STONEX

STONEX R180
Total Station
User Manual

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

www.stonex.it

Contents

1. Introduction

Thank you for purchasing R180 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

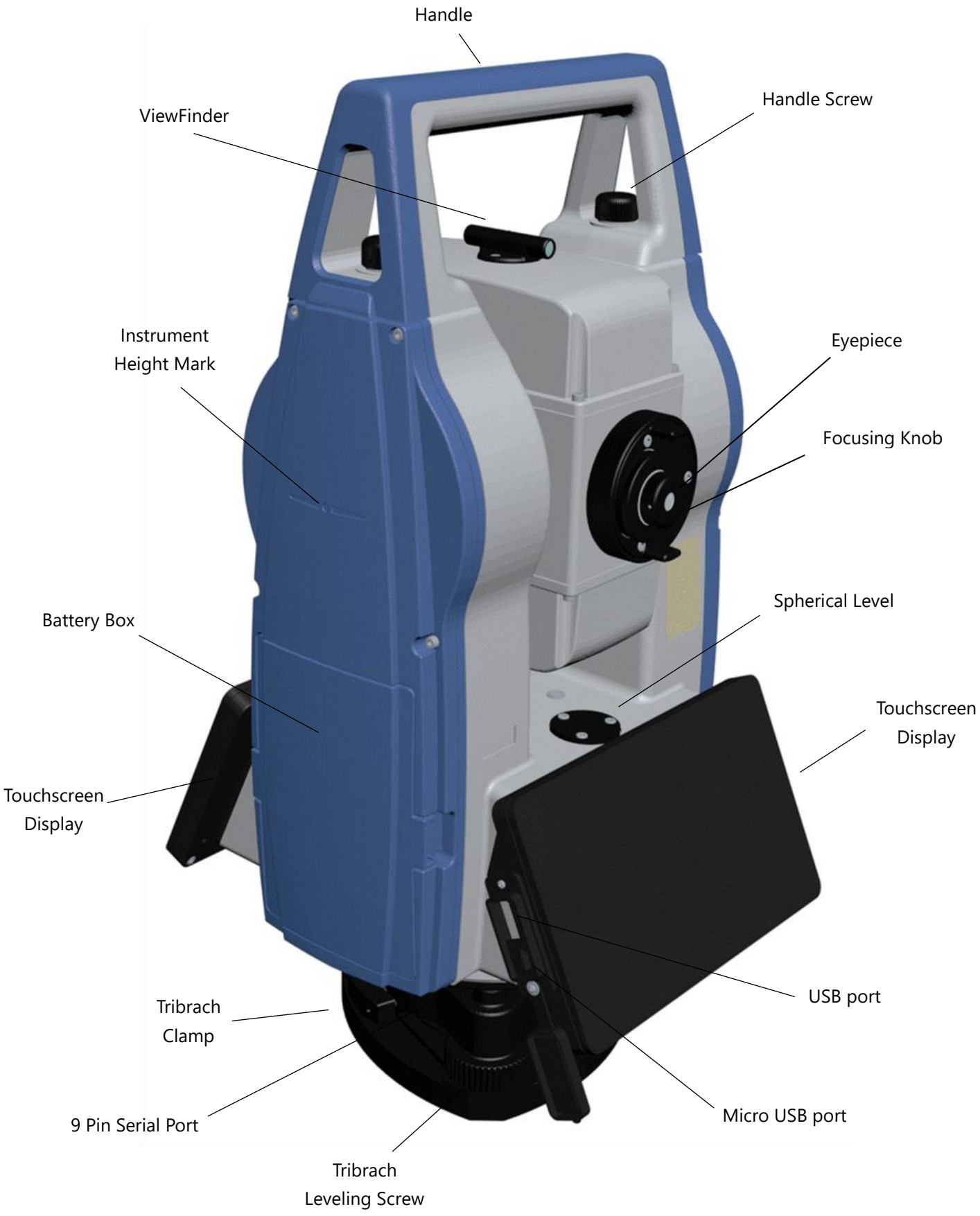
The R180 is a highly accurate and fast Android robotic station. It features a rotation speed of 180°/sec and an EDM accuracy of 1 mm + 1 ppm, with a range of up to 1000 m without a prism. The R180 is available in two versions, 0.5" and 1" second. For both models, the quietness and smoothness in prism searches and rotations are among the most observed and appreciated features.

