STRATUS AND SPECTRUM SURVEY

Static and Kinematic

Workflows Document

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CONTENTS

Introduction

This document gives you information about using the Stratus GPS survey system, with Spectrum Survey software, for three methods of field and office procedures: static, static with controller, and kinematic. The Appendices give additional information about survey network adjustments.

Section 1 - Stratus Static (No Controller)

You perform a static GPS survey when you want to obtain coordinates for a point. A static survey is one where the receiver is set up over a known or unknown point and remains stationary for the entire survey. To perform this survey, place the receiver on a tribrach, and then level the receiver. Next, turn on the receiver. Finally, allow the receiver to collect data for approximately 20 to 60 minutes, during which time make sure that you do not move the receiver. When the survey session is complete, you can turn off the receiver and move it from its position.

Static surveys are typically performed with two or more receivers - the more receivers used, the more points that can be occupied in a single session, and the more ground that can be covered. Generally, several sessions are required to cover the entire job site satisfactorily.

It is standard survey procedure to occupy all sites at least twice if not more times. It is also standard procedure to have more than one known site in the project. These procedures ensure that you collect a sufficient number of observations for each site. With sufficient data, you can use Spectrum Survey to run a network adjustment and detect any data problems or blunders in field procedures.

Field Procedures (Typical)

Follow these steps to set up and collect data for a static survey.

Set Up Receiver

1. Place the Stratus on a tribrach adapter, and then place the assembly on a survey tripod.
2. Position the tripod over the survey point. Make sure the receiver is level and targeted over the point.
3. Press the power button on the Stratus to start data collection.
4. Make sure you meticulously record the antenna and site information in a GPS logbook. You can use this information later when you process the data. If you do not have a logbook, there is a printable Stratus Field Notes report in Appendix D that you can use for recording data for your sites.

Collect Data

5. Use the Stratus occupation timer (based on vector length) as a guideline to ensure you collect sufficient data. Refer to the *Stratus Operations Manual* for more information.
6. Press the power button for approximately three seconds to stop data collection; the receiver will also power off. Note: Each time you turn on the receiver, you create a new *.str file.
7. Repeat steps 1 through 6 to collect all your field data.

Office Procedures

The following procedures explain how to work with GPS data after a static survey session.

Create Project and Download Data

Follow these steps to set up a Spectrum Survey project, and to download data from the Stratus to your PC.

1. Start Spectrum Survey by double-clicking on the desktop icon or through the **Start | Programs** menu.
2. Click **<Create New Project>**, and enter project information. Click **<OK>**.
3. Click **<Download files>** to transfer files from the Stratus to your PC. If you already downloaded the files, skip to step 13.
4. Connect the download cable to the Stratus receiver, and connect the cable's other end to the PC's COM port.
5. Turn on the Stratus receiver.
6. In the ***Download/Upload*** dialog box's right pane, select **Stratus Receiver** as the **Device Type**.
7. Click **<Settings>** to open the ***Communications Device Settings*** dialog box. Set the **Baud Rate** to **115,200**, and set the **COM** port to the one to which you connected your Stratus. Click **<OK>**.
8. Click **<Connect>**. Your files should appear in the right hand pane.
9. Select the *.str (Stratus) files that you want to download (use **<CTRL>** + Click to select multiple).
10. In the ***Download/Upload*** dialog box's left pane, select the download path. To best administer your files, try to use a consistent directory structure. For example, when you first create a project, Spectrum Survey creates a project directory with the sub-directory DATA. Select this sub-directory as the target path to download your files.
11. Press the arrow **< ← >**located in the middle of the dialog box to move files from the receiver to the PC (right pane to left pane). As the files download, a status bar displays the progress.
12. Repeat steps 4 through 11 for multiple Stratus receivers.

> Note: To avoid confusion, make sure you download all your *.str files for the same project to the same directory.

Import Data

Follow these steps to import data into a Spectrum Survey project.

13. When you finish downloading files to your PC, the ***Data File Manager*** dialog box automatically opens. You can also open this dialog box any time by selecting **File | Data File Manager** from the main menu.
14. Click **<Import>**. If you downloaded files to your project's DATA folder, then the files should appear in the ***Import Observations and Ephemeris*** dialog box. If you downloaded the receiver files to a different folder, navigate to that location.
15. Select the files you want to import into your project. A Stratus data file has the file suffix *.str. (use **<CTRL>** + Click to select multiple).

> **Note:** If you are certain your files are in the selected location and do not appear, make sure the **Files of Type** list displays **Sokkia**.

16. After you find and select your files, click **<Open>** to import the files into the ***Data File Manager*** dialog box.
17. In the ***Data File Manager*** dialog box, click **<OK>** to import the files into your project and display them in the ***Plan View***. During import, Spectrum Survey may display warnings for items such as: point proximity, etc. Carefully review the warning messages. The ***Plan View*** gives you an accurate display of all the points in the project.

Vector display troubleshooting

Spectrum Survey should automatically generate all vector combinations and display them in the ***Plan View***. The following table gives steps to take if you do not see vector combinations in the ***Plan View*** after you import your data.

