

Outline Setting up Sokkia SET 4BII Total Stations

1. [Set up and level tripod over point.](#)
2. Attach and [setup SDR33](#) data recorder if you are using one.
3. Turn Instrument ON.
4. Loosen the clamp on the telescope.
5. Rotate the telescope about the vertical axis by 360° . You should hear a beep at this point.
6. Rotate the telescope about the horizontal axis by 360° . You should hear a beep at this point.
7. [Configure the total station](#)
8. [Determine the orientation to a backsight point.](#) Point the total station at this point, and take your backsight. This can be done manually using the instrument keyboard or via a SDR33. If the current station and backsight station are in the SDR33 memory, then it will determine the angle and set the instrument, otherwise you will have to provide coordinates and angles (details given below).

You are now ready to start using the Instrument

Procedure for setting up a tripod & leveling Total Station

This can be one of the most time consuming procedures in surveying, and one of the most crucial. Any error in setting up the tripod is carried through the entire survey. Generally small setup errors (1 or 2 mm) are not a problem because they are non-systematic, and the EDM on Total Stations have an error or $\pm 3-5$ mm. I suggest the following procedure.

1. **Setup tripod.** Open up the tripod and extend the legs. Adjust the approximate height so that the total station will be at eye level. Set one leg on the ground. *This will be the "anchor" leg, and should not be adjusted in the following procedure.* Holding the other two tripod legs, and keeping the anchor leg in the same position, move the tripod until the plum bob (or optical plummet) is over the point. Do not worry about having the tripod level. When you are over the point, anchor the two remaining legs. You should still be exactly over

your point. I suggest that you attach a tribrac to the tripod, and use one of the reflector posts - these contain an optical plummet. Another option is to attach the Total Station at this point. Just be careful!

2. **Level the tripod.** By changing the length of two legs you used to position the tripod, level the top surface of the tripod using the bulls-eye level. The bubble should be within the inner circle. Be as precise as possible. *Do not change the length of the anchor leg.* After this procedure you should still be directly over the same point you were over in step 1.
3. **Attach instrument to tribrac.** Set instrument into tribrac and lock in place. Align the long bubble-level between two posts of the tribrac. Turning BOTH posts in opposite directions, center the bubble in the level. Turn the Instrument though 90° to align it with the third leg. Turn only the third leg until level. The instrument will now be level.
4. **Check alignment over point.** Use the optical plumb on the instrument to check that you are still over your point. If you are not, you may slide the entire tribrac assembly slightly to get over the point. If you move the tribrac, repeat the leveling procedure.

Short Instructions for SDR33 Setup

This section is intended as a quick reminder of the steps you need to perform. It assumes you are familiar with the way in which the SDR33 works. It is well worth your time to become familiar with the SDR33, it can make your surveying much more efficient.

There are two small "camera" batteries. These should be installed first. Make sure you get them in the correct way. Then install two 9v batteries. Always make sure that you have a spare set of 9v batteries before you go to the field. The camera batteries will maintain data stored in memory if the 9v batteries run out, but they cannot run the SDR33. Never store batteries in the data recorder since it will constantly draw power from them, even when off, to maintain memory. Remove all batteries when done with the data in the recorder. *Check that you have downloaded all data before you remove the batteries!* The best method is to manually delete the surveying jobs. You can only delete a job if it has been downloaded.

You should run through the following setup each time you use the SDR33. People using the data recorder before you may have used different settings.

Systematically move down the Function menu, starting with the *Job Menu item*. Check that each field is the way you want it. I would suggest checking the settings even if you were the last person to use the data recorder.

Turn the data recorder on. If you do not get to the screen with the Functions menu, either press the button, or press the F1 key (this is the FUNC softkey). The following is a rundown of the Function menu items. The options for each field are explained in the SDR33 manual. Below are suggested settings, and where appropriate I have made some suggestions on which settings to use.

Job

Specify a job name, or select a pre-existing job name. To select a pre-existing job, just highlight the name and press OK. To define a new job, press the "New" softkey (F1).

- When defining a new job, you will be asked to fill out the following items
- *Job*: Specify a name
- *S.F.*: Leave this set at 1.00000000000. This scale factor can be used to reduce you measurements to a plane coordinate system.
- *Point Id*: Usually use "Numeric". This used 4-digit numbers to distinguish between points.
- *Record elev*: You usually want the elevation. Set field to "Yes"
- *Atmos crn*: Set to "No"
- *C and R crn*: Set to "No"
- *Sea Level crn*: Set to "No"
- REMEMBER: use the ENTER key (bottom left corner) after you change a field. The OK key will enter a field and often assume you are then done with that menu.
- After defining a job, you will be able to enter a comment. To skip this, just press OK.