Equipped with the Android operating system, the R180 has Cube-a as onboard software. This enables users to navigate online and interact with the touch screen in an easy and familiar way.

The Cube-a onboard software includes all the classic functions of the program, as well as the integration of jobs done with GNSS and surveys done with the total station. This allows operators to achieve complex and professional work in a short time and with high accuracy. Additionally, the R180 has a camera and a guide light to further facilitate field work.

For more details about R180 technical features see (7 Technical Data) or contact your local dealer.

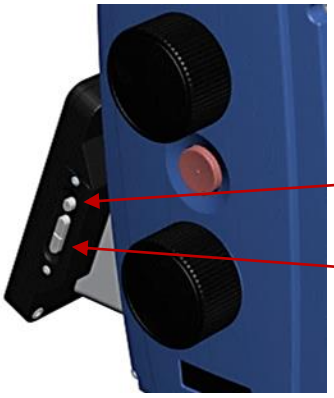
2.1. Hardware Description




Handle
ViewFinder
Handle Screw
BT Long Range
Antenna
Guidelight
On-Board Camera
FAST360° sensor
Vertical Motion
Micrometric Screw
Telescope
Measure Trigger
Button
Touchscreen
Display
Touchscreen
Display
Horizontal Motion
Micrometric Screw
Tribrach
Leveling Screw
Tribrach

2.2. Touchscreen Display

R180 total station is equipped with two color Touchscreen displays, usable to manage the instrument in all of its functions. Do not touch the screen with ball-pen, pencil or other sharp things to avoid damage on instrument.
There are also some physical keys, located on the lateral part of the touchscreen display of Face 1 (spherical bubble side). Here below their description:



Key	Function
[⏻]	Power key. Press and hold for power on/off the station.
🔊	Volume up and Volume Down

2.3. HW Technologies

Tdrive

Thanks to Tdrive motor, R180 Robotic total station boasts a rotation speed of 180°/sec, making it one of the fastest in its product category. Not only is it speedy, but it is also impressively quiet, with noise levels among the lowest in its class. Additionally, the Tdrive technology, with a very high-speed motor, allows for high-speed pursuit, even with a prism installed on moving vehicles. Not using gear technology ensures frictionless movement, greater durability, and less maintenance.

APC

The innovative robotic total station is designed with automatic prism centering technology that takes the guesswork out of surveying. With this advanced system, users can easily and quickly center their prism with minimal effort until 1000 m. Thanks to the total station's automatic centering feature, surveying processes can be streamlined and made more efficient. APC technology is configured to manage multiple prism situation collimating the one closer to the telescope optical axis. When the station loses the prism due an obstacle, if the prism remains in telescope field of view, the station re-center it immediately.

The state-of-the-art robotic total station features a cutting-edge 360° prism search technology that allows users to locate their target quickly and accurately from any angle. This advanced capability enables surveys to be completed with greater speed and precision, all while enjoying the convenience of a fully automated system. If the lock is lost, the total station, thanks to Fast360° technology, can quickly find the prism. This search method can be used up to 600 meters to find the prism in any direction.

R180 is further enhanced by the addition of a built-in camera, which can be used thanks to the presence of two 6-inch screens.

R180 is embedded with an electronic guidelight. it could be helpful to the surveyor to adjust prism position respect the telescope field of view, mainly during the stake out.

R180 is equipped with long range BT module on board, that guarantees a stable communication between instrument and an external device until 300 meters far from the total station.

