

SECTION C – SURVEYING PROCEDURES FOR TOTAL STATIONS WITH TRIMBLE® TSC2 DATA COLLECTOR

The following sections describe the procedures for surveying with various total stations used in Florida.

SECTION C-1: FLORIDA TRIMBLE® S6 SERIES TOTAL STATION WITH TRIMBLE® TSC2 DATA COLLECTOR

The use of the S6 Series total station and the Trimble® TSC2 data collector can greatly improve the efficiency of collecting and processing survey data. Survey data can be electronically recorded and stored for downloading to a computer for processing. The survey data must be collected in a manner that will be compatible with the software used for processing the data. The procedures described below shall be followed in collecting and recording the survey data using the Trimble® S6 Series Total Station and the Trimble® TSC2 data collector. Follow these procedures carefully and correctly.

In order to become familiar with the total station, read the *Trimble S Series Total Station User Guide*. The procedure will detail the setup of the data collector, equipment, Bluetooth, and field survey. Also, the procedure explains the use of the equipment to record survey shots and making turns. Please see Figures 1 and 2 for pictures of the total station and data collector.

Figure 1: Trimble S6 Total Station



Figure 2: Trimble TSC2 Data Collector



A. INITIAL SETUP OF SURVEY STYLE IN TSC2 DATA COLLECTOR FOR THE TRIMBLE® S6 SERIES SURVEY EQUIPMENT

NOTE: Once a survey style is established it *will not* need to be reestablished unless the Trimble® TSC2 data collector memory is erased or the user is supplied with a new Trimble® TSC2 data collector. The survey style may be setup in the office.

1. Turn on TSC2 data collector by pushing the green button on the lower left hand corner of the keypad.
2. From the Windows Mobile Desktop main menu (blue background), select the “**Survey Controller**” icon. See Figure 3.

Figure 3: “Survey Controller” icon



3. From the six icons, select “**Configuration**” > “**Survey styles**”.
4. VX & S Series is the pre-defined survey style for the Trimble S6 Series. Select “**Esc**” and proceed to Section B if survey style is already in the drop down menu. If this survey style is not already in the drop list, follow Steps 5 – 14.
5. On the bottom of the screen there is three small buttons, select “**New**”.
6. Name the new survey style (e.g. **VX & S Series**).
7. Select “**Conventional**” from the dropdown menu for the style type.
8. Tap “**Accept**”.
9. Select “**Instrument**”.
10. Set the following parameters on the instrument screen:
 - a. Manufacturer: “**Trimble**”
 - b. Model: “**VX/S Series**”

- c. Measurement mode: **“STD”**
 - d. Averaged observations: **“10”**
 - e. Auto F1/F2: **box left blank**
 - f. Measure dist on face 2: **box checked**
 - g. Autolock off for offsets: **box checked**
 - h. Set backsight: **“Azimuth”**
 - i. Servo auto turn: **“HA & VA”**
 - j. Select icon ^{1/2}
 - k. For page 2 leave the default settings.
 - l. Select **“Enter”** > **“Accept”**.
11. From the list menu, select **“Topo point”**.
 12. Set the following parameters on the instrument screen:
 - a. Measure display: **“HA VA SD”**
 - b. Auto point step size: **“1”**
 - c. View before storage: **box checked**
 13. Select **“Accept”** > **“Store”**.
 14. The survey style is now established. (Select **“Esc”** > **“Exit”** to return to the main menu.)

B. INITIAL TSC2 DATA COLLECTOR JOB SETUP (may be performed in the office)

1. Select **“Survey Controller”** from the main menu.
2. Open **“Files”** > **“New Job”**.
3. Fill out the resulting screen as follows:
 - a. Give name: Enter the name of the job (property and date)
 - b. Under the “Properties” table, set the following options:
 - Coordinate system: **“Scale Factor Only”** > **“Next”**
 - Set the scale factor to **“0.999600000”** then click **“Store”**
 - Units: **“US Survey Feet”**

- Linked Files: **“None”**
- Active Map: **“None”**
- Feature Library: **local office feature library**

NOTE: The feature table can be loaded onto the data collector in the office. Statewide feature table can be obtained from the Area Engineer or from the SO Engineering Section.

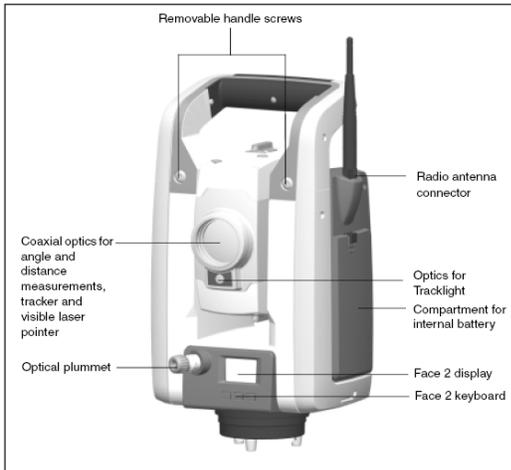
- Cogo Settings: **“Ground”**
- Use all the default settings for page 2.