Steps to Take if Vectors are Not Visible
Look in the ***Data File Manager*** to make sure you imported the correct files. Check the start time of each file to ensure there is overlap.
Make sure that you have the vector display turned on. Look in **View** on the main menu and see if there is a checkmark next to **Show Vectors**.
Go to **Tools | Define Combinations**. Based on your field occupation times, you may need to lower the minimum overlap value for **Define Vectors** from the default value. This might be necessary on shorter occupations.

Edit Coordinate System and Geoids

Follow these steps to edit your projects coordinate system and geoid model.

18. After you import data into the ***Plan View***, select **Edit | Coordinate System** from the main menu, and choose the map projection for your local area. You can keep the default **Geographic**, or change to a different map projection. If you require a map projection other than the predefined projection, click **<Add>** and pick the desired projection. Make sure you enter all the correct projection parameters. Otherwise, Spectrum Survey will not be able to correctly generate the coordinates. You can also change the units between meters and feet.

> **Note**: Some projections have pre-defined templates with the datum and ellipsoid parameters already defined. If another projection is required, you will have to provide some additional information to create the system.

19. Choose a geoid model if you want to see orthometric heights (mean sea level heights). Select **Edit | Geoid Model** from the main menu, and choose the current model for your area. Click **<OK>**.

Edit Data

Follow these steps to edit your survey data in Spectrum Survey.

20. In the ***Plan View***, double click on one point for which you know the coordinates. Type those coordinates in, and select **Use as GPS Reference Coordinate**. Click **<OK>**.

> **Note:** If you do not want to manually select a GPS reference coordinate, Spectrum Survey can automatically select a point for you. In this case, Spectrum Survey will base the coordinates of the points in your project on its auto-assigned point, and point coordinate values may not match values you already have for these points.

21. Select **Edit | Point** or **Select | Point** to add information to your points from your field notes. Enter in the instrument antenna heights and antenna type for all points. For Stratus, the antenna types are **Stratus_Vert** and **Stratus_Slant**. After you make all the changes, review the antenna information once to make sure it is correct.

> **Note:** The ***Point Editor*** dialog box (**Edit | Point**) enables you to view all related point information one point at a time. The ***Point List*** dialog box (**Select | Point**) enables you to view selected point information for all points simultaneously.

Process Data

Follow these steps to process your survey data in Spectrum Survey.

22. Select **Tools | Process Data** to start data processing. Spectrum Survey displays the processing status, and may display warnings for items such as antenna models, antenna heights, point proximity, etc. You should have entered antenna information before you tried to process, and you can ignore point proximity warnings if you know your points are close together.
23. After processing, Spectrum Survey displays a ***Process Summary*** report. Check this report to make sure that vectors are **FIXED**, and that you have a high percentage of **Observations Used**. Low percentages indicate that Spectrum Survey may have rejected many observations for various reasons such as multi-path, cycle slips, etc.

> **Note:** If you see a problem in the ***Process Summary*** report, you should look at the individual vector summary outputs for more information.

24. You can further investigate point information by looking at the individual point summaries through **Analysis | Processed Vectors | Vector Summary**.
25. At this stage, if everything is ok, you can adjust your network. See Appendix A - Network Adjustments.

Section 2 - Stratus Static (with Controller)

The purpose of a static survey is the same as listed under Section 1. See Section 1 - Stratus Static (No Controller).

However, this survey also incorporates the Stratus handheld controller; in which you can store field notes, such as point information, instead of manually writing everything in a field pad. In addition, you no longer have to manually enter the information in Spectrum Survey. Now, you can transfer the notes from the handheld into the project.

Field Procedures (Typical)

Follow these steps to set up and collect data for a static survey, using the Stratus receiver with the iPAQ handheld.

Set Up Receiver

1. Place the Stratus on a tribrach adapter, and then place the assembly on a survey tripod.
2. Position the tripod over the survey point. Make sure the receiver is level and targeted over the point.
3. Press the power button on the Stratus to start data collection.

Set Up Data Collector

4. Launch the Stratus controller application on the iPAQ data collector.
5. In the Stratus software, tap **<Controller Setup>** to open the ***Controller Setup*** window. Set the **Distance Unit** field appropriately, and set the time reference to your local time system. For the **Port** setting, if you plan to use infrared communications, set the option to **IrDA**. Tap **<OK>**.
6. Tap **<Static Survey>** to open the ***Static Survey*** window.
7. Tap **<Add>** to open the ***Add Static Observation*** window.

Configure Observation

8. In the **Point ID** field, type the point id that you want to assign to the point currently occupied.
9. Measure the antenna height.
10. In the **Ant. Height** field, type in the antenna height.

> **Note:** The height units depend on what you set in the ***Controller Setup*** window.

11. From the **Ant. Method** list, select the appropriate antenna measurement method. Choose one of the three available options: **Slant**, **Vertical**, and **True Vertical**. See Appendix E – Antenna Measurement Methods for more information.
12. Optional. In the **Desc** field, type a point description. Alternatively, you can tap the ellipsis button **<…>** to the right of the field and select a description from a previously configured list. Typically, you should give your point a description that you can use later to recall the point's details. For example, **survey marker** or **edge of curb**.
13. Use the **Rec. Interval** (recording interval) field to set the data-sampling rate. In other words, to set how often the receiver records data. For static surveys, a recording interval of 10 seconds is sufficient.