R180 is characterized by a trigger key located on the side of total station body. It can be used to perform measurements simply pressing it, without touching the display.

3. Preparation & instrument setting up

3.1. Battery and Charger

Installing / Replacing Battery

R180 carrying case contains two rechargable Li-ion (Li-64 model) batteries. Here below the description of their technical features.

Battery Voltage/Capacity	14.4 v / 6400 mAh
Operating Time	6 hours
Battery Charger	4 hours

Follow the procedure below to mount/remove the battery:

Mount the Battery	
a. Insert the battery in the battery box.	
b. Insert the battery box with the battery inserted, in the battery compartment (***Note***. When inserting the battery, be careful to put the electrodes on top as visible in the picture on the right).	

Remove the Battery	
a. Pull out the battery from the battery compartment by pressing the clips.	
b. Remove the battery from the battery box.	

Note 1. Use only official Stonex batteries for R180. We can't guarantee the correct works of the instrument with different battery types.

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

Follow the instructions below to recharge R180 batteries.

Charge the Battery	
a. Remove the charger and the cable from the carrying case. Insert the charger cable (A) in the battery hole (B).	
b. Insert the cable plug (D) into the charger (C)	
c. Insert the plug (E) in the electrical outlet. If the battery is not fully charged, the charger will begin charging the battery and the charger indicator will be in red until the complete charge. When charging is complete, the charger indicator will be fixed green, disconnect the battery from the charger, and then you can install it or use it as a backup battery.	

Note. Please use 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 power on/power off button for more than 1 second, to switch on the total station. The instrument automatically enters in the Android interface.

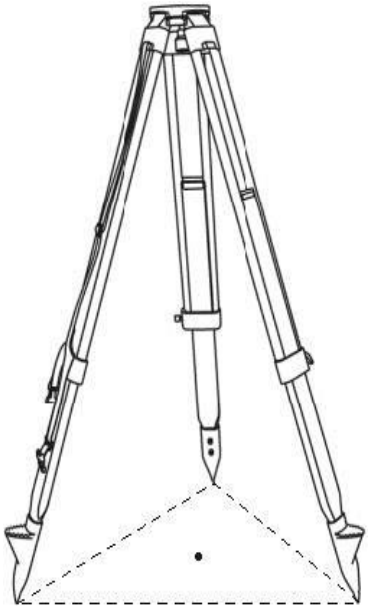
Press and hold for more than 2 seconds the power off key, the instrument prompt if the user wants to turn off or restart the total station and save the current settings.

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.

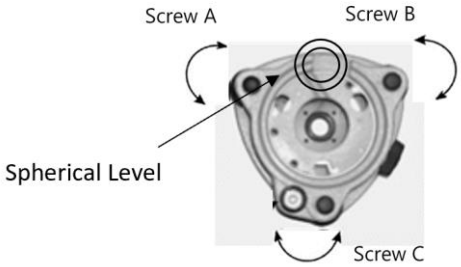


Note 1. The quality of the tripod setting up can affect the survey result. Remember to locate the tripod on a stable surface sticking the metal tips in the ground.

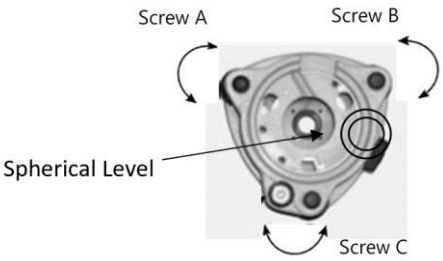
Note 2. It is recommended to check the stability of the tripod before each survey.

2. Leveling up the Instrument

Use tribrach leveling screws to level up the instrument, taking the spherical level on the station as reference.



Turn the instrument till the spherical 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.