Instrument

Make sure the SDR33 is connected to the total station. Under Model type, select SET 2-way, and press OK. The SDR33 will then get the serial number and current settings from the Total Station. It will also check the measurement modes being used by the SDR33.

Job Settings

- *Job*: Job name will be here
- *Atmos crn*: Set to "Yes".
- *C and R crn*: Set to "No".
- *Sea Level crn*: Set to "No".

Configure Reading

- *Type*: Total Stn
- *Auto pt num*: The number displayed here is the next automatic point number that will be used. It is usually set to 1000. I suggest using point numbers less than 1000 to indicate instrument points, and greater than 1000 to indicate surveyed points. If you are "Plane table" mapping with the total station, then you may want to set this number to 2, and use 1 as your first instrument point.
- *Topo view stored*: Set to "OBS". This stores the observations - horizontal angle, vertical angle, and slope distance.
- *Combine F1/F2*: Generally set to "No". If it is set to yes, the SDR33 will force you to take a F1 reading, then a F2 reading. It will then average the values and inform you if the difference between reading is greater than any tolerances you have set.
- *# dist rdgs*: Generally leave as "1". This is the number of distance reading the instrument will take. If greater than one, the distances are averaged. If you are only measuring angles then you can set this value to 0. This disables the EDM for normal readings.
- *Tracking*: Generally "No". If set to "Yes" then the EDM constantly takes measurements.
- *Code list active*: Generally "No", unless you have developed a code list.
- *Info blocks*: Set to "0". This is the number of comment block associated with each reading.
- *Code fields*: Set to "0".
- *Recip Calc*: Set to "Prompted"

Tolerances

This screen lets you specify tolerances. If you have the SDR average F1/F2 readings, or when it compares a backsight reading with previous values, if the new values differ by more than the tolerances, you will be warned, and asked what you want to do.

- *Type*: Generally "Total Stn"
- *Tol H.obs*: Generally 30 sec

- *Tol V.obs*: Generally 30 sec
- *Edm tol (mm)*: Generally 5 mm
- *Edm tol (ppm)*: Generally 3mm

Units

- *Angle*: Generally use "Degrees"
- *Dist*: Generally use "Meters". This is the 1990's ...
- *Pressure*: Generally use "Millibar". This is the same as hPa. The digital barometers we have use hPa.
- *Temp*: Generally use "Celsius". Our thermometers are in °C.
- *Coord*: Generally use "N-E-Elev". This is how coordinates are given.
- *Other grades*: Generally use "%"
- *Sideslope grade*: Generally use "%"
- *Sta..ing*: Generally use "10+00"
- *Decimals shown*: Generally use "3"
- *Zero azimuth*: Generally use "North"

Communications

See handout on downloading data.

Date and Time

Here you want to set the current time and date. The TimeOut is the time in minutes after which if there had been no keyboard activity the SDR33 will turn itself off. The Timestamp is the time increment between the SDR33 saving the current time in the data recorder. It is best to set 0, this turns off the Timestamp feature. If you happen to be trying to record a reading at the same time that the SDR33 is saving a timestamp you can have problems.

- *Date*: Current date
- *Time*: Current time
- *Time out*: Suggest 10
- *Timestamp*: Suggest 0

Job deletion

Use this menu item to select jobs for deletion. You cannot delete a job that has not been downloaded.

Calculator

The SDR33 has a built-in HP style calculator.

Feature code list

This allows you to have abbreviations for commonly used terms. If you have the *Code List Active* item in the Configure Menu set to yes then the SDR will insert the test associated with the abbreviation when making notes associated with a point. This is also used to identify different types of features you survey in. Plotting software can be configured to look at the feature and plot different symbols for that feature.

Hardware

This gives you a summary of the current hardware. Use this menu to change contrast, check batter condition, turn on the backlight, and change the volume level. The SYSTEM softkey gives you version numbers, and an idea of how much memory has been used, and how much is still available.

Upgrade

This option allows programs to be sent from a PC to the data recorder.

User program

The user can write their own programs for processing or collecting data using the data recorder. This allows you to load and run one of these programs.

Language

This should always read: English US.

Procedure for configuring Total Station

1. **Set up a notebook page**, or use the *Instrument Station Setup Checklist*. You will fill out this page before you enter all the numbers into the Total Station. This is done to make sure that nothing is missed.

