



USER GUIDE

SX12

SCANNING TOTAL STATION

Revision A
April 2023
57599032-ENG

Legal Notices

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Legal Notices

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Release Notice

This is the April 2023 release (Revision A) of the SX12 documentation. It applies to the SX12 scanning total station.

The original document is written in English. All documents in other languages are translations from the original English document.

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® *SX12 Scanning Total Station Regulatory Information Document* included with this Trimble product, or consult your Trimble dealer.

Registration

To receive information regarding updates and new products, please contact your local dealer.

Safety Information

For safety information, please refer to the Trimble® *SX12 Scanning Total Station Regulatory Information Document* delivered with the product.

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Introduction

- [About the SX12 scanning total station](#)
- [Related information](#)
- [Technical support](#)

This manual describes the Trimble® SX12 scanning total station. Even if you have used other total station products before, Trimble recommends that you spend some time reading this manual to learn about the special features of this product.

The SX12 scanning total station is available in two different models:

- Long range radio (LRR)
- Wi-Fi HaLow™ radio

Throughout this user guide the Trimble SX12 scanning total station will be referred to as the instrument. If a feature unique for a specific model is described, it will be referred to by its model name.

About the SX12 scanning total station

The SX12 scanning total station is an instrument that combines survey, imaging and high-speed scanning.



Related information

For more information about this product, please go to [trimble.com](https://www.trimble.com).

Technical support

If you have a problem and cannot find the information you need in the product documentation, please contact your local distributor or request technical support at [trimble.com](https://www.trimble.com).

Instrument Description

- Features
- Accessories
- Care and maintenance
- Adjustments and calibrations
- Transport
- Service

This section describes the features of the instrument and the labels on the instrument.

Features

Trimble recommends that you take some time to familiarize yourself with the names and the locations of the instrument features.



Front view of the instrument

1	model: Long range radio (LRR) / Wi-Fi antenna * or model: Wi-Fi HaLow radio / Wi-Fi antenna *
2	True Height mark
3	On/Off key and status indicator
4	Bottom Notch height mark
5	Optics for primary camera
6	Target Illumination light
7	Optics for over-view camera
8	Optics for distance measurement, Autolock® technology, tele camera, and optional laser pointer

*The type of radio antenna depends on the instrument model, see [Radio technology](#), page 39.



Back view of the instrument

1	Battery compartment
2	Plummet camera
3	Communication (COM) connector
4	Power (+12 V) connector
5	Coarse sight
6	Coarse sight

Accessories

For information regarding accessories available for the instrument, Please refer to <https://geospatial.trimble.com/Optical-Accessories>.

Care and maintenance

WARNING – Do not remove the instrument cover from the instrument. The instrument 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 instrument cover, the function of the instrument is not guaranteed and the warranty is invalidated.

The instrument 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 instrument:

- Do not subject the equipment to rough jolts or careless treatment.
- Keep the lenses and reflectors clean. Use only the cleaning cloths supplied with the instrument or other material that is designed for cleaning optical equipment.
- Keep the instrument protected and in an upright position, preferably in the instrument case.
- Do not carry the instrument while the instrument is mounted on a tripod. This can damage the instrument and the tribrach.
- Do not carry the instrument by the telescope barrel. Use the handle.
- When you need extremely precise measurements, make sure that the instrument has adapted to the surrounding temperature. Significant variations in instrument temperature can affect precision.
- If the instrument is moved from (extreme) cold to warm temperature, leave the instrument in the closed instrument case for at least 15 minutes in order to avoid internal condensation. Then open and leave the instrument case open until all moisture has dried.

Cleaning the instrument

CAUTION – Strong chemicals can damage the instrument. Never use strong detergents such as benzine or thinners on the instrument or the instrument case.

Cleaning the lenses

Be careful when cleaning the lenses.

1. If there is sand or dust on the lenses, soak the sand and dust with water from a spray bottle.
2. Remove the sand and dust carefully with a soft cloth. Do not rub.
3. With the cleaning cloths supplied with the instrument, gently clean the lenses in a circular motion from the middle and out towards the edge of the lens. Do not rub.

Cleaning the instrument

Except for the lenses, use a cloth damp with water to clean the instrument.

Moisture

If the instrument has been used in damp weather, take the instrument indoors and remove the instrument from the instrument case. Leave the instrument to dry naturally. If condensation forms on the lenses, allow

the moisture to evaporate naturally. Leave the instrument case open until all moisture has evaporated.

Storage

- Storage temperature range -40 °C to +70 °C (-40 °F to 158 °F) in a dry environment.
- Remove the battery from the instrument before storage.

Adjustments and calibrations

Adjustments

Trimble recommends that the following adjustments are carried out regularly:

- Adjustment of circular level on the tribrach
- Tightening of all screws on the tripod.

Calibrations

The instrument is tested to determine and compensate for instrument errors before delivery.

These errors can, however, change during transport and temperature changes. For this reason, Trimble recommends that calibrations are carried out in the following situations:

- Immediately prior to high-precision angle measurements in one face.
- Whenever the instrument may have been roughly handled during transport.
- After extended working or storage periods.
- If there has been a significant temperature difference from the previous calibration.

TIP – Any measurement errors introduced by collimation, tilt, or trunnion axis errors are canceled out when two-face measurements are used.

In-field calibrations are available for:

- Compensator
- Autolock technology
- Tele camera auto focus calibration
- Camera collimation for overview, primary and tele camera.
- Plummet camera calibration
- Laser (pointer) collimation (Optional)
- Laser (pointer) auto focus calibration (Optional)

Transport

Always transport the instrument in a locked instrument case. For longer trips, transport the instrument in the instrument case and inside the original shipping container.

Always remove the internal battery during transport.

When transporting batteries, make sure to follow national and international rules and regulations. Contact your transport company before shipping.

Storage of the carrying straps

When the carrying straps are not in use, you can store them in the carrying strap compartment on the instrument case.

TIP – Put the waist straps into the carrying strap compartment first, before the shoulder straps.

To take out and use the carrying straps:

1. Press the compartment lid lock downward and open the carrying strap compartment. The following photo shows the instrument case with the carrying straps inside the compartment:



1 Compartment lid lock 2 Carrying strap compartment

2. Lift the straps from the compartment. The straps are already attached to the instrument case. The following photo shows the carrying straps removed from the compartment:



3. Close the compartment lid, making sure that the carrying straps can move freely. The following photo shows the instrument case with the carrying straps ready for use:



Service

NOTE – There are no user-serviceable parts on the instrument.

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

Setup

- Setup
- Measure the instrument height
- Connect the internal battery
- Connect the external battery
- Power on/off the instrument
- Connect a controller
- Security
- Operator calibrations
- Pre-Measurement checklist

