFT/Go RIGHT: xxx FILL/CUT: xxx	Horizontal and vertical components of the distance still to go.

When you get closer to the design point, the graphic will change to assist you in more precisely locating the design point. The point to stake becomes the fixed center of the display and the rod becomes the object that is moving. This aids in precisely positioning the rod over the point. A red arrow indicates the direction in which to go.



1. Distance to go is between 3.0 and 0.3 m (10 and 1 ft): Four dark-green spots appear around the graphic.
2. Distance to go is less than 0.3 m (1 ft): The spots around the graphic turn light green.



- When you are satisfied with the location of the target, tap **Done** to access the **Stake Points** screen. The screen indicates how close you are to the design point.
- Stake the point and then do one of the following:
  1. Before moving on to the next point, you may want to store the location of the as-staked point: While still standing on the target, tap **Store**, name and describe the point (the default description prompted by Survey Pro is in the form "ST<*name_of_point_you have_just staked*>), then tap ✓ to collect the point. This point will be marked with a + icon.
  2. Or If you wish to stake the next point without storing the results of this staked point, tap **Stake Next**.

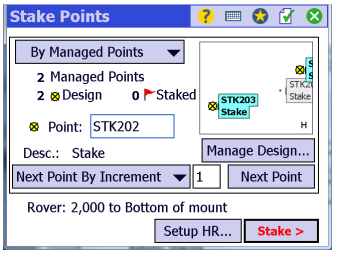
Whatever your choice, you will then be taken back to the **Stake Points** screen with the next point to stake automatically selected, (based on the **Increment** value you entered previously).

NOTE: At this stage, you may:

- Change the elevation of the design point after tapping **Change**.
- Tap the **Turn** button to automatically turn the instrument toward the design point.
- Tap the **Shot** button to re-measure the point.
- Collect a **Topo SS** point using the **Topo SS** button.

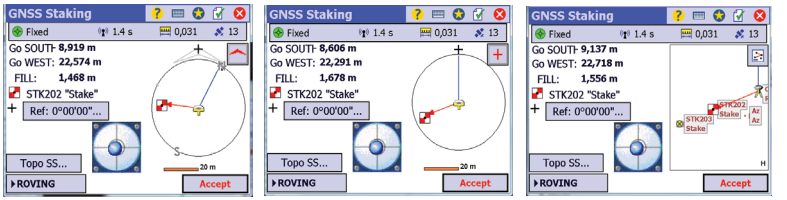
WARNING: Be sure you are using the **Store** button to store stakeout data. The **Topo SS** button only stores sideshot data.

Staking Points With GNSS



- Go to the **Stakeout** menu and tap **Stake Points**
- Select the point to be staked using one of the two possible methods, as well as the criterion allowing Survey Pro to prompt the next point to be staked (see *Selecting Points to Be Staked, "Next Point" Scenario on page 96*)
- Set the rover antenna height.
- Tap **Stake**. This opens the screen that will guide you to the point. Survey Pro offers three different navigation modes to help you walk to the design point (the screenshot examples shown below are those of an SP80 for which an e-level is displayed. Note that not all GNSS receivers have this tool. When no e-level is available, the corresponding area on the screen is left empty).

[1] [2] [3]



NOTE: In the example above, the direction to follow is provided as **Go South / Go West** instructions. Survey Pro can instead provide **Azimuth / Distance** to the point if it's more convenient for you. Go to **Job > Settings > Stakeout** tab to change the setting of the **Display Directions As** field. Point tolerance (different from acceptance criteria) can also be set on this tab.

Tap on the buttons shown in the upper-right corner (/ /) to change the navigation mode:

- : When this button is displayed, the top of the screen shows the direction in which you are walking (**[1]**). A large red arrow will appear as you walk. The North (**N**) and South (**S**) directions will be shown as well. You can also define a reference point or azimuth using the **Ref...** button. The resulting direction will appear as a blue line starting from your current position.
- : When this button is displayed, the top of the screen shows the selected reference point or azimuth you select through the **Ref...** button (**[2]**).
- : When this button is displayed, you see a copy of the map view on this screen (**[3]**), including background maps, if any made visible. You may tap within this area to switch to the complete map view.

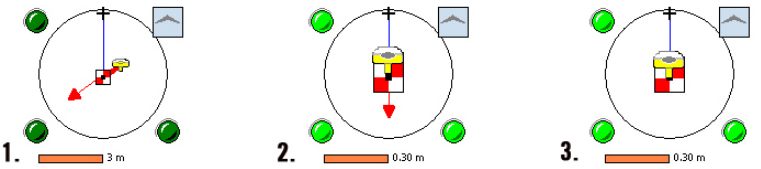
- Walk toward the design point following the instructions on the screen (see table below).

  Remember the rover receiver is always in dynamic mode (**>ROVING** button displayed) as you navigate to the design point:

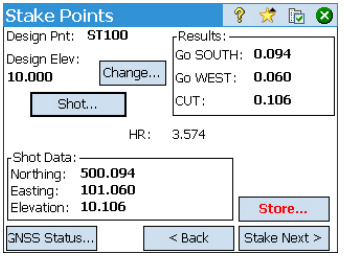
Symbol	Meaning
	Design point location.
	Your current location.
	Reference point or azimuth.
 10 m	Scale used on the graphic. Represents the circle radius.
Go N/S: xxx Go E/W: xxx FILL/CUT: xxx	Horizontal and vertical components of the distance still to go.

NOTE: You can use the **Topo SS** button any time along the way to store any point of interest. Survey Pro will ask you to name and describe that point before storing it.

When you get closer to the design point, the graphic will change to assist you in more precisely locating the design point. The point to stake becomes the fixed center of the display and the rod becomes the object that is moving. This aids in precisely positioning the rod over the point. A red arrow indicates the direction in which to go.



1. Distance to go is between 3.0 and 0.3 m (10 and 1 ft): Dark-green spots appear around the graphic.
2. Distance to go is less than 0.3 m (1 ft): The spots around the graphic turn light green.
3. Your current position is within the acceptance criteria defined on the **Stakeout** tab: The rover and the design point are practically superimposed at the center of the graphic.



- When you have located the design point and you wish to collect a static RTK occupation at this point in order to get a more precise position averaged from multiple epochs, you should toggle to occupying mode by tapping the **>ROVING** button (which is then changed into an **>OCCUPYING** button). This will turn the receiver into static mode for the occupation.
- When you are satisfied with the occupation results, you can tap **Accept** to finish the stakeout measurement. Depending on the acceptance criteria you set on the **Stakeout** tab, the button label may show **Wait xx** before it becomes an **Accept** button. The screen then shows the results of the position computation for the staked point.

NOTE 1: At this stage, you may tap **Shot** to re-measure the point. You may also change the elevation of the design point by tapping **Change**.

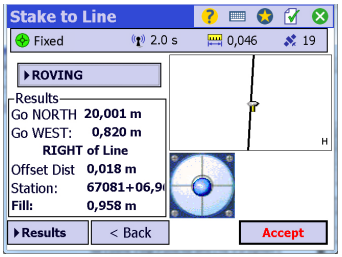
NOTE 2: If you are simultaneously collecting raw data for post-processing, the as-staked point is automatically stored when you tap **Accept** on the previous screen, provided you did a static occupation on the point.

