



Trimble SPSx20

Total Station

Revision C
June, 2017
P/N 57075001-ENG

Legal Notices

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Release Notice

This is the June, 2017 release revision C of the Trimble SPSx20 Total Station user guide, part number 57075001-ENG. It applies to the Trimble SPSx20 Total Station.

The following limited warranties give you specific legal rights. You may have others, which vary from state/jurisdiction to state/jurisdiction.

Product Warranty Information

For applicable product warranty information, please refer to the Warranty Card included with this Trimble product, or consult your Trimble dealer.

Regulatory Information

For applicable regulatory information, please refer to the Trimble SPS Series Total Station Regulatory Information Document included with this Trimble product, or consult your local dealer.

Registration

To receive information regarding updates and new products, please contact your local dealer or visit www.trimble.com/register. Upon registration you may select the newsletter, upgrade or new product information you desire.

Important Information

For safety information please refer to the Trimble SPS Series regulatory information document delivered with the product.

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Introduction

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Welcome

Welcome to the Trimble SPSx20 Total Station user guide. This manual describes how to setup and use the Trimble SPSx20 Total Station. Even if you have used an optical total station before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product.

In this user guide Trimble SPSx20 Total Station refers to all of the available models Trimble SPS620 and SPS720 Total Station. When the description needs to be distinguished between the models they will be referred to as Trimble SPS620 or SPS720 Total Station.

Related Information

For more information about this product, please visit our web site at:

www.trimble.com

Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, **contact your local Distributor**. Alternatively, request technical support using the Trimble web site at:

www.trimble.com

Your Comments

Your feedback about the supporting documentation helps us to improve it with each revision.

E-mail your comments to ReaderFeedback@trimble.com.

Registration

To receive information regarding updates and new products please register on the Trimble web site.

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Getting Started

- ▶ [Trimble SPSx20 Total Station Description](#)
- ▶ [Battery](#)
- ▶ [Turning Instrument On/Off](#)

Trimble SPSx20 Total Station Description

This section describes the Trimble SPSx20 Total Station controls. Trimble recommends that you take some time to familiarize yourself with the names and the locations of the controls, see [Figure 2.1](#) and [Figure 2.2](#).

Trimble SPSx20 Total Station



Figure 2.1 Operator's view of the Trimble SPSx20 Total Station



Figure 2.2 Front view of the Trimble SPSx20 Total Station

Face 2 Display

The face 2 display is a graphical display with a built-in backlight, and three control buttons. See [Figure 2.3](#)

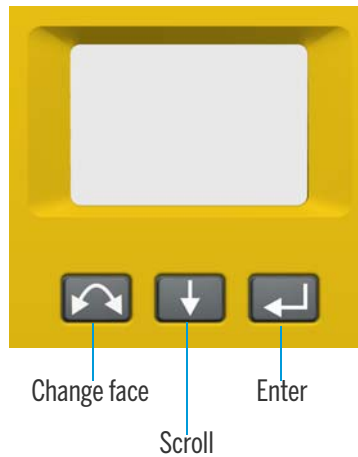


Figure 2.3 Face 2 display and keyboard

When a secondary function is available on a button, an icon appears at the bottom of the display. To access the secondary function, press and hold the appropriate key.

When a controller is connected to the instrument by cable or radio, the SCS900 Site Controller software running on the controller controls the face 2 display and keyboard, and determines which secondary functions are available. For details on how the software controls the face 2 display, refer to the SCS900 Site Controller software documentation.

When there is no controller attached to the instrument, and you turn on the instrument using the On/Off key, the face 2 display shows an electronic leveling screen. See [Figure 2.4](#)



Figure 2.4 Electronic leveling screen on the face 2 display

For information on how to access the compensator menu and instrument setup menu from the face 2 display and keyboard see [Instrument Setup on page 21](#).

Optical Plummet

The instrument is equipped with an optical plummet, which has 2x magnification and a focusing range of 0.5 m to infinity. The instrument can be positioned to an accuracy of 0.5 mm at 1.5 m over a ground mark.



Figure 2.5 Optical plummet

As shown in [Figure 2.5](#):

- To focus the crosshairs, rotate the eye-piece.
- To focus the optical plummet to the ground, push in or pull out the optical plummet.

For information on how to adjust the optical plummet see [Adjusting the Optical Plummet on page 43](#).

Battery

For battery safety and environmental information, please refer to the Trimble SPS Series regulatory information document delivered with the product.

Charging the Lithium-Ion Battery

The battery is supplied partially charged. Charge the battery completely before using it for the first time.

- To charge the battery, use only a charger that is recommended by Trimble for charging the Lithium-ion battery.
- Charge the battery before using the total station if the equipment has been stored for longer than six months.

For more information refer to the Trimble Dual Slot Charger User Guide.

Inserting the Internal Battery

The Trimble SPSx20 Total Station internal battery fits into the battery compartment on the side of the Trimble SPSx20 Total Station. This battery can easily be removed and replaced. To insert the battery:

1. Unclip the battery compartment door
2. Slide the battery into the battery compartment with the battery connectors positioned towards the top of the Trimble SPSx20 Total Station. See [Figure 2.6](#)



Figure 2.6 Removing and replacing the internal battery

Trimble Multi Battery Adapter

⚠ WARNING – Use only the specified battery and cable with the Multi Battery Adapter. Use the adapter only to provide power to the specified Trimble product. Never attempt to charge batteries while they are in the adapter. Please refer to the Trimble SPS Series regulatory information document delivered with the product.

The Multi Battery Adapter is an external battery adapter that holds and connects up to three Trimble SPSx20 Total Station batteries. The Multi Battery Adapter has a hook so that the adapter can be attached to the tripod. See [Figure 2.7](#)

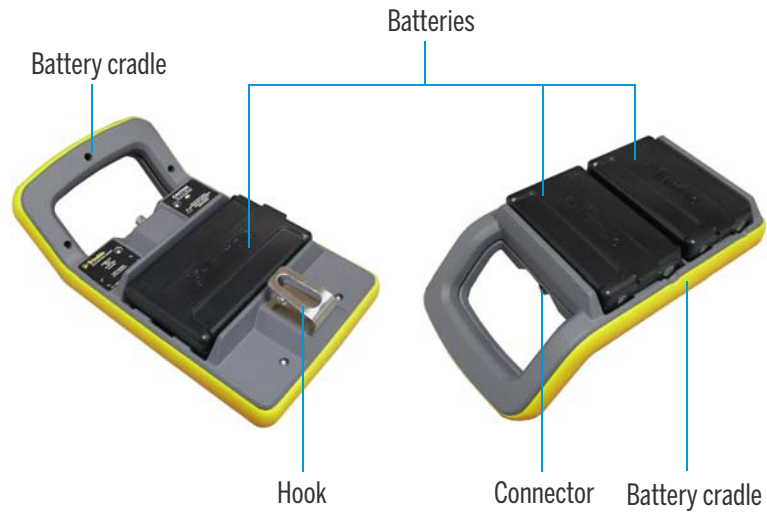


Figure 2.7 Multi Battery Adapter

Connecting the Trimble Multi Battery Adapter


The Trimble Multi Battery Adapter can be connected to the Trimble SPSx20 Total Station with a standard Trimble 6-pin Hirose battery cable. See [Figure 2.8](#)

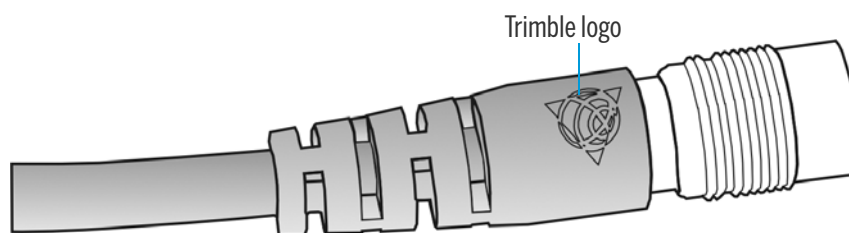


CAUTION – Use only the gray cables with 6-pin Hirose connectors from Trimble when connecting a cable to the Trimble SPSx20 Total Station and Multi Battery Adapter.



Figure 2.8 Connecting the Multi battery Adapter

 **TIP** – When connecting the cable to the Trimble SPSx20 Total Station, keep the Trimble logo on the connector upward.



Turning Instrument On/Off

The instrument is turned on/off with the On/Off and Trigger key, an LED in the key will indicate the instrument status.

Trimble SPSx20 Total Station

Turn Instrument On

Press the Trigger key to turn on the Trimble SPSx20 Total Station. The Trimble SPSx20 Total Station will also turn on if you connect a 12 V power supply to the 12 V power connector and a TSC3 Controller (or PC) to the communication (COM) connector.

The LED will be on solid.

Turn Instrument Off

To turn off the Trimble SPSx20 Total Station press and hold the Trigger key until the LED is off.

The LED will be off.

Setup

- ▶ Setup
- ▶ Starting the Instrument
- ▶ Leveling
- ▶ Instrument Setup
- ▶ The Laser Pointer
- ▶ Measuring the Instrument Height
- ▶ Connecting the TSC3 Controller
- ▶ Pre Measurement Check List

Setup

A stable setup is critical for high precision measurements.

Setup Stability

When performing a setup it is important to consider the following:

1. Set tripod legs wide apart to increase the stability of the setup. A setup where one leg is placed on e.g. asphalt and the other two on soil will still be a stable setup provided that the tripod legs are set wide enough. If it is not possible to set the tripod legs wide apart due to obstacles, then the tripod can be lowered to increase stability.

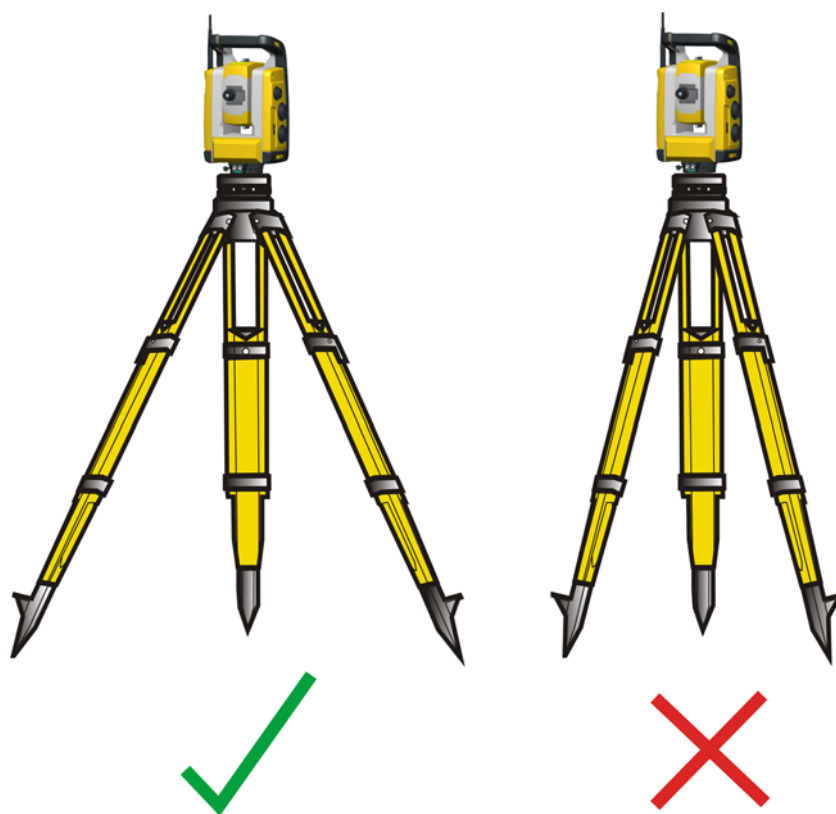


Figure 3.9 Correct set up

2. Make sure that all the screws on the tripod and/or tribrach are tightened to avoid any play.
3. Any high quality tripod and tribrach can be used. However, Trimble strongly recommends the use of tripod heads made of steel, aluminum or similar material. Tripod heads of fiberglass or other composite materials are not recommended.

See [Servo Technology](#) on page 56 for more information.

Measurement Stability

Take into account that precision instruments require sufficient time to adjust to the ambient temperature. The following rule-of-thumb for a high precision measurement applies: Temperature difference in degree Celsius (°C) x 2 = duration in minutes required for the Trimble SPSx20 Total Station to adjust to the new temperature.


Avoid sighting across fields with intense heat shimmer by sun light, e.g. at noon.

Starting the Instrument

NOTE – Before following any of the instructions below, put the instrument in the face 2 position, i.e. the telescope eyepiece, face 2 keyboard and display are pointing towards you.

The face 2 display menus described in this chapter can only be accessed when there is no controller connected (by radio or cable), please disconnect the controller before starting the instrument.

Start the instrument by pressing the trigger/on/off key.

Once you start the instrument, the Select Mode menu appears in the face 2 display, see Figure 3.10. To go to Setup/Level press .

NOTE – If no selection is made within 10 seconds the instrument will go to suspend mode. To return to the select mode menu press the trigger key.

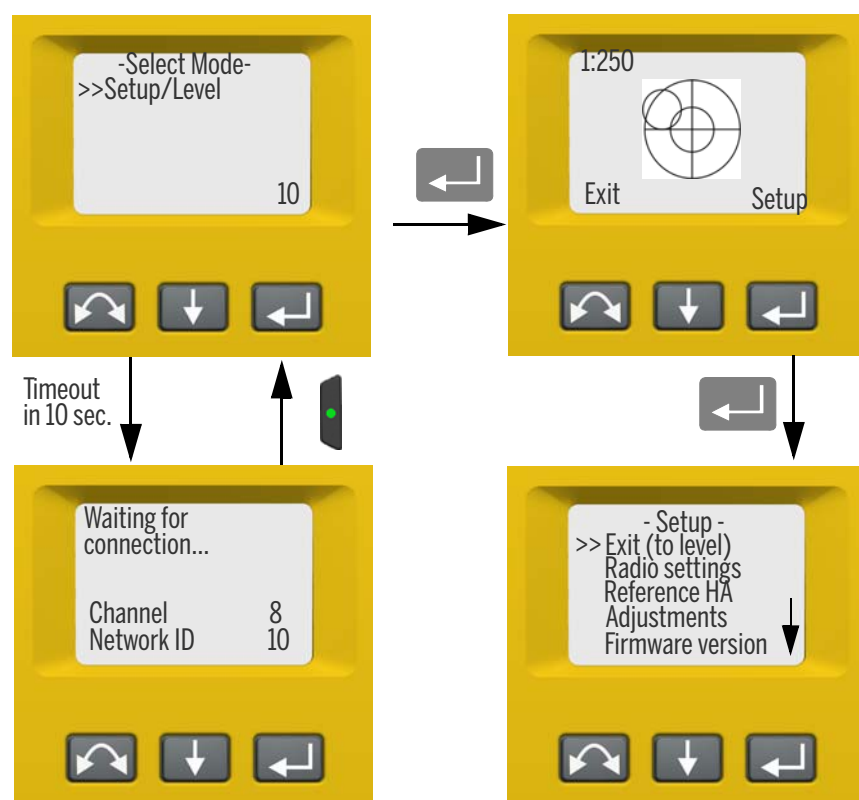


Figure 3.10 Select mode menu

Leveling

Once you have selected Setup/Level, the face 2 display appears with the electronic bubble for leveling. If there is a controller connected by radio or cable, the controller software controls the face 2 display.

Figure 3.11 shows the leveling process.

To toggle between a graphical or numerical display make a long press on .

To change the graphical displays sensitivity (zoom) make a short press on .

To accept and enter the setup menu press .