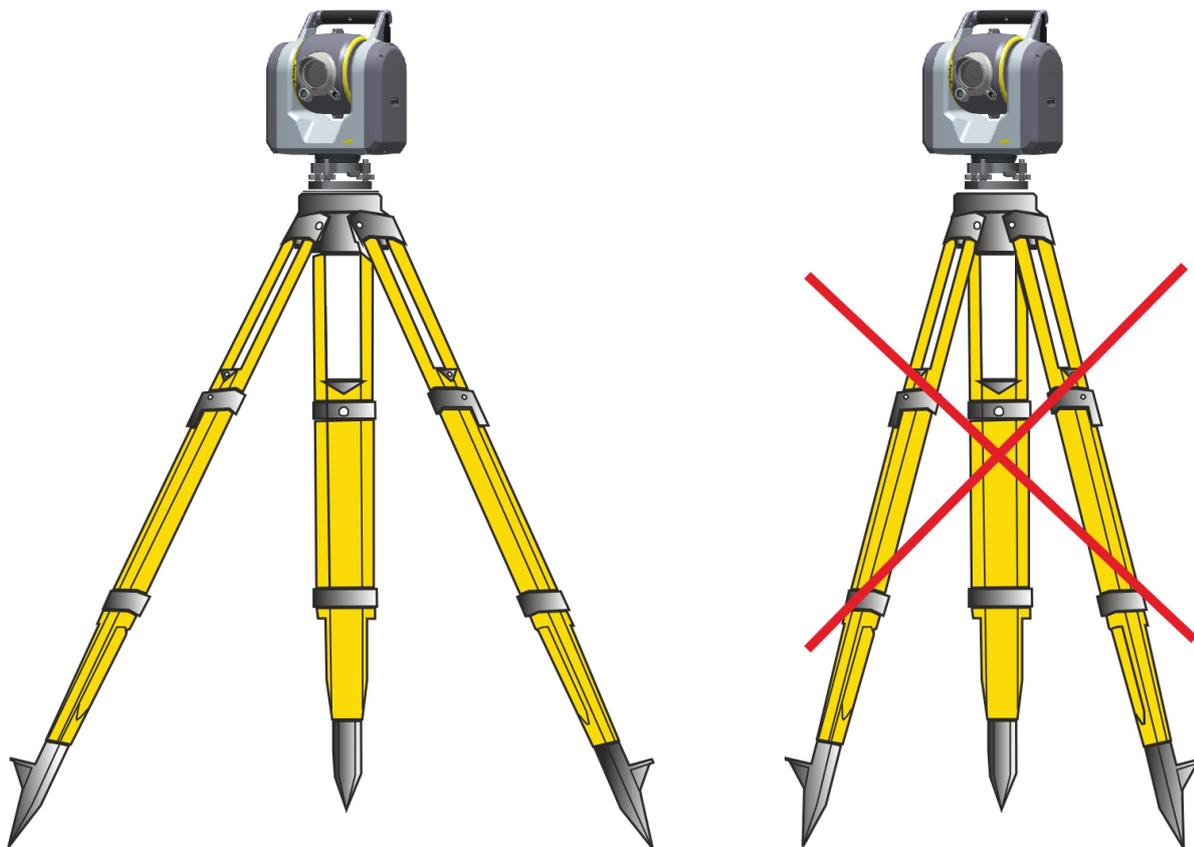
Setup

A stable setup is critical for high-precision measurements.

Setup stability

When an instrument is set up it is important to consider the following:

1. Set tripod legs wide apart to increase the stability of the setup. For example, a setup where one leg is placed on asphalt and the other two on soil is 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.



Correct instrument setup

2. Tighten all the screws on the tripod to prevent play.
3. Use a tripod and tribrach of high quality. Trimble recommends the use of tripod heads made of steel, aluminum or equivalent material. Avoid the use of tripod heads of fiberglass or other composite materials.

For more information, see [Servo technology](#), page 30.

Measurement stability

Take into account that the instrument requires sufficient time to adjust to the ambient temperature. The general guideline for a high-precision measurement is:

- Celsius: Temperature difference in degrees Celsius (°C) x 2 = duration in minutes required for the instrument to adjust to the new temperature.
- Fahrenheit: Temperature difference in degrees Fahrenheit (°F) = duration in minutes required for the instrument to adjust to the new temperature.

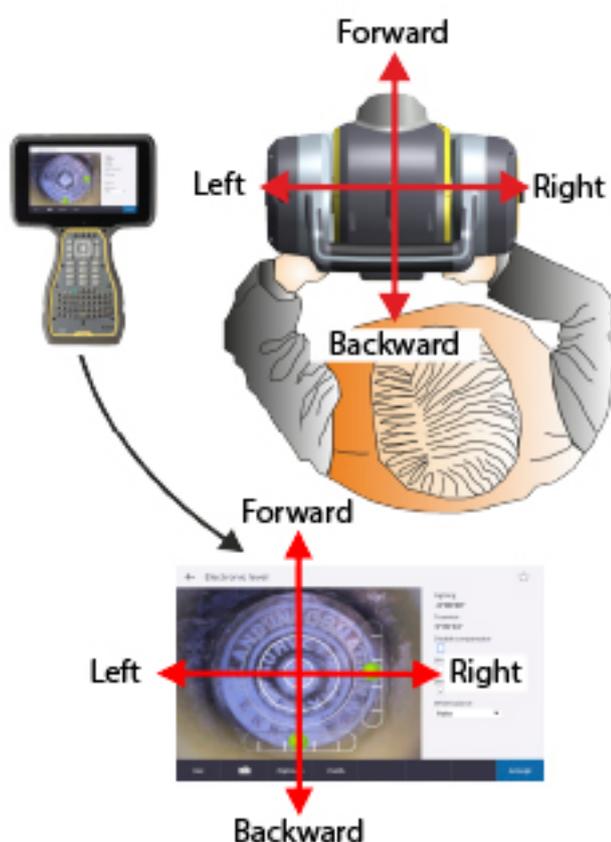
Avoid measurements across fields with intense heat shimmer from sunlight, for example at noon.

Set up over a point

The instrument is equipped with a plummet camera that is used to position the instrument over a point. The image from the plummet camera is displayed in the controller software. The camera is placed in the center of the instrument and it follows the rotation of the instrument, but the crosshair in the controller software will be fixed.

To position the instrument over a point, place yourself behind the instrument with the telescope pointing away from you and position the controller beside the instrument as shown below.

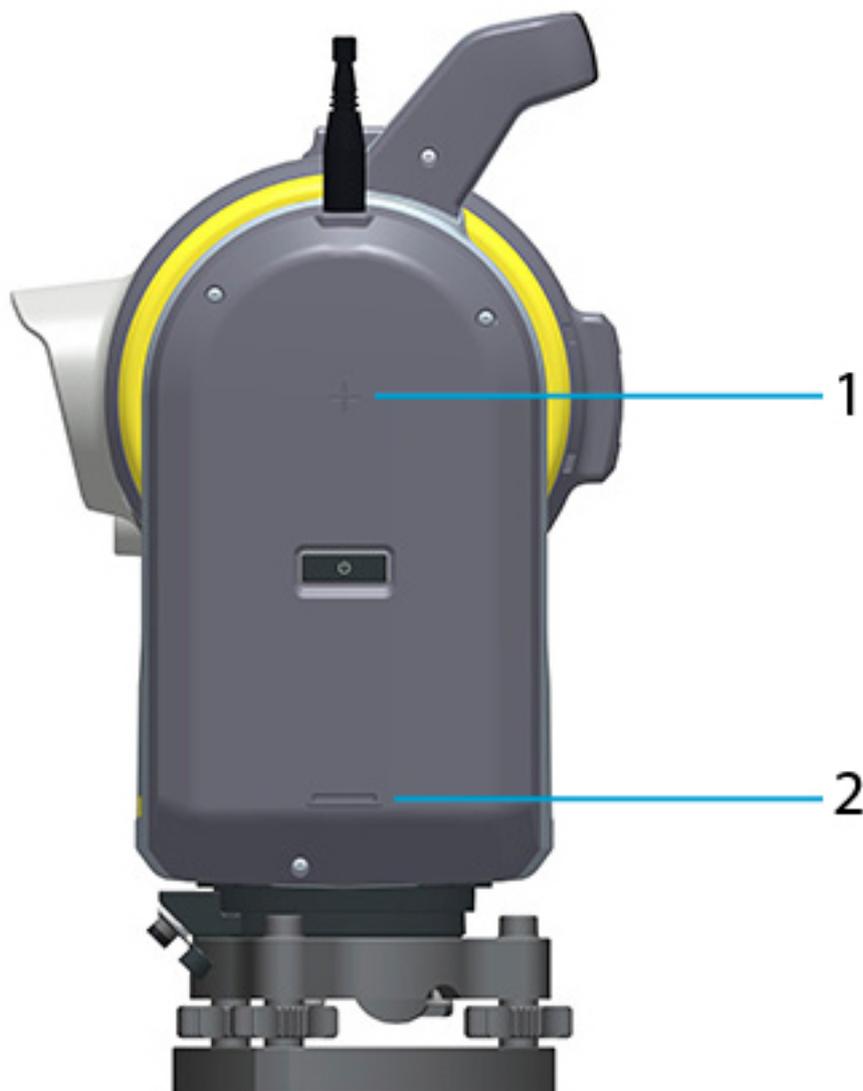
Move the instrument in relation to the point, so that the crosshair in the controller software sits directly above it.