WARNING: Be sure you are using the **Store** button to store stakeout data. The **Topo SS** button only stores sideshot data.

- Stake the point and then do one of the following:
  1. Before moving on to the next point, you may want to store the location of the as-staked point: While still standing on the target, tap **Store**, name and describe the point (the default description prompted by Survey Pro is in the form "ST<*name_of_point_you have_just staked*>), then tap ✔ to collect the point. This point will be marked with a + icon.
  2. Or If you wish to stake the next point without storing the results of this staked point, tap **Stake Next**.

  Whatever your choice, you will then be taken back to the **Stake Points** screen with the next point to stake automatically selected, (based on the **Increment** value you entered previously).

Other Stakeout Routines

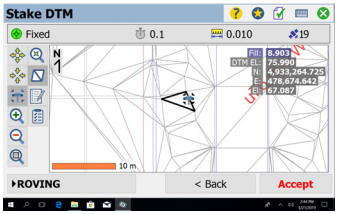


You can use Survey Pro for other stakeout routines:

- **Stake to Line**: Allows you to locate any position in relation to a predefined line. The line can be defined by two points, a point and direction, a polyline or the centerline of an alignment. Distance, direction and cut/fill information is provided so the rod/the rover can locate the line by traveling the shortest possible distance (a perpendicular offset to the line).

  Compared to point stakeout, the guidance screen (illustrated) will be automatically restored after you have stored a point, ready for storing the next point. This routine is often used to keep the rod on-line while clearing line along a property boundary.
- **Offset Staking**: Is used to stake the center of a road, the road edge, the curb/ditch edge, or any offset at fixed intervals. An existing polyline, alignment, or a specified point range can define the centerline of the road.
- **Slope Staking**: Is used to locate the catch points for a roadway in any terrain. The first screen is used to define or select the line that describes the centerline of the road to be slope staked. An existing polyline or alignment can be selected, or a series of existing points can be entered to define the centerline.
- **Point Slope Staking**: Is a simplified version of the **Slope Staking** routine.
- **Stake Skew Line**: is used to stake a usually short straight line (a skew line) intersecting the current polyline at a given point and with a given skew angle (for example this function is useful for staking a culvert going under a road).
- **Line and Offset**, **Curve and Offset** and **Spiral and Offset**: Are used to stake stations at fixed intervals on respectively a line, curve or spiral, or at an offset to it.
- **Show Station**: Allows you to see where the rodman/rover standing anywhere near a polyline, a range of points that define a line, or an alignment is located in relation to the line.
- **Store Offset Points**: Is used to store points in the current job at a specified offset from an existing polyline or alignment at a specified interval.
- **Stake DTM**: Allows you to stake an area and get cut/fill information between the point being staked and a reference DTM surface at the same horizontal coordinates (see chapter 9 in this manual for more detail).
- **Define a Location**: Is used to manually enter the distance and direction to a new point from any existing reference point and then stake out the new point.
- **Where is Next Pt?**: Provides instructions to locate the next point in the job taking into account the current location of the operator (or rodman) and a reference point.
- **Navigation**: Allows you to navigate to existing points using autonomous positions from a GPS receiver that outputs a NMEA signal. The routine also allows you to store coarse-precision GPS points.

9. DTM



Survey Pro allows you to stake DTMs (Digital Terrain Models) imported into Survey Pro. Survey Pro can also be used to create DTMs.

Survey Pro displays a large map view of the DTM so you can easily work from that view. In addition, you may choose which text data you want to view and choose to hide all the DTM triangles for better use of your background maps.

Before you start staking a DTM, you may set a vertical offset to the DTM surface so you can stake sub-grades and super-grades.

Survey Pro also allows you to calculate volumes and export the DTMs you created with the software.

NOTE: All screen shots in this chapter originate from a Ranger 7 data collector and are based on the use of a GNSS instrument. The same can be obtained from an optical instrument.

Importing a DTM File

The supported input formats for DTM data are the following:

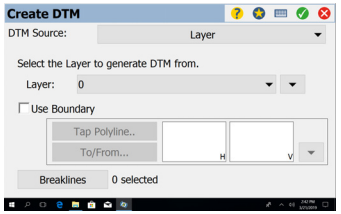
- **LandXML (*.XML)**: A Land XML file may contain more than one DTM surface. When you choose this file format, you will see an additional screen prompting you to select the surfaces from the Land XML file. You can import any or all of the surfaces in the Land XML file, and each one will be loaded as a separate DTM in your Survey Pro job.
- **DXF (*.DXF)**: Because a DXF file does not specify distance units, when you choose this file format you will be prompted to specify the units used in the file. The default choice will always be the current units of your job.
- **DTM (*.DTM)**: TDS/Spectra Foresight DTM format file. Because a DTM file does not specify distance units, when you choose this file format, you will be prompted to specify the units used in the file. The default choice will always be the current units of your job.
- **Trimble TTM (*.TTM)**: Trimble native format for DTM data.

To import a DTM file into the open job:

- From the main menu, select **DTM** then **Manage DTMs**.
- Tap on the **Import** button then select the type of file format you wish to import.
- Browse to the folder where the DTM file is stored, select the desired file, then tap .

NOTE: Imported DTMs cannot be edited in Survey Pro.

Creating a DTM

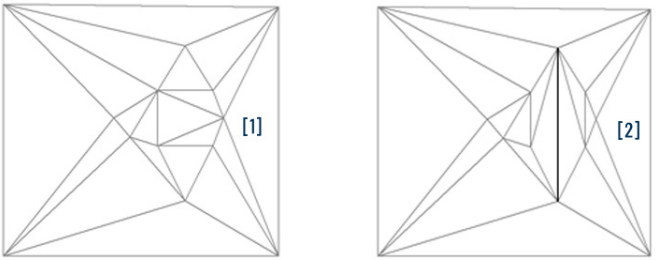


With Survey Pro, you can create a DTM from the points present in the open job. The DTM source can either be a layer or it can be individually selected points. In the latter case, there are multiple ways to select those points.

There are two optional ways to modify a DTM surface that you have created:

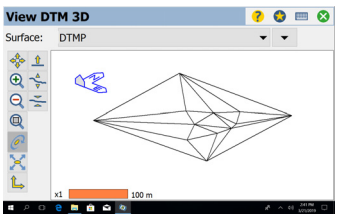
- Select a closed polyline as a *boundary* to the DTM. The boundary will include all the selected points in the interior and exclude all points outside the boundary when creating the DTM.
- Select one or more polylines used as *breaklines* to force TIN nodes at the breaklines (TIN: *Triangulated Irregular Network*).

  The illustration below shows how a breakline affects the TIN. [1]: without breakline, [2]: with breakline (no triangles cross the breakline).