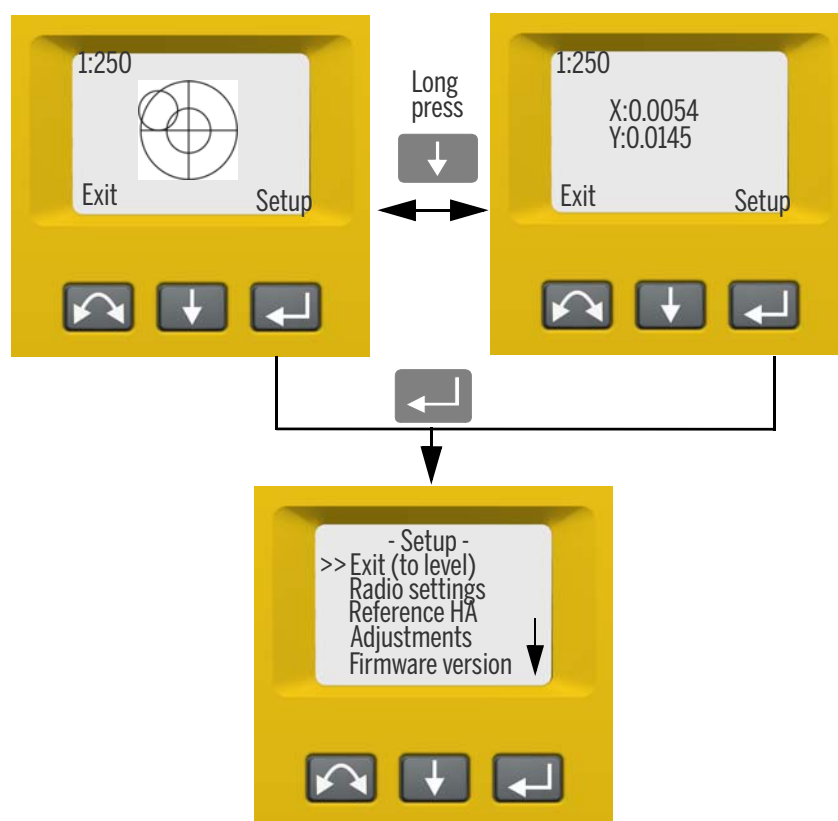


Figure 3.11 The leveling process

NOTE – If the instrument is inactive for longer than 300 seconds (5 minutes) it will go to suspend mode. See [Power Management on page 59](#)

Instrument Setup

With the face 2 display, you can access a number of instrument functions and routines without a controller attached:

In the leveling display select **Setup** by pressing , the Setup Menu appears:

NOTE – It is possible to access the instrument setup menu without levelling the instrument.



The instrument Setup menu is structured as follows:

- Exit (to level)
- Radio settings. See [page 22](#).
- Reference HA. See [page 26](#)
- Adjustments. See [page 27](#).
 - Back
 - Compensator calibration. See [page 27](#).
 - HA/VA and trunnion axis collimation. See [page 29](#).
 - Tracker collimation. See [page 33](#).
 - Laser pointer on/off. See [page 34](#).
- Firmware version information. See [page 36](#).
- Language settings

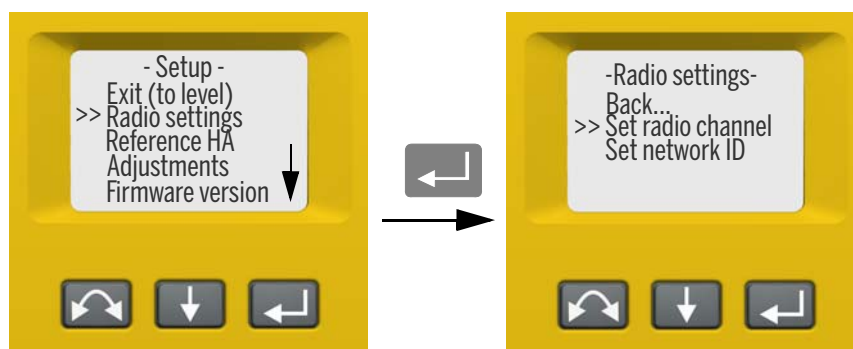
Radio Settings

In the Radio settings menu it is possible to set the radio channel and network ID number.

NOTE – The radio channel and network ID for machine control & Machine Guidance use must be set using the Trimble SCS900 software. These can not be set from the face 2 display.

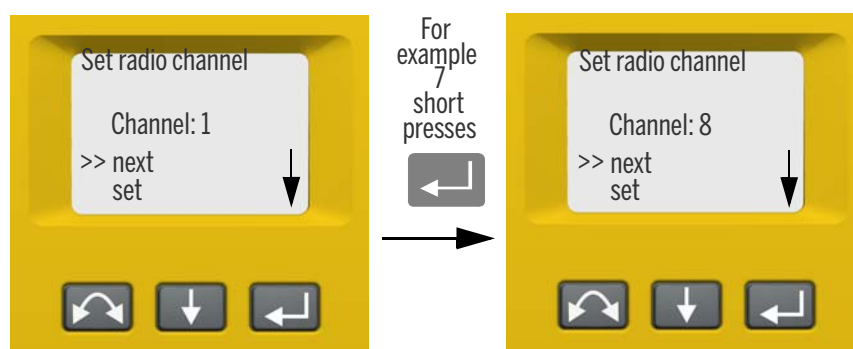
Set Radio Channel

1. Press to scroll to **Radio settings** and then press .
2. Press to scroll to **Set radio channel** and then press .

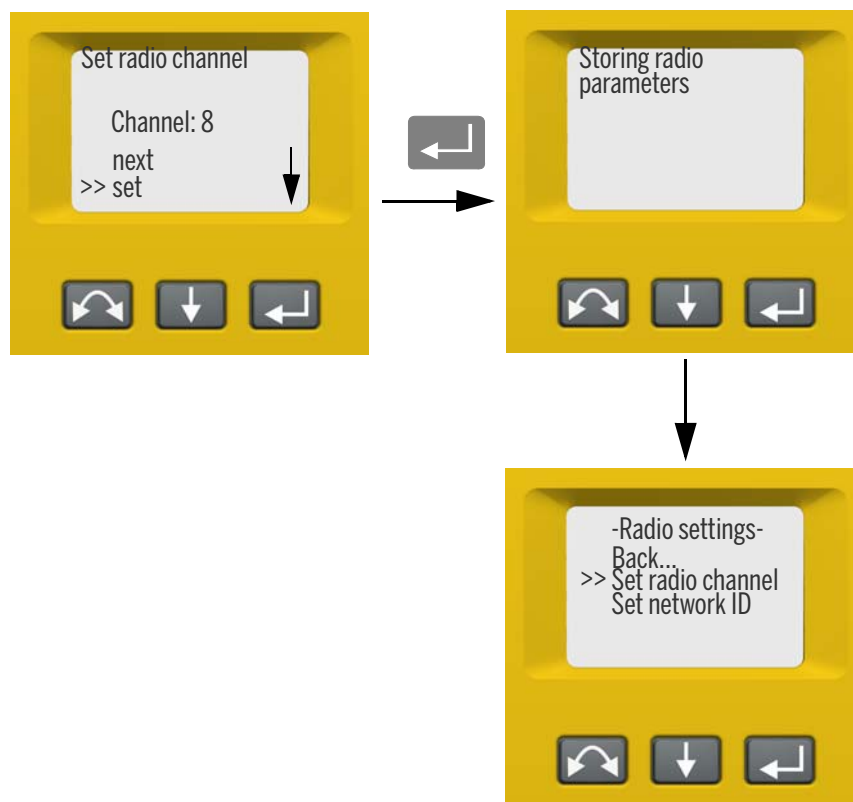


3. To change the radio channel number press to select **Next** and then press to change the channel number in the display.

NOTE – a short press on the enter key will increment the radio channel in increments of 1, pressing and holding the enter key, will increment the radio channel in steps of 10.



4. When you have found the channel number of your choice press to select **Set** and then press to store this channel number. You will then be returned to the **Radio Settings** menu.







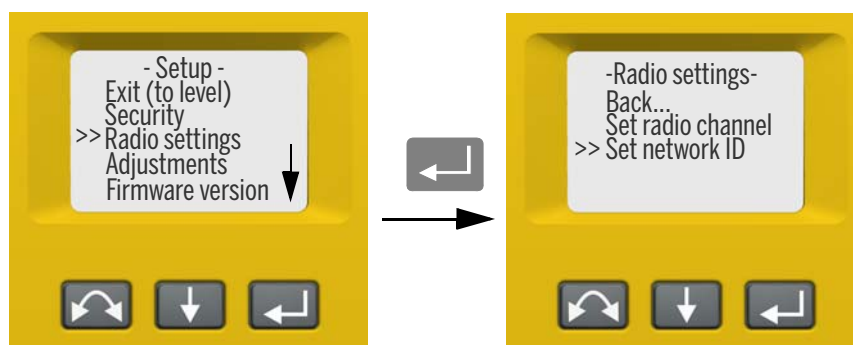
5. If you want to cancel press to select **Cancel** and then press to return to the **Radio Settings** menu.
6. To return to the Setup menu press to scroll to **Back** and then press .



Each combination of channel and network ID is unique, however try to keep each SPS system on a separate radio channel to avoid any likelihood of conflict.

NOTE – The instrument and machine or instrument and robotic rod have to have the same radio channel and network ID for communication over radio to take place.

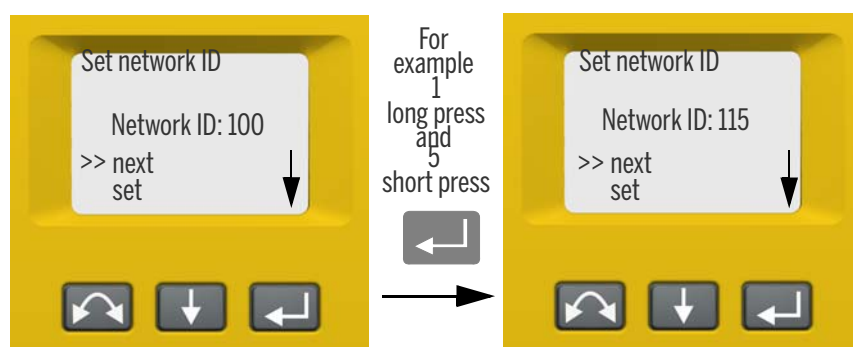
Set Network ID



1. Press  to scroll to **Radio settings** and then press .
2. Press  to scroll to **Set network ID** and then press .

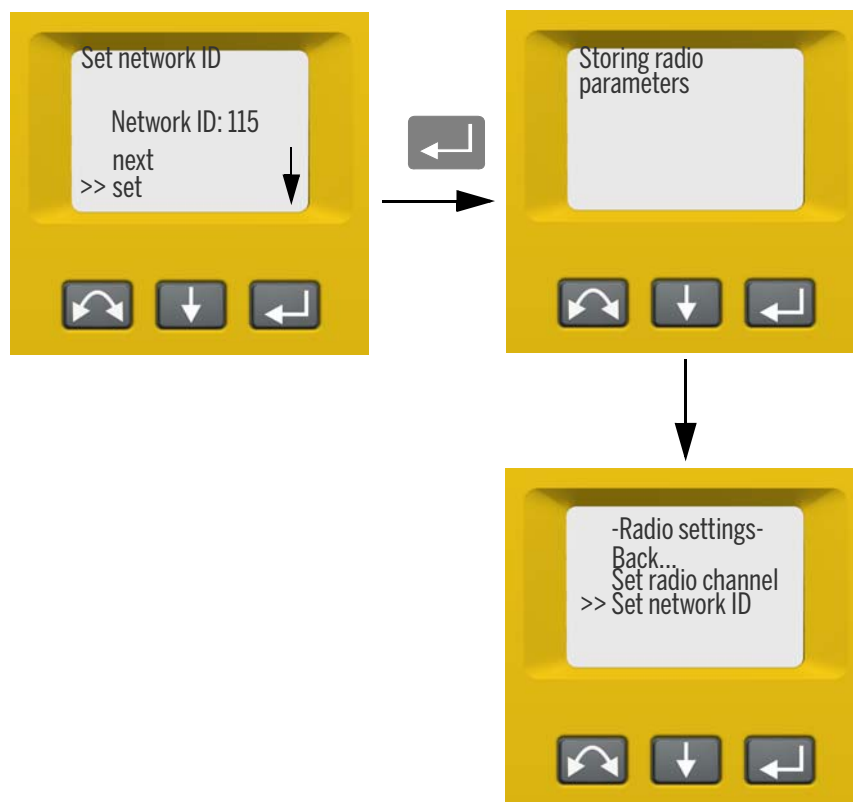


3. To change the network ID number press  to select **Next** and then press  to change the channel number in the display. The available network ID range is 0-255.

NOTE – a short press on the enter key will increment the network ID in increments of 1, pressing and holding the enter key, will increment the network ID in steps of 10.



4. When you have found the network ID number of your choice press  to select **Set** and then press  to store this network ID number. You will then be returned to the **Radio Settings** menu.



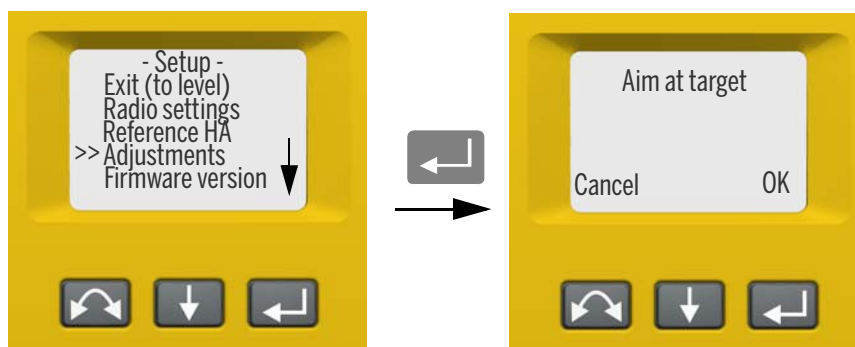
5. If you want to cancel press to select **Cancel** and then press to return to the **Radio Settings** menu.
6. To return to the Setup menu press to scroll to **Back** and then press .

Each combination of radio channel and network ID is unique, however try to keep each SPS system on a separate channel to avoid any likelihood of conflict.

NOTE – The instrument and machine or instrument and robotic rod have to have the same radio channel and network ID for communication over radio to take place.

Reference HA

1. Press to scroll to **Reference HA** and then press .





2. Aim the instrument in face 2 towards the target and then press enter  to set or  to cancel.

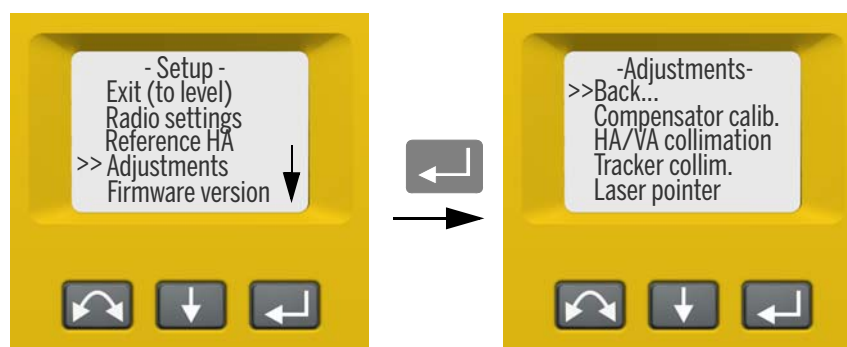
Since the instrument is aimed at the reference target in face 2 while setting the reference HA, the instrument's horizontal circle will be set to 180 degrees or 200 grads. This makes the reference HA 0 degrees or grads in face 1.

The Setup menu appears.

Adjustments Menu

The adjustments menu contains all the instrument collimation and calibration routines.

- Press  to scroll to **Adjustments** and then press .



Compensator Calibration



The SPSx20 Total Stations are all equipped with a dual axis compensator. The compensator is active when the instrument is switched on. The compensator should be calibrated periodically, to adjust for any minor changes in the instrument caused by normal wear and tear, shipping or temperature variations.

To calibrate the compensator, the instrument needs to be in perfect balance. After calibration the compensator sensor will automatically adjust and allow for changes in that balance caused by the presence or the absence of an internal battery.

To minimize imbalance in the instrument:

- An internal battery must be present in the battery compartment.
- The instrument handle must be attached.
- The instrument will automatically position the telescope and distance unit for best balance.

To start the compensator calibration:

- Level the instrument. The instrument will automatically check if the compensator is within range before the calibration is started.
- Press  to scroll to **Compensator calib.** and then press .
- Follow the instructions in the display. [Figure 3.12](#).

NOTE – Trimble recommends that you regularly carry out a compensator calibration, particularly when measuring during high temperature variations and where the highest measurement accuracy is required.