Note: It is very important that the recording interval matches the recording interval for all other receivers used in the survey.

14. Use the **Elev. Mask** field to modify at which elevation to start tracking satellites. Generally, satellite data that is lower than 5 degrees is noisier and more difficult to process. For static surveys, an elevation mask of 5 degrees is sufficient.

Start and Stop Observation

15. Tap **<Start>** to begin your static observation.
16. Occupy the point until the Stratus occupation indicator LED illuminates for your given baseline length (2, 5, 10, 15 or 20 km) between base and rover. Refer to the Stratus Operations Manual for more information on LEDs.
17. Tap **<Receiver>** and **<Stop>**. Then, choose a shutdown options:
    - **<End Job and Exit>** - Stops the Job, but leaves the receiver running.
    - **<End Job, Shutdown Receivers and Exit>** - Stops the job and turns off the receiver, which closes the file.
    - **<Exit Without Ending Job>** - Exits you out of this screen, but leaves the job active and leaves the receiver running.
    - **<Return to Survey>** - You return to the ***Static Survey*** logging screen. This is a way back in if you somehow had to exit out of the static survey.
18. Repeat steps 6 to 17 to collect additional static observations.

Office Procedures

The following procedures explain how to work with GPS data after a static survey session.

Create Project and Download Data from Receiver

Follow these steps to set up a Spectrum Survey project, and to download data from the Stratus to your PC.

1. The steps to create a Spectrum Survey project and download data from the receiver to the PC are the same as those for a static survey without a controller. See Create Project and Download Data, Page 4.

Download Data from Controller

2. Connect your handheld device to your PC.
3. Establish communications using **Microsoft Active Sync**.
4. In Spectrum Survey, if you are not already in the download section, select **File | Data File Manager** and click **<Download>**.
5. In the right pane, set the **Device Type** to **Stratus Controller**.
6. Click **<Connect>**. Your controller files should appear in the right hand pane.
7. Select the *.sta controller files that you want to download (use **<CTRL>** + Click to select multiple).

8. In the ***Download/Upload*** dialog box's left pane, select the download path. To best administer your files, try to use a consistent directory structure. For example, when you first create a project, Spectrum Survey creates a project directory with the sub-directory DATA. This sub-directory is where you should have downloaded your receiver files, and it is also where you should download your controller files. In any event, wherever you stored your receiver files is where you must also store your controller files.
9. Press the arrow **< ← >**located in the middle of the dialog box to move files from the receiver to the PC (right pane to left pane). As the files download, a status bar displays the progress.
10. Repeat steps 2 through 9 for multiple Stratus Controllers.

> **Note:** To avoid confusion, make sure you download all your *.sta files for the same project to the same directory.

Import Data

Follow these steps to import data into a Spectrum Survey project.

11. When you finish downloading files to your PC, the ***Data File Manager*** dialog box automatically opens. You can also open this dialog box any time by selecting **File | Data File Manager** from the main menu.
12. Click **<Import>**. If you downloaded files to your project's DATA folder, then the files should appear in the ***Import Observations and Ephemeris*** dialog box. If you downloaded the files to a different folder, navigate to that location.
13. Select the files you want to import into your project. If you used the Stratus controller in the field, you should select those files first. The reason is that each time you use the iPAQ with a receiver, the controller file records the receiver's serial number. Then, when you import the controller file, it searches for and automatically imports the associated receiver file. A Stratus controller has the file suffix *.stx (formerly *.sta files). Use **<CTRL> +** Click to select multiple files. Click **<Open>** to start the import.

> **Note:** If you are certain your files are in the selected location and do not appear, make sure the **Files of Type** list displays **Stratus Controller** for controller files.

14. Next, select any Stratus receiver files that are not associated with a controller file (for receivers that collected data during your survey, but for which you did not store data on the data collector).

> **Note:** If you are certain your files are in the selected location and do not appear, make sure the **Files of Type** list displays **Sokkia** for receiver files.

15. After import, the observations appear in the ***Data File Manager*** dialog box. Make sure all your files are present. If not, go back and import the missing files.
16. In the ***Data File Manager*** dialog box, click **<OK>** to import the files into your project and display them in the ***Plan View***. During import, Spectrum Survey may display warnings for items such as: point proximity, etc. Carefully review the warning messages. The ***Plan View*** gives you an accurate display of all the points in the project.

After you import your data, Spectrum Survey should automatically generate all vector combinations and display them in the ***Plan View***. If that does not happen, try the steps in Vector display troubleshooting, Page 5, to solve the problem.

Edit Coordinate System and Geoids

Follow these steps to edit your projects coordinate system and geoid model.

17. The steps to edit the coordinate system and geoid model are the same as those for a static survey without a controller. See Edit Coordinate System and Geoids, Page 5.

Edit Data

Follow these steps to edit your survey data in Spectrum Survey.

18. In the ***Plan View***, double click on one point for which you know the coordinates. Type those coordinates in, and select **Use as GPS Reference Coordinate**. Click **<OK>**.