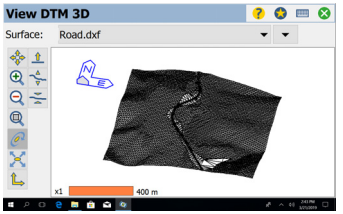


To create a DTM in the open job:

- From the main menu, select **DTM** then **Manage DTMs**.
- Tap on the **Create** button then select the source of your DTM (**Layer** or **Points**):
  - If the selected source is **Layer**, use the **Layer** scroll-down list to select the name of that layer. A boundary can be used to exclude some of the points on the layer if desired.
  - If the selected source is **Points**, use the **Manage Points** button to select all the points that should be part of the DTM.
- Enable the **Use Boundary** check box if you wish to define a boundary for the DTM, otherwise keep it disabled.
  If enabled, using the **Tap Polyline** button allows you to select a closed polyline created beforehand. Using the **To/From...** button allows you to create this closed polyline.
- If necessary, use the **Breaklines** button to add one or more polylines used as breaklines.
- Tap ✓, name the DTM and then tap ✓ again. You may use the **View DTM 2D** or **View DTM 3D** button to view the resulting DTM (see example on the left).



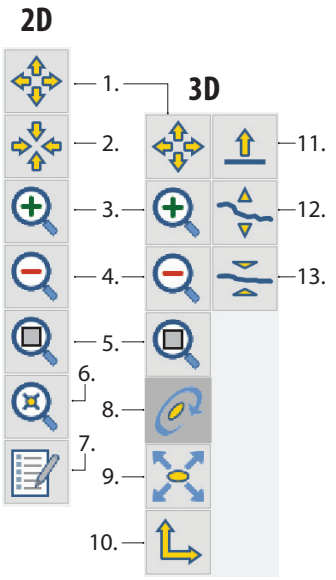
Viewing a DTM



To view a DTM found in the open job:

- From the main menu, select **DTM** then **Manage DTMs**.
- Select the DTM you wish to view then tap **View DTM 2D** or **View DTM 3D** to respectively visualize the DTM in two (2D) or three dimensions (3D). For a 2D view, tap on the DTM view once again to open the DTM preview and access the palette of buttons (on the left).

  Depending on whether you choose 2D or 3D, the palette is different as illustrated and explained below.



1. Sets the zoom level so that the entire job can be seen.
2. Sets the zoom level so that the active DTM can best be seen on the screen.
3. Zooms the map view in by one step after each click.
4. Zooms the map view out by one step after each click.
5. Allows you to drag a box across the screen. When your finger or stylus leaves the screen, the map will zoom to the box that was drawn.
6. Zooms to a point you specify. The whole map is then moved in such a way that the chosen point occupies the center of the screen.
7. Opens a window allowing you to change the map display options. These include showing/hiding point/line names, codes, elevations, etc. and giving access to grid lines, DTM list, layers list and basemaps list.
8. Allows you to change the 3D viewing angle. The changing icon below appears at the same time so you can adjust this angle by referring to the orientation of the three axes (Northing, Easting, Elevation):

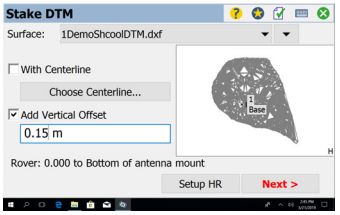
9. Allows you to drag the view in any direction without changing the 3D viewing angle.
10. Resets the view to a direct, overhead plan view.
11. Resets the view to side-on profile view. This viewing angle is perfect for identifying elevation spikes in the surface. The previous icon then looks like this: 
12. Increases the vertical exaggeration of the 3D view. The resulting magnifying ratio is indicated before the map scale value.
13. Decreases the vertical exaggeration of the 3D view. The resulting magnifying ratio is indicated before the map scale value.

NOTE: In 3D view, when seen from below, triangles are shaded.

Staking a DTM

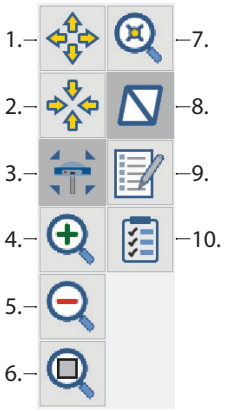
To stake a DTM:

- From the main menu, select **DTM** then **Stake DTM**.
- Select the desired DTM from the **Surface** drop-down list.
- Make the following additional settings:
  - **With Centerline**: If you wish to see station and offset data, enable this option and then tap **Choose Centerline** to specify this polyline. It is assumed this polyline has been created beforehand in the job. When you use a centerline, the following distances are computed: **Station** and **Offset Left/Right**.
  - **Add Vertical Offset**: If you wish to modify the elevation of the surface by a constant amount, enable this option and then enter a value in the text box underneath.



- Tap **Next>**.

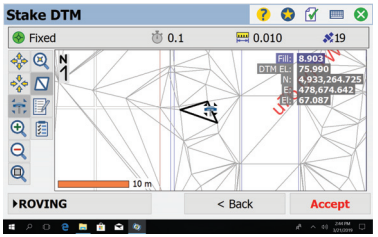
  While measuring on the DTM surface, you can use the palette of buttons on the left to change the view of the DTM:



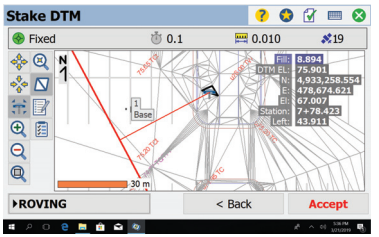
1. Sets the zoom level so that the entire job can be seen.
2. Sets the zoom level so that the active DTM can best be seen on the screen.
3. Activates the **Follow me** mode, which re-centers the map around the pole (or rod) location when the pole (or rod) gets too close to the edge of the map screen. The map is not constantly re-centered but only when required to keep the pole (or rod) on the screen.
4. Zooms the map view in by one step after each click.
5. Zooms the map view out by one step after each click.
6. Allows you to drag a box across the screen. When your finger or stylus leaves the screen, the map will zoom to the box that was drawn.
7. Zooms to a point you specify. The whole map is then moved in such a way that the chosen point occupies the center of the screen.
8. Shows or hides the DTM triangles.
9. Opens a window allowing you to change the map display options. These include showing/hiding point/line names, codes, elevations, etc. and giving access to grid lines, DTM list, layers list and basemaps list.
10. Opens a window allowing you to choose and order the data you wish to display on the map view (current values of **Cut/Fill**, **DTM EL**, **Northing**, **Easting**, **Elevation**, **Station**, **Offset Left/Right**). With an optical instrument, these parameters are also computed: **Horizontal Angle**, **Zenith Angle**, **Slope Distance**, **Horizontal Distance** and **Vertical Distance**. Use the up and down vertical arrows to move up or down the selected data within the list.

- On each position you occupy on the DTM surface, you can see that the corresponding triangle (TIN) has a bold contour (see [1] below). The **Station** and **Offset Right/Left** distances will also be computed if you are using a centerline (see [2] below).

[1]



[2]



- When required, you may log the position of any point by tapping **Accept** (or **Store** with an optical instrument).

Calculating DTM Volumes

Survey Pro allows you to compute the quantities of cut and fill and the resulting total volume between a DTM surface and a reference elevation, or datum, or between two DTM surfaces that you specify.