NOTE – If a compensator calibration has been performed, Trimble recommends you carry out an HA/VA and Tracker Collimation. Performing a compensator calibration invalidates the previously stored values from the last HA/VA and Tracker collimation, so it is imperative that you carry out these collimations each time you do a compensator calibration.

The calibration process involves the instrument automatically reading the compensator value at a series of predetermined positions through the full rotation of the instrument. The process takes approximately one minute to complete. During the process the instrument should be on a stable platform, free from vibration and untouched by the user.

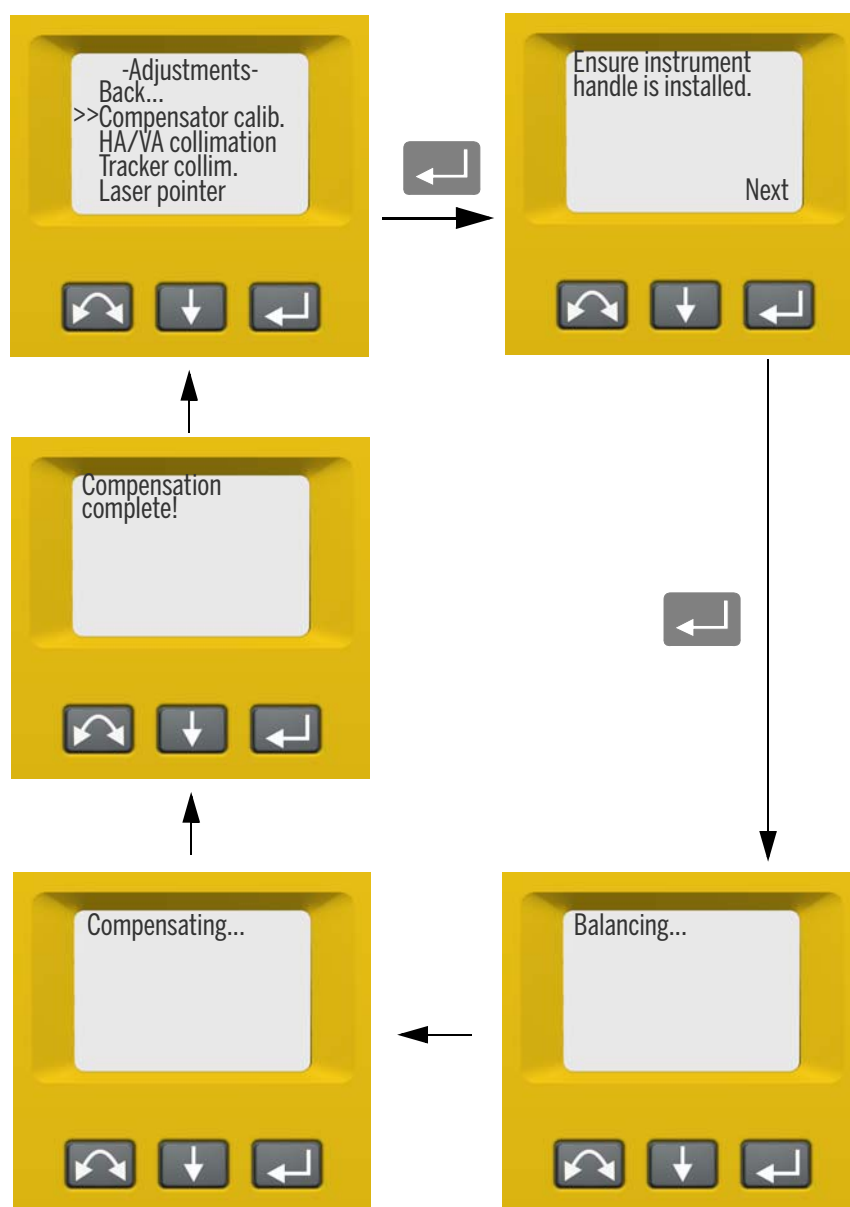


Figure 3.12 Compensator calibration routine

HA/VA Collimation and Trunnion Axis Tilt

The Trimble SPSx20 Total Station instrument utilizes precise angle and distance measurements to determine the 3D position of the point being measured. The instrument's design facilitates the ability to measure all points with a single pointing to the target in the face 1 position. All electronic total stations are subject to collimation errors in both the horizontal and vertical angle measuring systems, and also errors caused by the axis of the telescope not being truly perpendicular to the vertical of the instrument.

In order to compensate for these errors, the collimation routine allows the operator to accurately determine the current errors in the instrument, and store the errors as corrections to be applied to all measurements made in a single pointing to a target. In this way the Trimble SPSx20 Total Stations will always provide accurate 3D positions:

The Collimation errors and Trunnion axis tilt will change over time, the most common changes being caused by

- Wear and tear with use
- Bumps and knocks during transit
- Large changes in operating temperature

Trimble recommends that a HA/VA collimation check and tilt axis check be carried out routinely as follows:

- After any long uncontrolled transport of the instrument (e.g. after service or shipment to a new location)
- After any accidental knock or drop
- At any time when the operating temperature changes by more than 10°C (18°F)
- At any time when the instrument changes it's height above sea level by more than 500m (1640 Feet)
- At any time when the highest accuracy positions are required
- Routinely on a periodic basis (Monthly, weekly etc.)
- Anytime a compensator calibration is performed

Trimble also recommends that the operator keep a record of the dates and values measured so that any gross changes can easily be detected. Gross changes can indicate the need for a check by an approved service center.

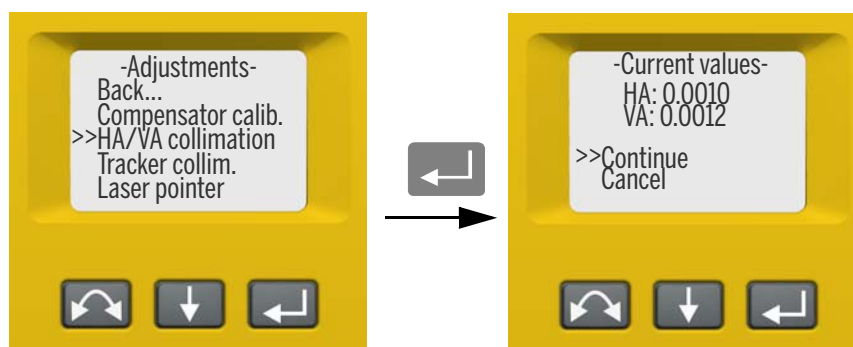
When carrying out collimation error checks using controller and SCS900 software, Trimble recommends that the user maintain a Site and Work Order in the SCS900 system especially for the purpose of tracking the instrument calibration process. SCS900 will store the new collimation and trunnion axis tilt values within the currently open work order. Maintaining a log of all instrument checks, helps QA and QC processes over the lifetime of the instrument.

The adjustment of the instrument for HA/VA collimation and Trunnion Axis tilt is a two stage process. The Horizontal and Vertical collimation and the trunnion axis tilt correction have been measured and stored in the instrument at the factory.




In all calibrations, multiple sightings will be made in both faces to ensure that any minor pointing errors can be eliminated in the accurate determination of current collimation error values.

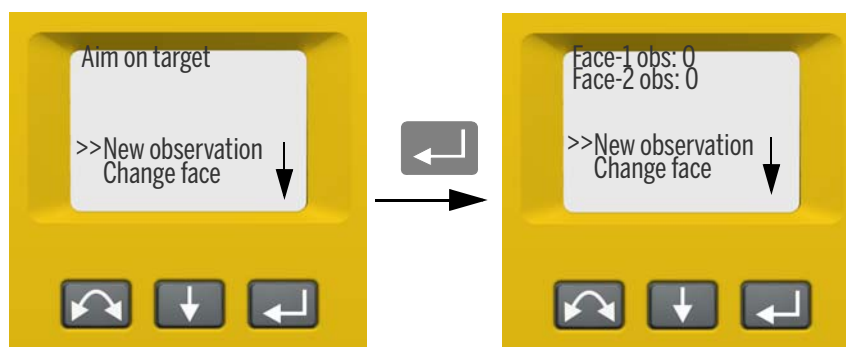
In a new instrument the values should be close to zero, over time these will change. The instrument allows a maximum value of 0.05 grads (0.045 degrees) in the HA, VA and Trunnion axis tilt values. If these values are exceeded, the instrument will need service to rectify a mechanical problem.

1. Press  to scroll to **HA/VA collimation** and then press .







The current collimation values appear.







2. Press  to scroll to one of the following:
 - **Continue** Then press  to continue the HA/VA collimation test.
 - **Cancel**. Then press  to return to the **Adjustments** menu.



If you select Continue:





3. Press  to scroll to one of the following:
 - **New observation**. Then press  to continue the HA/VA collimation test.
 - **Change face**. Then press  to change between face 1 and 2.
 - **Cancel**. Then press  to return to the **Adjustments** menu.

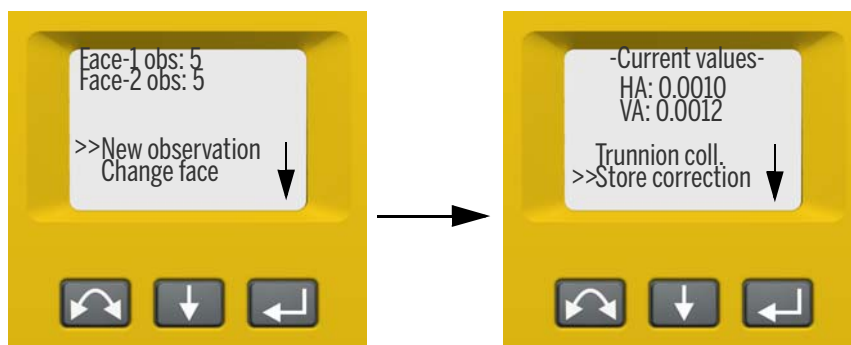
If you select New observation:

- a. Aim accurately in face 2 towards a point near the horizon at max. ± 5 grads (± 4.5 degrees) to the horizontal and at a minimum distance of 100 m (328 ft.).
- b. Press  to scroll to **New observation**. Then Press  to measure and record a pointing.
- c. Re sight the instrument at the same point and press the enter key again. Repeat this process for a minimum of 3 sightings in face 2.
- d. Press  to scroll to **Change face**. Then press  to change to face 1.
- e. Aim accurately towards the same point as that used in face 2.
- f. Press  to scroll to **New observation**. Then Press  to measure and record a pointing.

- g. Re sight the instrument at the same point and press the enter key again. Repeat this process for the same number of times as in face 2.

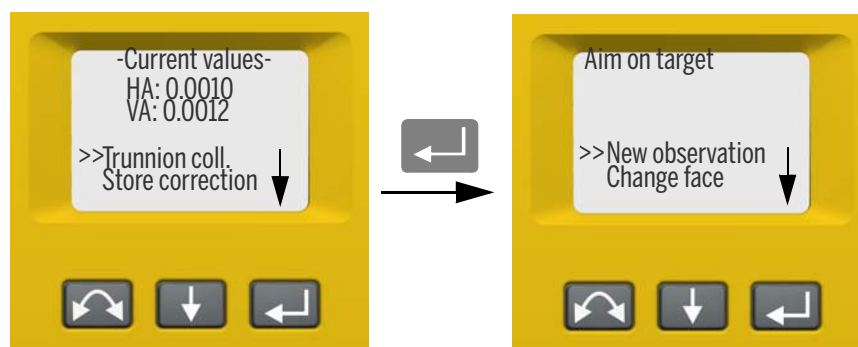
As observations are made on the first face (either face 1 or face 2), the angle values are stored and the counter increases. When one or more observations have been taken on each face, and the number of observations on each face are the same, the software calculates and displays the new horizontal and vertical collimation values.

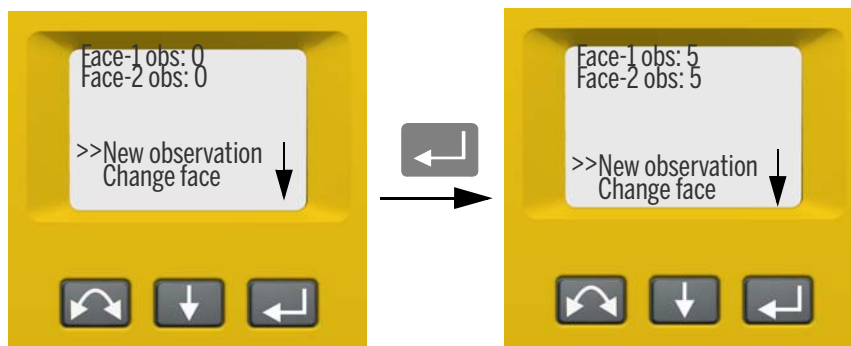
4. Press  to scroll to one of the following:
- **Trunnion coll.** Then press  to continue to Trunnion collimation.
 - **Store correction.** Then press  to accept and store the new collimation values.
 - **Cancel.** Then press  to return to the **adjustments** menu.



Select **Trunnion coll.** to continue with trunnion axis tilt collimation.

5. Press  to scroll to **Trunnion coll.** Then press  to continue the Trunnion axis tilt test.





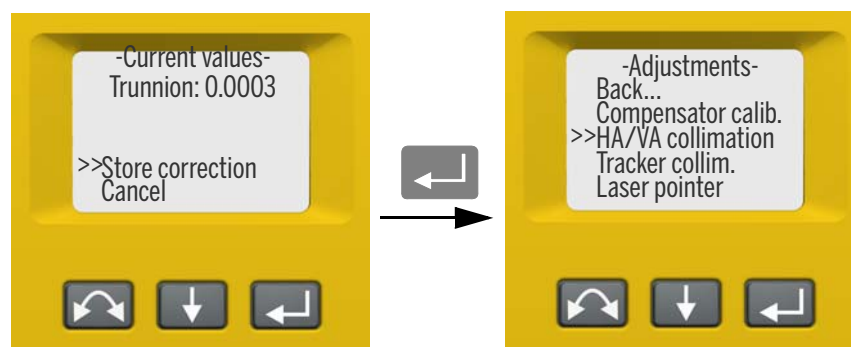
6. Press to scroll to one of the following:

- **New observation.** Then press to continue the trunnion axis tilt test.
- **Change face.** Then press to change face.
- **Cancel.** Then press to return to the adjustments menu.

If you select **New observation** the number of observations in both faces appears:

- a. Aim accurately in face 2 towards a point at least 15 grads (13.5 degrees) above or below the point where the collimation test was made at a minimum distance of 30 m (66 ft.).
- b. Press to measure and record angles.
- c. Press to scroll to **Change face**. Then press to change face.
- d. Aim accurately towards the point.
- e. Press to measure and record angles.

As observations are made on the first face (either face 1 or face 2), the angle values are stored and the observation counter increases. When one or more observations has been taken on each face, and the number of observations on each face are the same, the software calculates and displays the new trunnion axis tilt value.



7. Press to scroll to one of the following:

- **Store correction.** Then press to accept the new trunnion axis tilt value. The **Adjustments** menu appears.
- **Cancel.** Then press to return to the **Adjustments** menu.

NOTE – The instrument will prohibit a trunnion axis tilt test if it is made towards a point with an angle less than 15 grads (13.5 degrees) from the point where the collimation test was made. The trunnion axis tilt determination accuracy will improve with a steeper angle towards the measured point. The minimum distance for the trunnion axis tilt measurement is 30 m (66 ft.).

NOTE – If the trunnion axis tilt correction value is greater than 0.05 grads (0.045 degrees), the message **Fail Remeasure?** appears. Press Yes and then repeat the measurement procedure. If the value is greater than 0.05 grads (0.045 degrees) and you answer No to the re measurement message, the instrument uses the correction value previously stored in the instrument. If the value is greater than 0.05 grads (0.045 degrees), then the instrument must be mechanically adjusted at the nearest authorized Trimble service center.

