STONEX

STONEX R60
Total Station
User Manual

(March 2023) - Ver.1-Rev.2

www.stonex.it

Contents

1. Introduction

Thank you for purchasing R60 Stonex total station.
This manual includes important safety directions and instructions for setting up and using the product. Please read this manual carefully before using the instrument, so that our products can serve you better. When you begin to use the product, we assume that you are a competent user who has read through and understood the contents of this manual and is fully aware of the necessary dangers, warnings and cautions. In the event of any discrepancy between the information contained in this manual and the actual, the actual information shall prevail, and the Company reserves the right to make further revisions or changes to this manual without notice.

Basic operating instructions

- This product must be operated by professional. The user must be a professional measurer or a person with equivalent knowledge of measurement in order to be able to accurately understand this user manual and the relevant safety instructions and to use, check and calibrate the instrument correctly.
- Always use the instrument in a safe environment and wear the necessary safety equipment (e.g., helmet, reflective vest, safety shoes, etc.) properly.

The scope of using this instrument

- Operate instruments to observe, indicate, or direct the displacement of a specific target.
- Measure horizontal and vertical angles.
- Measure the distance to a specific target.
- Record, store and edit measurement data.
- Calculate data using built-in applications.
- Data exchange using USB storage devices or internet connection via WI-FI or Bluetooth module.
- Communication with the instrument using Bluetooth.
- The necessary calibration.
- Other operations guided by this manual.

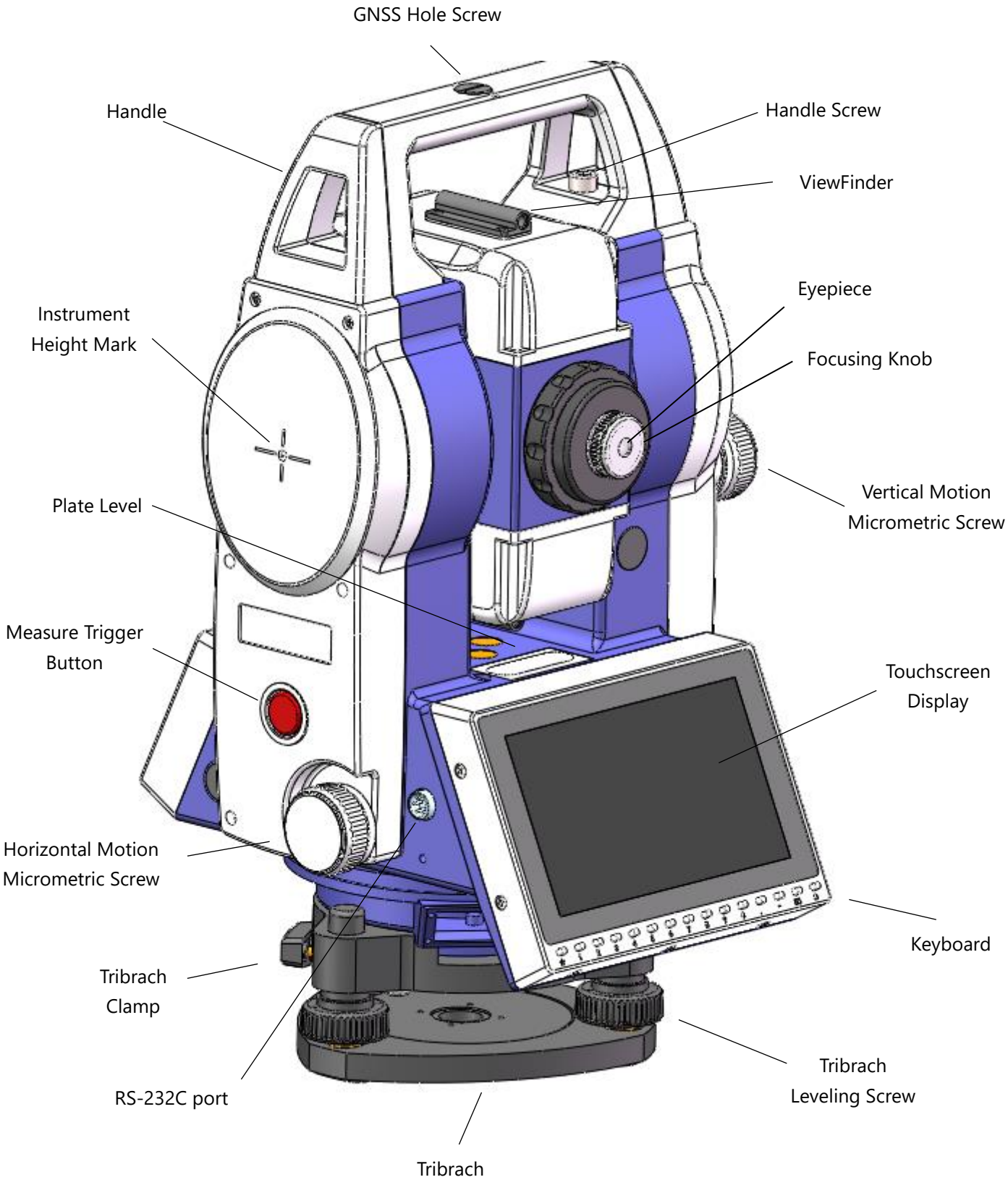
The scope of this instrument does not apply to

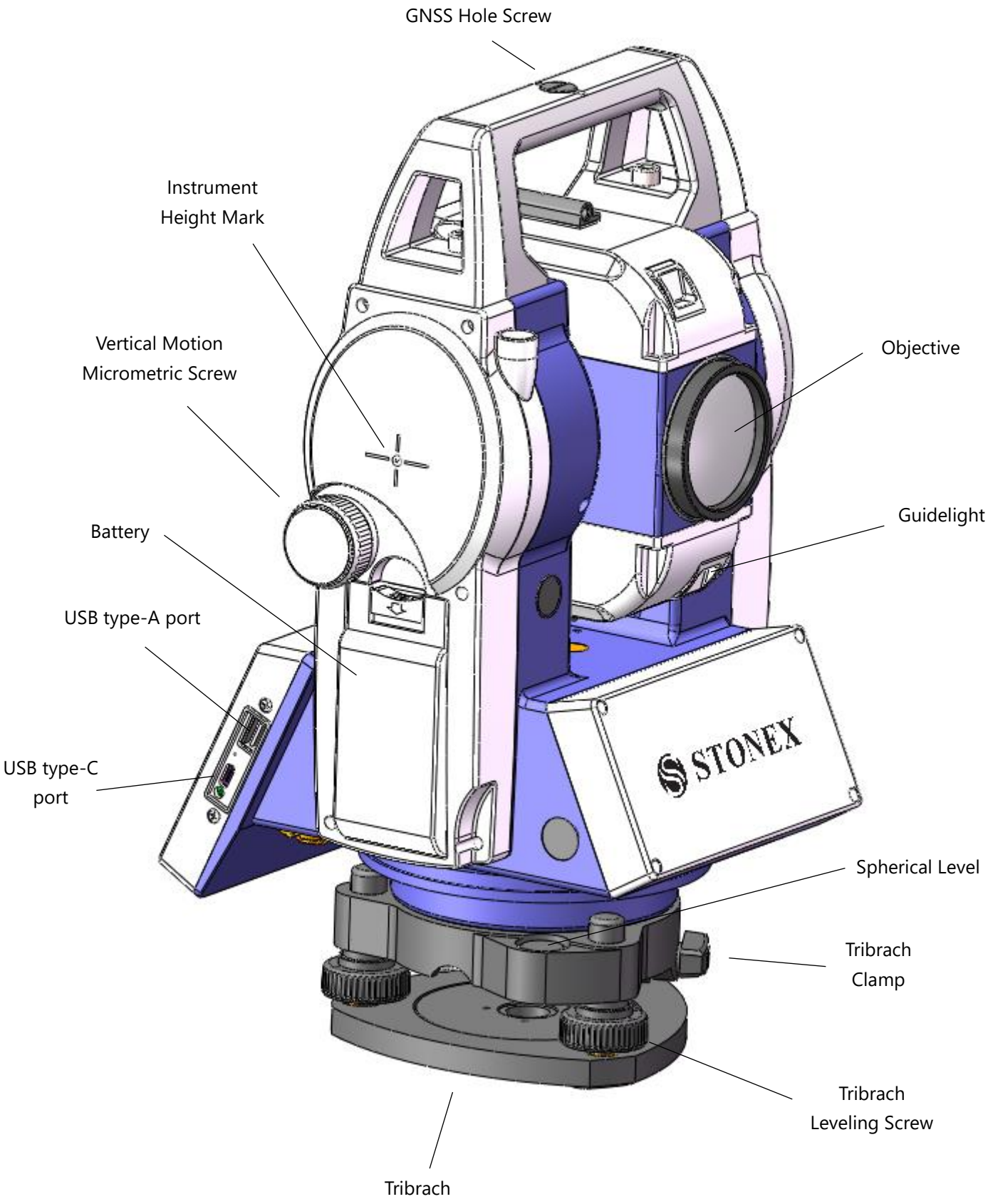
- Perform instrument operation in unsafe environments or where instrument weathering requirements are exceeded.
- Do not follow the Dangers and Warnings in the manual.
- Do not operate the instrument in accordance with the manual.
- Use the instrument beyond its capabilities.
- Adjustment, disassembly of instruments beyond what is specifically allowed.
- Repair or modification of instruments.

2. Instrument Presentation

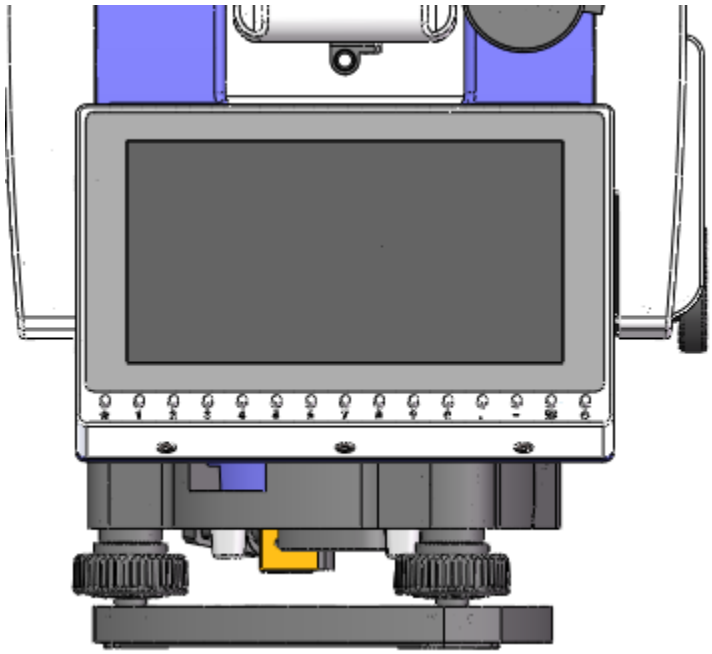
R60 is first Stonex Android-on-board Total Station. R60 has a 5.5-inch touch screen and the Android operating system, making it like a smartphone in terms of ease of use and familiarity for users, enriching the available functions with web browsing and data exchange.
Thanks to the Cube-a software onboard, with the new horizontal view, the operator can use background maps, have integration with GNSS surveys, and without cables get exchange functions between the TS and GNSS, with the Bluetooth connection.
The R60 is available in two versions, with accuracy of 2" - endless drives, and with accuracy of 1" - lock drives, this instrument has an accuracy of 2 mm + 2 ppm when measuring with a prism and has a range of 1000 m reflectorless. For more details about R60 technical features see 6 Technical Data or contact your local dealer.