To make these computations:

- From the main menu, select **DTM** then **Calc DTM Volumes**.
- Use the first **Surface** field to select the DTM you want to compare to a reference.
- Select the reference, either a datum (i.e. a flat plane) defined as the elevation of a point you select, or a second DTM (tap **Compare to DTM** and select the second DTM from the second **Surface** field).
- Tap **Solve**. The results are provided automatically on the **Result.** tab.

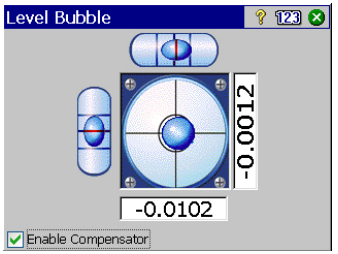
Exporting a DTM

The unique export format is LandXML (*.XML).

Assuming a DTM was created in the open job, do the following to export the DTM:

- From the main menu, select **DTM** then **Manage DTMs**.
- Select the surface from the list that you want to export.
- Tap on the **Export DTM** button.
- Browse to the folder where the exported file should be stored then tap .

10. Survey Pro's On-Board Version



Survey Pro is used on board a Nikon Nivo or Spectra Precision FOCUS total station. After you have powered on the instrument, wait until the screen displays the desktop. Then do the following:

- Double-tap the Survey Pro icon: . Survey Pro starts initializing the instrument. The Level Bubble screen is then shown (see screen example).
- Level the instrument and enable or disable the compensator, as required.
- Tap when done. This opens the **Quick Shot** screen.

You may take measurements with Survey Pro without opening a job. You may also create or open a job where you can collect all your measurements and/or use as reference other measurements you collected earlier in that job.

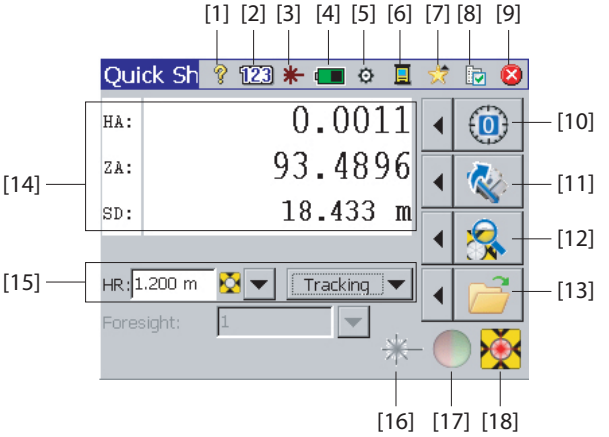
NOTE: The onboard version of Survey Pro will always start with no job open regardless of whether you ended your last Survey Pro session with a job open or not.

Working With No Job Open

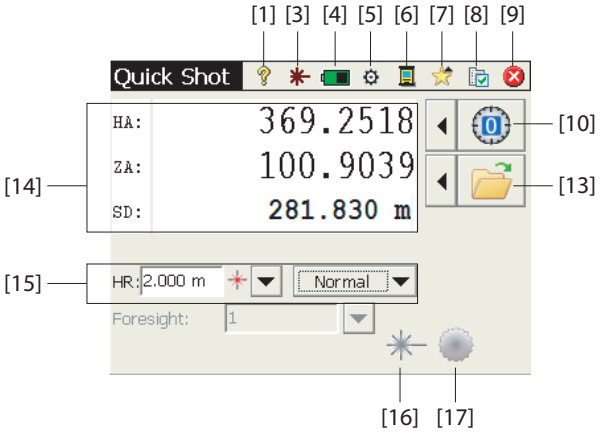
The **Quick Shot** screen you get at startup can be split into different parts:

- Command bar (**[1]** to **[9]**)
- Function buttons (**[10]** to **[13]**)
- Result pane (**[14]**)
- Target management and EDM measurement mode (**[15]**)
- Other control buttons (**[16]** to **[18]**).

Robotic Instrument:



Mechanical Instrument:



Command bar:

- **[1]**: Provides access to Online Help.
- **[2]**: (Robotic instrument only) Denotes keyboard used in numeric mode.
- **[3]**: Provides status of visible laser pointer:
  - : Off. Tapping this icon will toggle it On.

    NOTE: Standard safety precautions should be taken to ensure that persons do not look directly into the beam.

  - : On. Tapping this icon will toggle it Off.

  For safety reasons, this button is always accessible so that at all times you can easily disable the laser pointer whatever the screen you are on.
- **[4]**: Battery status. This icon provides access to the power off setting through which you can set an idle time at the end of which the instrument will be turned off automatically.
- **[5]**: Provides access to the instrument settings (specific to each instrument).
- **[6]**: This icon allows you to switch to another data collection mode (using a data collector through a serial cable, Bluetooth or in Robotic mode).
- **[7]**: Quick Pick function: Provides quick access to common Survey Pro functions. **About** and **Level Bubble** are the only two selections available unless a job is open. After a job is opened, the list will populate with available functions.

- **[8]**: Provides access to Survey Pro settings:
  - **Units** tab: Used to set distance and angle units, directions, azimuth type and the order in which to display/deliver coordinates.
  - **Format** tab: Used to set the number of decimal places displayed by the instrument for each type of measurement.
  - **Quick Shot** tab: Used to choose which results to display (HA, ZA, SD or HA, HD, VD) and which function to assign to the Measurement key (**Measure Only** or **Measure and Store**). **Measure and Store** requires an open job. See *Working With a Job Open on page 116*.)
- **[9]**: Used to exit.

Function buttons:

(More functions are available from these buttons with a job open. See *Working With a Job Open on page 116*.)

The left-arrow button located before each function button opens a related menu. Tapping directly on the function button is equivalent to selecting the first option on the menu.

- **[10]**: Sets the circle to 0 or to any value you specify.
- **[11]**: (Robotic instrument only) Turns to angles you specify, or to flip the instrument.
- **[12]**: (Robotic instrument only) Starts the search target or LockNGo function or stops the one you last activated.
- **[13]**: Opens or creates a job where measurements will be stored.

Result pane:

(Item **[14]**) on the screen example.)

Depending on how you set the **Display** field on the **Quick Shot** tab (see **[8]** above), this pane will either provide the measured values of:

- Horizontal angle (HA), zenith angle (ZA) and slope distance (SD)
- Or horizontal angle (HA), horizontal distance (HD) and vertical distance (VD).

Tapping on the display over these labels will also toggle between the display modes.

Target management:

(Item **[15]**) on the screen example.)