- c. Tap **“Enter”** > **“Accept”**.

NOTE: Use a surveyor’s field book to make necessary notes to the field conditions such as time, project, crew members, temperature, and weather, etc.

C. INITIAL SURVEY EQUIPMENT SETUP

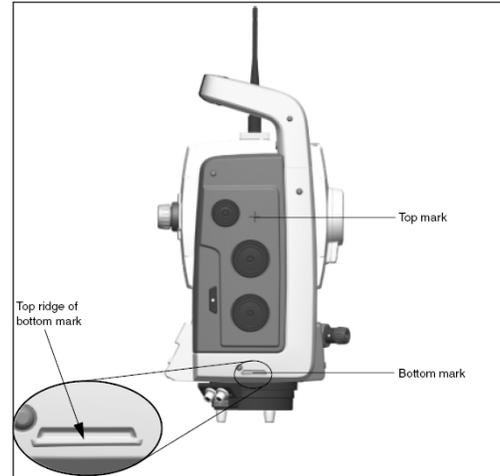
1. Find the existing control point or create a new control point.
2. Place tripod base level directly over control point. Make sure the tripod has a wide, stable stance and the legs are securely in the ground.
3. Place Trimble S6 Total Station on top and center on the tripod and securely screw the total station to tripod.
4. Using the 3 adjustable screws at the base of total station, level the total station using the leveling bubble located at the base of the total station as a reference.
5. Once level, slightly loosen the screw that connects the total station with the tripod.
6. Look through the optical plummet on the Trimble S6 Total Station and only focus the sight on the ground. See Figure 4 or *Trimble S Series Total Station User Guide* (Figure 3.16, page 25) for help on finding the optical plummet.

Figure 4: Anatomy of total station.

- a. To focus the crosshairs, rotate the plummet's eyepiece.
 - b. To focus the optical plummet to the ground, push the eye piece in or out.
7. Shift the total station horizontally until the cross hairs of optical plummet are exactly on the control point. Re-tighten the screw to secure the total station to the tripod.

NOTE: If the crosshairs of the optical plummet cannot be centered on the control point, center the tripod more closely over the control point. Make sure to re-level the total station and center the crosshairs of the optical plummet on the control point. Also, ensure the base of the total station is completely on the base of the tripod.

8. Measure the height of the instrument (I_h) by following the instructions below.
 - a. Using Figure 6, measure H_m to the hundredths (X.XXX) using a survey rod. H_m is defined as the distance from the control point to the bottom mark as seen on Figure 5. The distance from the top mark to the bottom mark is 0.158 meters.

Figure 5: Top and bottom marks on Total Station.**Figure 6:** Measuring the height of the instrument.

- b. Calculate I_h (**in meters**) by using the formula found in Figure 7 below.

Figure 7: Formula for calculation of I_h .

$$I_h(\text{meters}) = 0.158 + \sqrt{H_m^2 + 0.091^2}$$

$$I_h(\text{feet}) = 0.518 + \sqrt{H_m^2 + 0.298^2}$$

NOTE: Record the height of the instrument in your surveyor's field book. You will need to input this height into the data collector later in the setup process.

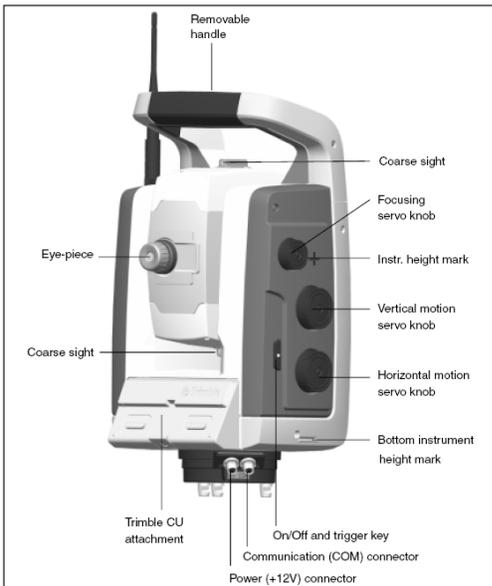
9. Attach the bipod to the survey rod. Place the survey rod on top of the desired bench mark. Ensure that the prism on the backsight is pointed towards the total station. Level the prism using the bubble level on the survey rod.
10. Measure the distance from the center of the prism to the base of the survey rod. Rod height is adjustable.