Set up over point with plummet camera

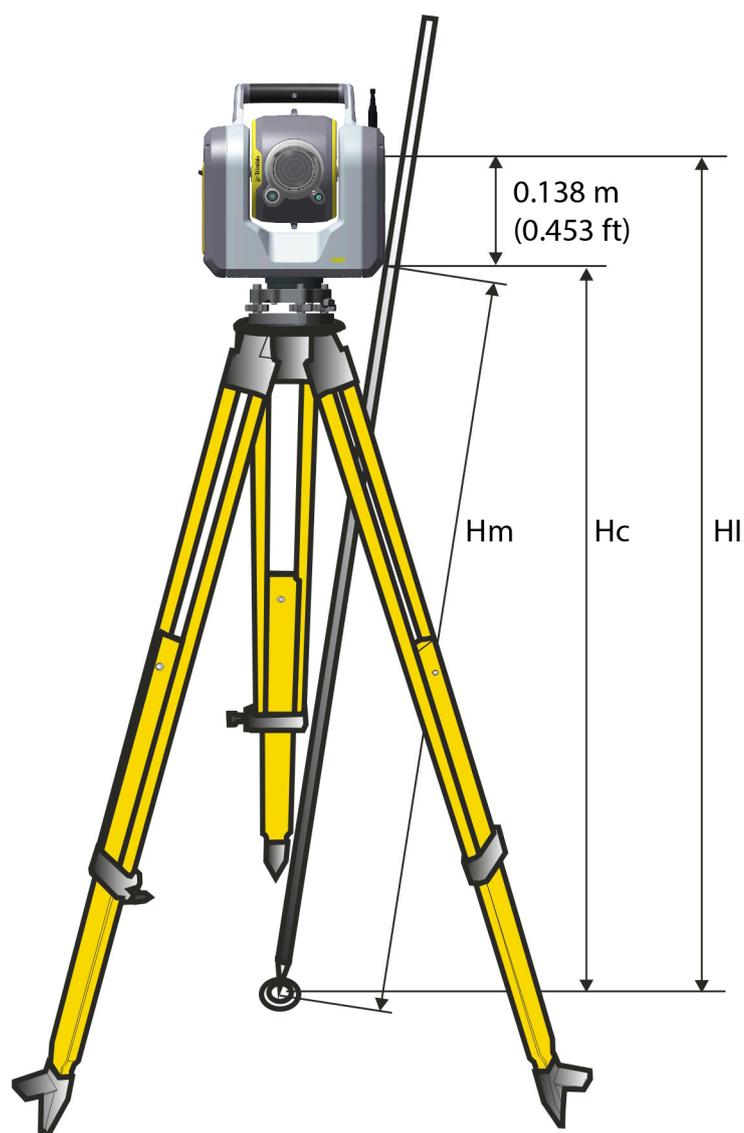
Measure the instrument height

There are two measurement marks on the side of the instrument. The true height mark corresponds to the trunnion axis of the instrument. The bottom notch height mark is 0.138 m (0.453 ft.) below the true height mark. Measure the bottom notch height mark to the top ridge of the notch.



(1) True height mark and (2) bottom notch height mark

The field software *automatically calculates* the true vertical height to the trunnion axis when using the bottom of notch measurement method.



Instrument height measurement

The measured distance (H_m) is corrected for the slope of the measurement to obtain a vertical measurement to the bottom notch height mark (H_c). The constant from the bottom notch height mark to the true height mark (0.138 m/0.453 ft.) is added to the H_c to obtain the vertical instrument height from the ground mark to the trunnion axis (HI). For more information, refer to the field software documentation.

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

$$HI = 0.138 + \sqrt{H_m^2 - 0.1398^2}$$

Connect the internal battery

The instrument internal battery fits into the battery compartment on the side of the instrument. This battery can easily be removed and replaced.

NOTE – The lithium-ion battery is not provided with the instrument and must be ordered separately.

NOTE – Use only an internal battery approved by Trimble with the instrument.

For information regarding internal battery for the instrument. Please refer to <https://geospatial.trimble.com/Optical-Accessories>.

To insert the battery:

1. Press the battery compartment lock downward to unlock.
2. Open the battery compartment.
3. Slide the battery into the battery compartment.
4. Close the battery compartment.



How to insert and/or remove the internal battery

Connect the external battery

The instrument has two external connectors in the base of the instrument. Both connectors can be used to connect an external power supply to the instrument. Trimble recommends to connect the external power supply to the connector marked PWR to keep the communication connector marked COM free for communication purposes.

For information regarding external power supplies for the instrument. Please refer to <https://geospatial.trimble.com/Optical-Accessories>.

NOTE – Use only a power supply approved by Trimble with the instrument.

Power on/off the instrument

Power on and off the instrument with the On/Off key.

CAUTION – If the equipment is used in a manner not specified by Trimble, the protection provided by the equipment may be impaired.

Power on the Instrument

With only the internal battery connected, power on the instrument with a short press on the On/Off key. With an external battery/power source connected to the power connector, the instrument will power on automatically.

Power off the instrument

To power off the instrument, press and hold the On/Off key until the On/Off key LED starts to flash with a high frequency, then release the On/Off key. The On/Off key LED will continue to flash with a high frequency until the instrument powers off.

On/Off key LED

The On/Off LED indicates different instrument modes, see table below.

On/Off key LED	Instrument mode	Description
Off	Off	-
Solid, yellow	On	<ul style="list-style-type: none"> The SX12 LRR model is connected to a controller with long range radio or Wi-Fi and the instrument is in RUN status. The SX12 Wi-Fi HaLow model is connected to a controller with Wi-Fi and the instrument is in RUN status.
Solid, green	On	<ul style="list-style-type: none"> The SX12 Wi-Fi HaLow model is connected to a controller with Wi-Fi HaLow radio and the instrument is in RUN status.

On/Off key LED	Instrument mode	Description
Long flash, yellow	Waiting for connection to a controller with long range radio	<ul style="list-style-type: none"> The SX12 LRR model is waiting for connection to a controller with long range radio. Change to Wi-Fi with a short press on the On/Off key.
Flash green	Waiting for connection to a controller with Wi-Fi HaLow radio	<ul style="list-style-type: none"> The SX12 W-Fi HaLow model is waiting for connection to a controller with Wi-Fi HaLow radio. Change to Wi-Fi with a short press on the On/Off key.
Short flash, yellow	Waiting for connection to a controller with Wi-Fi	<p>The instrument is waiting for connection to a controller with Wi-Fi:</p> <ul style="list-style-type: none"> For the SX12 LRR model, change to long range radio with a short press of the On/Off key. For the SX12 Wi-Fi HaLow model, change to Wi-Fi HaLow with a short press of the On/Off key.
High frequency flash, yellow	Changing status	The instrument is changing status.

Connect a controller

To use the instrument it must be connected to a controller running field software, such as the Trimble Access™ software.

When the instrument is started, it will automatically be available for a connection with a controller. The instrument can be set to connect to the controller with LRR (long range radio) and Wi-Fi, or Wi-Fi HaLow radio and Wi-Fi. Alternatively, the supplied USB 2.0 cable can be used to connect.

Wi-Fi password

When a controller is connected to an out-of-the box instrument for the first time, you will be prompted to set a new Wi-Fi password.

Set Wi-Fi password for connection to the SX12 total station

Instruments that have firmware S2.8.x or later installed are configured with a factory default password.

The first time you connect to a new instrument or to an instrument that has been upgraded to firmware S2.8.x, the field software prompts you to change the password from the factory default password to a password of your choice.

The password must have the following attributes:

- At least 8 characters long
- A minimum one numeric character
- A minimum of one symbol

The password you enter is stored in the instrument and in the software on the controller.

Tap **Accept** to set the defined Wi-Fi password to the instrument. The next time you reconnect to the instrument with the same controller, the connection is automatic and you do not need to re-enter the password.