- **HR** field: Enter the height of rod for the selected target
-  /  button: Specify the type of target used. Also provides access to the management of smart targets.
- Choose the EDM measurement mode. This is an instrument-dependent setting but these are the usual available options:
  - **Standard**: (Focus 30) Precise measurement mode, activated only when you trigger a measurement
  - **Tracking**: (Focus 30) EDM continuously measuring distances
  - **Normal**: (Nivo) Normal measurement mode
  - **Precise**: (Nivo) Precise measurement mode

Other control buttons:

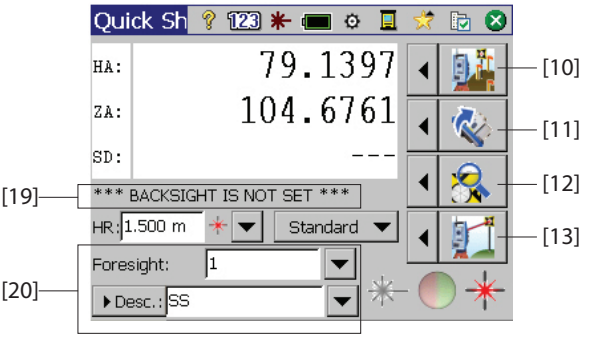
- **[16]**: A button equivalent to and bigger than button [3].
- **[17]**: Turns on or off the instrument's track light. The track light is for helping the rodman stay online when staking. It will flash more quickly when the instrument is locked to the target.

  The track light is instrument dependent. For example, the Focus 30 has two different colors (green and red) located on either side of the instrument. Nivo has two red colors, one that flashes and the other that doesn't.
- **[18]**: Instrument dependent. Shows LockNGo status (IDLE, MEASURING or Locked). Also shows if the current measuring mode uses a prism or reflectorless target.

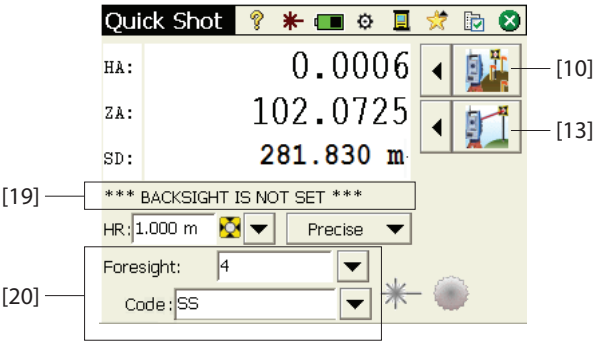
Working With a Job Open

If you open or create a job using button **[13]**, the **Quick Shot** screen will then show different options.

Robotic Instrument:



Mechanical Instrument:



The differences are listed below:

- **[10]**: With a job open, the **Quick Stake** screen can be accessed through this button. The **Stakeout**, **Station Setup** and **Check Setup** functions can be accessed by clicking on the arrow to the left of this button.
- **[11]** and [12]: Same as with no job open.
- **[13]**: With a job open, a sideshot can be taken and stored by pressing this button. The **Sideshot** and **Traverse** functions can be accessed by clicking on the arrow to the left of this button.
- **[19]**: The current station setup status is reported in this area.
- **[20]**: Use this area to name and describe each point you will be measuring and storing in the job. Make sure **MSR Key**= **Measure and Store** on the **Quick**

Shot tab if you plan to store measurement data (see **[8]** described earlier in this section).

With a job open, you can perform a lot of the most commonly used functions from the **Quick Shot** screen. To access the full set of Survey Pro functions, you can close the **Quick Shot** screen and access the Survey Pro main menu. Survey Pro can be used either in optical or leveling mode.

NOTE: To access the **Quick Shot** screen at any time, simply press the "star"/F1 hard key on the instrument.

Point Properties

If you take a look at the points present in your job (go to the main menu, then select **Job** > **Points**), you will see that each point is defined with the following parameters:

- **Point** (Point name)
- **Description**. More details in next section.
- **Code(s)**. More details on *page 120*.
- **Coordinates** (Northing, Easting, Elevation or Latitude, Longitude, Height, depending on the coordinate system defined for the job).
- **Layer**. More details on *page 122*.
- **Control** ("Yes" if the point was defined as a control point, "No" if not). This parameter is read-only.

At any time, from within this function, you can edit any of the listed points to modify one or more of these parameters.

Conversely, when collecting points in the field, the interface will never show the **Description** and **Code(s)** parameters at the same time, but only one of them, i.e. the one that beforehand, you will have chosen to display. To make that choice, go to the Home screen and select **Settings**> **Coding** and then set the **Code or Desc** field accordingly.

On the other hand, you may ask to be prompted for these parameters (+ the **Layer** parameter) JUST BEFORE Survey Pro actually stores the point. To configure Survey Pro to operate that way, go to **Job** > **Settings** and then open the **Surveying** tab. Check the options corresponding to the parameters you would like to key in just before the point is stored. On the **Surveying** tab, these options are:

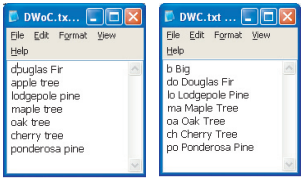
- **Prompt for Description**
- **Prompt for Code and Attributes**
- **Prompt for Layer**.

Descriptions

A description may be defined for each point you store in a job (e.g. tree, pavement). You can create a description list to automate the task of entering descriptions for points when they are stored. This is particularly useful when the same description is used frequently.

A description list is stored in Survey Pro as a description file (a TXT file you store in /Survey Pro Jobs/ for example), which may be in two different formats. Choosing one rather than the other determines how descriptions are entered:

[1] [2]



- **Description list without abbreviations [1]**: Only contains the list of descriptions you want to use.
- **Description list with abbreviations [2]**: Similar to the previous one except an abbreviation precedes each description (with a space or tab in between).

Go to **Job**> **Settings**> **Coding** to choose how you want to work with descriptions. Further down on this tab, you will find the following parameters that you can set at your convenience:

- **Use Description Shortcuts File**: Activate this parameter to use a description file that contains description shortcut abbreviations and click the associated **Browse** button to navigate to and select the file.

  Description Shortcuts files contain one shortcut/description pair per line where the shortcut and description are separated by a space or a tab. (The shortcut cannot contain spaces.)
- **Use Description List File**: Activate this parameter to use a description file containing a list of descriptions without abbreviations – one description per line and click the associated **Browse** button to navigate to and select the file.
- **Load Description List from Job File**: Activating this parameter results in descriptions used in the current job, as well as any new descriptions entered, to be included in the description list.
- **Add New Descriptions to Description List**: Activating this parameter results in only new descriptions entered since marking this box to be included in the description list. (If the preceding parameter is activated, new descriptions are added whether or not this parameter is marked.)
- **Show Suggestion List Automatically**: Activating this parameter results in a drop-down list of descriptions displayed as soon as text is entered into a **Description:** field. If this parameter is disabled, the list can be displayed by selecting **Suggestion List** using the power button associated with a **Description** field.

Codes

Codes can be used to quickly describe objects (points, lines), and in more detail than a standard text description, particularly when data is collected for several points that fit into the same object (e.g. a line).

Lists of codes are usually pre-defined and saved in xml format (file with fxl extension) for direct use in Survey Pro.