2.1. Hardware Description




GNSS Hole Screw
Instrument
Height Mark
Vertical Motion
Micrometric Screw
Objective
Guidelight
Battery
USB type-A port
USB type-C
port
STONEX
Spherical Level
Tribrach
Clamp
Tribrach
Leveling Screw
Tribrach

2.2. Keyboard



R60 total station is equipped with one color Touchscreen display and an alphanumeric keyboard. Do not touch the screen with ball-pen, pencil or other sharp thing to avoid damage on instrument.

Here below keyboard buttons description:

Key	Function
[★]	Quick functions key. Click on this button to enter in *Settings* menu of R60 Manager app (see 4.2.3 R60 Manager)
[0][1] … **[9][.][-]**	Numeric keys. Use these buttons for entering numbers.
BS	Cancel numbers and words when writing.
[⏻]	Power key. Press and hold for power on/off the station.

3. Preparation & instrument setting up

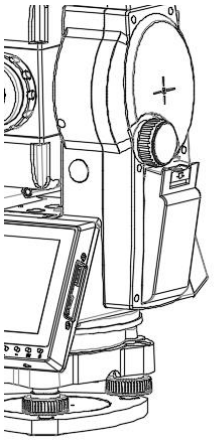
3.1. Battery and Charger

Installing / Replacing Battery

Follow the procedure below to mount/remove the battery:

1. *Mount the battery*
   - Insert the battery in the instrument battery vain.
   - Press the top of the battery until you heat a click.

2. *Remove the battery*
   - Press the top of the battery downward to remove it.
   - Remove the battery by pulling it toward you



Note 1. The battery connectors are protected by tape to reduce oxidation and scratches. ***REMOVE IT BEFORE USING THE BATTERY***.

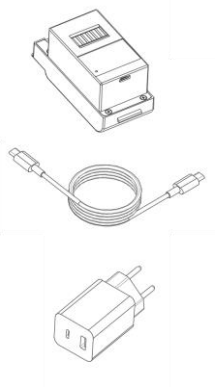
Note 2. Batteries must be charged before first use. For new batteries a complete charge/discharge operation can effectively improve battery performance. It is normal for the temperature of the battery and charger to rise during the charging process. Battery operating temperature range: -20℃ to +50℃. Low temperature will shorten the operating time of the battery, and too high temperature will shorten the life of the battery. Remove the battery and unplug the charger after each battery charge. Keep the battery and charger in a safe place. If you find that the battery level display is significantly inaccurate, it is recommended that you perform a complete charge/discharge operation.

Note 3. The battery's working time can be affected by many factors, such as environment temperature, recharging time, recharging and discharging times. So, we suggest the users to fully recharge the battery or prepare several full batteries before survey. For this reason, it is suggested to check the battery power before field work.

Note 4. The power consumption in distance measurement mode is more than in angle mode, if the instrument enters in distance measurement mode from angle mode, the power maybe auto-off because of lower battery.

Charging

1. Remove the charger and the cable from the carrying case.
2. Insert the USB type-C cable in the battery and in the charger.
3. If the battery is not fully charged, the charger will begin charging the battery and the charger indicator will flash in blue until the complete charge.
4. When charging is complete, the charger indicator will be fixed blue, pull the battery back to remove it, and then you can install it or use it as a backup battery.

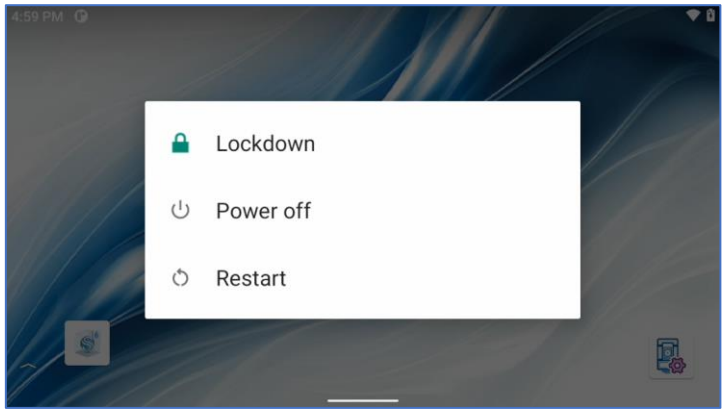


Please use the charger and battery from STONEX. Store, use and charge at the specified temperature conditions, taking care to avoid contact with liquids.

3.2. Power on / off

Press and hold **[⏻]** for more than 1 second in the power off state, the instrument starts and automatically enters in Android interface.

Press and hold for more than 2 seconds the power off key [⏻], the instrument prompt if the user wants to turn off or restart the total station and save the current settings.

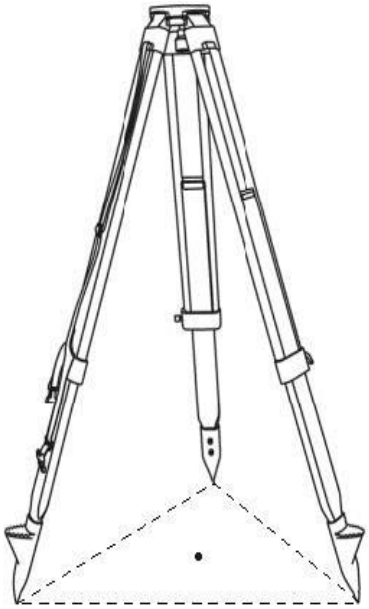


3.3. Instrument setting up

Locate the total station on a stable tripod or on a concrete pillar to guarantee its correct use and follow these guidelines for instrument setting up.

1. Setting up the Tripod and the Instrument

a. Adjust the tripod's three legs to nearly equal lengths that meet the height requirements for comfortable measurement.
b. Position the tripod over the station point. The three toes are firmly supported on the ground as equidistantly as possible, the center of the circle formed by the toes is close to the station point, and the tripod plate is nearly horizontal.
c. Take out the instrument and make sure that the instrument and its tribrach are firmly connected. Place the instrument onto the top plate of the tripod, fix the instrument with one hand, align the central knob of the tripod with the center hole of the tribrach with the other hand and tighten it.
d. Gently push the tribrach to make sure it is securely attached to the tripod plate.
e. Refine the tripod's three legs adjustment using the tribrach spherical level as reference.

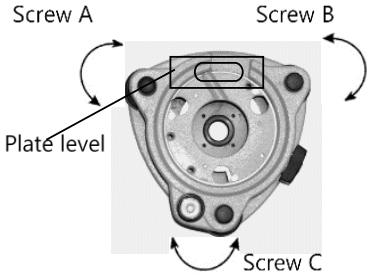


Note 1. The quality of the tripod setting up can affect the survey result. Remember to locate the tripod on a stable surface sticking the metal tips in the ground.

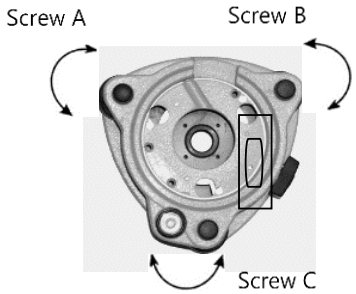
Note 2. It is recommended to check the stability of the tripod before each survey.

2. Leveling up the Instrument

Use tribrach leveling screws to level up the instrument, taking the plate level as reference.



Turn the instrument till the plate level is parallel to a line shaped with screws A and B. Adjust the screws A and B to make the bubble in the center of the level.

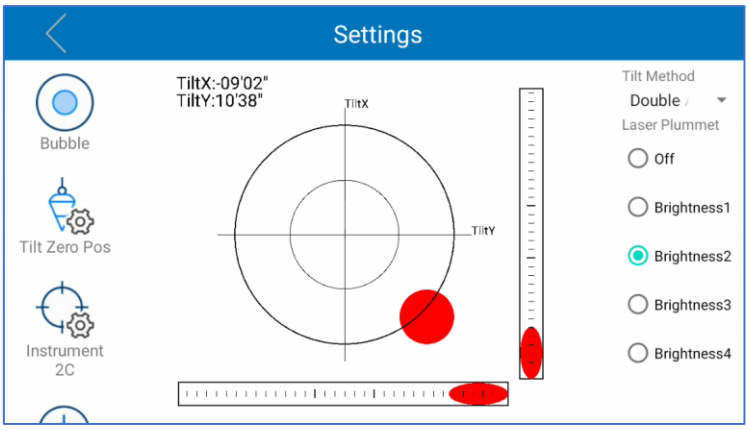


Turn the instrument approximately 90°. Adjust screw C, till the bubble in the center of the level.

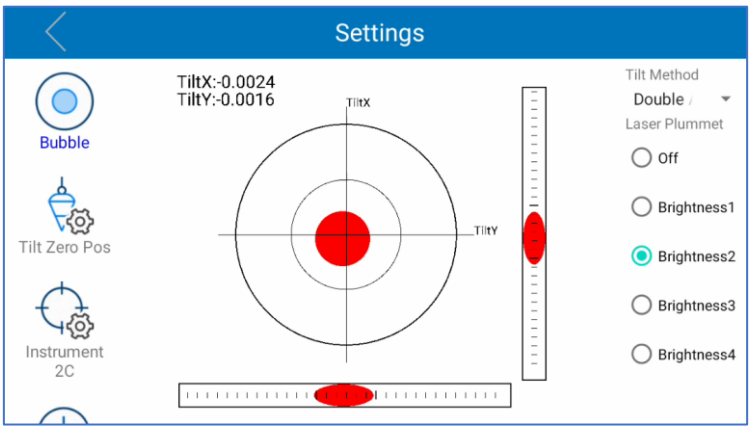
Repeat above steps until the bubble remains in the center of the plate level while the instrument is rotated to any position.

3. Accurate leveling-up with electronical level

Press and hold **[⏻]** to power on the instrument.
Click on **[★]** button to enter in the electronical bubble page.



Use the tribrach leveling screws to level up the instrument, taking the electronical level on the screen as reference. Adjust the screws to make the bubble, visible on the screen, in the center of the electronical level, as visible in the image below.