> **Note:** If you do not want to manually select a GPS reference coordinate, Spectrum Survey can automatically select a point for you. In this case, Spectrum Survey will base the coordinates of the points in your project on its auto-assigned point, and point coordinate values may not match values you already have for these points.

19. Although Spectrum Survey should transfer antenna information automatically from the notes you entered in the Stratus Controller, you should verify by reviewing all the antenna heights and antenna measurement methods through **Edit | Point** or **Select | Point**. As well, for any receiver points that are not associated with a controller file, you need to manually enter the antenna information.

> **Note:** The ***Point Editor*** dialog box (**Edit | Point**) enables you to view all related point information one point at a time. The ***Point List*** dialog box (**Select | Point**) enables you to view selected point information for all points simultaneously.

Process Data

Follow these steps to process your survey data in Spectrum Survey.

20. The steps to process data are the same as those for a static survey without a controller. See Process Data, Page 6.

Section 3 - Stratus Kinematic (Stop-and-Go)

The purpose of a kinematic (stop-and-go) GPS survey is to obtain coordinates for a number of points within one session. Typically, you place the base receiver in a stationary position, on a tripod over a known site, for the duration of the survey. You place the rover receiver on a survey range pole that you move from site to site. When at a site, you typically keep the rover stationary for a short duration, anywhere from a couple of minutes to ten minutes. The longer the rover occupies a site, the better in terms of a good, reliable solution.

For the most accurate results, you should obtain a fix solution for the kinematic survey. You can only achieve this with GPS receivers after you perform an initialization. There are two types of possible initialization with the Stratus system:

Static Initialization	Known Point Initialization
In a static initialization, which usually takes place at the start of the kinematic survey, the rover receiver occupies a site long enough to obtain a fix solution. This is typically from 20 minutes to 60 minutes, depending on the site's distance to the base receiver. Use the occupation timer LEDs on the Stratus to determine if the receiver has collected sufficient data for a static initialization.	In a known point initialization, which usually takes place at the start of the survey, the rover receiver occupies a site position with known coordinates. The rover occupies this position for 5 minutes to 10 minutes.

For both initializations, it is good procedure to perform another initialization at the end of the survey. If anything goes wrong during the survey, an initialization at the end of the survey can help during processing. If you are working on a large project, it is good procedure to perform initializations more frequently in the event that unnoticed data problem(s) occur in the field.

For L1 kinematic surveys, it is very important not to lose lock on satellites after you perform the initialization. If the receiver does lose lock, you must perform another initialization right away or re-occupy a site you previously occupied before the loss of lock. If you do not take these steps, or if the loss of lock goes unnoticed, the down time will appear in your processed results, and it will be very difficult to obtain good results (In other words, fixed integer ambiguity solution results).

Office Procedures (Pre-survey)

Using the POINT, Inc *Planning* software, you can determine the optimal times of day for kinematic surveying. Generally, it is wise to choose times when six or more satellites are available. It is also wise to stay away from periods during the day where you have a group of satellites setting or rising. Refer to the *Planning Reference Manual* for more information.

Alternatively, you can view satellite information using the Stratus Controller. See Appendix B – Obtaining an Almanac for more information.

Field Procedures

The following procedures explain how to collect kinematic data with the Stratus.

Set Up Base Receiver

1. Place the Stratus on a tribrach adapter, and then place the assembly on a survey tripod.
2. Position the tripod over the survey point. Make sure the receiver is level and targeted over the point.

3. Press the power button on the Stratus to start data collection.

Set Up Data Collector

4. Launch the Stratus controller software on the iPAQ data collector.
5. Tap **<Controller Setup>** to open the ***Controller Setup*** window. Set the **Distance Unit** field appropriately, and set the time reference to your local time system. For the **Port** setting, if you plan to use infrared communications, set the option to **IrDA**. Tap **<OK>**.
6. Observe the base receiver LEDs until the base receiver locks onto at least four satellites.
7. In the Stratus software, tap **<Kinematic Survey>** to open the ***Kinematic Job*** window.
8. Tap **Base | New Base** to open the ***Base Setup*** window.

Set Up Base Observation

9. The steps to set up base observations are the same as to set up static observations. See Configure Observation, Page 7.

> **Tip:** When you type in the base **Point ID**, it is wise to enter something like **9999** to make your base point easily identified later when you process the data.

Start and Stop Base Observations

10. Tap **<Start>** to begin your static observation.
11. After synchronization with the base, you can view other receiver settings by tapping the **Receiver** tab.
12. Tap **<OK>** to return to the main kinematic screen.

> **Note:** It is important to keep the base the same from this point forward. Do not move the base or turn off the base receiver until the end of the survey**.**

Set Up Rover Receiver

13. Place the rover Stratus on a survey range pole and bipod.
14. Press the power button on the Stratus to start data collection.
15. In the Stratus software, select **Rover | New Rover** from the ***Kinematic Job*** window.
16. Measure the antenna height.
17. In the **Ant. Height** field, type in the antenna height.

> **Note:** The height units depend on what you set in the ***Controller Setup*** window.