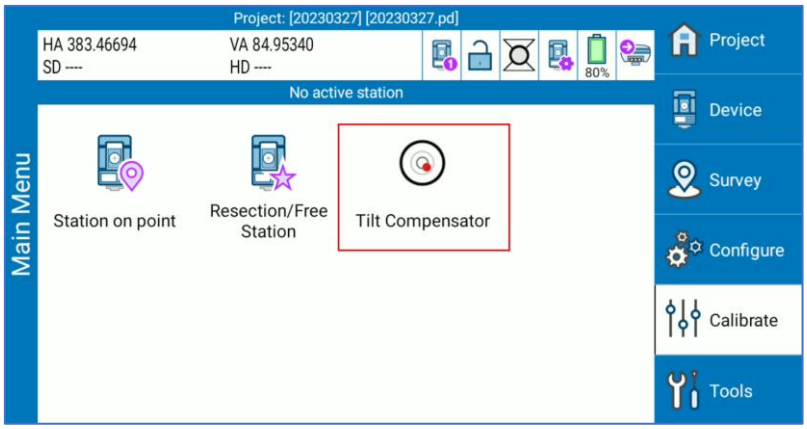


Turn the instrument approximately 90°. Adjust screw C, till the bubble in the center of the level.

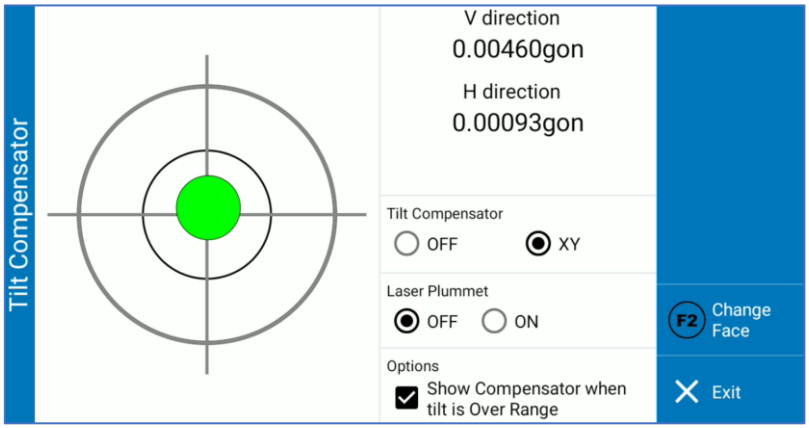
Repeat above steps until the bubble remains in the center of the spherical level while the instrument is rotated to any position.

3. Accurate leveling-up with electronical level

Press and hold **[⏻]** to power on the instrument. Enter in Cube-a -> Calibrate -> Tilt Compensator to access to 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 sperichal level is not centered when leveling up with electronical bubble, probably it's necessary to calibrate it (see 6 Calibration).

Clicking on *Tilt Compensator,* 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 two different options for this function:

a. *OFF* -> Electronic compensator not activated.
b. *XY* -> Electronic compensator activated in X and Y directions.

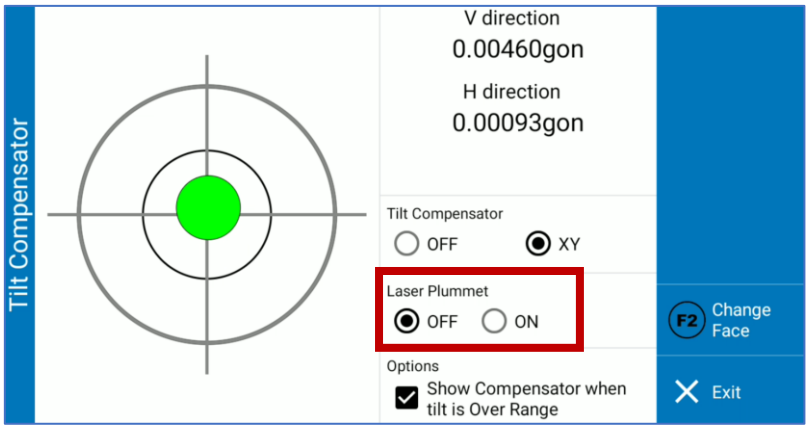
When the instrument is in operation, if the XY tilt compensation is on, the instrument will compensate and correct the VA and HA readings.