NOTE: Record the height of backsight in your surveyor's field book. You will need to input this height into the data collector later in the setup process.

D. BLUETOOTH SETUP

1. (Skip this step if data collector is on) Turn Trimble TSC2 data collector on by pushing the green button on the lower left hand corner of the keypad.
2. Turn on the total station. Please see Figure 7 to locate the On/Off and Trigger Key.

Figure 7: Additional features on the back of the total station.



3. If blue tooth is not automatically turned on, from the "Survey Controller" main menu on the TSC2 data collector tap

"**Configuration**" > "**Controller...**" > "**Bluetooth**".

4. If a Bluetooth connection was never previously set-up between the total station and the data collector, follow the instructions below. Otherwise skip to the next section.
 - a. Tap "**Config**" at the bottom of screen.
 - b. Verify that the "**Turn on Bluetooth**" box is checked.
 - c. Tap the "**Devices**" tab at the bottom of the screen.
 - d. Tap "**New Partnership...**". Wait for data collector to find total station.
 - e. Select the device which has the serial number of the total station listed. Tap "**Next**".

NOTE: The serial number of the device is located on the of the yellow Trimble S6 case.

NOTE: If the total station does not appear listed, restart the total station and tap "**Refresh**" on the data collector.

- f. Enter the passkey for the total station which is by default the last four digits of the Trimble S6 serial number. Tap "**Next**".
- g. Change the display name of device from the serial number to "Trimble S6". Tap "**Save**".
- h. Tap "**Ok**" which is located at the top right corner of the screen.
- i. Select "**Trimble S6**", under the "Connect to GNSS Receiver/ VX/S Series" drop-down box. All other default values can be left alone. Tap "**Accept**" and wait till the equipment establishes the connection.
- j. Once connected begin setup for collecting field data.

E. SETTING UP FOR COLLECTING FIELD SURVEY DATA

1. Confirm that the eye-piece is in the correct orientation by verifying that text next to the eye-piece is in the upright direction.
2. Once connected, the data collector should go to the “Electronic Level” screen. Verify that the text “Compensator in range” appears at the bottom of the screen. Tap **“Accept”**.
3. The data collector will now go to the “Corrections” screen. Enter the correct temperature. Tap **“Accept”**.
4. Use a magnetic compass to rotate the total station to as close to magnetic north as possible. In the “Survey Basic” screen, tap **“Zero”** on the bottom of the TSC2 screen. Tap **“Esc”**.
5. Point the lens of the total station in the direction of back sight. The prism and survey rod should be setup level on the bench mark. See below for details on how to accurately focus the cross hairs on the prism of back sight.

NOTE: See Figure 4 to locate the knobs that operate the sight.

- a. Turn the focusing servo knob until the benchmark can be seen clearly.
 - b. Adjust the vertical and horizontal motion servo knobs to align the cross hairs with the prism on the back sight.
6. From the survey controller main menu select **“Survey”** > **“VX & S Series...”** > **“Station setup”** > **“Accept”**.
 7. In the “Station setup” screen, enter the following information.
 - a. Instrument point name: **“1”**
 - b. Code: **“CP”**
 - c. Tap **“Enter”**.
 - d. Instrument height: Enter the height of the total station as measured in Step 8 of

Section “C. INITIAL SURVEY EQUIPMENT SETUP”.

8. Once the instrument height is entered, the “Key in instrument point” box appears below. Enter the following information:
 - a. Northing: **“5000” or exact value if known**
 - b. Easting: **“5000” or exact value if known**
 - c. Elevation: **“100” or exact value if known**
 - d. Control point: **box checked**
9. Tap **“Accept”** and/or **“Enter”**.
10. Now the information for the backsight’s benchmark must be entered.
 - a. Backsight point name: **“100”**
 - b. Code: **“BM”** (Benchmark)
 - c. Tap **“Enter”**.
 - d. Backsight height: Enter the backsight height as measured in step 10 of Section “C. INITIAL SURVEY EQUIPMENT SETUP”.
 - e. Azimuth (Keyed in): Enter the value for HA (horizontal azimuth) as seen on the bottom of the screen. To enter the degrees, minutes, seconds symbols, press the arrow next to the Azimuth text box then select **“Units...”**. Select each symbol individually to insert it.
 - f. Method: **“Average observations”**
11. Tap **“Enter”** > **“Measure”**. Wait until the data collector switches pages.
12. Verify that all information is correct. Tap **“Store”**.
13. Data Collector will announce “Station setup completed”.

F. COLLECTING FIELD SURVEY DATA

The following procedures explain the user how to use the equipment to survey.