2. **Measure *Instrument Height*.** Record instrument height. This should be measured from the ground to the tilting axis of the instrument. If setting up over a benchmark, measure height to top of BM *and* the height above the ground. The tilting axis of the instrument is marked on the side opposite from the on/off switch. It is a small hole inside a raised circle.
3. **Measure *Temperature*,** and record,
4. **Measure *Pressure*,** and record.
5. **Enter *PPM Correction into Total Station*.** The speed of light in air changes with the density of the air, so we must make a correction to the measured distance. This is done by measuring the temperature and pressure. The correction factor is in terms of parts per million (ppm), or mm/km. From the temperature and pressure you can look up the correction factor in a chart included with the total station, or you can enter the temperature and pressure in the instrument and it will calculate the correction
We apply the correction to the instrument. This way the corrected distance is passed to the SDR33 notebook. You must make sure that the SDR does not repeat the correction!
To enter the temperature and pressure, press the key (bottom right) then the EDM key (top left). From the menu select item [3. ppm], then item [2. Temp & Press]. Enter the temperature and press ENT, then enter the pressure and press ENT. At this time the top item in three line display above the main display will show the ppm correction.
6. **Record instrument coordinates.** *Eo*, *No*, *Ho* are the *E* and *N* coordinates of the station. *Ho* is, for our "plane-table" mapping purposes, the ground elevation. For the first instrument station you may want $E_o = 0.0$, $N_o = 0.0$, and $H_o = 100.0$. For subsequent instrument stations use the coordinates of the point that you are setting up on. These will be entered into the SDR33 notebook if you are using one.
7. **Record reflector heights and prism constants for each reflector.** The instruments are set for a default prism constant of -40mm. Some of the prisms we have are -30mm prisms. Measure the reflector height, DO NOT rely on the calibration on the rod's being correct.
8. **Enter a backsight, or desired angle.** Details given below. How you enter this depends on if you are using a SDR33 and on how much information the SDR33 contains.

Entering a Backsight

You should have the SDR33 notebook setup correctly before you enter a backsight to orient the Total Station. The backsight is a key step in setting up the instrument correctly. It is essential to get the instrument oriented correctly, and it is impossible to orient the instrument with any accuracy using a compass. Surveying measures the angle between two lines of sight, the actual bearing of the lines is generally not of importance. The important thing is to get a survey internally correct. You can establish the absolute orientation of your network of points by surveying in two known locations. For example, you may use existing benchmarks, or GPS to control two of your points.

Using the SDR33 Electronic Notebook

The SDR33 will not let you begin to collect data without either specifying a backsight or telling it that no backsight is needed.

Case I. Starting a new job

If you are starting a new job this is the time to set up your coordinate system. If you are making a control-point map then you will want to orient "North" along the long axis of your mapping project. Point the total station along the long axis and use the instrument control panel to set the direction to zero (see instructions below). Then, when the SDR33 prompts you for the instrument station number, enter any number (usually 1). When prompted for a backsight reading, just press OK, and then confirm that you want to skip the backsight. The SDR will not reset the instrument under these conditions.

If you are making a precise survey of a quadrilateral, then it is the angle between lines that is important, so you do not need to set a backsight. In fact, you do not need to set the orientation of the instrument, you can just start taking readings. When the SDR33 asks you for a backsight, just press OK and confirm that you do not want a backsight reading.

Case II. Continuing an existing job

If you are continuing a job where it is important to orient the instrument, you should set up the instrument over a known point, and set up a reflector over a second known point. When starting to use the SDR33 specify the station number where the instrument is located. If the point number exists in the current job, then the SDR will display the stations coordinates and ask you for a instrument height. If the point number is not found in the current job then you will need to enter the coordinates of the current instrument station and the instrument height.

After specifying the location of the instrument you have to indicate the backsight point number. Again, if this point exists in the current job, you will be asked to point the instrument at a target over this point and take a reading. If the point does not exist, you are given the choice of either entering the coordinates of the backsight point, or the direction to that point. Once you have entered the information about this point, then you will be asked to take a reading to this point

The SDR will set the horizontal circle to value you entered, or from its record of point. It will then take a reading to the point and verify that the range and elevation difference match what is has in the job database (if it is a pre-existing point).

Using the Total Station Keyboard

Press the [3] key. This will put the display in theodolite mode. The vertical (ZA) and horizontal (HAR) angles will now be displayed.

Point the Total Station at your target, or some clearly defined feature that you can accurately line up on again, and either press:

then the [0 SET] key to set a the instrument to zero (North)

or

then the [1] key. Now type in the horizontal angle in the form of *ddd.mmss*, where *d* is degrees, *m* is minutes, and *s* is seconds using the numeric keypad. Press when done.