If you connect to the instrument from a different controller, the field software prompts you to enter the Wi-Fi password that is saved to the instrument. Enter the password and tap **Accept**.

Change Wi-Fi password

If an instrument password has previously been stored on the controller, go to the Wi-Fi settings on the controller and tap **Forget password**.

There are two ways to change the Wi-Fi password on the instrument:

- Press the Power button on the instrument
- Connect the instrument to the controller via a USB cable

Press the Power button on the instrument

1. Press the Power button on the instrument **5 times** in rapid succession to reset the password stored in the instrument firmware to the factory default password.
2. The instrument's power button will blink rapidly, then the instrument will shut down.
3. Restart the instrument.
4. When you attempt to connect to the instrument, the controller software prompts you to change the password from the factory default password to a password of your choice.

NOTES –

- The 5 button presses must be done in a rapid succession. If the time between button presses is too long (more than 0.7 seconds), the password reset will be unsuccessful and a change in radio will occur instead.
- Instrument password functionality is not available when using the TDC600 Model 2 handheld. You cannot connect this type of controller to an SX12 that has a user-defined password set using Wi-Fi, unless you first reset the password in the instrument to the factory default password. To reset the password, use the Power button 5 press method.

Connect the instrument to the controller via a USB cable

1. Connect to the instrument using the USB cable.
2. On the controller, open the field software that you are using and change the password in the instrument settings. For example, in Trimble Access, the typical workflow is:

- a. Tap  and select **Instrument / Instrument settings**.
- b. Tap the **Password** softkey at the bottom of the Instrument settings screen.
- c. Enter the instrument password. The password must have at least 8 characters, with a minimum of one numeric character and one symbol.
- d. Re-enter the password and then tap **Accept**.
- e. Wait for around 30 seconds while the password is stored.
- f. When the software confirms the password has been changed, tap **OK**.

You will now be able to connect to the instrument using Wi-Fi.

Connect with long range radio

When LRR is used to connect to the controller, the LRR must be set in both the instrument and controller. To establish a connection, the radio channel and network ID settings must be the same for the instrument and controller.

To change the radio channel and/or network ID, the instrument must be connected to the controller using a cable or Wi-Fi.

To change communication from LRR to Wi-Fi, make a short press on the On/Off key. The On/Off key LED will flash with a high frequency. After the change is completed, the LED will short flash indicating it's waiting for a connection. If the controller and instrument have been connected previously and are set to automatically reconnect, they will do so and the LED will turn on solid.

To change communication to cable, connect cable from controller to the instrument COM connector.

NOTE – Due to bandwidth restrictions of the LRR, images are transferred from the instrument to the controller at a slower speed than other communication modes. Trimble recommends transferring only single images, not large multi-image panoramas, using LRR mode. For faster transfer of images and scans, Trimble recommends using Wi-Fi HaLow, Wi-Fi, or cable.

Connect with Wi-Fi HaLow radio

Wi-Fi HaLow connects to the controller using the instrument's serial number as the device ID. Select the device to connect to the controller.

To change communication from Wi-Fi HaLow radio to Wi-Fi, make a short press on the On/Off key. The On/Off key LED will flash with a high frequency until the change is completed.

Connect with Wi-Fi

When Wi-Fi is used to connect to the controller, the instrument's serial number is used as the device ID. Select the device to connect to the controller.

It can take a while before the instrument appears as a device after the instrument has been started.

To change communication from Wi-Fi to LRR, make a short press on the On/Off key. The On/Off key LED will flash with a high frequency. After the change is completed, the LED will short flash indicating it's waiting for a connection. If the controller and instrument have been connected previously and are set to automatically reconnect, they will do so and the LED will turn on solid.

Connect with cable

When a controller is connected with a cable to the instrument COM connector in the base unit, it is automatically selected as the primary communication.

If the cable is disconnected, the instrument will start to search for the controller using LRR or Wi-Fi.

NOTE – Use only a communication cable approved by Trimble.



1 COM connector 2 To controller

Security

To avoid unauthorized use of the instrument, you can activate a PIN code.

PIN code

The PIN code is a four-digit code where each digit can be set between 0 to 9, for example “1234”. The PIN code can be activated and changed by the user in the field software. Please refer to the field software documentation for more information.

The default PIN code is “0000”. With this code set, the security is not activated and you are not prompted to enter PIN code at start up.

NOTE – If the wrong code is entered more than 10 times, the instrument will be locked and the PUK code needs to be entered.

PUK code

The Personal Unblocking Key (PUK) code is a ten-digit code where each digit is set between 0 to 9, for example “0123456789”. If an incorrect PIN code has been entered 10 times, enter the PUK code to unlock the instrument.

The PUK code is set at the factory and cannot be changed. The PUK code is available in the field software before the PIN code is set. Please make a note of the PUK code and save it in a safe place.

NOTE – If the PUK code has been lost, please contact your authorized Trimble distributor to retrieve the PUK code.

Operator calibrations

The operator can perform the following instrument calibrations:

- Autolock collimation
- Compensator calibration
- Camera collimation for overview, primary and tele camera.
- Plummet camera calibration
- Laser (pointer) collimation (Optional)

These calibrations are performed by the field software on the controller. Please refer to the field software documentation for more information.

Trimble recommends that these calibrations are carried out on a regular basis to obtain the highest precision of the instrument.

In addition, Trimble recommends that these calibrations are performed:

- Immediately prior to high-precision angle measurements in one face.
- Whenever the instrument may have been roughly handled during transport.
- After extended working or storage periods.
- If there has been a significant temperature difference from the previous calibration.

Pre-Measurement checklist

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

- Lenses are clean
- Instrument is correctly leveled

- Tracker collimation error
- Correct radio channel and network ID is selected (LRR only)
- Measure instrument height

Allow sufficient time for the instrument to adjust to the ambient temperature. See [Measurement stability, page 16](#).

Instrument Technology

- Angle measurement technology
- Measurement technology
- Servo technology
- Autolock technology
- Image technology
- Laser pointer technology
- Radio technology

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:

- Instrument mislevelment (deviation of the plumb axis)
- Horizontal and vertical collimation error
- Trunnion axis tilt

Correction for mislevelment

The instrument automatically corrects for mislevelments up to $\pm 6'$. The instrument warns the operator immediately of any mislevelments in excess of $\pm 6'$ (± 0.11 gon).

The instrument also utilizes SurePoint™ accuracy assurance technology to automatically correct the pointing of the telescope for all mislevelment and trunnion axis errors in real time during operation.

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

HA/VA collimation

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

The vertical collimation error is the difference between the vertical circle zero and the plumb axis of the instrument.

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

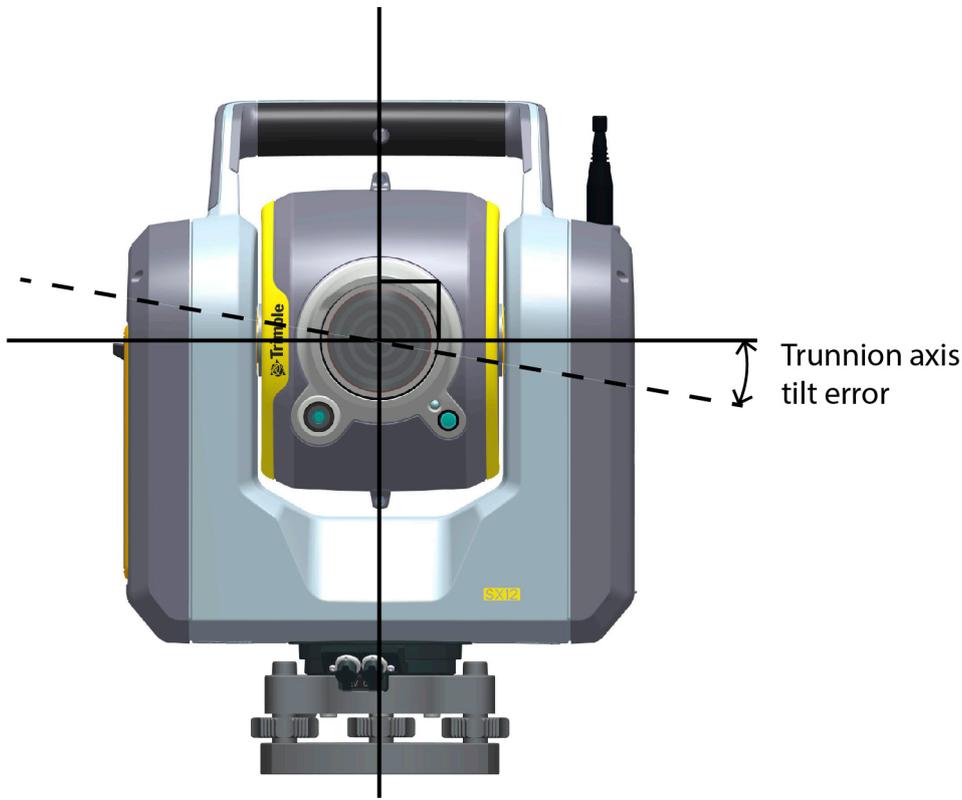
Autolock technology

The instrument is equipped with Autolock technology that can automatically lock onto and track a prism target.