18. From the **Ant. Method** list, select the appropriate antenna measurement method. Choose one of the three available options: **Slant**, **Vertical**, and **True Vertical**. See Appendix E – Antenna Measurement Methods for more information.
19. Optional. In the **Desc** field, type a point description. Alternatively, you can tap the ellipsis button **<…>** to the right of the field and select a description from a previously configured list. Typically, you should give your point a description that you can use later to recall the point's details. For example, **survey marker** or **edge of curb**.

20. Use the **Rec. Interval** (recording interval) field to set the data-sampling rate. In other words, to set how often the receiver records data.

> **Note:** It is very important that the recording interval matches the recording interval for all other receivers used in the survey.

21. Use the **Elev. Mask** field to modify at which elevation to start tracking satellites. Generally, satellite data that is lower than 5 degrees is noisier and more difficult to process.

22. Set the **End Reading** value. There are three options:

Auto Epochs (default)	This setting counts the number of measurements at a site and takes into account the recording interval. If you select this option, you should set the **Reading Duration** epoch count to **10 measurements** or more.
Auto Seconds	This setting counts the number of seconds at a site. If you select this, you should set the **Reading Duration** to more than **30 seconds**. If you use a value less than 30, you need to be more cautious in field procedures. When you set this value, you must take into account the recording interval, as this will determine how many actual measurements the receiver will record. For example, if the Auto Second is set to 30 seconds and the Recording Interval is set to 2 seconds, then the receiver will make 15 measurements at the site.
Manually	This setting means the site reading will only stop when you tap **<Stop>**.

23. Set the **Reading Duration** value. This setting depends on the option you selected in the previous step, and it will either refer to the number of measurements (if **Auto Epochs** is selected) or number of seconds (if **Auto Seconds** is selected).

24. Tap **<Start>** and synchronize with the receiver. This will create a new file on the receiver and is the recommended method.

> **CAUTION:** Do not tap **<Set>**, as this will update the receiver file with the current settings.

25. The ***Receiver*** tab enables you to view important information about the receiver.

26. Tap **<OK>**to return to the main kinematic menu.

Perform Kinematic Initialization

Follow the steps to perform a kinematic initialization over a known or unknown point. The steps clearly indicate when a step is different between a known point or unknown point initialization.

27. Position the rover over a point (using rover pole and bipod), steady the pole, and tap **<Read>**. The ***Take Reading*** window opens to start the reading process.

28. In the **Point ID** field, type in the point id you want to assign to the currently occupied point.

29. *KNOWN*: When the point is known, select **Init Type** and choose **Known Coordinate**.
UNKNOWN: When the point is unknown, select **Init Type** and choose **Static OBS**.

30. Measure the antenna height.

31. In the **Ant. Height** field, type in the antenna height.

> **Note:** The height units depend on what you set in the ***Controller Setup*** window.

32. From the **Ant. Method** list, select the appropriate antenna measurement method. Choose one of the three available options: **Slant**, **Vertical**, and **True Vertical**. See Appendix E – Antenna Measurement Methods for more information.

33. Optional. In the **Desc** field, type a point description. Alternatively, you can tap the ellipsis button **<…>** to the right of the field and select a description from a previously configured list. Typically, you should give your point a description that you can use later to recall the point's details. For example, **survey marker** or **edge of curb**.
34. Tap **<Read>** to start taking readings.
35. End survey.
    KNOWN: For known points, the point reading will end depending on what you selected in the **End Reading** list: **Auto Epochs**, **Auto Seconds**, or **Manually**.
    UNKNOWN: For this static initialization site, wait until the appropriate occupation time LED illuminates before you tap **<Stop>**. This is a very important step, because you want to make sure that you obtain a FIXED vector. Also, this does not need to be done as the first step in the survey, it is just important that it is done during the survey and that the fixed vector is obtained through processing.

> **Note:** The **Auto Epoch** and **Auto Seconds** do not apply for static observation (for unknown points). To stop the observation, you must manually tap the **<Stop>** button.

Start Kinematic Stop-and-Go Survey

36. After you perform the initialization, go to another site you wish to occupy.
37. Steady the rover pole over the point and use the bi-pod legs if necessary.
38. Modify any of the information (Point ID, Point Type, Antenna Height, Antenna Measurement Method, and Description) as necessary.
39. Tap **<Read>** to start this observation. If you selected the **Auto Epochs** or **Auto Seconds** setting for point duration, wait until the counter reaches its completion. If you selected **Manually**, tap **<Stop>** to end the reading when you want. It is very important that the range pole remains stationary (level) during your site observation.
40. Move to next site. While moving from point-to-point, try to keep the receiver as close to level as possible. In addition, when you move between points, you should avoid areas that could cause the receiver to lose lock, such as tree canopies or high buildings. Some route planning may be necessary.
41. Repeat steps 36 to 40 until you collect all the points in your survey.

Rover Loss of Lock

If during kinematic work you hear three beeps coming from the Stratus, you know that the receiver has lost carrier phase lock. In the event that you lose lock, follow the steps in the following table.