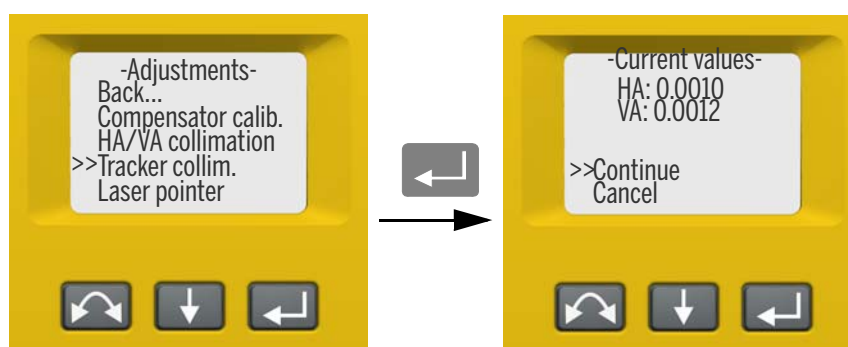
Tracker Collimation



The instrument tracker unit is designed to be coaxial with the instrument cross hairs. For this reason a tracker collimation check needs to be carried out on a regular basis (under the same conditions as the HA/VA collimation check) to ensure that any slight misalignment is corrected for.

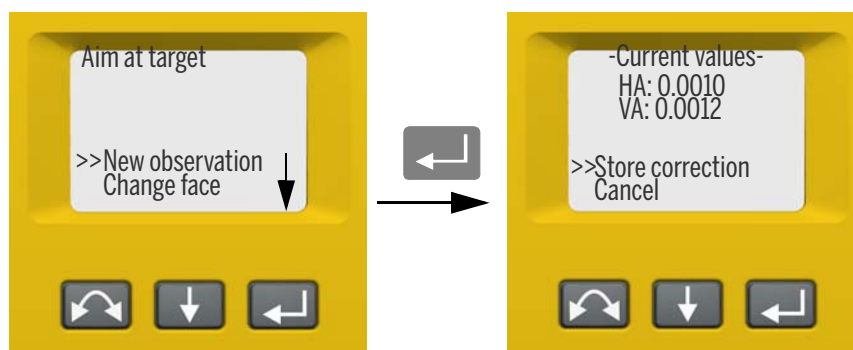
Perform the test over a similar distance as that you will be working on, but at least 100 m. The prism target must be very still during the test (Trimble recommends that you use a tripod or bipod mount for the target) and must be in clear line of sight without any obstructing traffic. The instrument is calibrated to accurately point at the center of the target in both horizontal and vertical axes. The calibration is used to correct the positions of all points measured using the Autolock® technology function. The measured calibration values are stored and used until a new set of calibration values are determined.

NOTE – The adjustment between the two optical axes, i.e. the Telescope and the Tracker, may differ. See Aiming on page 54

1. Press  to scroll to **Tracker collim** then press .



2. Accurately aim towards a prism.
3. Press  to scroll to **New observation** and then press .



4. The instrument will measure to the target in both faces automatically and then display the current values.
5. Press to scroll to one of the following:
 - **Store correction.** Then press to save the correction values.
 - **Cancel.** Then press to return to the **Adjustments** menu
6. Once the instrument has stored the correction values, the **Adjustments** menu appears.

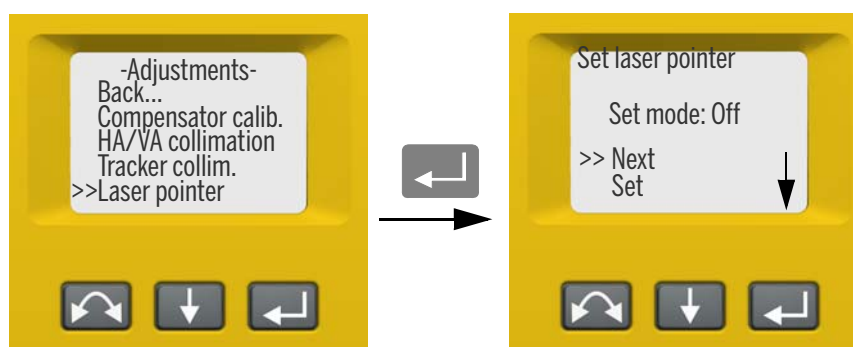
Laser Pointer

The laser pointer is a visible laser that is emitted from the telescope along the line of sight. The laser is used to visibly indicate the point being measured, and is especially useful when employing the DR reflectorless EDM for measurement. The laser pointer is clearly visible in areas of shadow, inside buildings and tunnels and also at night, however in bright sunshine it is generally not readily visible with the human eye.

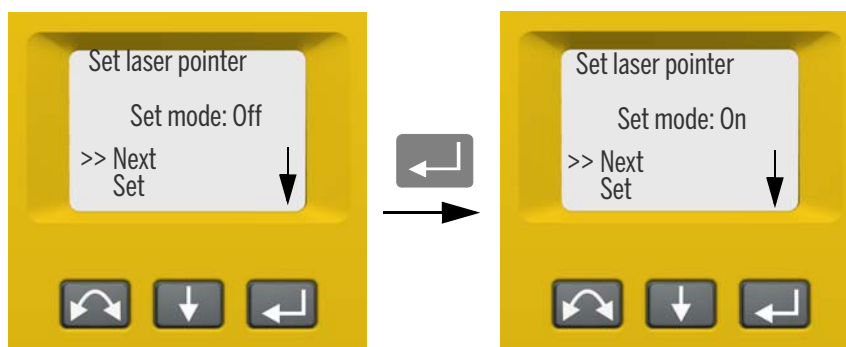
The following controls allow the laser pointer to be switched On and Off.



Note: The laser pointer is mechanically aligned to the telescope cross hairs. The laser may require periodic adjustment to keep it perfectly aligned for measurement. In order to adjust the laser pointer it has to be switched On, [see page 3-37](#).

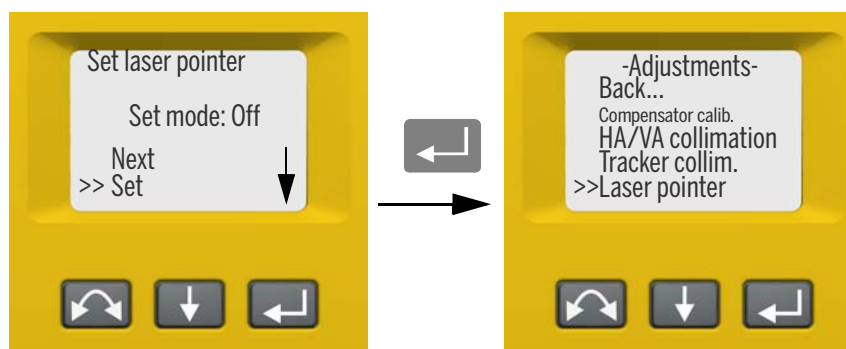
1. Press to scroll to **Laser pointer** then press .





2. To change the laser pointer setting press  to select **Next** and then press  to select **On** or **Off**



3. When you have found the setting of your choice press  to select **Set** and then press  to store this setting. You will then be returned to the **Adjustments** menu.

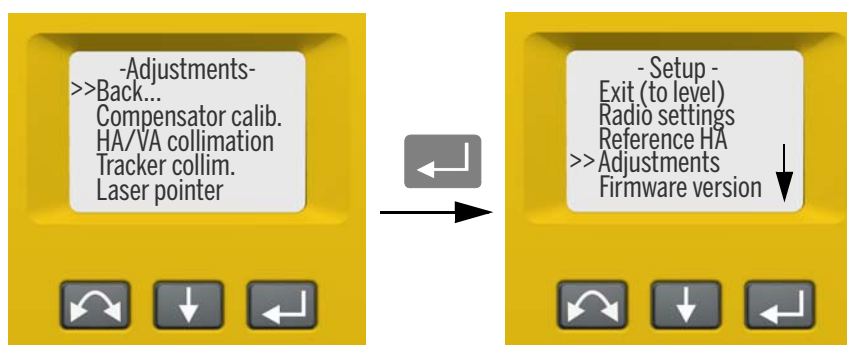


4. If you want to cancel Press  to select **Cancel** and then press  to return to the **Adjustments** menu.



With the laser pointer on, you can adjust the beam, For more information, see [The Laser Pointer, page 37](#).

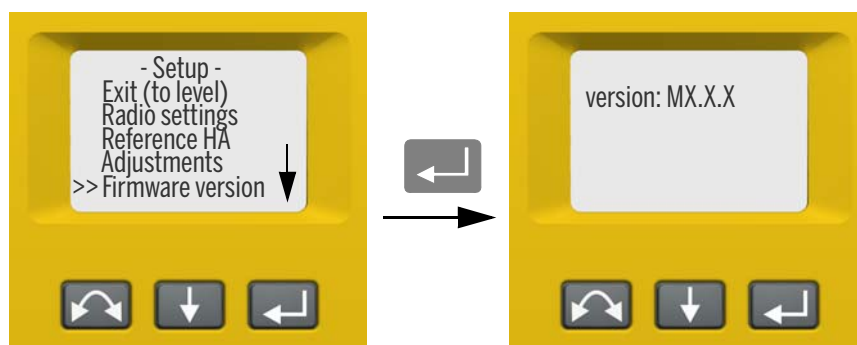
Back

1. To return to the **Setup** menu, press  to scroll to **Back...** and then press .





Firmware Version Information

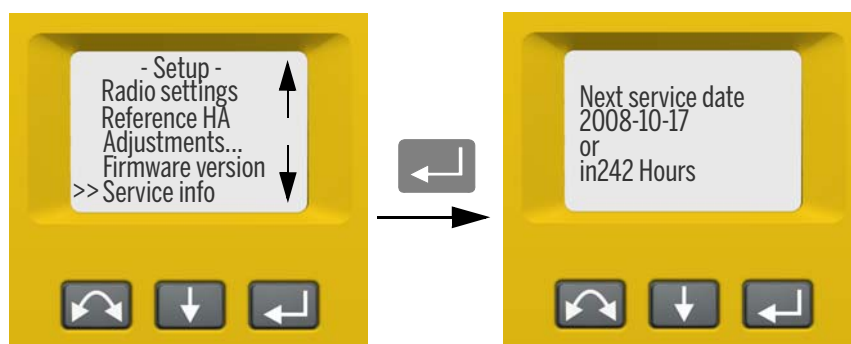
1. Press  to scroll to **Firmware version** and then press . The instrument firmware version appears on the screen. The program will return automatically to the **Setup** menu.



Service Info





In the **Service info** menu it is possible to see the date for the next recommended service occasion or how many run time hours the instrument has left before service is recommended.

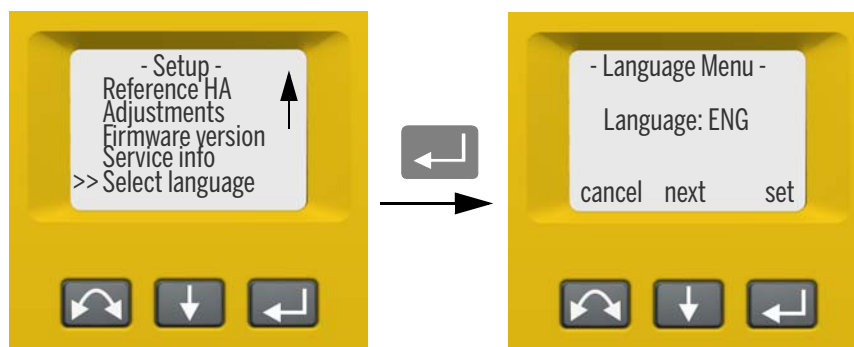
1. Press  to scroll to **Service info** and then press . The instrument service info appears on the screen. The program will return automatically to the **Setup** menu.



Select Language

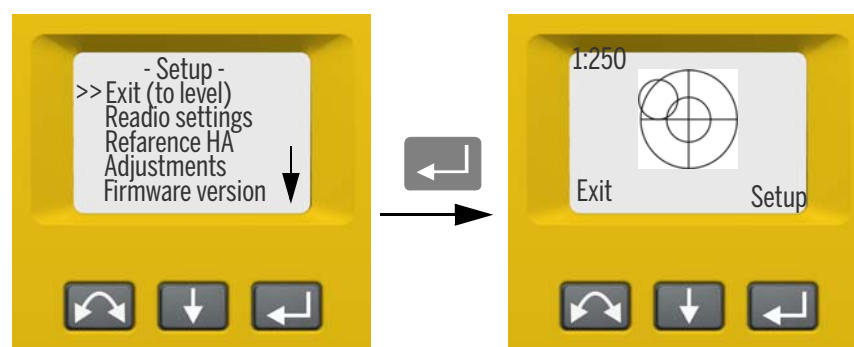
In **Select language** it is possible to select the language for the Face 2 display.

1. Press  to scroll to **Select language** and then press .
2. Press  to scroll through the available languages.
3. Press  to set language.



Exit Menu

1. To exit the **Setup** menu press to scroll to **Exit (to level)** and then press . The electronic level appears.



NOTE – If the instrument is left idle for more than 300 seconds (5 minutes) during any of the above routines, then the instrument goes to suspend mode.

The Laser Pointer

The Trimble SPSx20 Total Station uses a red laser as a laser pointer. The laser pointer is coaxial with the line of sight of the telescope. If the Trimble SPSx20 Total Station is well adjusted, the red laser pointer coincides with the line of sight. External influences such as shock or large temperature fluctuations can displace the red laser pointer relative to the line of sight.

Checking the Laser Pointer Alignment

CAUTION – Viewing the laser spot on the Laser adjustment plate through the telescope is safe. Do not try to make the adjustment using a prism, the reflected light from a prism can dazzle your eyes.

CAUTION – Do not use the laser pointer as an aid when searching for prisms, the reflected light can dazzle your eyes. The reflected light will not damage your eyes, but might be uncomfortable.

To avoid faulty measurements using the laser pointer, use the supplied Laser adjustment plate to check the laser alignment regularly and before you attempt precise distance measurements:

1. Setup the Laser adjustment plate 25–50 meter away, facing the Trimble SPSx20 Total Station, [see Figure 3.13](#).
2. Activate the laser pointer function to switch on the red laser beam.
3. Aim the Trimble SPSx20 Total Station to the center of the Laser adjustment plate and then inspect the position of the red laser spot in relation to the telescope cross-hairs.
4. If the red laser spot lies outside the cross-hairs, the Laser Pointer needs to be adjusted, [See Adjusting the Laser Pointer on page 38](#)

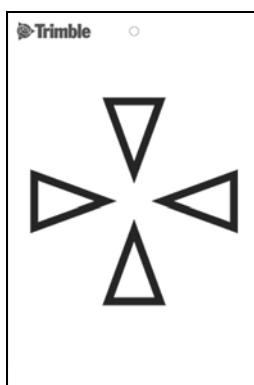


Figure 3.13 Laser adjustment plate

Adjusting the Laser Pointer

The following steps describes how to adjust the Laser Pointer.

1. Pull out the two plugs from the adjustment ports on top of the telescope housing. [Figure 3.14](#)



Figure 3.14 Laser pointer adjustment ports

2. To correct the vertical position of the laser spot, insert the allen key into the vertical adjustment port and turn it as shown in [figure 3.15](#).

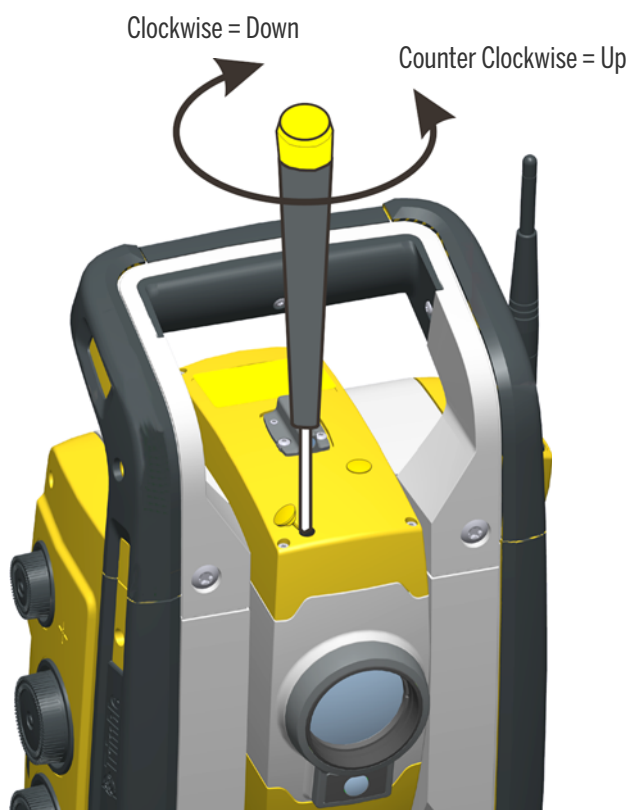


Figure 3.15 Vertical position adjustment

3. To correct the horizontal position of the laser spot, insert the allen key into the horizontal adjustment port and turn it as shown in [Figure 3.16](#).