To correct for the tracker collimation errors, carry out an Autolock collimation test. The Autolock 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 instrument. The Autolock collimation correction values are then applied to all subsequent angle measurements observed when Autolock is enabled. Angles observed in a single face are corrected for collimation errors, which removes the need to measure in both instrument faces.

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 instrument.



The trunnion axis tilt error is measured at the factory and stored in the instrument as a correction value. This correction value is then applied to correct the horizontal angle value and the telescope is automatically re-pointed using Surepoint technology.

Average measurements to reduce sighting errors

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

- Use Autolock. When Autolock is enabled, the instrument automatically locks onto and tracks the target. Manual sighting errors are reduced.
- Automatically average angles during distance measurement. When measuring in Standard mode, the instrument takes approximately 1.2 seconds to measure the distance. Angles returned to the instrument at 2,000 Hz are averaged over the 1.2-second period to obtain an averaged angle measurement.

Measurement technology

The instrument is equipped with a distance unit, which is capable of working in different modes. This means that the instrument can measure in prism mode, direct reflex (DR) and in scanning mode.

Distance measurement technology

The EDM is a pulsed laser distance unit that determines distances by precisely measuring the time of flight of the transmitted light pulse. The distance unit generates a short laser pulse, which is transmitted through the telescope to the target. The pulse reflects off the target surface and returns to the instrument where the unit determines the time difference between the transmitted pulse and the received pulse. The unit uses the time difference to calculate the distance to the target.

Scanning technology

During scanning the EDM is in scanning mode. The instrument measures distances and angles while turning around the horizontal and vertical axis to sweep over the selected area. A third axis is added with a rotating prism in the measuring beam's optical path. The rotating prism deflects the measuring beam to increase the speed with which the laser beam moves over the scanned area. This technology makes it possible to increase the number of measured positions in the scan.

Servo technology

The instrument is equipped with servo controlled motors to position the instrument.

NOTE – Due to the high-speed servo 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. If the setup, tripod and/or tribrach are unstable the instrument servos might oscillate slightly in an effort to compensate for that instability. An unstable setup could negatively influence the resulting measurement precision. See [Setup, page 15](#).

Trimble MagDrive™ servo technology is an electromagnetic direct drive system, which gives high turning speeds and accuracy. The frictionless motion removes servo noise and reduces instrument wear.

Autolock technology

Autolock controls the instrument servos and aims the instrument correctly towards the target.

The instrument is equipped with image-based Autolock technology, which is used for a robotic or a conventional measurement with Autolock to lock onto and track a prism.

The Autolock optics are coaxial with the distance measurement optics and the tele camera.

NOTE – The overview and primary camera is not coaxial with the Autolock optics. This has an optical effect over very short distances. Although the overview camera shows that the instrument is aimed directly at the prism, Autolock will not lock on to the prism. The reason for this is that the narrow beam of the Autolock transmitter is not reflected back to the Autolock receiver. To get lock on the prism, move the prism slightly to the side.

CAUTION – For precision measurements when using a 360 degree prism, better results are obtained when one of the prisms is pointing directly at the instrument.

Image technology

The instrument is equipped with a total of four cameras: overview camera, primary camera, tele camera and plummet camera. Each camera performs a different task.

Overview camera

The overview camera is positioned parallel with the EDM axis but with an offset. It has a fixed focus with a 54° field of view.

The overview camera is used for the following zoom levels:

- Zoom level 1-2 when the laser pointer is off.
- Zoom level 1-2 when the laser pointer is on.

Primary camera

The primary camera is positioned parallel with the EDM axis but with an offset. It has a fixed focus with a 12° field of view.

The primary camera is used for the following zoom levels:

- Zoom level 3-4 when the laser pointer is off.
- Zoom level 3-6 when the laser pointer is on.

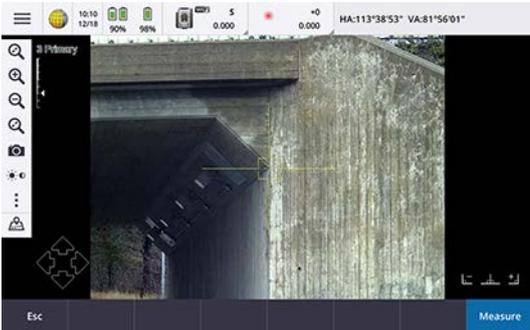
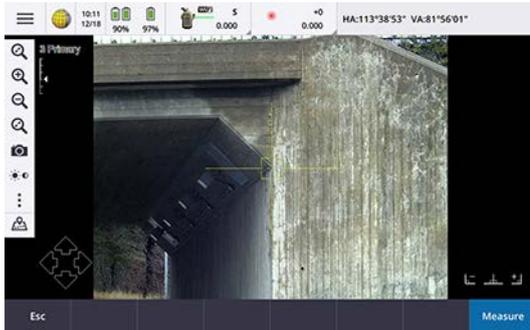
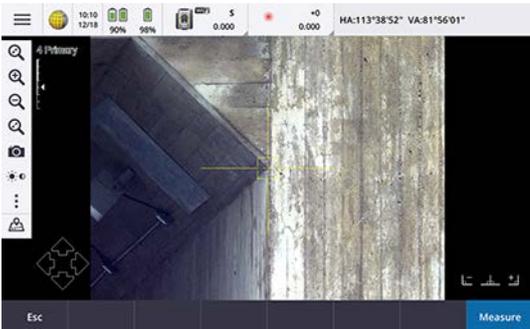
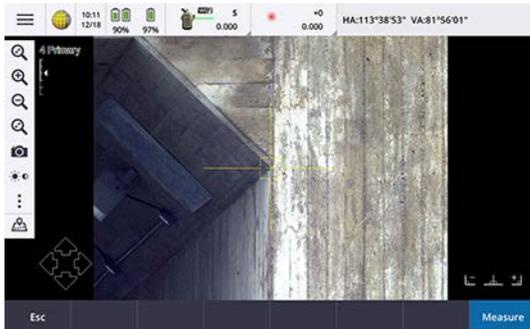
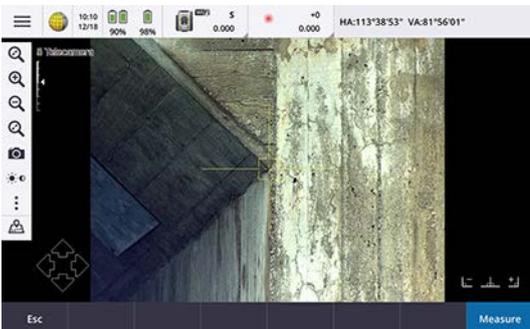
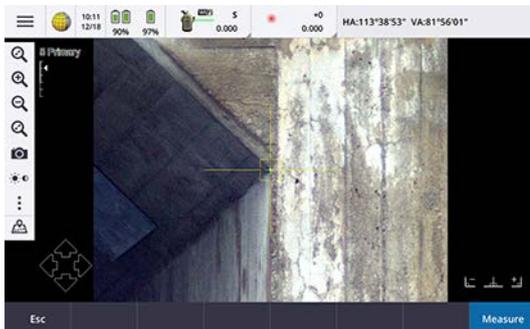
Tele camera

The tele camera is positioned coaxial with the EDM axis. It is equipped with an auto focus with a 2° field of view.