Steps in the Event of Loss of Lock
Move to an area free of obstructions and wait for two beeps, indicating you have regained lock.
Go back to a previously occupied site (prior to the loss of lock). Steady the range pole over the point.
Select that same point ID from the **Point ID** list, and select **Re-Initialize** under **Init Type**. Tap **<Read>**. Note: The measurement must be within 5 cm in order for Spectrum Survey to properly initialize the rest of the survey.
Continue your survey.

End Survey

42. It is generally good practice to perform an initialization at the end of your survey, in case an unnoticed loss of lock occurred. These steps are the same as those in Perform Kinematic Initialization, Page 13.
43. To end the survey, tap **<Rover>** and choose the serial number of your rover receiver.

44. Tap the ***Receiver*** tab, and then choose **<Stop>**. Tap the shutdown option **<End observation and shutdown receiver>**.
45. Return to your base receiver, and in the ***Kinematic Job*** window, tap **<Base>**.
46. Select the vector observation from the list, and tap the ***Receiver*** tab.
47. Tap **<Stop>** and choose from the four shutdown options. If you choose **<End observation and shutdown receiver>**, the Stratus software will prompt you to synchronize with the receiver. Then, it will turn off the receiver.
48. Tap **<OK>** in the ***Kinematic Job*** window to exit.

Kinematic Field Notes
Make sure during kinematic work that you never turn off the rover receiver while you are surveying. If this happens, then you need to re-synchronize (and re-initialize).
It may benefit you to field mark some of the observations with nails, pins, etc., as you measure them. Then, should you experience loss of lock, the marks will save you from having to go all the way back to the initialization point. This step is not required, but it could help you out, especially if you know you are going to be entering a noisy area (For example, an area with a lot of trees, buildings, or power lines).
It may benefit you to **<End>** your survey on a re-initialization (re-occupation) of a previously surveyed point in the job. Spectrum Survey does process in reverse as well, so this could aid in ensuring better post processed accuracies.

Office Procedures (Post Survey)

Perform the following procedures on data collected during a kinematic stop-and-go survey.

Create Project and Download Data from Receiver

Follow these steps to create a Spectrum Survey project, and to download data from the receiver to the PC.

49. The steps to create a project and download data are the same as those in Create Project and Download Data, Page 4.

Download Data from Controller

Follow these steps to download data from the iPAQ controller to the PC.

50. The steps to download data from a controller are the same as those in Download Data from Controller, Page 8.

Import Data

Follow these steps to import data to your Spectrum Survey project.

51. The steps to download data from a controller are the same as those in Import Data, Page 9.

Edit Coordinate System and Geoids

Follow these steps to edit the coordinate system or geoid models.

52. The steps to edit coordinate systems and geoids are the same as those in Edit Coordinate System and Geoids, Page 5.

Edit Data

Follow these steps to edit your survey data in Spectrum Survey.

26. In the ***Plan View***, double click on one point for which you know the coordinates. Type those coordinates in, and select **Use as GPS Reference Coordinate**. Click **<OK>**. Make sure you perform this step for all base stations and all known initialization stations.

21. Although Spectrum Survey should transfer antenna information automatically from the notes you entered in the Stratus Controller, you should verify by reviewing all the antenna heights and antenna measurement methods through **Edit | Point** or **Select | Point**. As well, for any receiver points that are not associated with a controller file, you need to manually enter the antenna information.

> **Note:** The ***Point Editor*** dialog box (**Edit | Point**) enables you to view all related point information one point at a time. The ***Point List*** dialog box (**Select | Point**) enables you to view selected point information for all points simultaneously.

Process Data

27. Select **Tools | Process Data** to start data processing. Spectrum Survey displays the processing status, and may display warnings for items such as antenna models, antenna heights, point proximity, etc. You should have entered antenna information before you tried to process, and you can ignore point proximity warnings if you know your points are close together.

28. After processing, Spectrum Survey displays a ***Process Summary*** report. Check this report to make sure that vectors (if you used **Static Obs** initialization) are **FIXED**, and that you have a high percentage of **Observations Used**. Low percentages indicate that Spectrum Survey may have rejected many observations for various reasons such as multi-path, cycle slips, etc.

> **Note:** If you see a problem in the ***Process Summary*** report, you should look at the individual vector summary outputs for more information.

29. You can further investigate point information by looking at the individual point summaries through **Analysis | Processed Vectors | Vector Summary**.

30. To see a simple (abridged) points listing with fixed or float status, select **Analysis | Point List**.

Export Data

31. To export the data, select **Tools | Export | Points**, and highlight all the points you wish to export. You can use the **<Shift>** or **<CTRL>** button on your keyboard to select multiple points.

32. Choose **ASCII** for the export format, and choose how you want to display the coordinate format (N,E or E,N). There are two choices for height format: Orthometric (geoid applied) or the plain ellipsoidal height.

33. Click **<OK>** when you are ready to export. Spectrum Survey will require you to name the file and specify a directory location.

Appendix A - Network Adjustments

The purpose of a network adjustment is to better analyze and adjust your data. A survey network typically has more observations than unknowns, meaning there is usually more than one vector going into an unknown site. A network adjustment enables you to use all this observation information to compute one coordinate for the point. In the case where there are many observations, it also enables you to detect if there have been any blunders with these observations, where something does not fit.