If plate level is not centered when leveling up with electronical bubble, probably it's necessary to calibrate it (see 5 Calibration).

Clicking on *Tilt Method,* it is possible to activate/deactivate the electronic compensator. This function is very important to compensate the not perfect leveling up of the instrument, that could bring errors in VA/HA readings. The enabling of this function allows to correct leveling up errors and improve the quality of the readings.
There are three different options for this function:

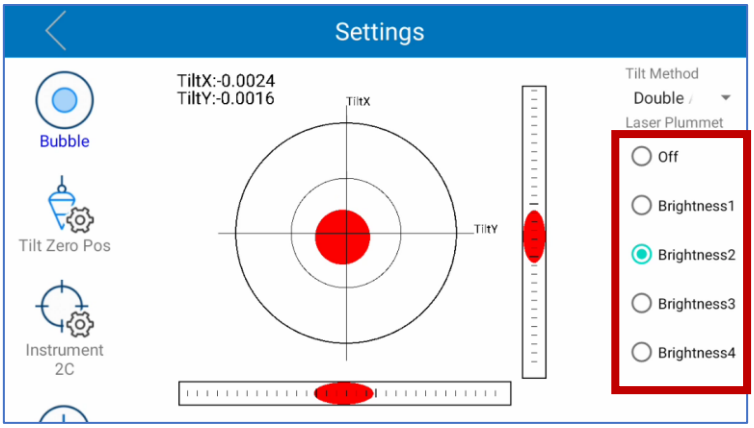
a. *Don't Fix* -> Electronic compensator not activated.
b. *Single Axis* -> Electronic compensator activated only in one direction.
c. *Double Axis* -> Electronic compensator activated in X and Y directions.

When the instrument is in operation, if the Double Axis tilt compensation is on, the instrument will compensate and correct the VA and HA readings.

To avoid accidental tilting of the instrument which may affect the measurement accuracy, it is recommended that the user always switches on the Double Axis compensation option during normal operation.

4. Centering with laser plummet

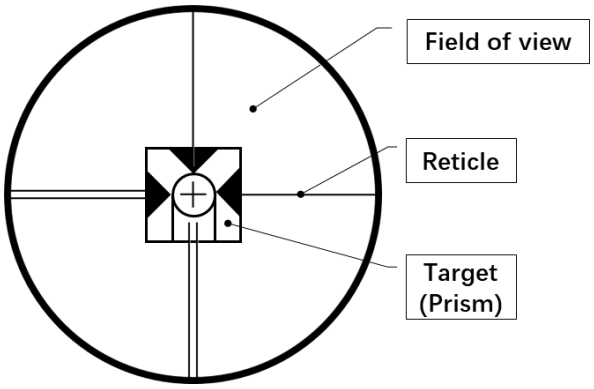
The centering operation is necessary to align total station vertical axis to reference station point. To make easier this operation, it is possible to activate the instrument laser plummet. In electronical bubble page the option *Laser Plummet* can enable/disable/change intensity of the laser plummet. There are five levels of brightness intensity, as visible in the image below.



To center the instrument, follow this procedure:

a. Slightly loosen the central knob, observe the relative position of the laser spot and the station point, slowly push the tribrach to slide on the tripod plate until the laser spot is precisely aligned with the station point, and then tighten the central knob.
b. Verify the leveling of the instrument on electronical bubble page.
c. If the instrument is leveling up the procedure is completed, otherwise repeat the steps described in 3.3 Instrument setting up.

3.4. Focusing and Collimating



General focus and collimate process:

a. *Diopter adjustment* -> Looking through telescope at a brigh monochromatic background. Turn the eyepiece's diopter ring clockwise to the end, observe the reticle, slowly turn the ring counterclockwise until the reticle image is sharp and clear.

b. *Rough targeting* -> Rotate the telescope to aim for the target with the viewfinder, observe from the eyepiece to confirm that the target is in the field of view.

c. *Focusing* -> Observe the target from the eyepiece, slowly turn the focusing ring until the target image is sharp and clear.

d. *Precisely collimating* -> Observe the target from the eyepiece, adjust the horizontal and vertical drive to aim the reticle precisely at the center of the target.

e. *Start measuring*

3.5. Trigger Key

Trigger key is a button located on the side of total station body. It can be used to perform measurements simply pressing it without touching the display.

Note. Trigger Key works only in *R60 Manager* -> *Measure* page (see 4.2.3 R60 Manager) and in *Cube-a*

3.6. Tribrach assamble/disassemble

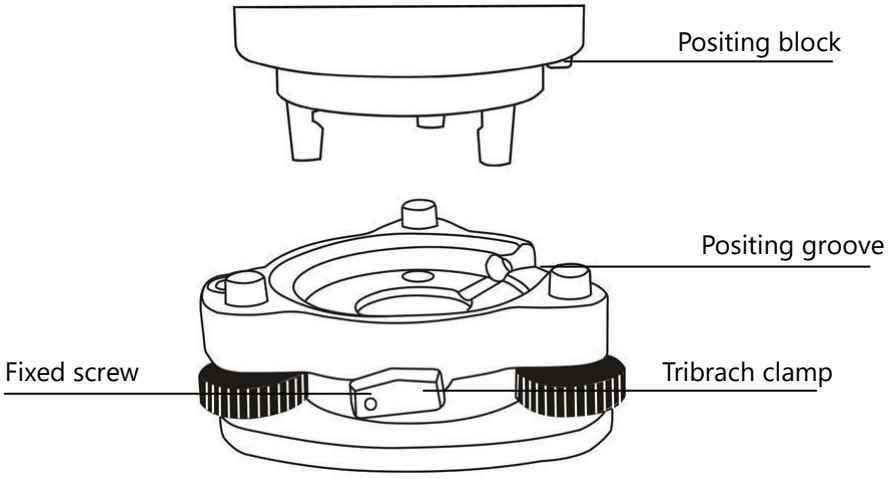
Use the tribrach clamp to assemble or disassemble the instrument from the tribrach.

Disassemble

Rotate the tribrach clamp counterclockwise until the lever is loosen.
One hand holds up the tribrach, another hand holds the carry handle of the instrument and lift out the instrument from the tribrach.

Assemble

Put the instrument into the tribrach lightly, let the communication port against in the indentation of the tribrach. Rotate the tribrach clamp clockwise until the lever is tighten.



Note. If the instrument doesn't need assembly or disassembly from tribrach frequently, it is possible to fix the tribrach clamp by fixed screw to avoid the disassembly by accident. Screw out the fixed screw by driver to fix the clamp.

3.7. GNSS Handle

R60 is equipped, as visible in 2.1 Hardware Description, with a GNSS handle. This accessory allows to mount a GNSS receiver above the station using a proper connector. This configuration has a lot of advantages in mixed survey, that requires the simultaneous use of a GNSS receiver and a Total Station. Refer to R60 video tutorial for a detailed overview about this configuration.

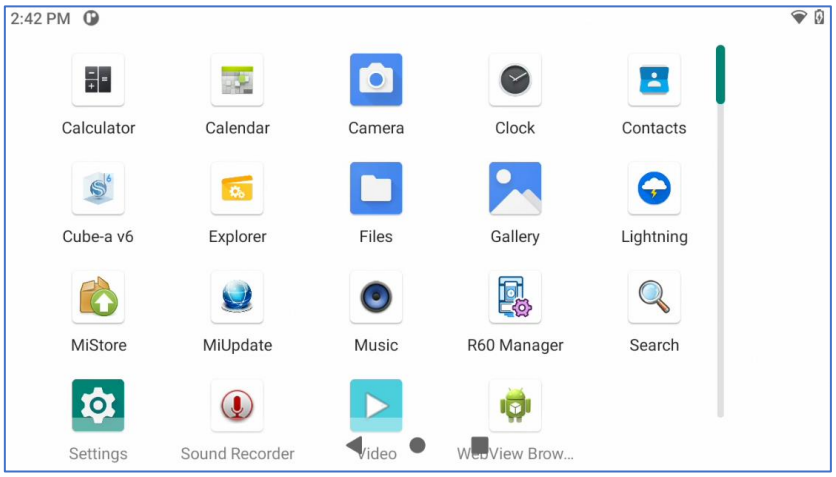
4. Android Operative System

R60 is first Stonex total station characterized by Android operative system on board. Using Android on a total station provides a lot of advantages improving instrument functionality, simplicity and usability from different points of view. The operative system is in fact the same one installed on a Smartphone with the applications and the functions typical of a classical Android device. The user will work using a familiar and already known interface, increasing its efficiency and decreasing working time.

R60 has some pre-installed applications usable to manage the Android operative system and some other ones designed for total station management.

These applications can be divided in two different categories:

- Android default app
- R60 technical app



4.1. Android default app

This group contains the default pre-installed Android applications. These apps can't be used to manage the total station, but they offer tools and functions proper of Android operative system. Here below their description:

Calculator -> Instrument internal calculator.

Calendar -> Calendar app.

Camera -> Access to the Camera of the device (***Note***. R60 is not characterized by camera on-board. For this reason, this application doesn't work).

Clock -> Enter in the clock application of the device.

Contacts -> App for contact list management.

Explorer -> This application can be used to access to the device internal memory. Its use is suggested for developer purpose.

Files -> This application can be used to access to the device internal memory. In this app will be included all the survey data and user files.

Gallery -> This application allows the user to open and manage images and photos.

Lightning -> This application can be used to access to Web Internet (***Note***. It's necessary to connect the instrument via WI-FI to Internet before using this application).

Music -> This application allows the user to open and manage audio files.

Settings -> App for Android settings system management.

Sound Recorder-> App to record sound (***Note***. R60 is not characterized by microphone sensor on-board. For this reason, this application doesn't work).

Search -> This application can be used to search on Web Internet. (***Note***. It's necessary to connect the instrument via WI-FI to Internet before using this application).

Video -> This application allows the user to open and manage videos.

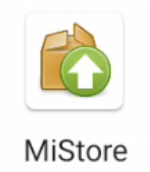
Web View Browser -> This application can be used to access to Web Internet (***Note***. It's necessary to connect the instrument via WI-FI to Internet before using this application).

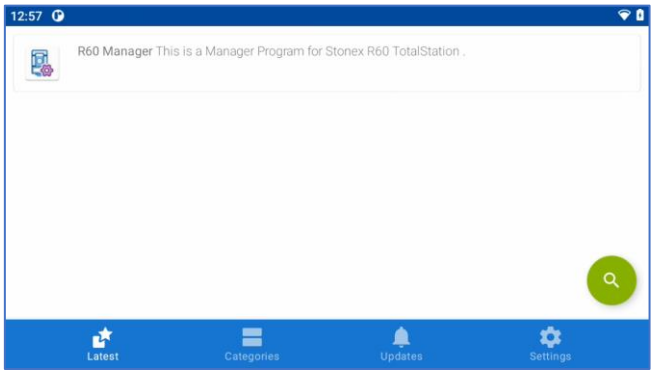
4.2. R60 Technical app

This group contains the applications necessary to manage R60 total station in all its functions (***Note***. These apps are necessary for instrument configuration, update and management, please don't unistall them). There are four pre-installed applications on the total station: MiStore, MiUpdate, R60 Manager and Cube-a. Below their description.