The tele camera is used for the following zoom levels:

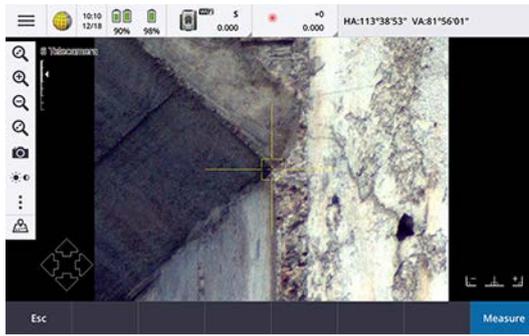
- Zoom level 5-8 when the laser pointer is off.
- The tele camera is not used when the laser pointer is on. The tele camera and laser pointer share the same optical path, and so only one may be used at a time.

Zoom level	Laser pointer off	Laser pointer on
1	<p>Overview camera</p> 	<p>Overview camera</p> 

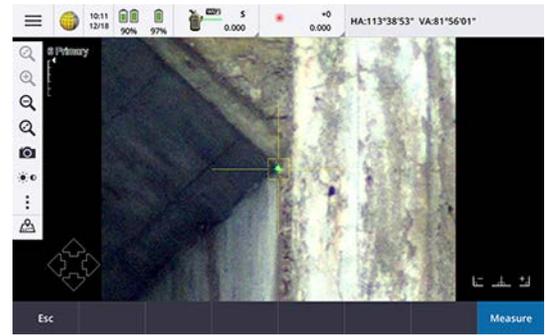
Zoom level	Laser pointer off	Laser pointer on
2	<p>Overview camera</p> 	<p>Overview camera</p> 
3	<p>Primary camera</p> 	<p>Primary camera</p> 
4	<p>Primary camera</p> 	<p>Primary camera</p> 
5	<p>Tele camera</p> 	<p>Primary camera</p> 

	Zoom level Laser pointer off	Laser pointer on
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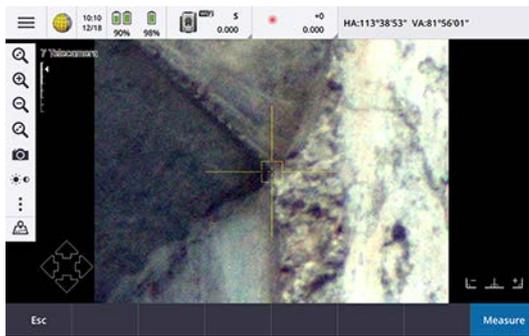
6 Tele camera



Primary camera

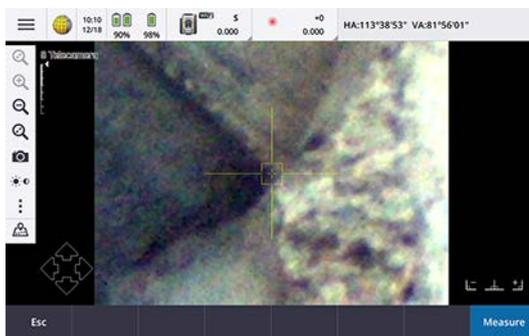


7 Tele camera



N/A

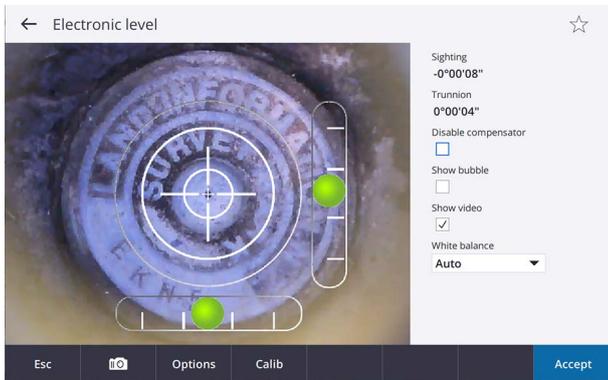
8 Tele camera



N/A

Plummet camera

The plummet camera is a camera-based solution that replaces the optical plummet. It has a fixed focus with a 6° field of view. The plummet camera can be used to document your setup. Click the camera symbol in the display to take a snap shot.



NOTE – The orientation of the plummet camera is aligned to a user standing at the back side of the instrument. See [Set up over a point, page 16](#).

Laser pointer technology

As an option the instrument can have a green laser pointer activated. The laser pointer is automatically focused to provide a small spot size at different distances. The laser pointer can also be manually focused, please refer to the field software documentation for more information.

Laser pointer brightness settings

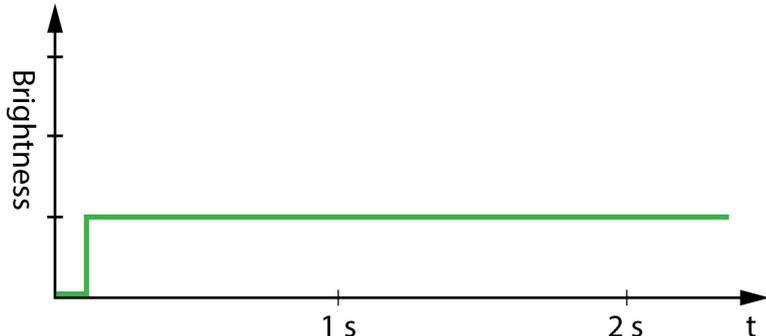
The brightness of the laser spot reflection can be perceived differently depending on the ambient light, reflection from object and/or range to the object. To adjust for this difference in the perceived brightness, the user can select different settings in the Trimble Access™ field software.

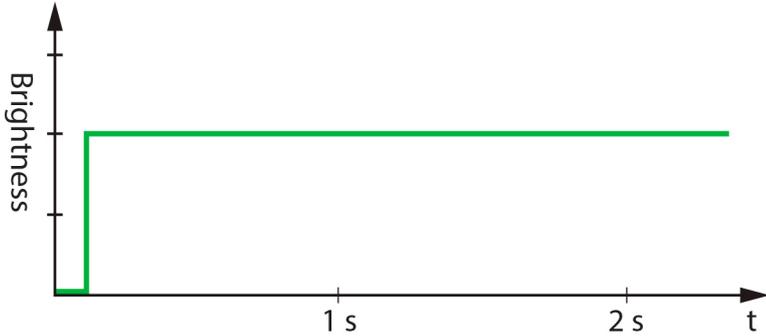
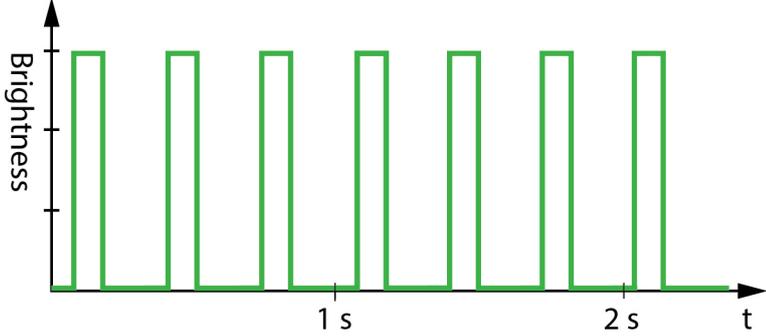
- Low-Light. This setting is suitable in the following conditions:
 - Indoors
 - In dull light conditions (low ambient light)
 - When pointing at highly reflective surfaces
 - At close range
- Standard. The standard setting is suitable for use under normal conditions.
- Extended Range Flash. The Extended Range Flash setting can be used to find the laser spot in difficult conditions. It is suitable in the following conditions:
 - Outdoors
 - In bright light conditions (high ambient light)
 - When pointing at low- to non-reflective surfaces
 - At long range

The brightness level and flashing pattern for these settings depends on what EDM mode the instrument is in.