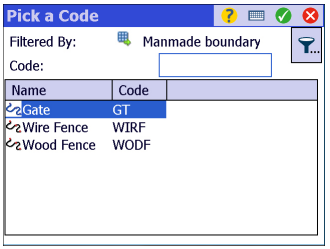
Go to **Job**> **Settings**> **Coding** to choose how you want to work with codes. Further down on this tab, you will find the following parameters that you can set at your convenience:

- **Use Code Definition File**: Activate this parameter to use a feature code file (*.FXL) with the current job. FXL files can be created and customized with Spectra's Feature Definition Manager software. When this parameter is activated, tap the **Browse** button to select an FXL file.
- **Show Suggestion List automatically**: Activating this parameter results in a drop-down list of codes displayed as soon as text is entered into a **Code:** field. If this parameter is disabled, the list can be displayed by selecting **Suggestion List** using the power button associated with a **Code** field. Double-clicking a code in the list will replace the entered text with the selected code.

Adding a Code to either the Traverse/Sideshot Screen or GNSS Data Collection screen:

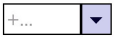
On either of these screens, if you start typing text in the **Code:** field and the **Show Suggestion List automatically** parameter has been activated beforehand, then Survey Pro will automatically display a list of matching codes from the FXL file, compatible with the first letter or letters you have just entered, thus making it quicker to choose the code you want to associate with the measurement you are about to do.

If the **Show Suggestion List automatically** parameter has been deactivated, then no list of recently used codes will be prompted but tapping will give access to the following:



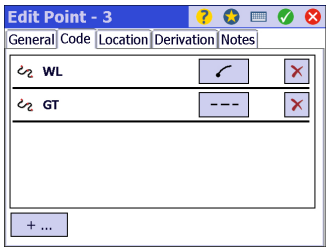
- {List of the most recently used codes}: You may select one from the list if it's the one you are looking for.
- **Pick Code**: Allows you to select a code that has not been used yet in the job. When selecting this option, a new screen is displayed that shows the complete list of codes stored in the selected FXL file. Both abbreviation and plain definition are shown for each code. Select a row from the list and then tap . Survey Pro will then come back to the previous screen. In the **Code:** field, you will see the abbreviation corresponding to the selected code. Note that the list of codes may be first sorted out by code group before selecting a code. This is done using the button and then selecting a code group.

- **Add/Edit Code**: Allows you to associate several codes to the point you are about to measure. In addition, for each code you choose, you can edit the workline command assigned to it. When several codes are selected, the **Code:** field looks like this:



- **Suggestion List**: Same as **Pick Code** above except that Survey Pro still shows the same screen and the list of codes is shown in a drop-down menu attached to the **Code:** field.

Associating a linework command to a code: Most of the codes may be completed with a workline command more accurately defining what the concerned point represents in your job. Below is the list of the available commands:



Command	Command Name
ST	StartLine
END	EndLine
STA	StartTangentArc
ETA	EndTangentArc
SNTA	StartNonTangentArc
ENTA	EndNonTangentArc
IG	DoNotJoinLine
JPT	JointToPointNumber
CL	CloseLine
SSC	StartSmoothCurve
ESC	EndSmoothCurve
SR	StartRectangle
SCC	StartCircleCenter
SCE	StartCircleEdge
H	HorizontalOffset
V	VerticalOffset

(These commands can be customized using the Feature Definition Manager installed with Survey Office.)

To add a linework command, do the following after you have added/edited a code using the **Add/Edit Code** option in the drop-down menu attached to the **Code:** field:

- Tap 

in the corresponding line to open the list of commands.
- Select one and tap . The line then shows an icon specific to, and representative of the command you have just selected (see screen example).

Layers

Layers help you manage the data in a job. Any number of layers can exist in a job and any new objects (points, polyline, alignments) can be assigned to any particular layer.

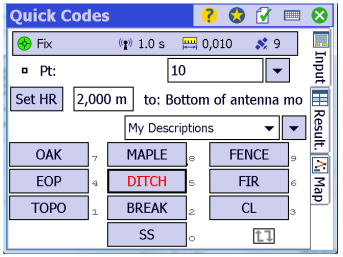
The visibility of any layer can be toggled on and off, which gives full control over the data that is displayed in a map view. This is useful to reduce clutter in a job that contains several objects.

Layers can be added, deleted and renamed with the exception of Layer 0 and the Control Layer. Layer 0 is a special layer that must exist in every job for compatibility with AutoCAD and for storing objects not assigned to any other layer. The Control layer is a special layer used by Survey Pro to denote control points in the job. Control points are protected and cannot be modified.

Use the Power button located near the **Layer** field to manage your layers. Use the **Set Active** button on the Manage Layers screen to set the default layer used in your measurements.

Quick Codes Function

The Quick Codes function is available in both Optical and GNSS Surveying. It is particularly useful when you have to collect a series of points for which you anticipate that a different description or code will have to be defined for each new point you collect.



- To access the function, go to the main menu and tap **Survey** > **Quick Codes**.

  The Quick Codes function allows you to quickly choose a description or code from the displayed set of up to 10 descriptions or codes. Whether Survey Pro shows a set of codes or descriptions depends on the selection you've made in **Job** > **Settings** > **Coding**.

  By default, Survey Pro only contains a single set of descriptions or codes but, using the big scroll-down button next to the displayed set, you may create new sets with more of your own descriptions or codes. Using the same scroll-down button, you may also rename or delete an existing set.

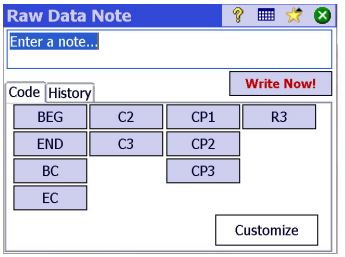
  When several sets exist in Survey Pro, use the scroll-down list to select the set from which to pick a description or code.

- To toggle between **Descriptions** and **Codes**, go back to **Job** > **Settings** > **Coding** and change the selection in the **Code or Desc.** field.
- To define or change the description or code attached to a cell, tap and hold the cell until Survey Pro shows a new screen allowing you to define or change the Description or Code. An empty cell means the cell has no Description or Code attached to it.
- To store a point with a Description or Code, enter the point name and then tap on the cell holding the Description or Code you wish to assign to the point. Alternately you can press on the corresponding numeric key (0 to 9) on

the keyboard (there is a number shown to the right of each cell indicating which numeric key to press to select the Description or Code held by that cell). The point is then stored right away.

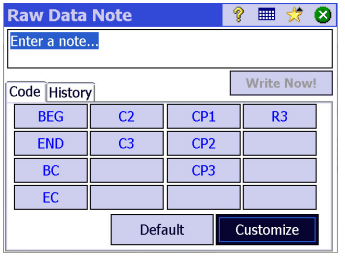
Notes

Survey Pro lets you attach one or more notes to each of your points so you can freely add any comment you will find useful to better describe them. Once created, a note CANNOT be deleted.
While modifying a point, do the following to add a note:



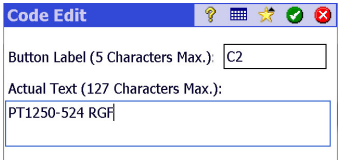
- Tap on the **Notes** tab.
- Tap on the **Add Note** button.
- Tap your note in the upper edit field.
- When finished, tap **Write Now!** to validate the note.
- Tap ✔ to return to the **Notes** tab. The new note appears at the bottom of the list. The note header shows the date and time when the note was created.