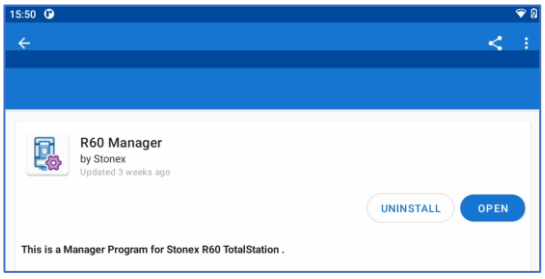
4.2.1. MiStore

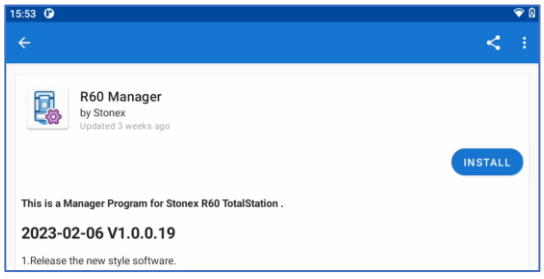
MiStore app is dedicated to "R60 Manager" application update via Internet (***Note***. The instrument must be connected to Internet)





Enter in MiStore app and swipe down to refresh the page. The application finds on the server the last "R60 Manager" version, as visible in the image above.
Before updating "R60 Manager" app, it's necessary to uninstall the old one. Click on the icon in the photo above to enter in the page visible in the photos below. Click on "Uninstall" to uninstall the old "R60 Manager" app (left image). After this operation, the "Install" icon appears, like visible in the right image below. Click on "Install" to install new "R60 Manager" app version.



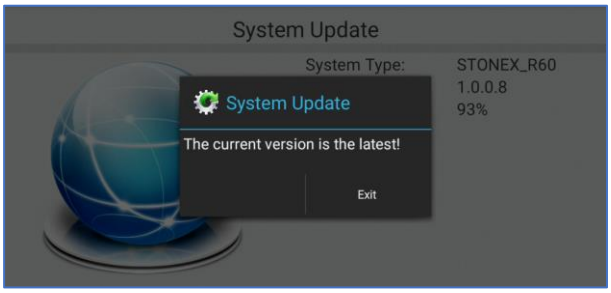


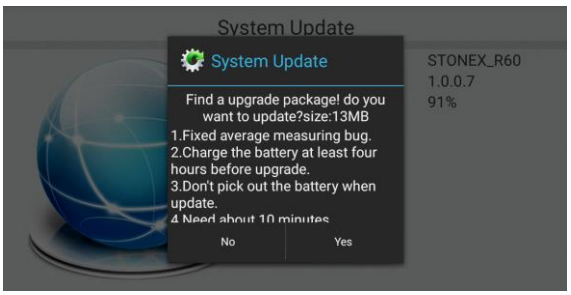
Note. If the "Install" icon doesn't appear, enter in "MiStore" app -> "Settings" section and enable "Include incompatible versions" option.

4.2.2. MiUpdate

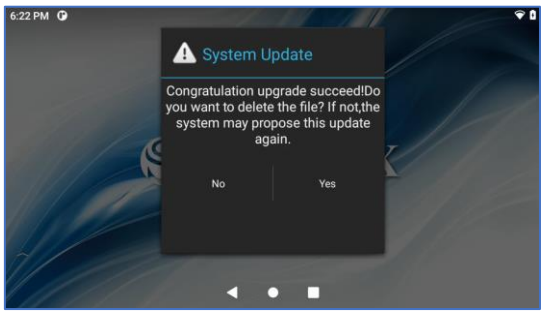
This application is dedicated to total station firmware (FW) update.
Clicking on the icon the following screen appears.

In this application, it is possible to read the current FW version (in the example above 1.0.0.8), verify the battery level (in the example above 94%) and check the presence of FW update.
Click on "Remote Check", the user can verify if it's necessary to update the FW instrument (***Note***. The instrument must be connected to Internet and the battery level must be above 70% for FW update). Click on "Exit" to close the application. If the FW installed on the total station is the last version, the message in the left image appears; instead, if it is necessary to update the instrument FW, the message in the right image appears. This message contains some suggestions to follow to avoid problems during FW update procedure. Click on "YES" to update R60 FW. This procedure needs about 5 to 10 minutes; after finishing download, the system will auto reboot and update (***Note***. Don't remove the battery during FW update).



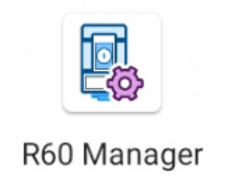


After instrument auto reboot, the following message appears. Click on YES to remove the old FW file from the instrument cache memory.



4.2.3. R60 Manager

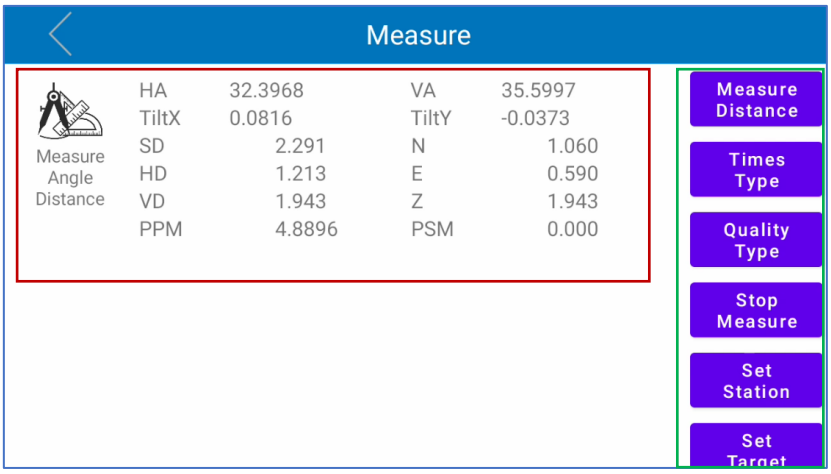
This application is dedicated to R60 management from a functional, operational and configuration point of view. Clicking on the icon the following screen appears.



"R60 Manager" is organized in three menus: *Measure*, *Service* and *Settings*, as visible in the image above. In the screen upper bar, it's possible to read the instrument battery level (top-left) and the total station FW version (top-right). Clicking on "Exit", the user can close the application.

R60 Manager – Measure menu

In this menu the user can measure and visualize angles and distances without store them. As visible in the image below, the "measure" interface is organized in two main sections.



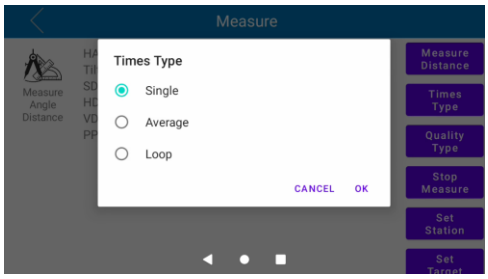
The central section (red squared in the photo above) contains all the information related to the measurements performed by the instrument. Below the list of the data included in this part:

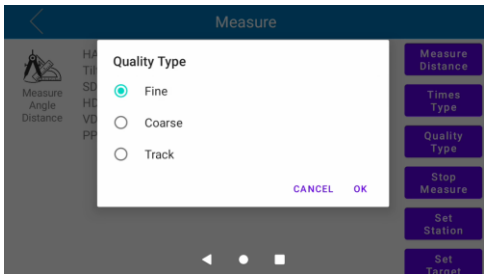
- *HA* -> Horizontal angle reading
- *VA* -> Vertical Angle reading
- *TiltX* -> Tilt reading in X direction
- *TiltY* -> Tilt reading in Y direction
- *SD* -> Slope Distance
- *HD* -> Horizontal Distance

- *VD* -> Vertical Distance
- *N* -> Nord coordinate
- *E* -> Est coordinate
- *Z* -> Z coordinate
- *PPM* -> Atmospheric Correction
- *PSM* -> Prism Constant

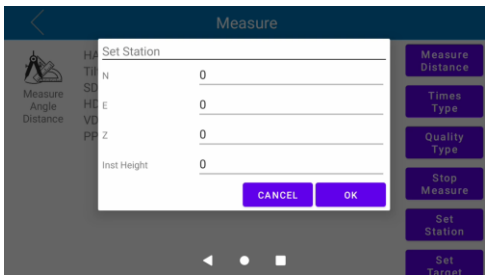
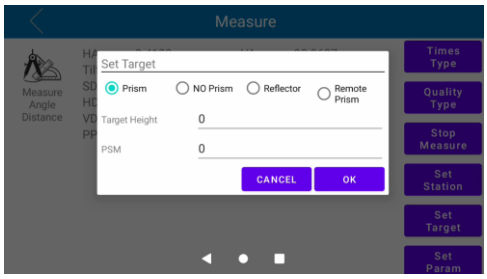
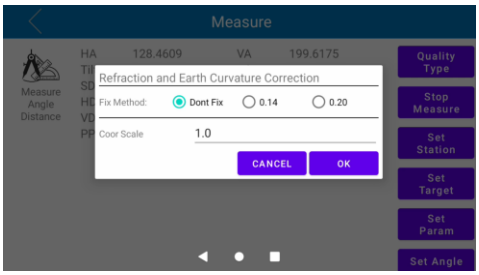
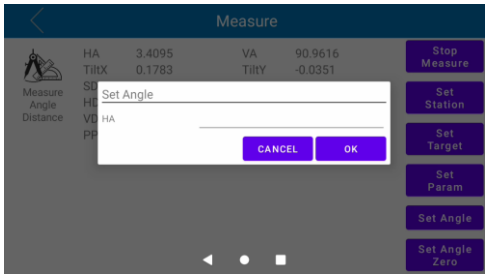
The lateral bar (green squared in the photo above) allows the user to configure the instrument and perform the measurement. In this section there are some icons with different functions, here below their description.

Measure Distance	Click on this icon to start to measure.