EDM In standard mode (STD)

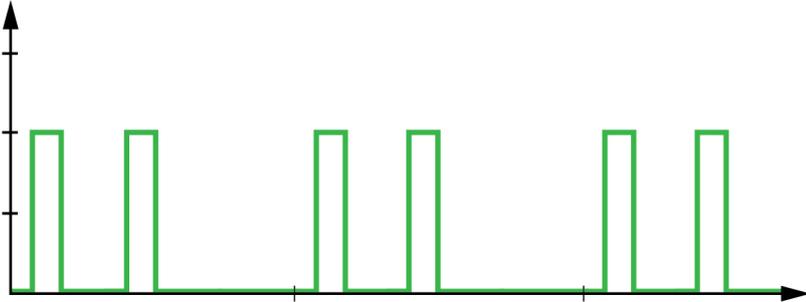
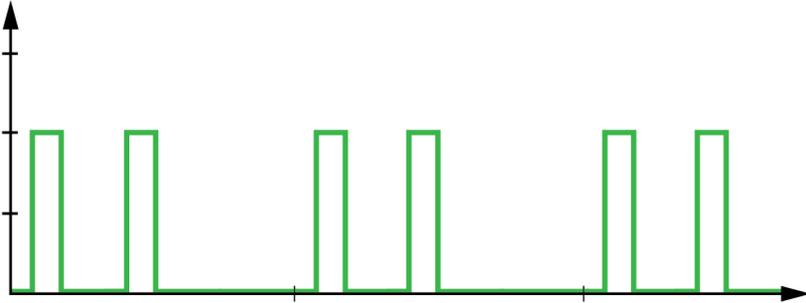
When the EDM is in standard mode (STD), The brightness level and flashing pattern for the three possible settings are as described in the following table.

Setting in Trimble Access	Description
Low-Light	 <p>The graph plots Brightness on the vertical axis against time (t) on the horizontal axis. The vertical axis has three tick marks, and the horizontal axis has two tick marks labeled '1 s' and '2 s'. A green line starts at a low brightness level, remains constant for a very short time, then jumps vertically to a higher brightness level. It remains at this higher level for a duration that extends past the 2 s mark on the time axis.</p>

Setting in Trimble Access	Description
Standard	 <p>The graph shows a constant brightness level over time. The vertical axis is labeled 'Brightness' and has three tick marks. The horizontal axis is labeled 't' and has two tick marks labeled '1 s' and '2 s'. The brightness starts at a low level, then jumps to a higher, constant level at the beginning of the time period.</p>
Extended Range Flash	 <p>The graph shows a flashing brightness pattern over time. The vertical axis is labeled 'Brightness' and has three tick marks. The horizontal axis is labeled 't' and has two tick marks labeled '1 s' and '2 s'. The brightness is zero most of the time, with periodic rectangular pulses of high brightness. There are seven pulses in total, with the first pulse occurring at the start of the time period.</p>

EDM in tracking mode (TRK)

When the EDM is in tracking mode (TRK), The brightness level and flashing pattern for the three possible settings are as described in the following table.

Setting in Trimble Access	Description
Low-Light	 <p>The graph shows a low-light flashing brightness pattern over time. The vertical axis has three tick marks. The horizontal axis has two tick marks labeled '1 s' and '2 s'. The brightness is zero most of the time, with periodic rectangular pulses of low brightness. There are six pulses in total, with the first pulse occurring at the start of the time period.</p>
Standard	 <p>The graph shows a standard flashing brightness pattern over time. The vertical axis has three tick marks. The horizontal axis has two tick marks labeled '1 s' and '2 s'. The brightness is zero most of the time, with periodic rectangular pulses of medium brightness. There are six pulses in total, with the first pulse occurring at the start of the time period.</p>

Setting in Trimble Access	Description
Extended Range Flash	

Collimation

There can be a small difference in the optical alignment of the laser pointer in relation to the crosshair and the EDM that cannot be physically adjusted. The measurement will, however, be made at the position where the laser pointer and crosshair is aimed.

The instrument compensates for this small alignment difference by using the collimation values.

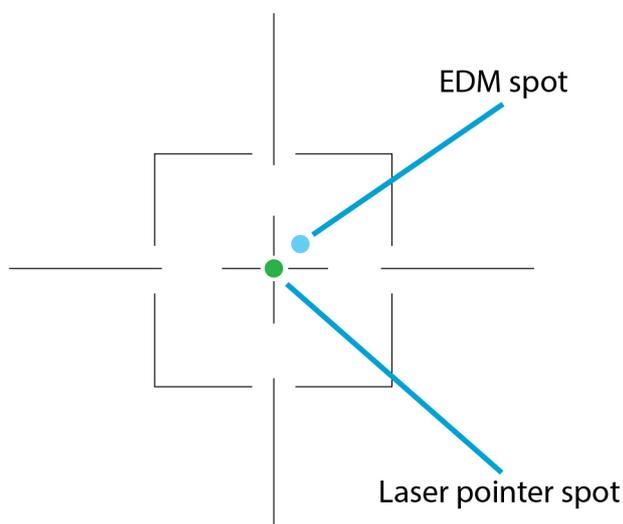
The laser pointer collimation value can be measured in the field. Refer to the field software documentation for more information.

How the instrument compensates for the difference in alignment depends on what EDM mode the instrument is in.

TIP – Use standard mode (STD) when performing high-precision measurements.

EDM in standard mode (STD)

When the EDM is in standard mode (STD), the camera crosshair is aligned with the laser pointer. The EDM alignment may differ slightly from the laser pointer, depending on instrument temperature and range (up to 20 mm @ 50 m).



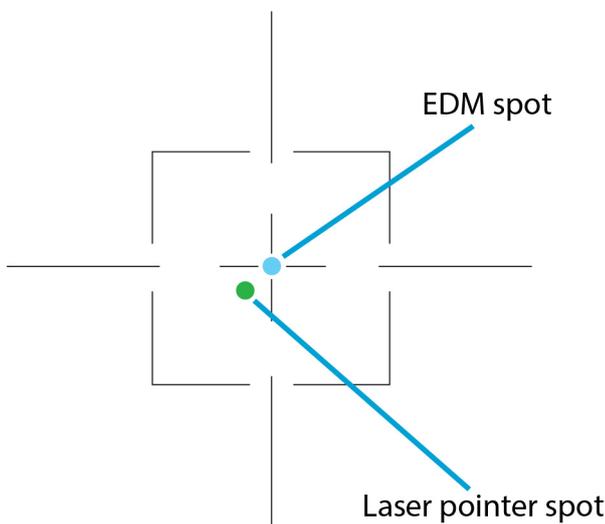
In STD mode the crosshair is aligned to the laser pointer. The EDM spot position relative to the crosshair and laser pointer will change slightly depending on instrument temperature, instrument face, and range. For a cold instrument in face 1, the EDM spot is up and to the right from the laser pointer, as shown above. For a warm instrument in face 1, the EDM spot is down and to the left relative to the laser pointer. In face 2, the opposite is true.

The compensation is automatic and when a STD measurement is made:

1. The laser pointer is turned off.
2. The crosshair is aligned with the EDM using the collimation values.
3. The servos adjust the instrument so that the crosshair and the EDM is aimed to the point that is to be measured.
4. The measurement is made.
5. The crosshair is aligned with the laser pointer using the collimation values.
6. The servos adjust the instrument so that the crosshair and the laser pointer is aimed to the measured point.
7. The laser pointer is turned on.