1. Move the prism to the desired survey point location.
2. Tap **“Survey”** > **“Measure topo”**.
3. In the “Measure Topo” screen, enter the following information.
 - a. Point name: **“1000”**
 - b. Code: Use the appropriate alpha or numeric code. Tap **“Enter”**. See Appendix C-A for Florida NRCS numeric and alpha survey codes.
 - c. Method: **“Angles and distance”**
 - d. Target height: The height of the backsight should be correctly inputted every time the height of the backsight is adjusted.
4. Tap **“Measure”** > **“Store”**. The equipment will announce “observation stored”.
5. Repeat steps 3 and 4 until all the shots have been taken for the given control point. Note that the point name automatically increases in value after each shot.
6. If a Turn becomes necessary, continue to Section “G” before powering down the data collector.

G. MAKING A TURN

1. Once a Turn becomes necessary set a new control point. Make sure the new control point has adequate vision to get the most out of the turn.
2. Setup a prism over the control point.
3. In the “Measure Topo” screen, enter the following information.
 - e. Point name: **“xxxx”**
 - f. Code: Use the appropriate alpha or numeric code such as “CP2” for the next

control point. CP1 will be the current instrument point. Tap **“Enter”**.

- g. Method: **“Angles and distance”**
 - h. Target height: The height of the backsight should be correctly inputted every time the height of the backsight is adjusted.
4. Tap **“Measure”** > **“Store”**. The equipment will announce “observation stored”.
Record the number of the shot in the field book.
 5. Tap **“Escape”**.
 6. Before performing the turn, end the survey by selecting **“Survey”** and the **“End conventional Survey”**.
 7. Turn off the Trimble S6, and then move to and setup a new control point (CP2). See Section “C. INITIAL SURVEY EQUIPMENT SETUP”.
 8. Measure and record the height of instrument. See Section “C. INITIAL SURVEY EQUIPMENT SETUP” Step 8. Record in field book.
 9. Set rod with bi-pod over the previous control point (CP1). Measure the height of rod and record in field book. See Section “C. INITIAL SURVEY EQUIPMENT SETUP” Step 10.
 10. Turn on the instrument and aim towards last control point or the previous instrument point.
 11. Plug in or turn on Bluetooth the TSC2 data collector to the instrument.
 12. Go to **“Survey Controller”** if not there already.
 13. Wait until the TSC2 connects to the total station.
 14. Once connected, the data collector should go to the “Electronic Level” screen. Verify that the text “Compensator in range” appears at the bottom of the screen. Tap **“Accept”**.

15. Enter local corrections and tap **“Accept”**.
 16. Use tangent screws to precisely aim to prism.
 17. Tap **“Zero”** > **“Measure”** > **“Escape”**
 18. Make sure the correct job is opened.
 19. Tap **“Survey”** icon.
 20. Select the survey style for the Trimble S6 total station, if not selected.
 21. Select **“Station Setup”** from menu.
 22. Enter local corrections and tap **“Accept”**.
 23. Under Station Setup screen, Select the arrow next to the **“Instrument point name”** field. Select **“List”** from the menu.
 24. Select the point name/code (CP2) given to the control point.
 25. Northing, easting, and elevation will populate.
 26. Enter the new height of instrument (Section “G. Making a Turn” Step 6) and record the height in your field book.
 27. Tap **“Enter”** > **“Accept”**.
 28. Enter the backsight information by selecting the arrow next to field **“Backsight point name”** and select **“List”** from menu.
 29. Select the point name/code (CP1) given to the previous control point or instrument setup point.
 30. Enter height of rod (See Section “G. Making a Turn” Step 7) for **“Backsight height”**.
 31. Tap **“Enter”**.
 32. Method: **“Averaged observations”**
 33. Tap **“Measure”**. This will automatically populate the field according to the chosen point.
 34. Tap **“Store”**.
 35. Data Collector will announce “Station setup completed”.
 36. Tap **“Survey”**.
 37. Tap **“Measure Topo”**.
 38. Continue with survey. See Section “F. COLLECTING SURVEY DATA” Steps 3-4.
- #### H. TO END A SURVEY
3. To end the survey, tap **“Esc”**.
 4. From the “Survey Controller” main menu tap **“Survey”** > **“End conventional survey”**.
 5. To power down data collector push the green button for three seconds then select **“Shutdown”** > **“Yes”**.
 6. Power down Total Station by pushing the power button down for 3 seconds.
 7. Disassemble the equipment to and setup for transport/storage.
 8. For a procedure on how to import the TSC2 job file into Civil 3D, refer to EFH Chapter 1, Section D, sub-section B *“IMPORTING A TSC2 JOB FILE INTO AUTOCAD CIVIL 3D”*.

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