After you process your data and are satisfied with the results, the next step in Spectrum Survey is to perform a network adjustment. You need to identify your known coordinates and the control points in your survey network. When you perform a network adjustment, you typically start with a free adjustment. This enables you to see if there are any problems within the network or data, disregarding any external factors such as other known coordinates.

1. A free adjustment only needs one fixed point. You can set this up in the ***Point Editor*** (**Edit | Point**). Choose the point to fix from the **Point Name** list.
2. Select the **Fix Horizontal** and **Fix Vertical** check boxes.

   Note: An adjustment requires you fix at least one point horizontally and one point vertically, or one point both horizontally and vertically.

3. Type in the coordinates for the known point.
4. Select **Edit | Adjustment Parameters**. In the ***Weighting Method*** section, select the **Use Weight Matrix from GPS Processing** option. This is the ideal adjustment for most GPS surveys because in the weighting process, it takes into account the GPS data quality and vector length. In contrast, the **Use Standard Weight** box weights all vectors as a function of length instead of data quality. Click **<OK>**.
5. To complete the free adjustment, leave your one horizontal and vertical fixed point(s), and double-click another known control point. Type in the known values. Do not fix this point vertically or horizontally. Click **<OK>**.
6. Click **Select | All**, and then select **Tools | Run Adjustment | Full Adjustment**. When the adjustment completes, the ***Adjustment*** report automatically opens. You can sort the data in the report by selecting **Analysis | Adjustment | Report Options**.

What to Look for in Adjustment Reports
View the *Input Coordinates and Corrections* section of the ***Adjustment*** report. Look at the input coordinate value of your known points and the corrections in N, E, and Z. These corrections should be minimal and should all be in the same direction (azimuth). The corrections display how much the point moved from the input value to the adjusted value. If the corrections are small, then you can constrain this point for use in the **Constrained Adjustment**. A constrained adjustment is similar to a free adjustment except that more than the minimum amounts of points are fixed. The free adjustment measures how well the pure adjustment fits without the introduction of control.
Look for high residuals that may bias the adjustment. As a rule of thumb, you do not want to see anything above .030 meters here unless you are dealing with some very long vectors. The overall survey ppm requirement will help determine this as well.
View the *Chi Squared Test on the Variance Factor* section. Ideally, you want your variance factor (VF) to be at or near 1; however, it will very rarely ever be a perfect 1.0000. A variance factor of one signifies that your data does not have any blunders and that the weighting strategy used is appropriate. If the number is very high, it indicates your weighting is too optimistic and there maybe blunders present. If the number is very low, it generally indicates that your weighting is too pessimistic. Failing the Chi-Squared test does not necessarily mean there are problems, but it does mean the data does not fit as per expectations.

7. If you find a vector that is causing problems, you can remove it from the adjustment. Choose **Select | Vector** and highlight the vector in question from the report. Select **Exclude from Adjustment** and click **<Apply>** to change the status of **Exclude** to **Yes**. If you choose **Select | All** or **Select | Last Adjusted** and then **Tools | Run Adjustment | Full Adjustment**, Spectrum Survey will re-adjust the data without the problematic vector.
8. Repeat the above steps to add more points that are fixed, and remove bad data as necessary, until you fix all known points and all data is acceptable.

Appendix B – Obtaining an Almanac

The reason why you need to obtain an almanac is to check GPS status. Using this GPS information, you can determine:

- How many satellites are available and where they are in the sky.
- If there are any times of the day when the minimum amount of satellites required for your job (static or kinematic) are not available.
- The DOP (dilution of precision) at any given time.

All of these factors are very useful and help in determining why you may not be able to survey at a particular time, or why you may not obtain the expected results. To view almanac information in the field, you must have a Stratus Controller and a Stratus GPS receiver.

Field Procedures (Typical)

Follow these steps in the field to obtain an almanac, and to determine the best time and place to survey.

1. Place the Stratus on a tribrach adapter, and then place the assembly on a survey tripod.
2. Position the tripod over the survey point. Make sure the receiver is level and targeted over the point.
3. Press the power button on the Stratus to start data collection.
4. Give the Stratus sufficient time to acquire satellites and satellite information. Approximately 10 minutes.
5. When the satellite LED indicates the receiver is tracking at least four satellites, you can begin.
6. In the Stratus software, tap **<GPS Status>**. If you do not have an almanac on the controller (GPSDRVR.alm), the software will prompt you to connect to the Stratus. This process may take around 15 seconds. If you already have an existing almanac on the device, then hit **<Link>** to connect to the Stratus and update the almanac.
7. After you download the almanac information, tap the ***Sky Plot*** tab. You can move the sliding time bar to the right to determine the optimal GPS survey conditions. As the bar moves, the sky plot updates to tell you how many satellites you will have in the sky at that time.
8. Tap the ***Satellites*** tab to see information about PDOP relative to the selected time of day.
9. Tap **<OK>** to exit ***GPS Status***.

Appendix C – General Tips

The following tips will help to keep your system working and will assist in ensuring that system accuracy is as you expect.