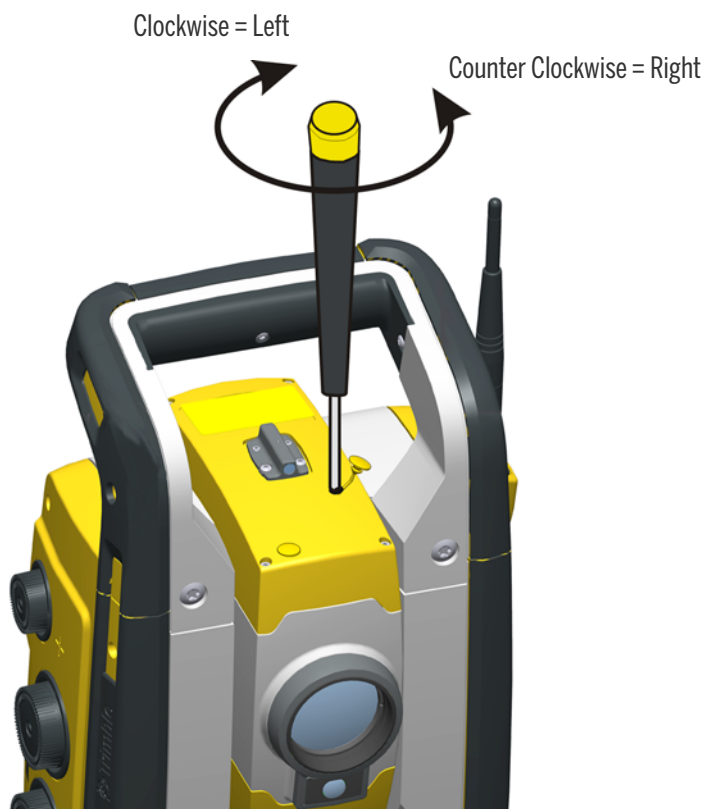


Figure 3.16 Horizontal position adjustment

4. Check the alignment of the laser spot and the cross-hairs. Throughout the adjustment procedure, keep the telescope pointing to the adjustment target. The adjusting screws are of a high tension because they are self locking. The screws tighten automatically after you adjust them.
5. Refit the plugs in the adjustment holes. Make sure that the plugs are correctly fitted for proper sealing against the cover.

CAUTION – To keep out moisture and dust, make sure that the plugs are correctly fitted in the adjustment ports.

Measuring the Instrument Height

There are two measurement marks on the side of the Trimble SPSx20 Total Station. The top mark corresponds to the trunnion axis of the Trimble SPSx20 Total Station. The bottom mark is 0.158 m (0.518 ft.) below the top mark. Measure the bottom mark to the top ridge of the mark as shown in [Figure 3.17](#)



Figure 3.17 Instrument height marks

When there is a TSC3 attached running a field application software, the software has additional functions that reduce the bottom mark measurement to the required vertical instrument height to the trunnion axis, [see Figure 3.18](#) and the following paragraph.

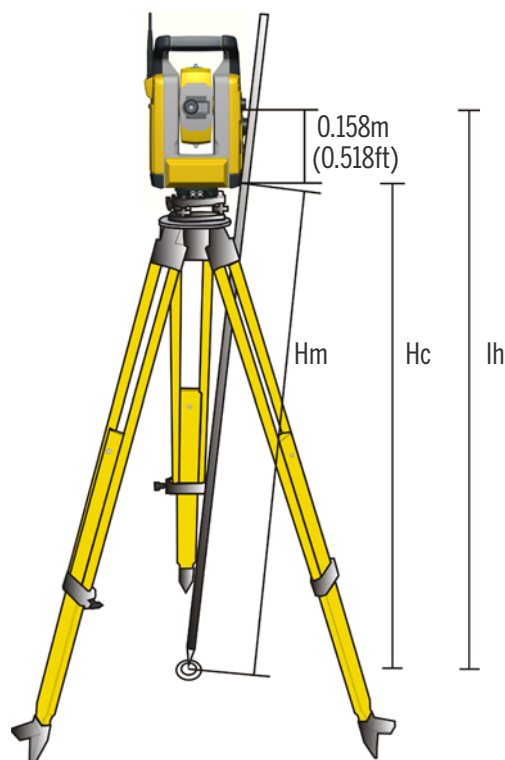


Figure 3.18 Instrument height measurement

The measured distance (H_m) is corrected for the slope of the measurement to obtain a vertical measurement to the bottom mark (H_c). The constant from the bottom mark to the top mark (0.158 m/0.518 ft.) is added to the H_c to obtain the vertical instrument height from the ground mark to the trunnion axis (l_h). For more information, refer to the field software documentation.

Alternatively, to obtain an accurate measurement to the top mark (l_h), you can manually measure the slope distance from the ground to the bottom mark (H_m). To calculate the total instrument height (l_h), insert the measured slope distance (H_m) into the formula below:

$$l_h = 0,158 + \sqrt{H_m^2 - 0,091^2}$$

Adjusting the Optical Plummet

1. Set up the instrument and level it over a ground mark so that the tripod height is 1.5 m (± 0.1 m) (4.920 ft. (± 0.328 ft.)) as shown in [Figure 3.18](#)
2. Note the position of the inner circle of the optical plummet in relation to the ground mark.
3. Turn the instrument 200 grads (180 degrees).
4. Note the position of the inner circle of the optical plummet in relation to the ground mark. If the inner circle of the optical plummet reticule moves in relation to the ground mark, you must adjust the plummet reticule location.

5. Adjust out half of the error with the four adjustments screws on the optical plummet.
6. Turn the instrument 200 grads (180 degrees).
7. If there is no movement between the inner circle of the optical plummet reticle in relation to the ground mark, no further adjustment is needed.

CAUTION – When adjusting the optical plummet with the four adjustment screws it is important that the screws are correctly adjusted. When one screw is adjusted the opposite screw must be adjusted equally in the reverse direction, in order to keep the correct tension on the optics. Do not overtighten the screws, this might damage the optics.



Figure 3.19 Optical plummet adjustment

Connecting the TSC3 Controller

The TSC3 is used as a controller for the Trimble SPSx20 Total Station.

Connecting With Cable

The TSC3 is connected from the Trimble SPSx20 Total Station Communication (COM) connector to the TSC3 RS232 connector using cable part number 53002021.



Figure 3.20 TSC3 connected to the Trimble SPSx20 Total Station with cable for servo and Autolock measurements.

Connecting in Robotic Mode

The TSC3 is connected directly to the Trimble SPSx20 Total Station via the integrated radio.



Figure 3.21 TSC3 connected to the SPSx20 Total Station using the integrated radio for robotic measurements

Pre Measurement Check List

Before you begin measurement or stake out operations, check the following items:

- Lenses are clean
- Trimble SPSx20 Total Station is correctly leveled
- Collimation error
- Tracker collimation error
- Trunnion axis tilt
- Correct radio channel and network ID are selected (robotic measurements only)
- Laser Pointer beam alignment
- Measure instrument height
- Allow sufficient time for the Trimble SPSx20 Total Station to adjust to the ambient temperature, see [page 20](#)

Trimble SPSx20 Total Station Technology

- ▶ Angle Measurement Technology
- ▶ Distance Measurement Technology
- ▶ Tracker Technology
- ▶ Radio
- ▶ Tracklight
- ▶ Servo Technology
- ▶ Power Management
- ▶ Power Supply
- ▶ External Communication
- ▶ Removable Handle

Angle Measurement Technology

The principles of angle measurement are based on reading an integrated signal over two opposite areas of the angle sensor and producing a mean angular value. This eliminates inaccuracies caused by eccentricity and graduation.

In addition, the angle measurement system compensates for the following automatic corrections:

- Mislevelment (deviation of the plumb axis).
- Horizontal and vertical collimation error.
- Trunnion axis tilt. See [page 49](#)

Correction for Mislevelment

The Trimble SPSx20 Total Station automatically corrects for mislevelments up to $\pm 6'$. The Trimble SPSx20 Total Station warns the operator immediately of any mislevelments in excess of $\pm 6'$ (± 0.11 grads).

Corrections for the horizontal angle, vertical angle, and slope distance are calculated in the field application software and applied to all measurements.

Correction for Collimation Errors

The horizontal collimation error is the deviation of the sighting axis from its required position at right angles to trunnion axis.

The vertical collimation error is the difference between the vertical circle zero and the plumb axis of the Trimble SPSx20 Total Station.

Traditionally, collimation errors were eliminated by observing angles in both faces. In the Trimble SPSx20 Total Station, a pre-measurement collimation test is performed to determine the collimation errors. Angular measurements are observed in both faces, the collimation errors are calculated, and the respective correction values are stored in the Trimble SPSx20 Total Station. The collimation correction values are then applied to all subsequent angle measurements. Angles observed in a single face are corrected for collimation errors, which eliminates the need to measure in both faces.

Carry out a collimation test in the following situations:

- Whenever the Trimble SPSx20 Total Station may have been roughly handled during transport.
- When the ambient temperature differs by more than 10°C (18°F) from the previous collimation test.
- Immediately prior to high precision angle measurements in one face.

Trimble SPSx20 Total Station Tracker Collimation

A Trimble SPSx20 Total Station can automatically lock and track a prism target. Pointing errors caused by slight misalignment of the Trimble SPSx20 Total Stations tracker have a similar effect to the HA and VA Collimation errors detailed above.

To correct for the tracker collimation errors, carry out a tracker collimation test. The tracker collimation test automatically observes angular measurements to a target in both faces, the tracker collimation errors are calculated and the respective correction values are stored in the Trimble SPSx20 Total Station. The tracker collimation correction values are then applied to all subsequent angle measurements observed. Angles observed in a single face are corrected for collimation errors, which removes the need to measure in both faces.

Carry out a tracker collimation test in the following situations:

- Whenever the Trimble SPSx20 Total Station may have been roughly handled during transport.
- When the ambient temperature differs by more than 10°C (18°F) from the previous collimation test.
- Immediately prior to high precision angle measurements using the tracker in a single face.

Correction for Trunnion Axis Tilt

The trunnion axis tilt error is the deviation of the trunnion axis of the telescope from its required position at right angles to the plumb axis of the Trimble SPSx20 Total Station. See [Figure 4.22](#)

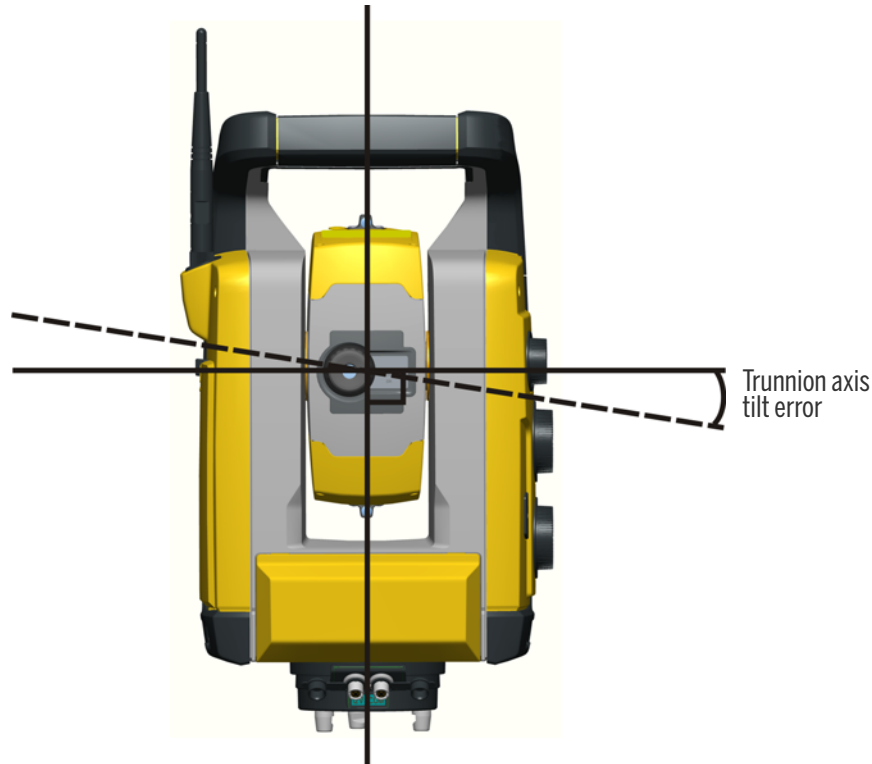


Figure 4.22 Trunnion axis tilt error

In the Trimble SPSx20 Total Station, perform a pre-measurement trunnion axis tilt test to determine the trunnion axis tilt error. Angular measurements are observed in both faces, the trunnion axis tilt error is calculated, and the respective correction value is stored in the Trimble SPSx20 Total Station. The trunnion axis tilt correction value is then applied as a correction to the horizontal angle value.

Carry out a trunnion axis tilt test in the following situations:

- Whenever the Trimble SPSx20 Total Station may have been roughly handled during transport.
- When the ambient temperature differs by more than 10°C (18°F) from the previous collimation test.
- Immediately prior to high precision angle measurements in one face, especially where the vertical angles significantly deviate from the horizontal plane.

Averaging Measurements to Reduce Sighting Errors

The Trimble SPSx20 Total Station automatically reduces sighting errors caused by the misalignment of the Trimble SPSx20 Total Station to the target or by pole movement during measurement. The following techniques can be used:

- Use Autolock. When Autolock is enabled, the Trimble SPSx20 Total Station automatically locks onto and tracks the target. Manual sighting errors are reduced.
- Automatically average angles during distance measurement. When measuring in Standard mode, the Trimble SPSx20 Total Station takes approximately 1.2 seconds to measure the distance. Angles returned to the Trimble SPSx20 Total Station at 1000 Hz, are averaged over the 1.2-second period to obtain an averaged angle measurement. The resultant angle measurement is an average of over 1200 observations.
- Use average measurement methods in the field software.

Distance Measurement Technology

Trimble SPSx20 Total Station are equipped with a combined distance unit. This means that the Trimble SPSx20 Total Station can measure to a prism or to normal surfaces (direct reflex (DR) mode). The following sections describes the system.

DR PLUS EDM

The Trimble SPSx20 Total Station EDM is a pulsed laser distance unit that determines distances by precisely measuring the flight time of the transmitted light pulse. The distance unit generates many short laser pulses, which are transmitted through the telescope to the target. The pulses reflect off the target surface and return to the instrument where the unit determines the time difference between the transmitted pulses and the received pulses. The unit uses the time difference to calculate the distance to the target.

The distance unit includes additional functions that allow you to control the accuracy and precision of a DR measurement through the field application software.

field application software includes:

- Standard Deviation. This allows you to configure the required precision of the DR measurement before the distance will be accepted. The distance measurement process will be carried out by the instrument until the preset standard deviation value has been achieved. The default standard deviation value is 0.003m. Setting this value to a higher number gives shorter measurement time but is less accurate, especially when measuring to surfaces at greater distances or at oblique angles to the line of sight.
- Weak Signal. This allows you to accept a DR measurement that is below the normal instrument specification. This is useful when measuring to poor reflective surfaces, or when trying to achieve the maximum range of the instrument.
- Min.-Max Range. This allows you to specify the DR measurement interval. For example, when you measure to a small object at 50 m with a background object at 200 m, set the min.-max range from 2 m to 100 m. The distance meter is then tuned to provide a distance within the specified range and to ignore any signal from outside the defined range. By default, the min.-max range is 2–300 m.