Times Type	Click on this icon to define the EDM measure mode type. It's possible to choose between "Single" (single measure), "Average" (measure the same point more than one time and mean the measurements) and "Loop" (continuous measure)	

Quality Type	Click on this icon to define the measure quality type. It's possible to choose between "Fine" (precise measurement), "Coarse" (coarse and quick measurement) and "Track" (tracking measurement)	

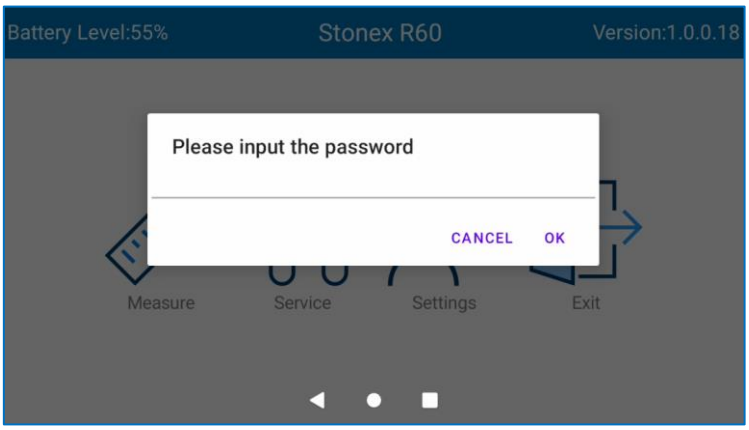
Stop Measure	Click on this icon to stop the measurement.

Set Station	Click on this icon to set station point coordinates and instrument height.	
Set Target	Click on this icon to select the target typology. It's possible to choose between "Prism", "No Prism", "Reflector" and "Remote Prism". In this section, it's also possible to set the target height and introduce the prism constant (PSM).	
Set Param	Click on this icon to select the correction method. It's possible to choose between "Don't Fix" (), "0.14" () and "0.20" () to set the refraction and Earth curvature correction (11.2 Refraction and Earth Curvature Correction). In this section, it's also possible to set the scale factor ("Coor Scale").	
Set Angle	Click on this icon to set the HA angle to a specific value.	
Set Angle Zero	Click on this icon to set the HA angle value to 0.	

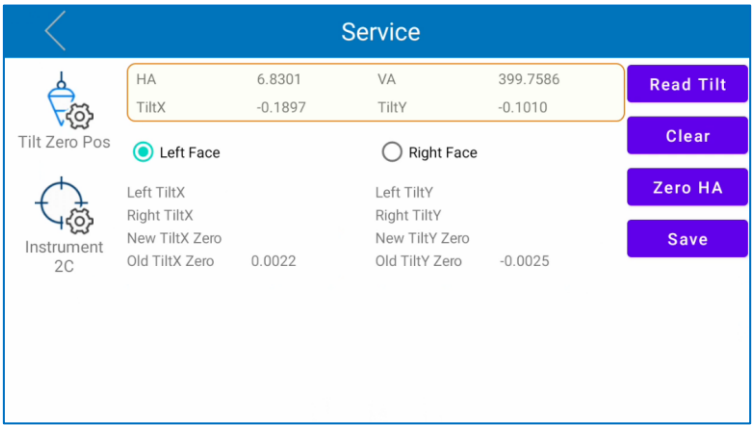
R60 Manager – Service menu

This menu is dedicated to total station calibration and service operations. It's possible to access to it with a password:

12345678



Before calibrating the instrument, see chapter 5 Calibration for more information and details about instrument calibration. After inserting the password, the following screen appears.

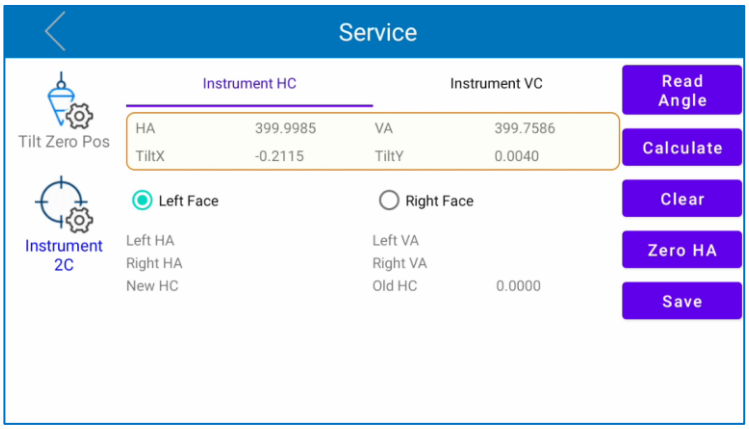


Two different calibrations can be performed in service menu: "Tilt Zero Pos" and "Instrument 2C".

Choose "Tilt Zero Pos" to enter in tilt offset (zero position) page correction. In this menu it's possible to calibrate the tilt sensor. Follow the procedure below to calibrate it:

- Aim at the crosshair of collimator at telescope in "Left Face" (Face 1 -> face with the display and the plate bubble) and click on "Read Tilt".
- Select "Right Face", rotate the instrument 180°/200 gon and aim at the crosshair of collimator at telescope in "Right Face" (Face 2 -> face with instrument serial number) and click on "Read Tilt".
- Click "Save"

Choose “Instrument 2C” to enter in angles calibration page. In this menu it’s possible to calibrate HA and VA angles. This menu is divided in two parts: “Instrument HC” and “Instrument VC”.



Follow the procedure below to calibrate HA and VA angles using “Instrument HC” menu for HA calibration and “Instrument VC” menu for VA calibration:

- Aim at the crosshair of collimator at telescope in “Left Face” (Face 1 -> face with the display and the plate bubble) and click on “Read Angle”.
- Select “Right Face”, rotate the instrument 180°/200 gon and aim at the crosshair of collimator at telescope in “Right Face” (Face 2 -> face with instrument serial number) and click on “Read Angle”.
- Click “Calculate”.
- Click “Save” to save the performed calibration.

Note 1. “Clear” icon deletes the calibration stored. Be careful to use this option. If a user deletes the calibration, it’s necessary to re-calibrate the instrument.

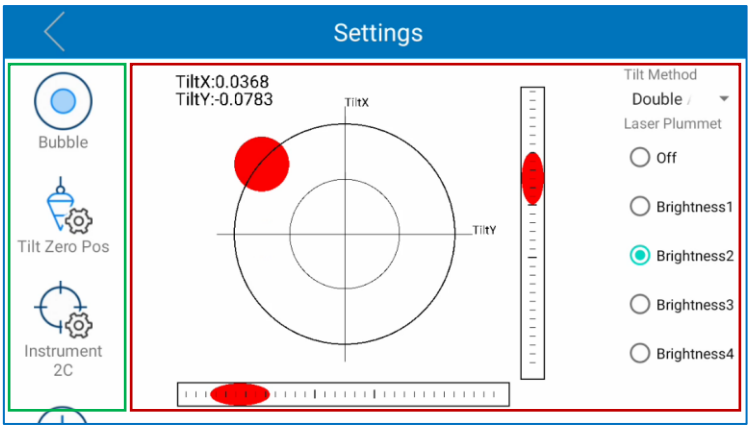
Note 2. It’s suggested to calibrate the instrument after long trip in order to guarantee its quality and reliability.

Note 3. This operation must be performed following the guidelines include in this user manual to guarantee instrument quality and reliability.

Note 4. For any service questions, doubts or problems please contact your local dealer.

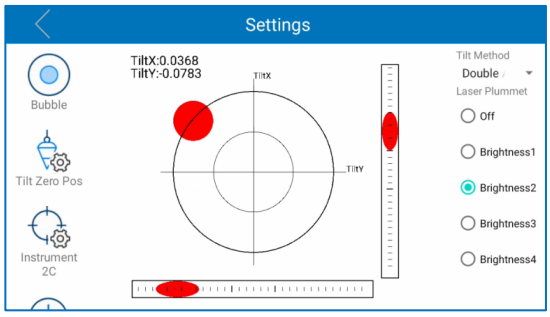
R60 Manager – Settings menu

In this menu the user can configure and sets the total station main parameters. As visible in the image below, the "settings" interface is organized in two main sections.

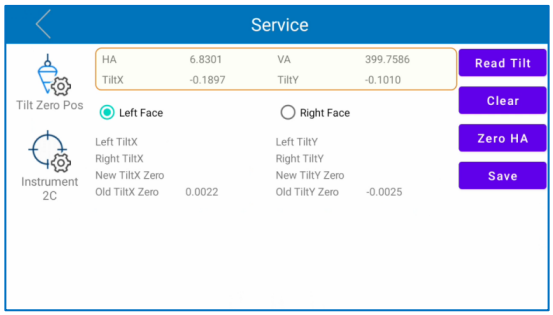


The lateral section (green squared in the photo above) is a scrolling menu containing different functions, that can be used to configure the total station. When the user select a function in the lateral bar, the central section (red squared in the photo above) changes according to the icon clicked.
Here below the list of the functions included in this menu.

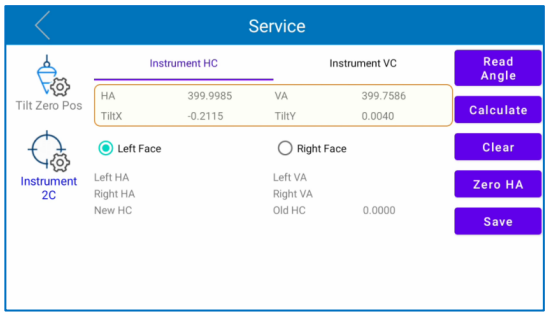
See chapter 3 Accurate leveling-up with electronical level.



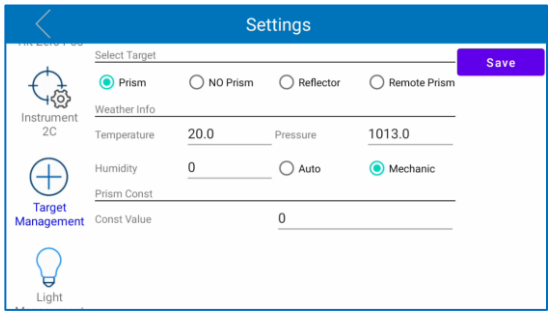
See chapter 4.2.3 R60 Manager (service section).



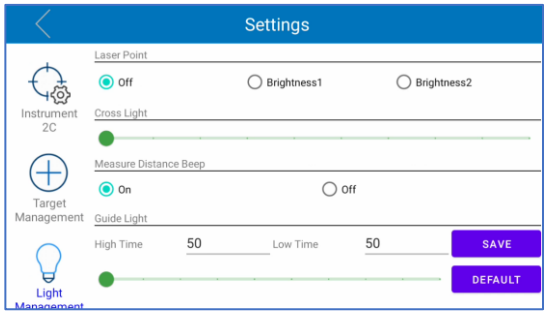
See chapter 4.2.3 R60 Manager (service section).



Click on this icon to set the T*arget type* (choose between "Prism", "No Prism", "Reflector" and "Remote Prism"), the *Weather Info* (click on "Mechanic" to input manually the temperature, pressure and humidity values; click on "Auto" to use the data collected automatically by total station sensors; 11.1 Atmospheric Correction). In this page the user can also add the prism constant.