Survey Pro allows you to customize the note editor so you can enter your notes more quickly. Up to16 buttons are made available for this purpose. Through each of them, you can preset up to 127 characters of text and/or numerals, The label of each button (5 characters max., also editable). should reflect the character string held by the button.



While creating or modifying a point, do the following to customize a button:

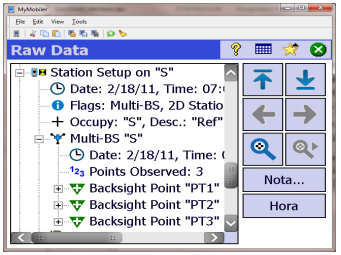
- Tap on the **Notes** tab.
- Tap on the **Add Note** button.
- Tap **Customize**.
- Tap on the button you want to customize (for example "C2"). This opens the **Code Edit** screen on which you can define a new character string for the button. You can also change the label if appropriate.



- Tap ✔ to validate the new button definition and return to the previous screen.
- Tap **Customize** again to end the button definition sequence.
- If you now tap the button you have just defined, this will preset the edit field with the new text held by the button. You may complete or modify this text if necessary before tapping **Write Now!** to validate your entry.
- As previously, tap ✔ to return to the **Notes** tab.

Note the presence of the **History** tab, which you can use to list all the notes you have entered previously. These can be listed either in alphabetical order, from the most recent to the oldest, or from the most to the least frequently used.

Raw Data Viewer



The Raw Data Viewer lists every action performed in the current job since it was created. The reported actions are always listed from the oldest (top of the list) to the most recent one (bottom of the list).

By default, each action is represented in one line but you can extend the line by tapping on the "+" sign to read more details on this action. Conversely, you can collapse the line by tapping the "–" sign

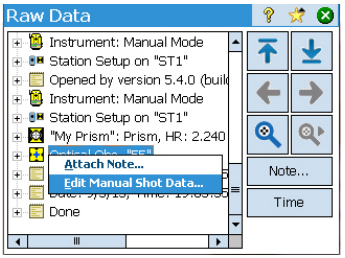
When you open the Raw Data Viewer from **Job** > **View/Edit Raw Data**, the last action will be highlighted. If you access the Raw Data Viewer while you are editing a point (i.e. by tapping **View Raw** on the **Derivation** tab), the viewer will spot the action the point originates from (manual entry, measured point, imported point, etc.).

Raw Data Viewer Toolbox

The Raw Data Viewer is fitted with a toolbox that you can use as explained below.

Icon	Function
	Takes you to the first action logged in the job.
	Takes you to the last action logged in the job.
	Takes you back to the previous action you highlighted in the list of actions.
	Valid only after you have used the left-arrow button just above. Allows you to scroll back through the different actions you went through previously with the left-arrow button.
	Opens the "Find Point" function where you can define a search criterion (point name).
	Valid only after the Find Point function has been set. Takes you to the next occurrence of the point name in the list.
Note...	Allows you to add a note as a new entry at the bottom of the list of actions. Adding a note in this case is done in the same way as when adding one for a point.
Time	Instantly adds the current date & time in a new line at the bottom of the list of actions.

Editing Manual Shots



All manual shots performed in traverse/sideshot, repetition shots or leveling (single- or three-wire) may be edited from within the Raw Data Viewer:

- In the Raw/Data Viewer, tap and hold the stylus on the desired observation and select **Edit Manual Shot Data**. This opens the **Enter Shot Data** window showing the measurements currently stored for this observation.
- Correct the measurements as desired and then tap ✔.

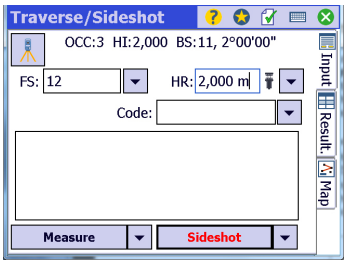
  Following this action, the observation is automatically updated with the measurements you have just modified and all the points affected by this change are re-calculated as well.

Managing Smart Targets

In earlier versions of Survey Pro, there was a separate list for backsight and foresight targets. From Survey Pro 5.2, there is now a single list of optical targets, so you can choose to take an observation to any target from any measurement routine.

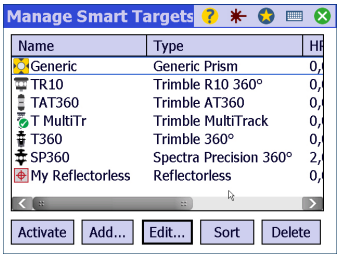
This enhancement makes certain routines, such as repetition, multiple sideshots and shoot from two ends, much easier to use.

With all optical targets now managed from a single list of targets, you will notice some changes to the way "height of target" edit fields are handled in the case where you have a fixed backsight target defined in the station setup: When you choose your fixed backsight target as the target for the current observation, the edit field disappears and the height of the fixed backsight target is shown in static text next to the smart target selector. This prevents you from changing the height of the fixed backsight target.



When you upgrade to Survey Pro 5.2 or higher, you will notice that all of your optical targets are now merged into a single target selection list. There is no longer a separate list of backsight and foresight targets.

To make sure you select the target you are actually using, Survey Pro shows an icon that clearly identifies its type. Below are examples of targets and the way Survey Pro represents them on the Traverse/Sideshot screen.

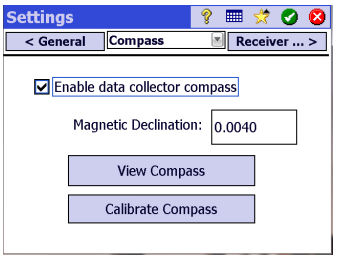


Icon	Target type	Icon	Target Type	Icon	Target Type
	Generic		Trimble AT360		Trimble MultiTrack
	Reflectorless		Trimble R10 360°		
	Trimble 360°		Spectra Geospatial 360°		

In the list of existing targets, the currently active one is shown with a green tick over it (e.g. Trimble MultiTrack).

Electronic Compass

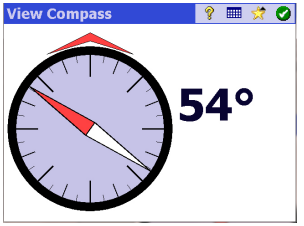
Survey Pro can integrate the use of an electronic compass if the model of data collector you are using if fitted with one.



Setting the Electronic Compass

Go to **Job** > **Settings**. If your data collector is fitted with a built-in electronic compass, a **Compass** tab can be selected from the **Settings** screen. Open this tab. Different functions can be performed from this tab:

- Check or clear the **Enable data collector compass** box to respectively enable or disable the use of the electronic compass in Survey Pro.
- Enter the magnetic declination (in degrees and fractions of a degree)
- If the compass is active, view the compass reading:



- Calibrate the compass. The calibration procedure is specific to the model of data collector used. Usually however, you are requested to rotate the data collector in the vertical and/or horizontal plane. The data collector will provide the necessary instructions on the screen as you progress, until the procedure is complete.