Beam Divergence

All distance meter measurement beams diverge as the range from the instrument increases. The divergence of the distance meter beam relates to an increase in the size of the area being sampled, not to a degradation of the measurement precision. See [Figure 4.23](#)

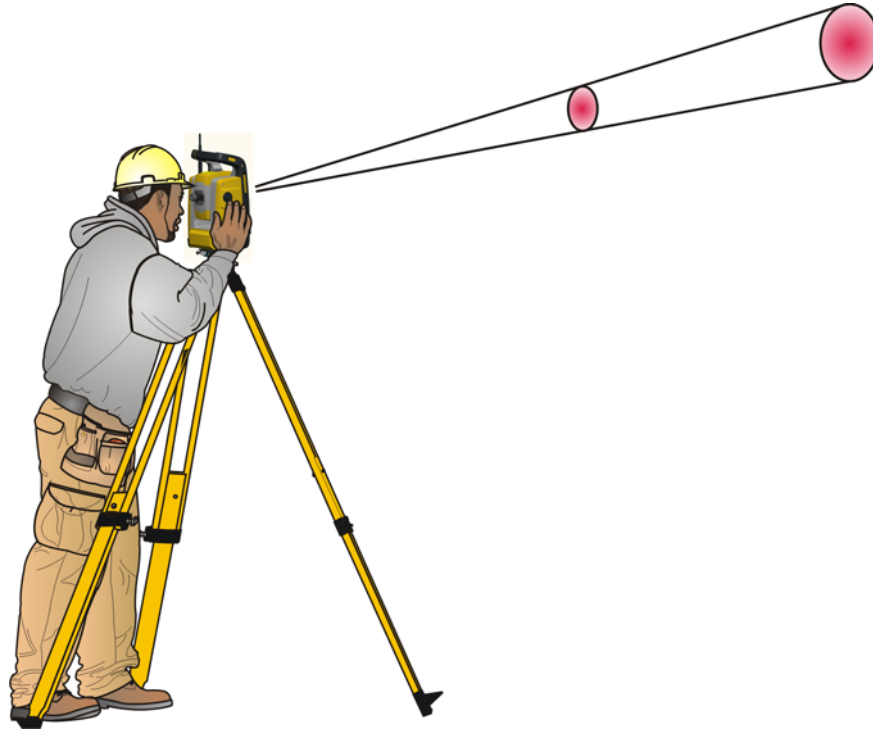


Figure 4.23 Beam divergence.

A larger measuring area at longer range is generally better because it enables smaller objects, such as power lines and antennas, to be detected and accurately measured. With a smaller measuring area, these small objects can be easily missed. A smaller measuring area has advantages when measuring tight corners and vertices at close range. When observing measurements to a tight corner, the distance

meter beam divergence introduces a range error caused by the size of the sampling area. See [Figure 4.24](#)

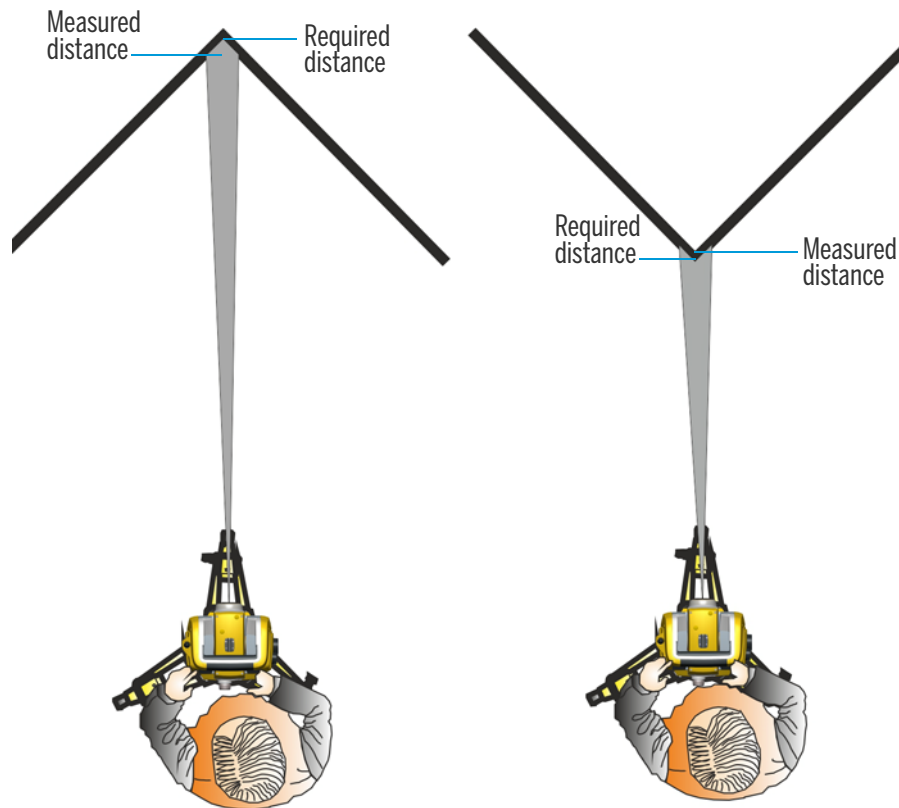


Figure 4.24 Measuring to an inner and an outer corner

Although the problem is reduced with a beam that uses a smaller measuring area, the error can not be completely eliminated. The most accurate solution to measure to tight corners and eliminates errors caused by beam divergence, is to use an offset measurement method such as that used in the field application software:

1. Measure two points on the face of the building.
 2. Aim the Trimble SPSx20 Total Station at the corner to store the correct horizontal and vertical angle.
- See [Figure 4.25](#)

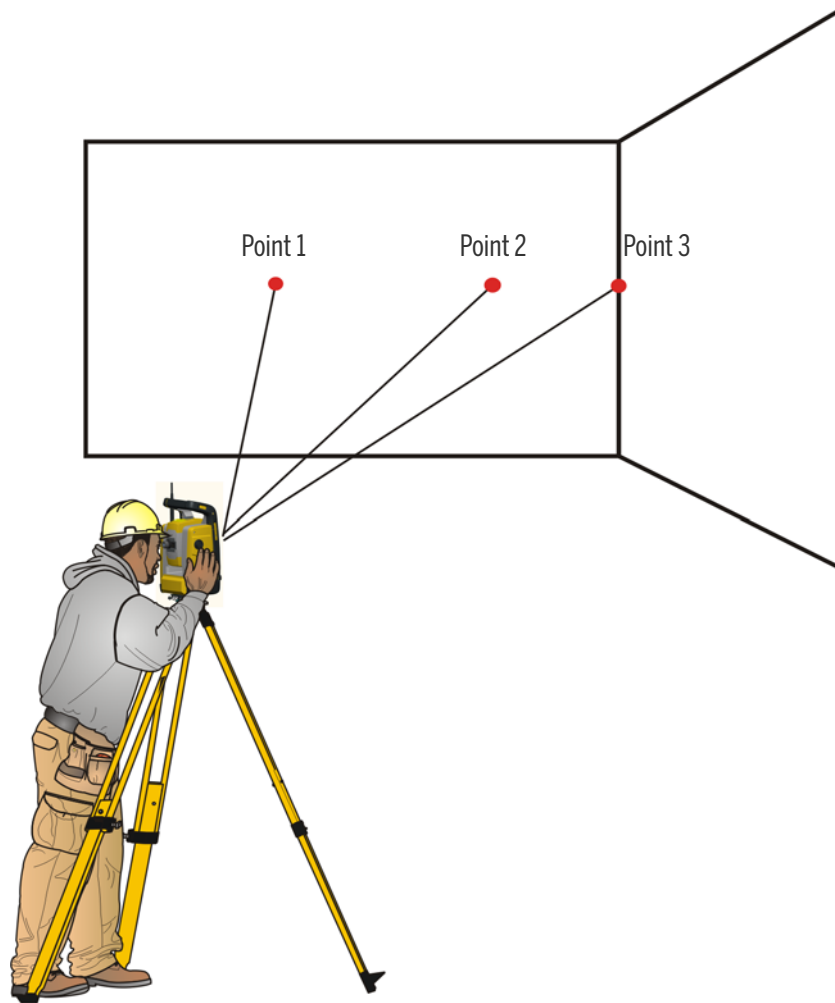


Figure 4.25 Offset measurement

With offset measurements, you can accurately measure difficult locations with DR instruments, and eliminate beam divergence errors. For more information, refer to the field application software documentation.

Tracker Technology

The Trimble SPSx20 Total Station is equipped with Tracker technology.

Tracker technology controls the Trimble SPSx20 Total Station servos and aims the Trimble SPSx20 Total Station correctly towards the target. See [Figure 4.26](#)

 **TIP** – To assure maximum performance from the Tracker technology keep the lens clean and dry.

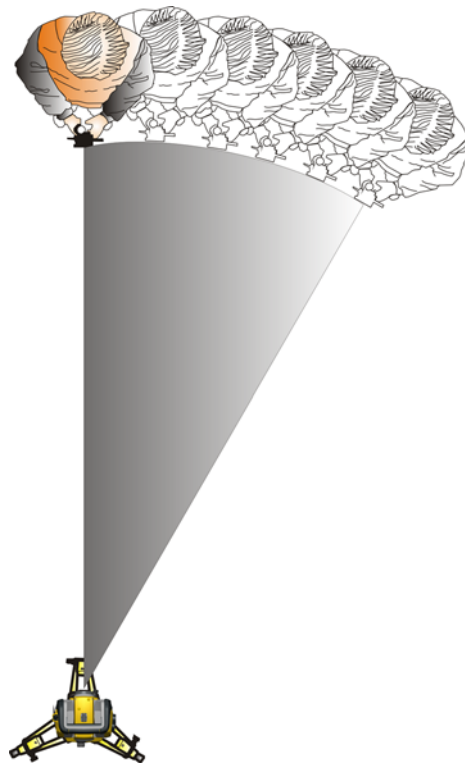


Figure 4.26 The Trimble SPSx20 Total Station Tracker function.

Aiming

The adjustment between the two optical axes, the telescope and the tracker, may differ. The difference will make it seem like the Trimble SPSx20 Total Station does not point towards the center of the prism, when using tracker, [figure 4.27](#). This is not a problem since the two axis have their own separate collimation data. It is however important to make collimation test for both axes.

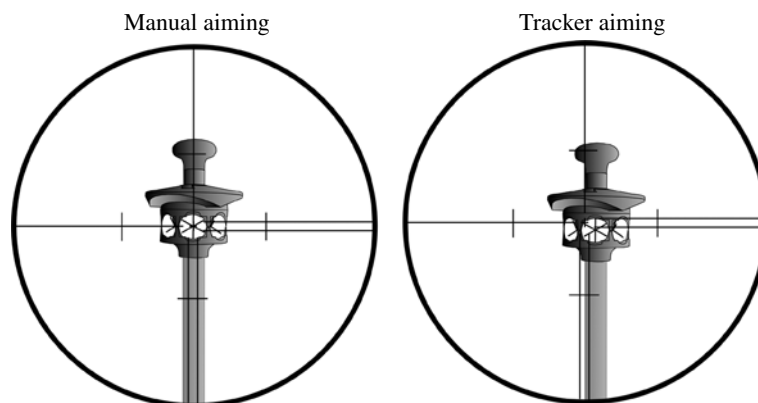


Figure 4.27 Difference between manual and tracker aiming.

How to Check Aiming

You can check how well the Trimble SPSx20 Total Station is calibrated by measuring toward the prism with and without tracker and compare the measured angles:

1. Aim manually at a prism and read out the horizontal and vertical angles.
2. Turn on tracker and let the Trimble SPSx20 Total Station lock on to the same prism automatically, read out the horizontal and vertical angles.
3. Compare the angles between manual and tracker aiming.

If the difference between the read out angles is significant, you should carry out both a horizontal and vertical angle collimation adjustment, and a tracker collimation adjustment.

After a full tracker collimation, the pointing of the instrument can still be different between manual and tracker assisted pointing. The angles to the target in both cases will however be the same - the collimation errors stored for the tracker will effectively make the instruments tracker pointing match the pointing when done with the human eye.

Radio

Internal Radio

The Trimble SPSx20 Total Station has an internal radio to support robotic operations.

The internal radio is a 10 mW radio that operates in the public free 2.4 GHz band. The radio uses frequency hopping technology to reduce radio interference and maintain radio communications in even the harshest RF environment.

To maintain radio communication with the Trimble SPSx20 Total Station, the Controller at the pole must also be connected to a 2.4 GHz external radio. The TSC3 is equipped with an integrated 2.4 GHz radio module.

Tracklight

Tracklight[®] unit is a visible guide light that enables the rod holder to position themselves into the Trimble SPSx20 Total Stations current line of sight. The Tracklight can be used during stakeout in all operational modes, and is also of great benefit when operating in robotic mode as a means of checking that the Trimble SPSx20 Total Station is tracking, or when trying to reacquire lock by walking into the sight line of the tracker, or using the remote joystick control in robotic mode. Tracklight consists of a flashing two-colored light, with each color lying in its own lateral projection sector. If the rod holder is to the left of the

measuring beam, they will see a red flashing light; if they are to the right, they will see a green flashing light. See [Figure 4.28](#)

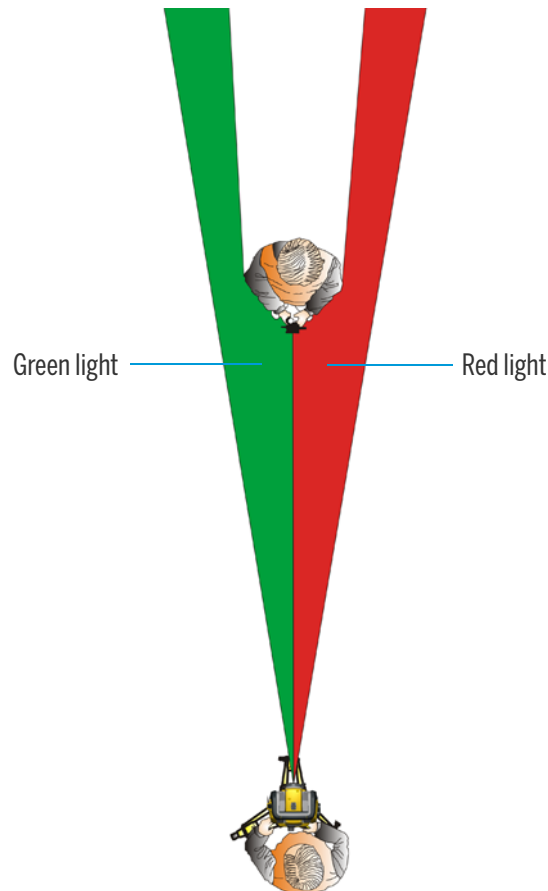


Figure 4.28 Tracklight

TIP – You can use the Tracklight for clearing sight lines and as an aid to find prisms in the dark or unfavorable sighting conditions.



CAUTION – Do not use the laser pointer as an aid when searching for prisms, the reflected light can dazzle your eyes. The reflected light will not damage your eyes, but might be uncomfortable.

Servo Technology

The Trimble SPSx20 Total Station is equipped with servo controlled motors to position the Trimble SPSx20 Total Station and to focus the telescope.

Due to the high speed position servo used in the Trimble SPSx20 Total Station it is important to use a high quality tripod and tribrach. It is also important to set up the tripod in a position for best stability, [see figure Figure 4.29](#). If the setup, tripod and/or tribrach is/are unstable the Trimble SPSx20 Total Station servos might oscillate slightly in an effort to compensate for that instability. An unstable setup that could negatively influence the resulting measurement precision. [See Setup on page 19](#)

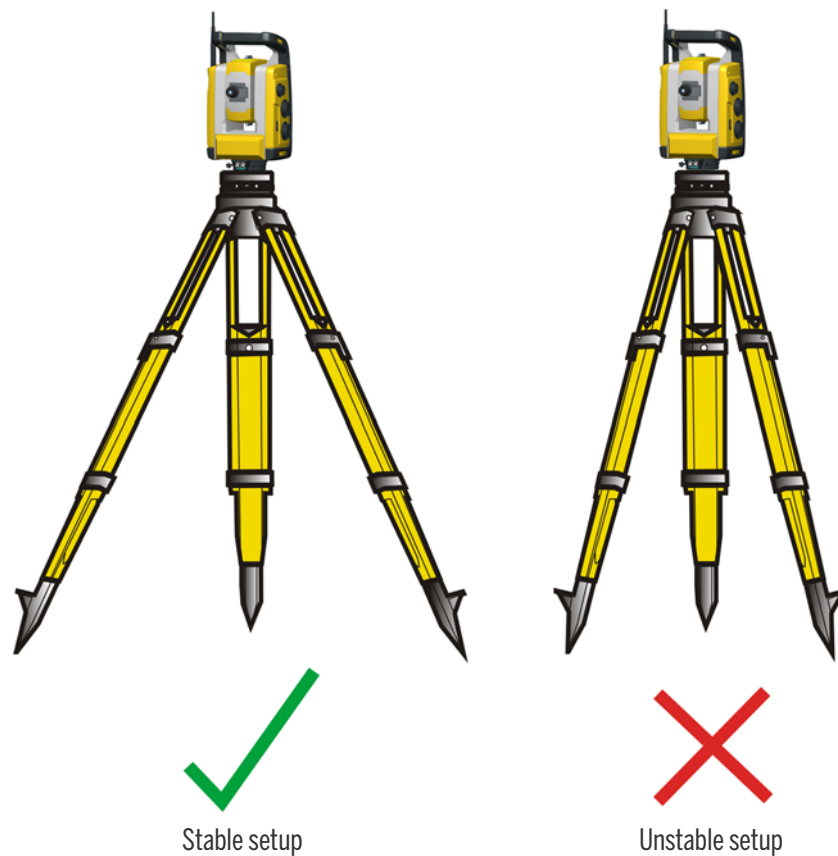


Figure 4.29 Tripod setup

Position Servo

Trimble MagDrive™ servo technology is an electromagnetic direct drive servo system which gives high turning speeds and accuracy. The frictionless motion removes servo noise and reduces instrument wear. The system provides endless horizontal and vertical motion, including endless fine adjustment. The Trimble SPSx20 Total Station uses servo when performing a number of different operations such as turning the horizontal and vertical motion knobs, for automatic test and calibration, or when using Autolock technology for robotic surveying. See [Figure 4.30](#)

NOTE – Due to the high speed servo it is important to use a high quality tripod and tribrach.