Enabling the option "Show Compensator when tilt is Over Range", Cube-a displays a message when the instrument is not levelled, like in the image below, and returns in the electronical bubble page.

Note. 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

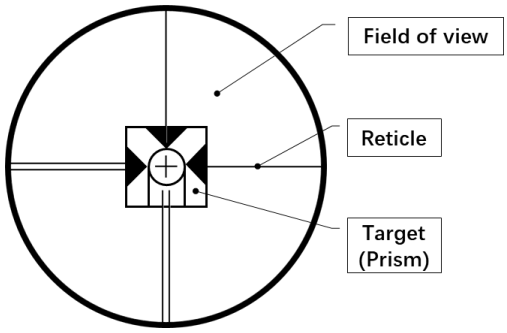
The centering operation is necessary to align total station vertical axis to reference station point. To make easier this operation, it is possible to activate the instrument laser plummet. In electronical bubble page of Cube-a, the option *Laser Plummet* can enable/disable, as visible in the image below.



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. Tribrach assamble/disassemble

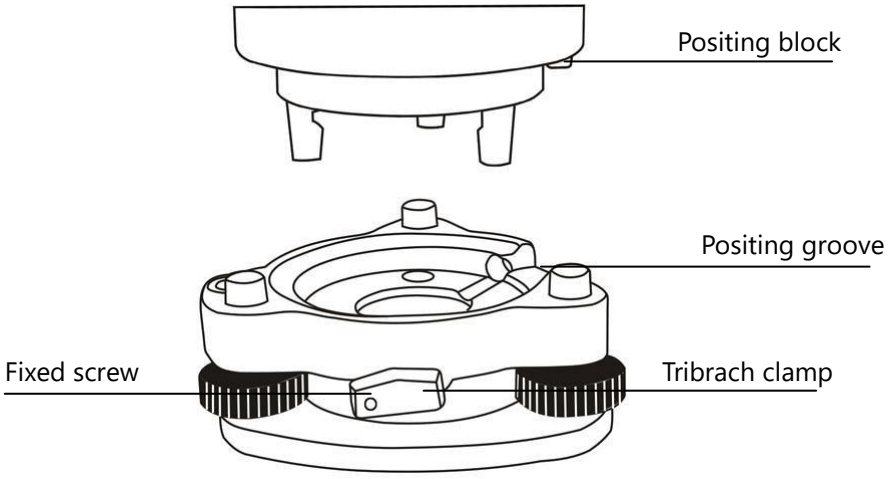
Use the tribrach clamp to assemble or disassemble the instrument from the tribrach.

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.

4. Android Operative System

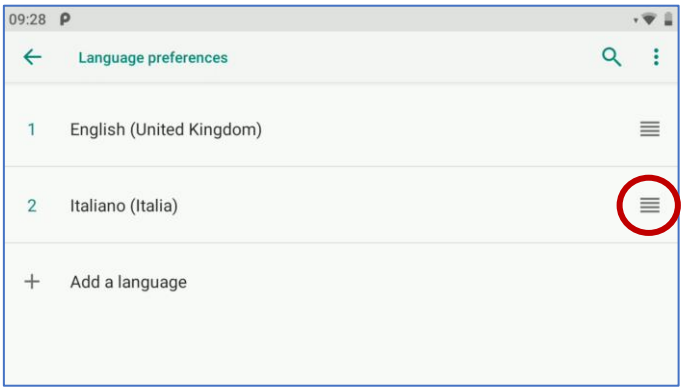
R180 is first Stonex robotic total station characterized by Android operative system on board. Using Android on a total station provides a lot of advantages improving instrument functionality, simplicity and usability from different points of view. The operative system is in fact the same one installed 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.