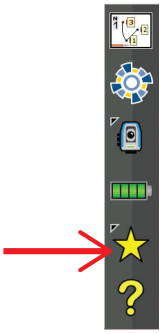
Using the Electronic Compass

Once running and if properly calibrated, the electronic compass will assist you in the following ways while using Survey Pro:

- The current value of heading will continuously be displayed in the upper-left corner of the active map (e.g. **Compass Heading**: 111°)
- In optical stakeout, North and south indicators will be placed on the compass screen.
- In GNSS stakeout, for which these indications already exist without an electronic compass running, the heading value given by the compass being more accurate than the one provided by the GNSS –especially when the rover is stationary or moving slowly– the N/S indicators shown on the stakeout screen are those derived from the electronic compass, and not from the GNSS.

While staking out a point with the electronic compass active, the  button on the stakeout screen gives access to the compass settings as well.

Quick Pick



This tool provides a shortcut to preset Survey Pro functions/routines. When you tap on the yellow star, you have direct access to a list of Survey Pro functions (the *Quick Pick* list). Just tap on one of the items in that list to run the corresponding function.

A list of functions is defined by default, picked from the different Survey Pro menus. You can customize the list by selecting **Edit Quick Pick** at the bottom of the Quick Pick list. This opens the quick pick editor (**Quick Pick Editor**).

In the right-hand pane, you can read the currently active shortcuts (i.e. the Survey Pro functions listed when tapping on the yellow star). In the left-hand pane, you can read the list of available functions per menu. Use the **Menu Items** field to select the menu you want to pick functions from. In this list, the functions already defined as shortcuts in the Quick Pick list are shown in bold characters.

For example, you want to add **View Report** in the Quick Pick list:

- Select **Job** from the **Menu Items** field.
- Scroll down the list of functions available from that menu until you can select **View Report** in the list.
- Tap on the **Add -->** button. The **View Report** function is added at the bottom of the Quick Pick list. It can now be run directly from this list.
- Tap ✓ to save your changes and close the quick pick editor.

Other buttons are available in the **quick pick editor**:

- **<-- Remove**: Use this button to remove the function selected in the right-hand pane from the Quick Pick list.
- **Defaults**: Use this button to revert to the default Quick Pick list. Confirmation is required before the default Quick Pick is restored.
- **Move Up** / **Move Down**: Use this button to rearrange your Quick Pick list. The selected function is respectively moved by one position, up or down respectively.

RTX Correction Service

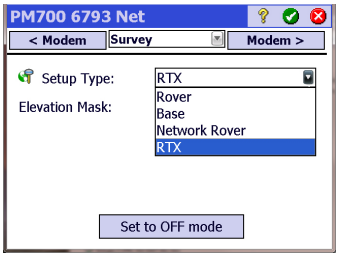
RTX™ (for Real Time eXtended) is a Trimble worldwide service delivering corrections to RTX-enabled GNSS receivers allowing them to compute centimeter-accurate positions without the need to work from a particular base.

With Survey Pro, RTX corrections are delivered via the Internet. With the offered service (*CenterPoint*™ RTX), accuracy is 3.8 cm after 30 minutes of convergence time[1] (accuracy is 30 cm after 10 minutes, 20 cm after 15 minutes).

RTX supports GPS, GLONASS, QZSS and BeiDou constellations.

NOTE: RTX corrections will be received only if your data collector is connected to the Internet.

Using an RTX-enabled GNSS receiver with Survey Pro:



- In Survey Pro, select **Manage Instruments** from the GNSS icon in the command bar, and then tap on **Add Receiver Profile**.
- Scan for an RTX-enabled GNSS receiver through Bluetooth. Wait until the scan is complete.
- Select the receiver from the list of Bluetooth-detected receivers, tap **Next>**, choose a "network type" profile for this receiver and then tap **Finish**.
- In the **Receiver Profiles** list, select the newly added receiver and tap .
- Select "**RTX**" from the **Setup Type** scroll-down list and tap
- Go back to the **Survey** menu and tap **Start Survey**.
- Select the receiver from the list of receiver profiles and tap **Connect** directly (you don't need to specify the network from which RTX corrections are delivered).

  Survey Pro then tests the RTX service subscription validity. If you have 10 or less days left, a warning message will pop up prompting you to take the necessary steps to renew the subscription. If the subscription has expired, another message will show up reporting this situation and the receiver will not be allowed to proceed.

  If the subscription is still valid, the message "**Waiting for RTX engine to initialize...**"is displayed. This initialization step may take a while. In the meantime, you can set the antenna (model, height value, height type) and possibly start raw data recording for further post-processing (see in the lower part of the screen).

NOTE: A message will be reported if initialization fails, prompting you to try again.

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1. The convergence time is the time required before the expected, nominal accuracy is achieved for the delivered RTX positions.

After the RTX engine has initialized, the message "**Waiting for position to converge**" is displayed (this step usually takes more time than RTX engine initialization). When the position has converged, the message "**Rover receiver is ready to set. Press [Finish] to continue**".

- Tap **Finish**. You can now start collecting data.

NOTE: Convergence is achieved when the computed HRMS has been less than the requested value for five epochs in a row. The requested value of HRMS is the one specified on the **RTX** tab in **Job** >**Settings**>**Meas. Mode**.

If the **HRMS** box is left unchecked, Survey Pro will use a default value of 5 cm for the HRMS to decide on whether the position has converged or not.

Using the Quick Start Button to Reduce Convergence Time

While waiting for the position to converge, you may – with some GNSS receivers only – speed up the process by using the Quick Start procedure:

- Make sure the antenna height is set at the right value.
- Tap on the **Quick Start** button.
- Pick a point from the job where to start initialization (the location of this point in the field must be visible). Its coordinates must be geodetic ones (in ITRF2008 epoch 2005.0).
- Move your receiver in the field to the selected point and keep it motionless right over this point.
- Tap on the **Start** button. This button is changed into a **Stop** button. Wait until the process is complete, which is effective when the **Stop** button is changed into a **Done** button.
- Tap **Done**. You can now start collecting data.

Memo for GNSS Users

Assuming the following:

- A receiver profile has been created previously so you can use your RTK rover in a network.
- If you are using a "network rover", a network has also been defined previously for the purpose of receiving corrections from an IP server. (No network profile needs to be created if you are using a "rover" receiving corrections from a base via radio.)
- A new job file needs to be created in which a known coordinate system and a geoid are used.

Then proceed as indicated below:

- Turn on your receiver.
- Start Survey Pro on the data collector.
- Create a job in which you select the coordinate system and geoid used.
- Tap the instrument icon and select **Switch to GNSS**.
- Go to **Survey >Start Survey**.
- Select the receiver profile prepared earlier for your rover.
- Select the network used (skip this step if you are using a "rover", and not a "network rover").
- Tap **Connect**.
- Wait until the rover receives data from the base.
- Confirm/change the point where the base is located.
- Set acceptance criteria for all your measurements.
- Make sure the receiver continuously delivers a "Fixed" position solution. (You may also go to **Survey > GNSS Status** to check the GNSS reception status and then come back to **Survey > Data Collection**.)
- Start collecting your data (points, offset points, lines). Data may be collected using one epoch of data (always the case when collecting data along a line), or by averaging the position through a static occupation on each point.
- When finished, select **End Survey** on the Home screen.