Figure 4.30 Position servo

Focus Servo

The Trimble SPSx20 Total Station is equipped with a focus servo. The focus motion knob is on the side of the Trimble SPSx20 Total Station for easy access.

The focus knob is connected to a servo motor that is built into the telescope. When you turn the focus motion knob, the servo motor adjusts the focusing lens. See [Figure 4.31](#)



Figure 4.31 Focus servo

Power Management

The power management in the Trimble SPSx20 Total Station can set the instrument to one of three different modes.

- Off mode
- On mode
- Suspend mode

Trimble SPSx20 Total Station

Off Mode

In the off mode the Trigger key LED is off.

Press the Trigger key to turn on the Trimble SPSx20 Total Station. The Trimble SPSx20 Total Station will also turn on if you connect a 12 V power supply to the 12 V power connector and a TSC3 (or PC) to the communication (COM) connector.

NOTE – During startup the Trigger key LED will flash once every second.

On Mode

In the on mode the Trigger key LED will be on solid.

To turn off the Trimble SPSx20 Total Station press and hold the Trigger key until the LED is off.

The Trimble SPSx20 Total Station will go to off mode if the battery is very low (battery capacity less than 2%).

Suspend Mode

In the suspend mode the Trigger key LED will flash once every other second,

To turn the Trimble SPSx20 Total Station on press the Trigger key or turn on the Trimble SPSx20 Total Station from a remote application.

To turn the Trimble SPSx20 Total Station off press and hold the Trigger key until the LED is off.

In Suspend mode the Trimble SPSx20 Total Station will turn off automatically after 2 hours.

Power Supply

The power management in the Trimble SPSx20 Total Station has been designed to deliver the most operating time in the field. The power management system includes the internal battery, optional external battery pack and the Trimble battery charger.

Internal Power Supply

The primary power supply for the Trimble SPSx20 Total Station is a rechargeable, removable Lithium-ion battery. The supplied battery is designed for use in the Trimble SPSx20 Total Station and features:

- Battery gauge to easily check power supply
- Rugged design
- One battery type for Trimble SPSx20 Total Station and accessories.

The Trimble SPSx20 Total Station battery is on the side of the Trimble SPSx20 Total Station and is easily removed and replaced. See [Figure 4.32](#)



Figure 4.32 Removing and replacing the internal battery

To check the power supply in the Trimble SPSx20 Total Station battery using the built in battery gauge, press the button on the side of the battery. See [Figure 4.33](#)



Figure 4.33 Internal battery power gauge and button

When you press the button, four LEDs on the Trimble SPSx20 Total Station battery show the power level. Each LED corresponds to a power level of 25% so that when the power level is at 100%, all four LEDs are lit. If the battery is completely discharged, all LEDs are unlit.

When the button is pushed and all the LEDs flash, the battery needs to be reconditioned in the battery charger.

When the battery capacity is between 0 and 10% one LED is flashing. A battery with a flashing LED might not be able to start a Trimble SPSx20 Total Station. If started, with a battery with a flashing LED, the operating time will be between 5 and 15 minutes.

The capacity of the battery is 4.4 Ah.

External Power Supply


The Trimble SPSx20 Total Station has two external connectors in the base of the Trimble SPSx20 Total Station; one for communication and one for an external power supply. External power can be provided by one of the following:

- Multi Battery Adapter
- Car battery

With the Trimble SPSx20 Total Station Multi Battery Adapter, you can connect up to three Trimble SPSx20 Total Station batteries. Connect the Multi Battery Adapter to the external power connector on the Trimble SPSx20 Total Station using a grey Trimble cable with 6-pin Hirose connector. The Trimble SPSx20 Total Station Multi Battery Adapter can be attached to a tripod or placed on the ground, and has a carrying handle.

As an alternative to the Multi Battery Adapter, An external 12 V car battery can be used. Use one of the following cables:

- The Cable - 3.0m, Car battery (croc clips) to Hirose 6 pin.
- The Cable - 3.0m, Cigarette lighter to Hirose 6 pin

 **CAUTION** – Use only the gray cables with 6-pin Hirose connectors from Trimble when connecting a cable to the Trimble SPSx20 Total Station and Multi Battery Adapter.

Charging the Battery

See Trimble charger user guide for information.

Battery Low Message

If the battery capacity drops too low the Trimble SPSx20 Total Station shuts down. You must then change the battery within two hours to prevent losing instrument parameters and functions such as instrument height, target height, coordinates, bearing, and dual axis compensation. After that time, the system resets all parameters and functions to default values.

NOTE – This safety backup of the instrument parameters and functions will work only when **Bat low** appears on the display: it will not function if you remove the battery during operation.

External Communication

Communication (COM) Connector

The communication (COM) connector on the base of the Trimble SPSx20 Total Station can be used for:

- Communication to a desktop computer.
- Communication between a controller and the Trimble SPSx20 Total Station.

- Installing firmware upgrades to the Trimble SPSx20 Total Station.



CAUTION – Use only the gray cables with 6-pin Hirose connectors from Trimble when connecting a cable to the instrument.

Removable Handle

The handle of the Trimble SPSx20 Total Station is removable for measurements in confined spaces, or for instances where the handle obstructs the sighting line.

The Trimble SPSx20 Total Station handle is placed so that it will not obscure measurements in the face 1 position, or restrict plumbing vertically beneath an overhead marker or sighting up a vertical shaft.

The handle can be removed by:

1. Unscrew the two Torx screws securing the handle to the Trimble SPSx20 Total Station, use a T30 Torx key.
2. Slide the handle horizontally away from the front of the Trimble SPSx20 Total Station. See [Figure 4.34](#) and [Figure 4.35](#)




Figure 4.34 Removing the Trimble SPSx20 Total Station handle



Figure 4.35 Detaching the Trimble SPSx20 Total Station handle

Attaching the handle:

Attaching the handle is completed by reversing the above operations.

 **CAUTION** – Make sure that the handle is firmly attached before you lift the Trimble SPSx20 Total Station.

Options & Accessories

- ▶ Trimble Standard Rod
- ▶ Trimble Target ID
- ▶ Trimble MT1000 MultiTrack Target
- ▶ Backsight Target

Trimble Standard Rod

The Trimble standard rod is available with the Trimble SPSx20 Total Station. The rod contains the following features:

- Graduated scale in meters and feet.
- Fixed target height positions
- Leveling bubble

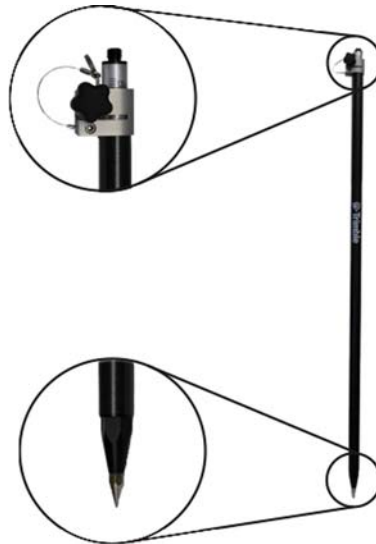


Figure 5.36 Trimble Standard Rod

Trimble Target ID

The target ID is an optional unit that connects to the Trimble stake writer rod to transform the prism from a passive target to an active target. See [Figure 5.37](#)

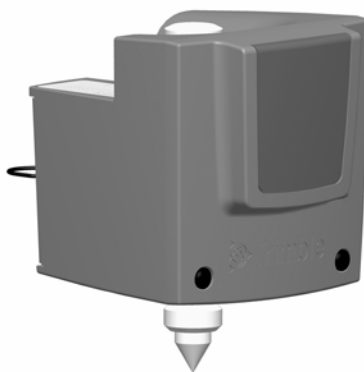


Figure 5.37 Trimble Target ID

You can configure the target ID to eight different IDs, which are then used by the Trimble SPSx20 Total Station to ensure that the instrument locks onto and (optionally) tracks only the target with the correct Target ID. Configure the Target ID through its own LED display. See [Figure 5.38](#)

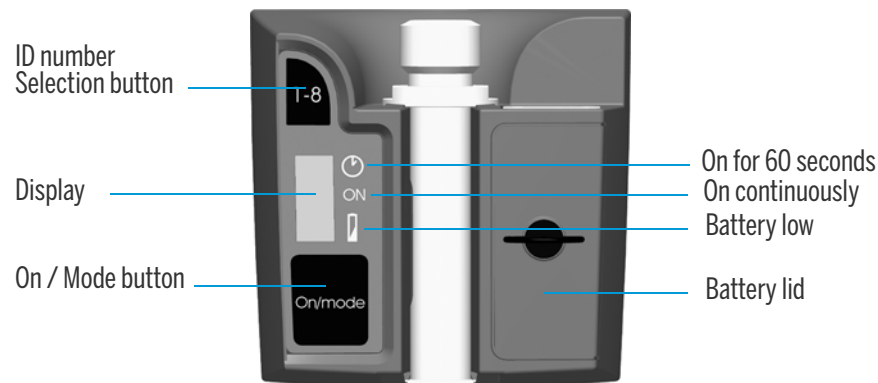


Figure 5.38 Target ID controls

Press the power button one or more times to access the following modes:

- On for 60 seconds
- On continuously
- Off

A bar appears beside the active mode.

When the Target ID is on, the current target ID appears. Press the ID number selection button to change the current target ID number.

The Target ID is powered by two AA size batteries that will operate the unit for approximately 12 hours continuous use. A dot appears beside the battery symbol when battery power is low.

Fitting and Removing the Target ID

1. Screw the adapter and mini rod on to the top of the rod and tighten.
2. Push the Target ID on to the mini rod until it locks in place. The spring lock will hold the Target ID in place.

Removing the Target ID is the reverse operation to fitting.

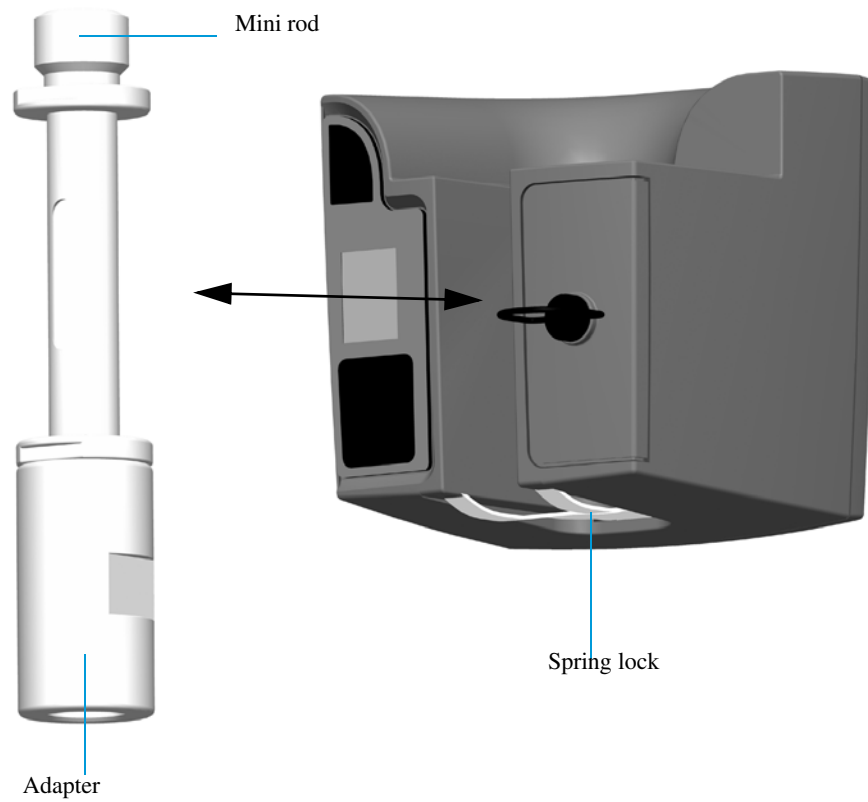


Figure 5.39 Fitting or removing the Target ID.

LED Information

The Target ID has been tested and complies with the regulations for a Class 1 LED product. See [Figure 5.40](#).

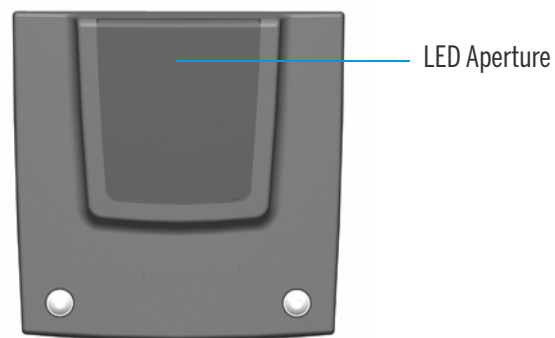


Figure 5.40 Target ID LED Aperture

Changing the Batteries in the Target ID

1. Turn the screw securing the battery lid a quarter of a turn counter-clockwise and then remove the battery lid.
2. Hold the target ID at an angle and let the two used batteries slide out.
3. Insert two new AA size batteries.
4. Fit the battery lid and then secure it by turning the screw a quarter of a turn clockwise. See [Figure 5.41](#).

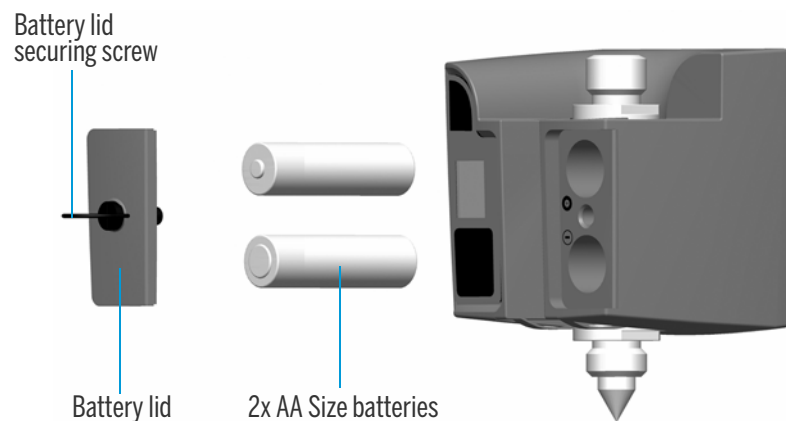


Figure 5.41 Target ID battery change

Trimble MT1000 MultiTrack Target

The Trimble MultiTrack™ target provides fully coaxial passive and active tracking via an integrated 360° prism ring and 2 active 360° LED rings. The active LED rings support the selection of a unique ID to ensure that 8 different targets can be operated on a single site with full confidence that the correct target is always used.