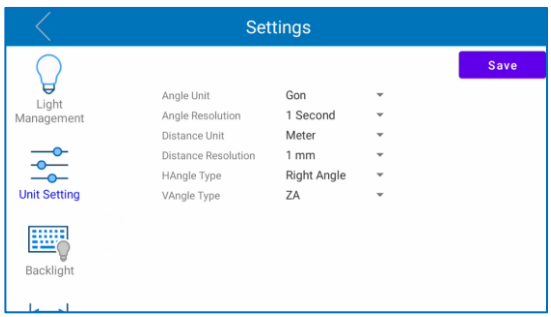


Click on this icon to turn on/turn off the laser pointer, the telescope cross light, the beep measure sound and the Guide Light. "High Time" is the high-level time of pulse, "Low Time" is the low-level time of pulse. Changing the time is possible to change guidelight frequency



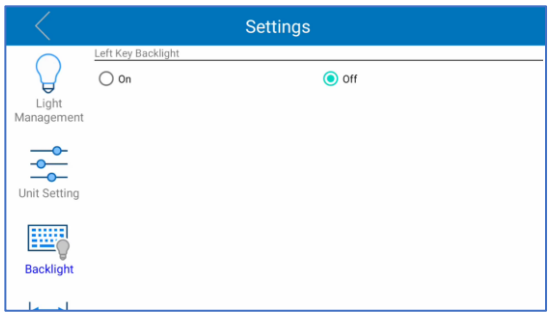
In this section it's possible to set instrument:

- *Angle Unit*: angle measure unit formats are DMS, Degree, Rad, Gon, Mil.
- *Angle Resolution*: angle displayed resolution formats are 1 second, 0.1 second, 0.01 second.
- *Distance Unit*: distance measure unit formats are Meter, US-Feet, US-Inch, INT- Feet, INT- Inch.

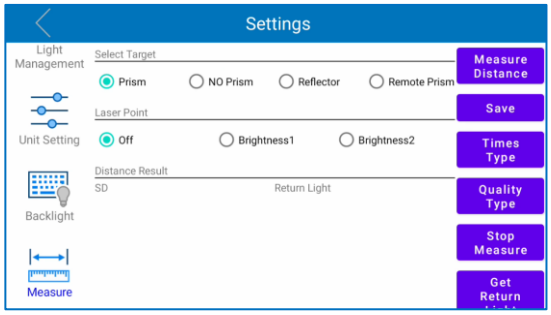


- *Distance Resolution*: distance displayed resolution formats are 1 mm, 0.1 mm, 0.01 mm.
- *HAngle Type*: choose HA angle reading incrementation between "Right Angle" (horizontal angle clockwise incrementation) and "Left Angle" (horizontal angle counterclockwise incrementation).
- *VAngle Type*: choose the VA angle reading type between ZA (0 is set when the telescope is turned upwards in the vertical direction, vertical angle range 0°-360°/400 gon), VA (0 is set when the telescope is horizontal, vertical angle range 0°- 360°/400 gon), HLR90 (0 is set when the telescope is horizontal; vertical angle range 0°/±180°) and GR (vertical angle is displayed in percentage).

Click on this icon to turn on/turn off the background keyboard illumination.



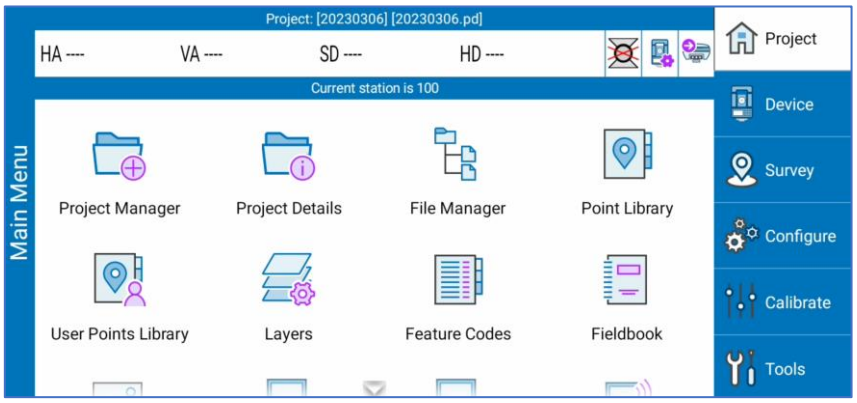
Click on this icon to enter in measure distance testing menu. See 4.2.3 R60 Manager (measure section) for a description of the icons in the lateral bar. Click "Get Return Light" to check the return light signal. Click "Backup UserP" to back up user parameters configuration set in this page. Click "Restore UserP" to restore saved user parameters configuration.



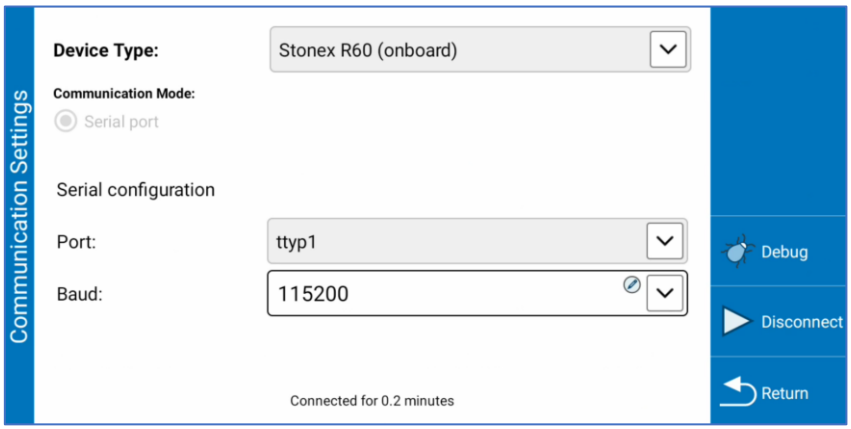
4.2.4. Cube-a

Cube-a is a Stonex field software for professional surveying and GIS which has been designed and developed for the Android platform. Thanks to the flexibility of the Android environment, the user interface is very simple and intuitive, and this makes surveyors ready for any work, saving time and increasing productivity. With Cube-a is possible to perform a GNSS, GIS and Total Station survey. The software can be installed on any device equipped with Android operating system.

After software activation (refer to Cube-a user manual), the following screen appears. As visible in upper status bar, the station is not connected to the software because the angle readings are not visible.



Click on "Device" -> "Total Station Communication" to check the status of the connection. Configure the instrument communication as in the photo below and click on "Connect" to activate the connection of the instrument with Cube-a.



If the angle readings are visible in the upper status bar, the station is correctly connected to the software.
If not, repeat the procedure above after turning on/turning off the total station.
If the problem persists, contact your local dealer.

See Cube-a user manual for more information about the software.

5. Calibration

5.1. About Calibration

Some errors checking and calibration operations can be carried out by the user by running calibration procedures. These procedures need to be carried out carefully and correctly. The detailed procedure is described in the following sections.
The instrument is factory calibrated to exacting specifications, but rapid temperature changes, vibrations or impacts may cause unexpected deviations and a reduction in the accuracy. The user is advised to check and calibrate the instrument frequently.

In the following cases it is highly recommended to check the instrument:

- Before using the instrument for the first time
- Before each high-precision measurement operation
- After a bumpy or long transport
- After long periods of storage
- After a violent and accidental impact or after falling over
- The difference between the current temperature and the temperature at the time of the last calibration is greater than 10°

In addition to the instrument errors described in this section, some other errors can be calibrated by professional operation. But the calibration process must be carried out either at the factory or an authorised workshop by specialist staff with specialist equipment. Any self-adjustment or calibration will result in unpredictable instrument failure or accuracy problems.

Note. Before calibrating the instrument error, the instrument must be precisely levelled following the electronic level. The relationship between the tribrach, tripod and the ground must be stable and avoid any vibration and impact throughout the procedure. The instrument must be acclimatised to the ambient temperature before the calibration. During the whole procedure, the instrument must be protected from direct sunlight which can cause overheating on one side of the instrument.

5.2. HA calibration

The HA calibration is a procedure necessary for calibrating HA angle, reducing HZ-collimation error. HZ-collimation error is an error due to the fact that the telescope axis of the instrument is not perpendicular to telescope horizontal rotation axis. In the plane formed by telescope axis and the telescope horizontal rotation axis, the angle between the perpendicular line of the telescope horizontal rotation axis through the centre of the instrument and the telescope axis is the HZ-collimation Error.

Determine the HZ-collimation error

1. Set up the tripod and instrument stable.
2. Power on the instrument. Precisely level the instrument.
3. In Face 1, accurately aim at a target about 100m away whose height was similar as the instrument.

Record HA_L.

4. Turn to Face 2, accurately aim at the same target again. Record the HA_R.
5. Calculate the horizontal collimation error Hz:

$$Hz = \frac{(HA_L - HA_R \pm 180)}{2}$$

6. If $|Hz| > 8"\ (20\ mgon)$, a program calibration is required. Refer to 4.2.3 R60 Manager (service section) for HA calibration procedure.

5.3. VA calibration

The VA calibration is a procedure necessary for calibrating VA angle, reducing Vertical Index Error. Vertical Index Error is an error due to the fact that the telescope axis of the instrument is not perpendicular to telescope vertical rotation axis. In the plane formed by telescope axis and the telescope vertical rotation axis, the angle between the perpendicular line of the telescope vertical rotation axis through the centre of the instrument and the telescope axis is the Vertical Index Error.

Determine the Vertical Index Error

1. Set up the tripod and instrument stable.
2. Power on the instrument. Precisely level the instrument.
3. In Face 1, accurately aim at a target about 100m away whose height was similar as the instrument. Record VA_L.
4. Turn to Face 2, accurately aim at the same target again. Record the VA_R.
5. Calculate the vertical index errore i:

$$i = \frac{(\mathrm{VA_L} - \mathrm{VA_R} - 360°)}{2}$$

6. If $|i| > 8"\ (20\ mgon)$, a program calibration is required. Refer to 4.2.3 R60 Manager (service section) for VA calibration procedure.

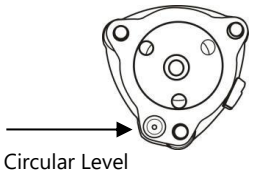
5.4. TILT calibration

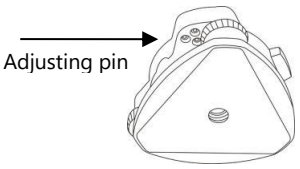
The TILT calibration is a procedure necessary for calibrating the tilt sensor. Refer to 4.2.3 R60 Manager (service section) for Tilt Zero Pos calibration procedure.

5.5. Mechanical Check and Adjust

Check and Adjust the Instrument Circular Level

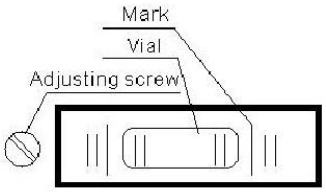
1. Set up the tripod and instrument stable.
2. Power on the instrument. Precisely level the instrument following the electronic level.
3. The circular level should stop right at the center.
4. If not, use the adjusting pins to adjust related screws till the bubble is in the center.