- Try to keep static vectors under 20km. Because of above normal atmospheric activity, it is very difficult to obtain fixed integer value solutions in long baselines.
- Make sure you fully charge all batteries overnight, so that you have fresh batteries to use in the morning.
- Follow the manufacturer's advice on how to use and charge batteries to keep them in good working order for a long time.
- Always take spare batteries in case batteries run down or fail to work.
- Always save data after each days work. As well, ensure that you back up this data.
- Clear the receiver's memory as needed to ensure that the receiver has sufficient disk space available.
- When working at cold temperatures (below 10 degrees Celsius), it is a good idea to have spare batteries or use the external battery pack.
- Always get multiple vectors to points whose coordinates you are trying to determine.
- Always check in with more than one base (reference) site.

Appendix D – Sample Field Notes Form

Stratus Field Notes

Project Name: Project Location: Date: Observer's Name:	Site ID: _____ Site Name: _____ Receiver S/N: _____ Session #: _____ Control Type: (circle) Horiz. Vert. New

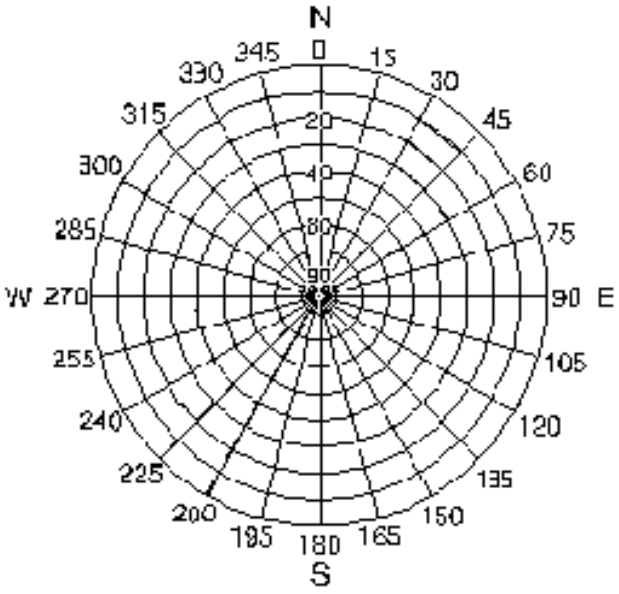
Antenna Height Parameters (measured)

Stratus Slant	Stratus_Vertical	Stratus_True_Vertical
_____M / FT 	_____M / FT 	_____M / FT 

Observation Times

Observed Time:	# Of Satellites	OBS Timer (LED)
Start Time: _____AM/PM	_____	N/A
End Time: _____AM/PM	_____	1st, 2nd, 3rd, 4th, 5th (circle)

NOTES:

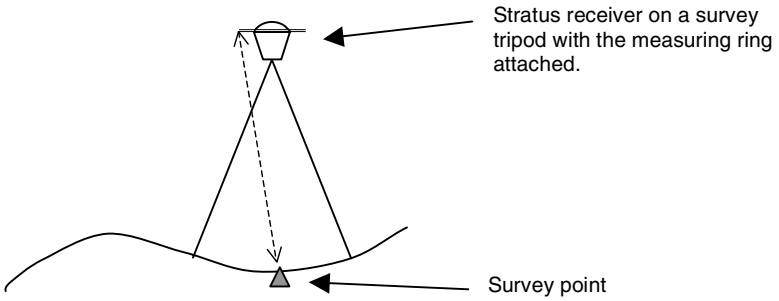
Obstruction Diagram	**Site Sketch:**
	

Appendix E – Antenna Measurement Methods

There are three antenna measurement methods available when using the Stratus GPS receiver: **Slant**, **Vertical**, and **True Vertical**. It is very important that you select the appropriate antenna measurement method, because Spectrum Survey uses this measured antenna height, along with this antenna measurement method, to compute the elevation of the survey point.

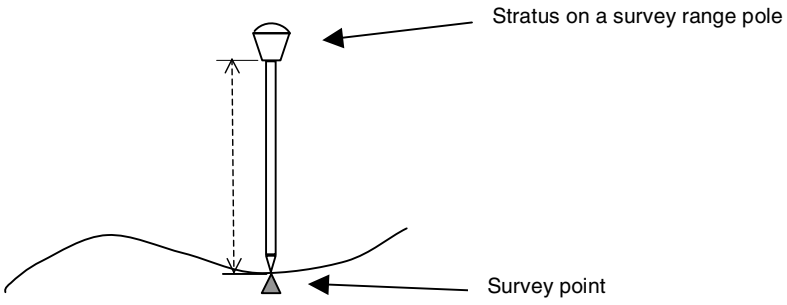
Slant

Typically, you will use the slant measurement method for site occupations where you use a tripod. For the Stratus, attach the tape measure end to the measurement ring provided with the Stratus, and stretch the tape to the survey point.



Vertical

Typically, you will use the vertical measurement method for site occupations where you use fixed height range poles, and the receiver is a rover. For the Stratus, use the tape measure to find the distance from the bottom of the receiver to the survey point.



True Vertical

Use the true vertical measurement method in similar circumstances as the vertical method. However, use the tape measure to find the distance from the phase center of the Stratus (near the rubber bumper area) to the survey point. You will rarely use this method.