Features

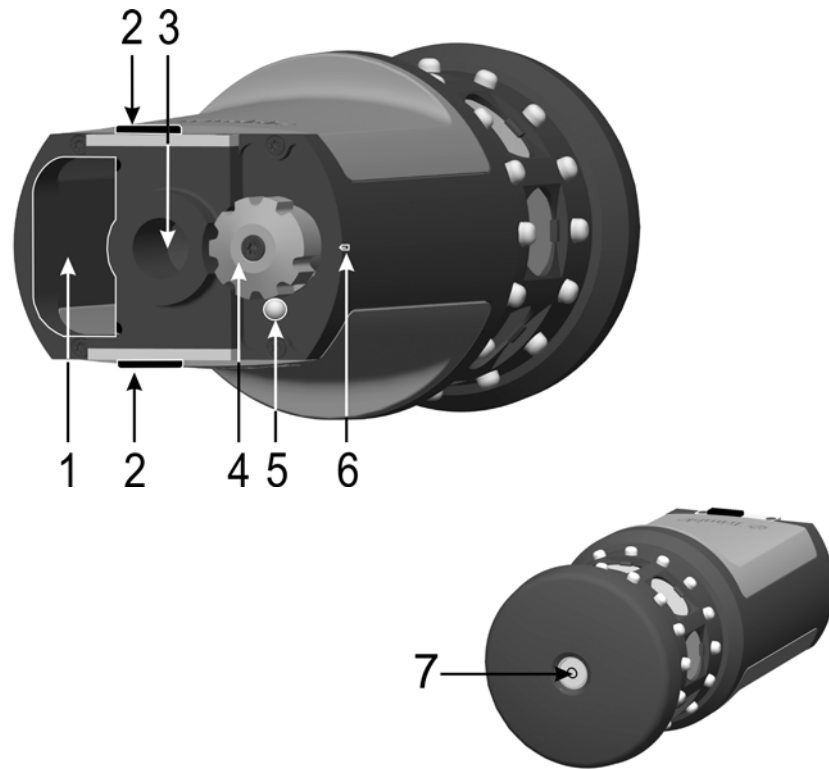


Figure 5.42 Trimble MT1000 MultiTrack Target Features

1	Battery compartment	5	On/Off and battery low indicator LED
2	Battery locks	6	Position indicator
3	5/8" Thread	7	Circular level
4	Channel select (on/off switch)		

Measures

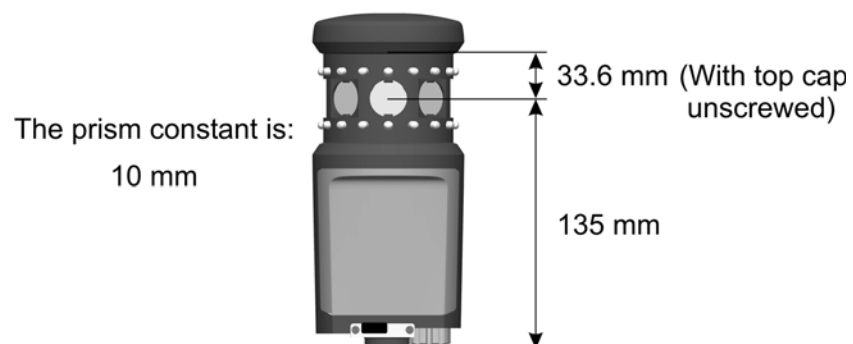


Figure 5.43 Trimble MT1000 MultiTrack Target Measures

Fitting and Removing the Battery

To fit the battery, push the battery in to the battery compartment (1) with the battery connectors (2) facing upwards and inwards until the battery locks clicks (3) in place.

To remove the battery, slide the battery locks open (4), The battery can now slide out of the battery compartment (5).

The battery is a Trimble 7.4 V Li-Ion battery.

The Trimble MultiTrack Target will provide active tracking for up to 8 hours from one fully charged battery. When the on/off and battery low indicator LED starts to flash the battery will have approximately 40 minutes operation time remaining.

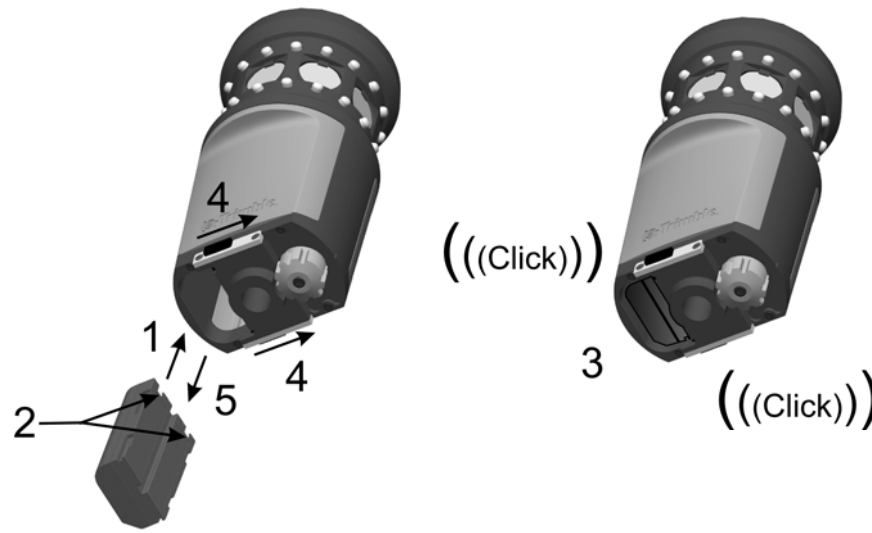


Figure 5.44 Fitting and Removing the Battery

Specification Label

To read the specification label unscrew the top cap of the target (1).

NOTE – The accuracy specification for Active mode is valid within 15° from horizontal. For vertical angles outside of this range it is recommended to use passive mode or to use a tiltable target to ensure the most precise results.

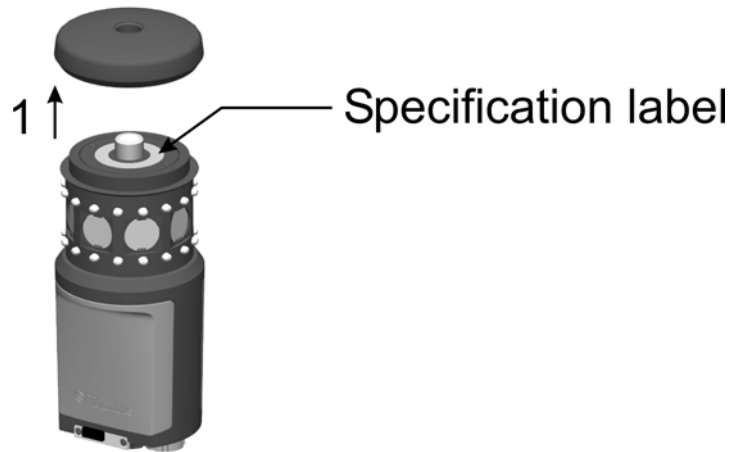


Figure 5.45 Trimble MT1000 MultiTrack Target specification label

Backsight Target

Backsight Target Kit Accessory Case

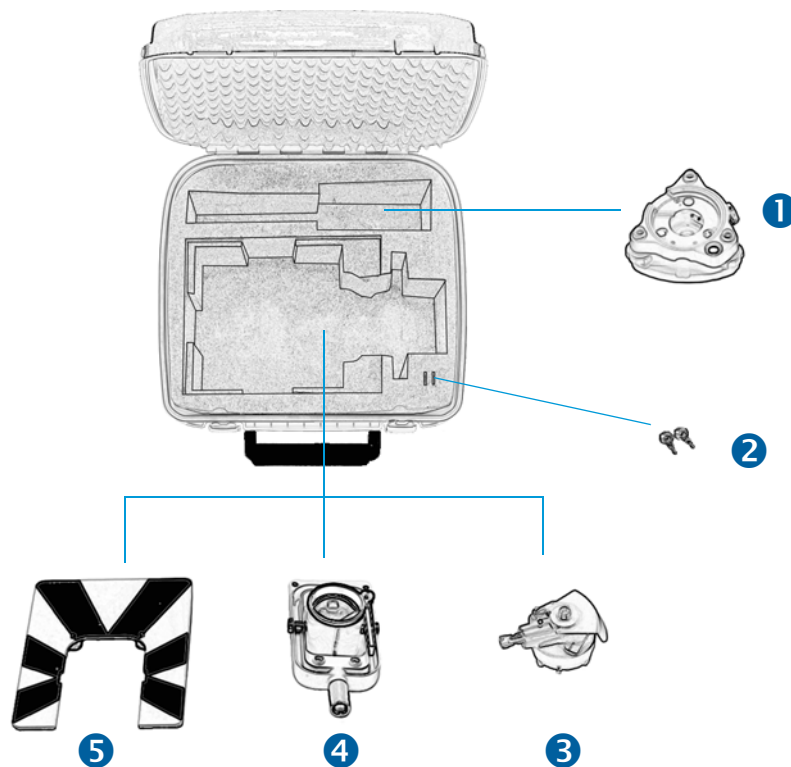


Figure 5.46 Contents of the traverse kit 2 accessory case

Item	Description
1	Tribrach
2	Accessory case keys (2x)
3	Prism base with level and optical plumb
4	Prism
5	Sighting target

Measuring the Target Height

There is a height measurement mark on the side of the prism base that can be turned out for easier reading of the height. The height measurement mark is 0.158 m (0.518 ft.) below the target (signal) height. Measure to the top ridge of the mark. See [Figure 5.47](#)

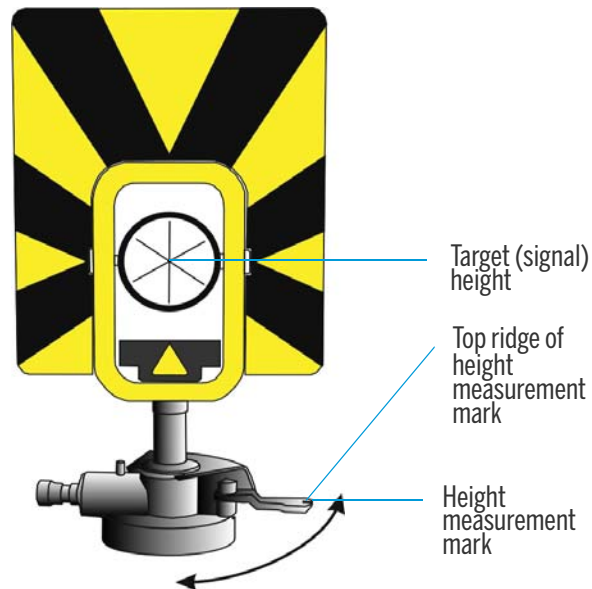


Figure 5.47 Target height marks

When there is a controller attached running a field application software, the software has additional functions that reduce the bottom mark measurement to the required vertical target (signal) height. See [Figure 5.48](#) and the following paragraph.

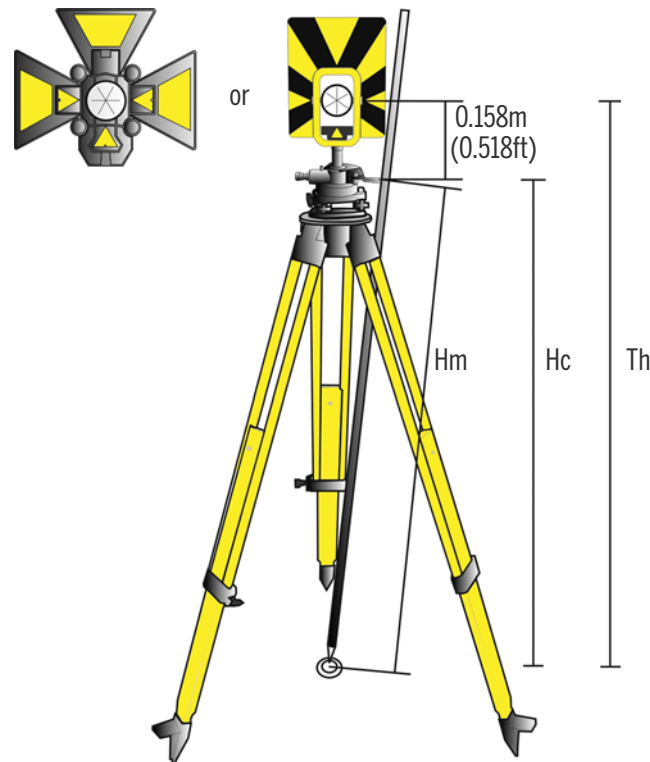


Figure 5.48 Target height measurement

The measured distance (Hm) is corrected for the slope of the measurement to obtain a vertical measurement to the bottom mark (Hc). The constant from the target height measurement mark to the target (signal) height (0.158 m/0.518 ft.) is added to the Hc to obtain the vertical target height from the ground mark to the target (signal) height (Th). For more information, refer to the field software documentation.

Alternatively, to obtain an accurate measurements to the target (signal) height (Th), you can manually measure the slope distance from the ground to the bottom mark (Hm). To calculate the total target height (Th), insert the measured slope distance (Hm) into the formula below:

$$Th = 0,158 + \sqrt{Hm^2 - 0,091^2}$$

Attaching the Accessory Case to the Trimble SPSx20 Total Station Case

The accessory case can be fitted on top of the Trimble SPSx20 Total Station case for transport to a job site. Use straps (not included) as shown in [Figure 5.49](#).




Figure 5.49 Accessory case fitted to the top of the Trimble SPSx20 Total Station case

Care and Maintenance

- ▶ [Care and Maintenance](#)
- ▶ [Transporting the Trimble SPSx20 Total Station](#)
- ▶ [Servicing](#)


Care and Maintenance

 **WARNING** – Do not remove the cover from the Trimble SPSx20 Total Station. A Trimble SPSx20 Total Station is designed to withstand normal electromagnetic disturbance from the environment but it contains circuits that are sensitive to static electricity. If an unauthorized person opens the cover of the Trimble SPSx20 Total Station, the function of the Trimble SPSx20 Total Station is not guaranteed and the warranty is invalidated.

The Trimble SPSx20 Total Station is designed and tested to withstand field conditions, but like all precision instruments, it requires care and maintenance. Take the following steps to get the best results from the Trimble SPSx20 Total Station:

- Do not subject the equipment to rough jolts or careless treatment.
- Keep the lenses and reflectors clean. Use only lens paper or other material that is designed for cleaning optical equipment.
- Keep the Trimble SPSx20 Total Station protected and in an upright position, preferably in the Trimble SPSx20 Total Station case.
- Do not carry the Trimble SPSx20 Total Station while mounted on a tripod. Doing so can damage the tribrach screws.
- Do not carry the Trimble SPSx20 Total Station by the telescope barrel. Use the handle.
- When you need extremely precise measurements, make sure that the Trimble SPSx20 Total Station has adapted to the surrounding temperature. Significant variations in temperature can affect precision.

Cleaning

 **CAUTION** – Never use strong detergents such as benzine or thinners on the Trimble SPSx20 Total Station or the Trimble SPSx20 Total Station case.

Be very careful when cleaning the Trimble SPSx20 Total Station, especially when removing sand or dust from lenses and reflectors. Never use coarse or dirty cloth or hard paper. Trimble recommends that you use anti-static lens paper, a cotton wad, or a lens brush.

Getting Rid of Moisture

If the Trimble SPSx20 Total Station has been used in damp weather, take the Trimble SPSx20 Total Station indoors and remove the Trimble SPSx20 Total Station from the Trimble SPSx20 Total Station case. Leave the Trimble SPSx20 Total Station to dry naturally. If condensation forms on the lenses, allow the moisture to evaporate naturally. Leave the carrying case open until all moisture has evaporated.

Transporting the Trimble SPSx20 Total Station

Always transport the Trimble SPSx20 Total Station in a Trimble SPSx20 Total Station case. For longer trips, transport the Trimble SPSx20 Total Station in the Trimble SPSx20 Total Station case and inside the original shipping container.

Servicing

NOTE – There are no user-serviceable parts on the Trimble SPSx20 Total Station.

Trimble recommends that you take the Trimble SPSx20 Total Station to an authorized Trimble service workshop for service and calibration once a year. This is to guarantee that the specified accuracies are maintained.

When you send the Trimble SPSx20 Total Station to a service center, clearly write the name of the sender and the receiver on the Trimble SPSx20 Total Station case. If repairs are required, enclose a note in the Trimble SPSx20 Total Station case. The note should clearly describe any fault or symptoms, and indicate that servicing is required.