Check and Adjust the Instrument Plate Level

1. Set up the tripod and instrument stable.
2. Power on the instrument. Precisely level the instrument following the electronic level.
3. Turn the instrument and make the plate level be parallel to a line linking two leveling foot screws. The plate level should stop right at the center.
4. If not, use the adjusting pin to adjust related screws till the bubble is in the center.



Check the Laser Plummet

The laser plummet spot should be checked on a bright, flat horizontal surface (e.g., on a piece of white paper). The size of the laser spot is related to the condition of the projected surface and the ambient brightness.

1. Set up the tripod and instrument stable.
2. Power on the instrument and level it precisely.
3. In "R60 Manager -> "Settings" adjust the brightness level of the laser plummet to project a clear spot on the ground. Mark the center of the spot.
4. Slowly rotate the instrument horizontally one turn, observe the displacement of the centre of the laser spot.
5. If the displacement is in a clear circular motion and the diameter of the track circle exceeds 3 mm, a calibration is required.

The laser plummet calibration needs to be carried out by an authorised service centre.

Check the laser pointer spot

The laser pointer spot should be corresponded to the center of the aimed target.

1. Set up the tripod and instrument stable.
2. Power on the instrument and level it precisely.
3. Aim a cross/target located at 25 meters away from the instrument.
4. Verify that the center of the spot corresponds to the center of the target.
5. If the displacement is more than 2 mm respect the cross/target center, a calibration procedure is required.

The laser pointer spot calibration needs to be carried out by an authorised service centre.

Check the viewfinder

1. Set up the tripod and instrument stable.
2. Power on the instrument and level it precisely.
3. Aim a cross/target located at 50 meters away from the instrument.
4. Observe the viewfinder whether collimating the cross mark.
5. If the viewfinder aims the cross/target, the adjustment is not necessary, if not a calibration procedure is required.

The viewfinder calibration needs to be carried out by an authorised service centre.

6. Technical Data

ANGLE MEASUREMENT

Accuracy[1]	1" / 2"
Reading system	Absolute encoder
Angle Units	DEG 360°/GON 400/MIL 6.400
Display resolution	0.1" / 0.00002g / 0.0005 mil

TELESCOPE

Magnification / Field of view	30x / 1°30'
Tube length	156 mm
Minimum focus distance	1.0 m (3.3 ft)
Reticle illumination	10 brightness levels adjustable
Effective aperture	Ø 45 mm
Laser pointer	Red light, coaxial

TILT SENSOR

Type	Dual axis
Compensation range/accuracy	≥3.0'

DISTANCE MEASUREMENT RANGE[2]

Prism mode	5.000 m[3]
Reflective sheet (6 cm x 6 cm)	800 m[3]
Reflectorless[6]	1000 m[4]

DISTANCE MEASUREMENT ACCURACY[5]

Prism mode	2 mm + 2 ppm
Reflective sheet (6 cm x 6 cm)	3 mm + 2 ppm
Reflectorless	3 mm + 2 ppm

MEASUREMENT TIME

Prism (Track/Fast/Standard)	0.4 / 0.6 / 1.0 sec
Reflectorless	1.5-5 sec

DISTANCE MEASUREMENT

Distance Units	m / US ft / INT ft
Display Resolution	0.0001 m / 0.001 m 0.00 1 ft / 0.01 ft

LASER PLUMMET

Laser type	635nm semiconductor laser
Accuracy	±1.0 mm @ 1.5 m
Spot	2.5 mm @ 1.5 m

LEVEL VIAL SENSITIVITY

Plate level	30"/ 2 mm
Circular level	8'/ 2 mm

ENVIRONMENTAL CONDITIONS

Operating Temperature	-20°C to +50°C (-4°F to 122°F)
Storage Temperature	-40°C to +70°C (-40°F to 158°F)
Waterproof/Dustproof	IP55

PHYSICAL SPECIFICATION

Dimensions	358 x 211 x 220 mm
Weight including battery and tribrach	6.5 Kg

POWER

Battery Voltage/Capacity/Type	7.2Vdc / 5200mAh /Li-ion
Batteries number	2
Operating time	Up to 8 hours (one internal battery)[7]
Battery charger	AC 100 - 240V, charging time 3h

OTHER SPECIFICATIONS

CPU	CORTEX-A55 Quad-Core
Display	5.5" color touch, 720 x 1280 px
OS	Android
Memory	4GB+32GB
Interface	USB type-A, USB type-C, RS232, Bluetooth, Wi-Fi
Guide light	Yes
Sensors	Temperature / Pressure

ONBOARD FIELD APPLICATION PROGRAMS

Cube-a TS-GPS, R60 Manager

Specifications subject to change without notice.

[1] Standard deviation based on ISO 17123-3

[2] Good condition: cloudy, no haze, visibility about 40km, no heat shimmer, breeze. Under optimal conditions on Kodak Grey Card (90% reflective)

[3] Class 1

[4] Class 3R

[5] Standard deviations based on ISO 17123-4

6 Under optimal conditions on good surface

7 Battery duration depends also on display brightness

7. Carrying Case

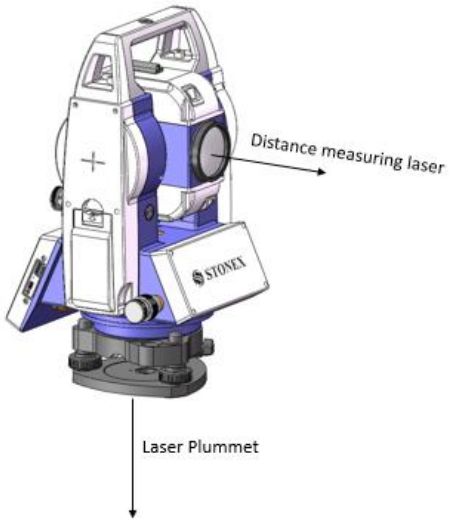
Open the transport case, remove instrument and check for completeness:

- Total Station
- Tribrach
- Battery charger (AC 100 - 240V)
- Charger Cable
- Cable Type C/USB type A
- Battery × 2
- Lens Cap
- Carrying strap x2
- Rain cover
- Reflective tape/RP30 × 4
- Reflective tape/RP60
- Tools bag
- Cleaning Cloth
- Cleaning Brush
- Wrench (1.5 mm)
- Wrench (2.5 mm)
- Adjusting Pin
- Screwdriver
- USB stick with user manual
- Silica gel

8. Precautions for safety

8.1. Laser damage

The instrument uses a visible red laser for distance measuring. The laser is emitted from the center of telescope objective when measuring or laser pointer is turned on.
The instrument's laser plummet uses a visible red laser to indicate the position of the vertical axis. The laser is emitted from the bottom of the instrument along the center axis during leveling and centering operations.



In accordance with the state of the international standard IEC 60825-1(2014-05), the product is classified as different Laser class on different working mode.

Working Mode	Laser Class
Distance measuring with reflector prism and tape	Class 1
Distance measuring without reflector	Class 3R
Laser plummet	Class 2

Direct laser beams can cause eye discomfort, temporary blindness and residual images. Prolonged exposure to laser beams can cause permanent damage to the eyes.

- Do not look directly at the laser beam at any time, and do not use optical equipment such as binoculars to view the laser beam.
- It is prohibited to direct a laser beam at another person.
- Do not stare at the spot of laser for a long time at close range.
- Avoid direct the laser at any highly reflective object that is not a reflector prism or tape, such as windows, mirrors, traffic signs, etc.
- Turn off the pointer and laser plummet as much as possible when not working on distance measuring or centering.

8.2. Glare damage

Looking directly at hard light can cause eye discomfort, temporary blindness and residual images, and prolonged exposure to direct bright light can cause permanent damage to the eyes.

- Viewing the sun through the instrument's telescope is prohibited at any time.
- Avoid using instruments to aim at objects that are strongly reflecting sunlight, such as mirrors, glass, water, car surfaces, etc.
- Avoid observing strong lights and other light sources.

8.3. Fire risk

The design and manufacture of the instrument and its accessories follow the relevant standards and directives to avoid as much as possible the danger of high temperature, fire and other dangerous conditions in normal operation. However, using the instrument under special conditions, using it irregularly and disassembling it may lead to localized high temperature, fire or even explosion.

- The use of this instrument in coal mines is prohibited.
- When there are dangerous, flammable or explosive gases or liquids in the vicinity of the workplace, it is prohibited to operate the instruments.
- Do not use the instrument in a hot environment or near flames.
- Batteries must not be placed in fire or high temperature environments.
- The battery should not be covered by any object during charging to avoid the risk of overheating and fire.
- The battery must not be disassembled.
- Avoid keys, metal objects connected to the electrodes of the battery, or the electrodes of the charger.
- Avoid the use of unqualified, faulty or damaged sockets when charging, and prohibit any operation that uses wires directly connected to the plug.
- Avoid contact of the instrument, batteries, chargers, adapters, power cables, etc. with any liquid. Avoid using, storing, or charging the instrument in a raining, dripping, or wet environment.
- Batteries shall be transported in proper packaging.
- Do not use any batteries, chargers, adapters, power cables, etc. that are not supplied by the Company.
- If any abnormality or damage is found in batteries, chargers, adapters, cables, etc., stop using them immediately and dispose of them properly.
- Keep batteries, chargers, etc. clean to avoid excessive dust accumulation.
- Do not make any modifications to the instrument, batteries, chargers, adapters, cables, etc.

8.4. Electric shock risk

This instrument is powered by rechargeable batteries. The charger needs to be connected to city power during the charging process, and any improper handling of electricity may result in electric shock.

- Prohibit operate near high-voltage power transmission and large power facilities.
- Whenever possible, avoid using centering rod near electrified railroads, power lines, etc.
- Outdoor work during thunderstorms is prohibited.
- Do not operate instruments, batteries, chargers, etc. with wet hands.
- Avoid keys, metal objects connected to the electrodes of the battery, or the electrodes of the charger.
- Avoid the use of unqualified, faulty or damaged sockets when charging, and prohibit any operation that uses wires directly connected to the plug.
- Avoid contact of the instrument, batteries, chargers, adapters, power cables, etc. with any liquid. Avoid using, storing, or charging the instrument in a raining, dripping, or wet environment.
- Do not use any batteries, chargers, adapters, power cables, etc. that are not supplied by the Company.
- If any abnormality or damage is found in batteries, chargers, adapters, cables, etc., stop using them immediately and dispose of them properly.
- Do not make any modifications to the instrument, batteries, chargers, adapters, cables, etc.

8.5. EMC

The instrument is designed and manufactured in accordance with the relevant standards for electromagnetic compatibility, but it may still cause electromagnetic interference that interacts with other electronic equipment nearby. Instrument and charger in operation may interfere with nearby sensitive electronic equipment and affect their normal operation. Strong sources of electromagnetic radiation in the nearby environment may also interfere with the instrument, causing unpredictable measurement errors, abnormal operation and, in particularly serious cases, even irreversible damage.