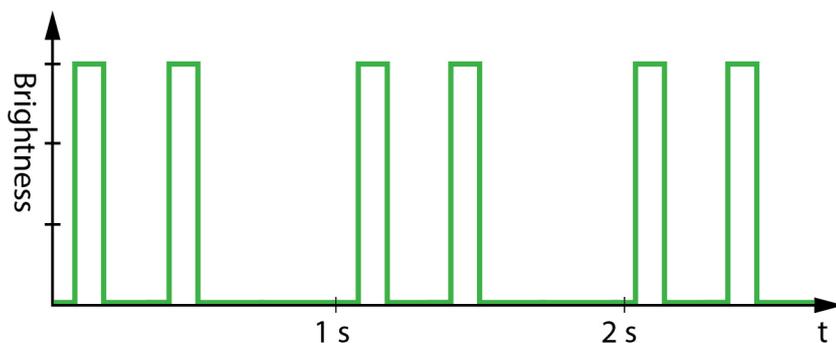
EDM in tracking mode (TRK)

When the EDM is in tracking mode (TRK), the camera crosshair is aligned with the EDM. The laser pointer alignment may differ slightly from the EDM depending on instrument temperature and range (up to 20 mm @ 50 m).



In TRK mode the crosshair is aligned to the EDM. The EDM spot position relative to the crosshair and laser pointer will change slightly depending on instrument temperature, instrument face, and range. For a cold instrument and in face 1, the EDM spot is up and to the right from the laser pointer, as shown above. For a warm instrument and in face 1, the EDM spot is down and to the left relative to the laser pointer. In face 2, the opposite is true.

To indicate that the laser pointer may not be aligned with the crosshair, the laser pointer flashes in a special pattern.



Laser pointer flashing pattern to indicate that the laser pointer is not aligned with the crosshair

TIP – Please refer to the field software documentation for information on further functions.

Radio technology

The SX12 LRR model is equipped with a 2.4 GHz long range radio and a Wi-Fi radio. It uses a radio antenna that is unique for the model.



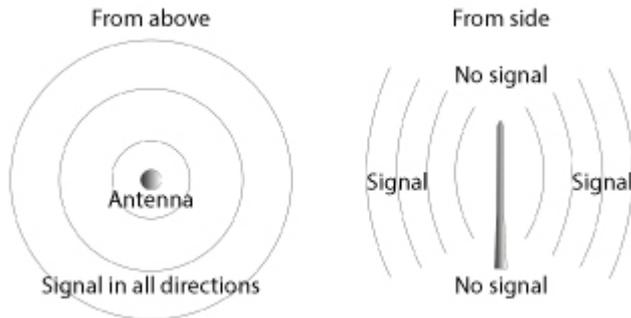
TIP – Trimble recommends to use long range radio when radio range is preferred over data transfer speed, for example robotic surveying, and the Wi-Fi radio when data transfer speed is preferred over radio range, for example scanning.

The SX12 Wi-Fi HaLow model is equipped with a Wi-Fi HaLow radio and a Wi-Fi radio. It uses a radio antenna that is unique for the model.



Antenna signal direction

The antenna radiates in all directions except from the top and bottom.

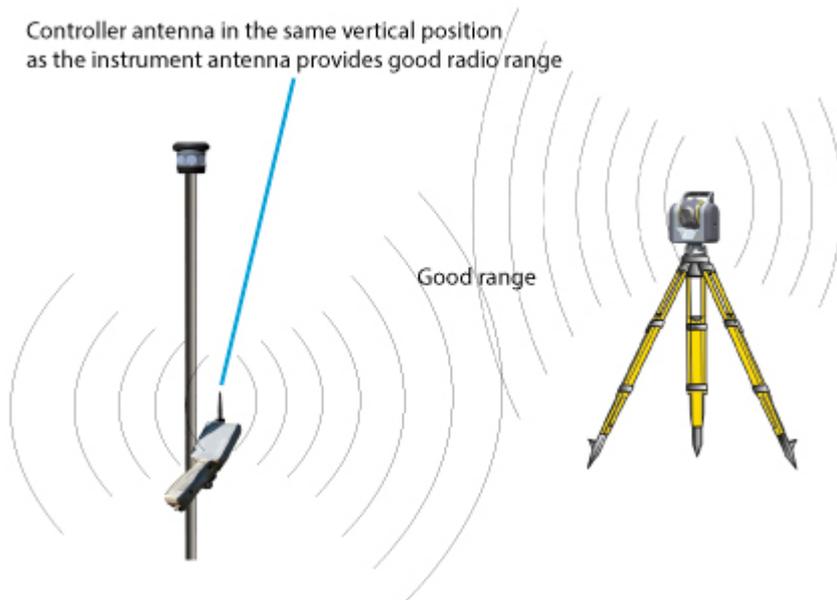


Radio signal from antenna

To get good radio range it is therefore important that the antennas are oriented in the same direction. As the instrument antenna is fixed in a vertical position, make sure to position the tiltable antenna on the controller in the same vertical position as the instrument antenna.



Poor radio range with controller antenna not in the same vertical position as the instrument antenna



Good radio range with controller antenna in the same vertical position as the instrument antenna

Line of sight

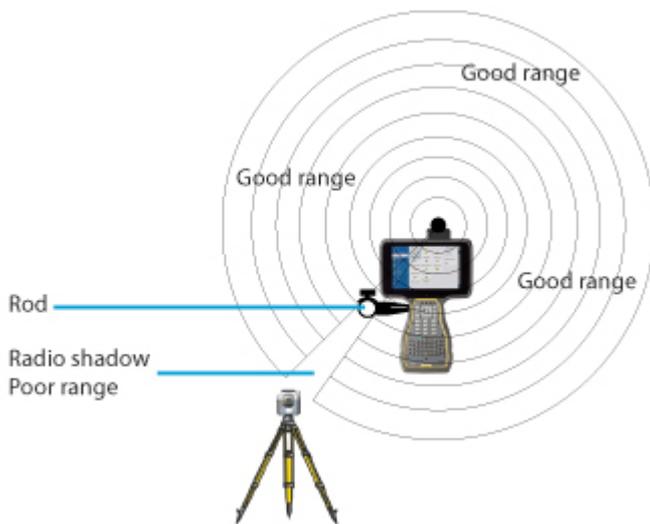
When using 2.4 GHz radios, the antennas must have line of sight to achieve good communication and maximum radio range. Objects between the antennas create a radio shadow that decreases the radio range with the risk of losing radio connection.

For example objects like bushes, trees, houses and vehicles can create a radio shadow, but also the human body and the equipment.

If radio connection is lost, try to obtain line of sight between the antennas to restore connection.



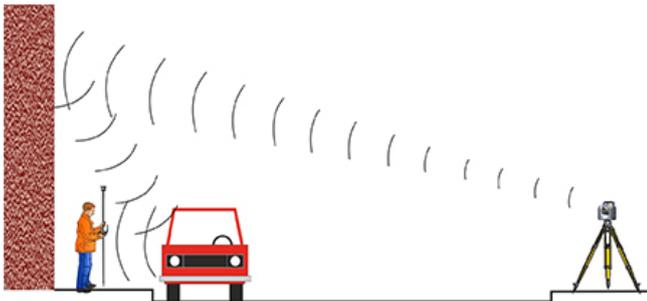
Human body creating radio shadow



Equipment creating radio shadow

Environment

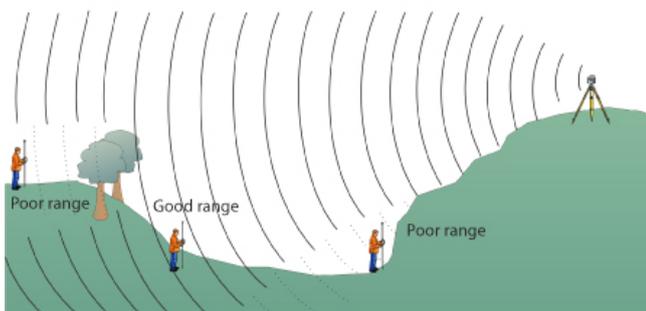
In an urban environment the radio signal can reflect between objects, for example buildings and parked cars, thereby providing a good radio coverage even without line of sight.



Reflecting radio signals in an urban environment

In an open terrain the line of sight becomes more critical as the radio signal does not have anything to reflect against.

To obtain a good radio range, try to position the instrument as high as possible in relation to the surrounding terrain.



Example of radio signals in open terrain