- Avoid using instruments in environments of strong electromagnetic interference, such as near large electrical utilities, high-power radio transmission facilities, wireless communication equipment, big electric motors, etc.
- If abnormal display, abnormal jumping of measurement data and other abnormalities are detected during operation, stop operation immediately and turn off the instrument. Continue operation only after confirming that the surrounding electromagnetic compatible environment is suitable for continued operation.

8.6. Mechanical injury

Instruments and tripods are heavy objects that may cause damage to people, equipment or other items if dropped, fallen or broken. Be careful when handling, using, and transporting the instruments, as they are precision instruments.

- To avoid the risk of injury from collapsing, the tripod should be set up carefully according to the instruction, and the clamping screws should be tightened after the adjustment of the tripod legs.
- The instrument must be properly fixed on the tripod and checked frequently to avoid injury from falling or damage to the equipment.
- In all cases, be aware of the possible danger posed by the sharp toe of the tripod legs. Care shall be taken when setting or handling.
- Dropping and high intensity shaking of the transport case may damage the case and the instrument.
- Do not sit or stand on the transport case and avoid placing heavy objects on the case.
- Do not use a transport case with broken body, damaged hinges, or latches.
- Avoid strong vibrations, shocks to the instrument, tripod, transport case, etc.

8.7. Other saftety items

- It is not permitted to use the instrument in locations where measurement operations are prohibited by law or other regulations.
- Pay attention to the safety of the surrounding environment when using the instrument to avoid accidents or equipment damage caused by traffic accidents, falling objects, collapsing buildings, ground subsidence, mechanical equipment collisions and other accidents.

8.8. General Notes

Before using the instrument, be sure to check and confirm that the instrument and accessories are complete and that all functions work properly.

- Do not aim the instrument at the sun.
- A qualified tripod is required to set up the instrument.
- The use of a qualified tribrach is required for the instrument. Fasten the instrument with its tribrach correctly.
- When measuring, the instrument and tribrach must be properly and solidly fixed on the top plate of tripod with the fixing screw. The clamping screws should be tightened after the adjustment of the tripod legs.
- Avoid vibration of the instrument and tripod during measurement.
- When handling instruments, avoid bumping and dropping as much as possible.
- When lifting the instrument, always grip the handle properly and make sure it is securely attached to the instrument.
- Do not leave the apparatus in a hot environment for too long, paying particular attention to

environments where the temperature may be too high, such as in a car when it's hot.

- Sudden changes in the temperature of the instrument will affect the measurement accuracy. If the ambiente temperature changes too much, the instrument should be left for a period to adapt before starting measurements.
- Avoid direct sunlight on the instrument during measurement, and it is recommended to use umbrellas or other shelters.
- Check the battery level to ensure sufficient operating time.
- It is recommended that you do not remove the battery while the instrument is on. Please remove and install the battery after the instrument is turned off.
- Any obstructions in the path of view between the instrument and the target to be measured during distance measurement operations may lead to erroneous measurements.
- Necessary self- check should be performed after collision, collapse, etc., as well as after long-term storage and long-distance transportation of the instrument.

8.9. Disclaimer

- The user of this product should have sufficient measuring skills and use it in accordance with the user manual.
- The user should carry out periodic self-check of the instrument's performance.
- The manufacturer and its agents cannot be held responsible for the consequences and loss of profit resulting from non-compliance with these operating instructions.
- The manufacturer and its agents are not responsible for any loss of work due to changes in data, loss of data, environmental disturbances, etc.
- The manufacturer and its agents cannot be held responsible for the consequences and loss of profit due to improper handling, incorrect setting up or improper connection to other products.
- The manufacturer and its agents cannot be held responsible for any direct or indirect consequences and loss of profit resulting from intentional damage, improper use or accidental operation of the product.
- The manufacturer and its agents shall not be liable for any direct or indirect consequences and loss of profit caused by force majeure (such as earthquakes, storms, lightning, floods, fires, collapses, etc.), or by third parties.

9. Care and Transport

9.1. Storage

Storage of the Instrument

The instrument is a precision instrument. In order to ensure the function and accuracy, when not in use for a long period of time, the instrument needs to be stored in a dry place without direct sunlight and within a certain temperature range. About the temperature range refer to 6 Technical Data.
Especially in hot weather when instruments need to be stored in transport vehicles such as cars, it is important to be aware of the limits of the temperature range.

Storage of the batteries

- The batteries should be removed from the instrument or charger before storing.
- The battery must be fully recharged again before use after long-term storage.

Always keep batteries away from wet conditions. Wet or waterlogged batteries must be completely dried and checked for proper appearance and voltage before storage and use.

9.2. Transport

Field Manual Transport

- Place the instrument in its original transport case. Carry it properly by hand or use the original carrying strap.
- Alternatively, by keeping the robust mounting and upward, the instrument can be carried with the tripod's legs splayed across on the shoulder.

Collisions and drops of instruments are avoided wherever possible to ensure the safety of persons and instrument.

Transportation by Transport (car, train, ship, plane, etc.)

When transporting, the transport case must be used. Place the instrument in the case and fasten it securely so that the body of the instrument is not subjected to violent shocks and vibrations.
When instruments are transported during hot or cold seasons, it is important to note the temperature range restrictions. After long distance transport, the instrument needs to be checked and calibrated according to the operating instructions before the instrument can be used.

Battery Transport

National and international regulations and guidelines must be followed when transporting batteries. Contact your local shipping company for related information before shipping.

9.3. Cleaning and Drying

Surface of Objective and Eyepiece

- Do not touch the optical surfaces with your hands or other hard objects at any time.
- Blow the dust off the lens and prisms before cleaning.
- For cleaning use a clean, soft lens wiping cloth, lens paper, cotton swabs etc. If necessary, use pure water or pure alcohol to moisten them.

Do not use other liquids as they may damage the instrument parts.

Fogging of Glass Surface

If the temperature of the lens is lower than the ambient temperature, then it will tend to fog up. Generally, do not wipe, it can be left for a period of time, so that it slowly adapts to the surrounding temperature, the fog will generally disappear on its own.

Cables, Plugs and Charger

Keep clean and dry all times. When not in use, can wipe with a clean, dry cloth.
Do not use water or wiping tools with water to clean electrical accessories.

10. Environmental recycling

The cardboard box, the plastic in the package and the various parts of this product have to be recycled and disposed of in accordance with the current legislation of your Country.

For Countries in European Union (EU)

- The disposal of electric and electronic device as solid urban waste is strictly prohibited: they must be collected separately.
- Contact Local Authorities to obtain practical information about correct handling of the waste, location and times of waste collection centers.
- The dumping of these devices at unequipped or unauthorized places may have hazardous effects on health and environment.
- The crossed dustbin symbol means that the device must be taken to authorized collection centers and must be handled separately from solid urban waste.

For Countries outside European Union (EU)

The treatment, recycling, collection and disposal of electric and electronic devices may vary in accordance with the laws in force in the Country in question.

11. Appendix

11.1. Atmospheric Correction

The distance results measured by the instrument are correct only when corrected by the atmospheric correction value of ppm (mm/km, 10^{-6}). This scale correction value is calculated from the local meteorological parameters entered at the time of measurement. The atmospheric correction is related to factors such as atmospheric pressure and temperature.
For high precision distance measurements, the atmospheric correction must be accurate to 1ppm，the relevant meteorological parameters must be re-determined at the time of the distance measurement. The air temperature must be accurate to 1°C and the atmospheric pressure to 3hPa. The prevailing atmospheric parameters are entered into the instrument and the atmospheric correction for the distance measurement is automatically calculated.

The instrument default parameters：

Air temperature **20 ℃**
Atmospheric pressure **1013.25 hPa**
Atmospheric correction **0 ppm**

Atmospheric correction formula:

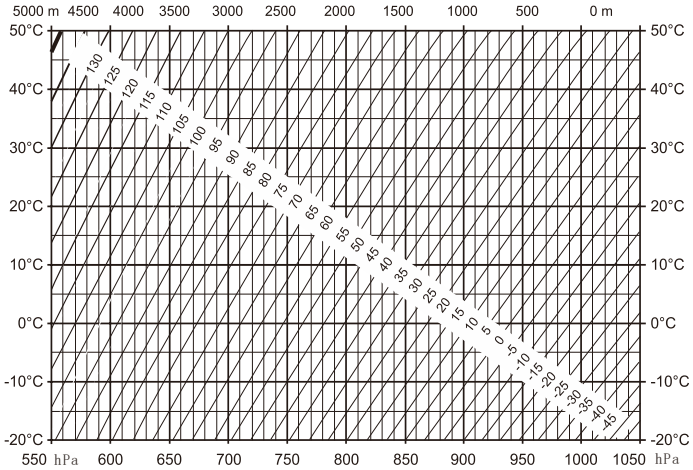
$$\mathbf{kPT} = 279.097 - 0.29528 \times \mathbf{P} / (1 + 0.0036 \times \mathbf{T})$$

kPT: atmospheric correction (ppm)
P: pressure (hPa)
T: temperature (℃)

$$\mathbf{SD} = \mathbf{SD_0} \times (1 + \mathbf{kPT})$$

$\mathbf{SD_0}$: original slope distance
SD: corrected slope distance

Atmospheric correction values can be conveniently found on the atmospheric correction chart below. The temperature is read on the horizontal axis of the chart and the pressure on the vertical axis, the value on the diagonal of its intersection is the atmospheric correction value.



For Example:

The air temperature is **+15 ℃**

The atmospheric pressure is **1013 hPa**

From the chart, the atmospheric correction is about **-5 ppm**

11.2. Refraction and Earth Curvature Correction

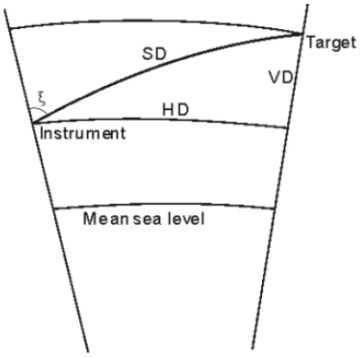
Considering the correction of refraction and earth curvature for distance measurement, the formula for SD, HD and VD applied in the instrument are as followings:

HD = **Y** - **A** × **X** × **Y**

VD = **X** + **B** × **Y²**

HD: corrected horizontal distance

VD: corrected vertical distance



Y = **SD** × | sin ξ |

X = **SD** × cos ξ

SD: corrected slope distance

ξ: the **ZA** (zenith 0)

A = (1 – **k** / 2) / **R**

B = (1 – **k** / 2) / 2**R**

k: atmospheric refractive index, default **0.13**

R: average radius of the earth **6.37 × 10⁶** m

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