4.1. Android Useful Options

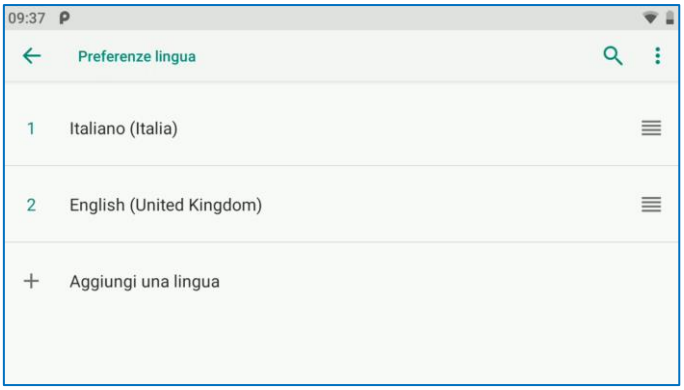
Android Operative System offers many functions, useful to adapt the instrument to user needs and to the different environment conditions typical of on-field works.
Here below the description of some useful functions, included in Android Operative System:

a. Change Device Language

Enter in *Settings application -> System -> Languages & input -> Languages.*



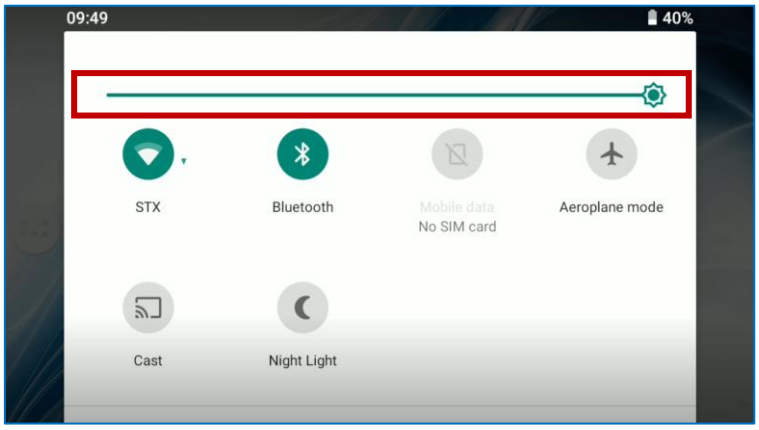
Click on "Add a language" to set the language of the device; then drag the added language to the top of the page, holding down the icon in the red circle.



As visible in the image above, the device language was changing in Italian simply moving Italian language at the top of the list.

b. Screen Illumination

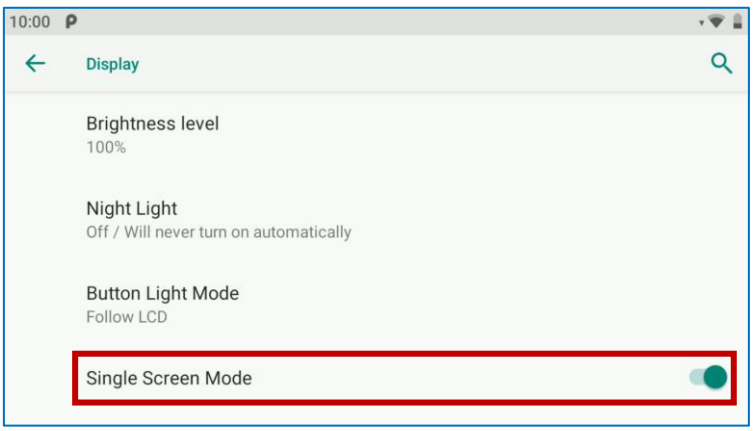
Scroll down the quick Android menu as visible in the image below. Use the screen illumination adjustment bar to modify screen illumination and adapt the tablet to different light condition.



It's also possible to access to display settings from *Settings -> Display -> Brightness Level* to modify screen illumination.

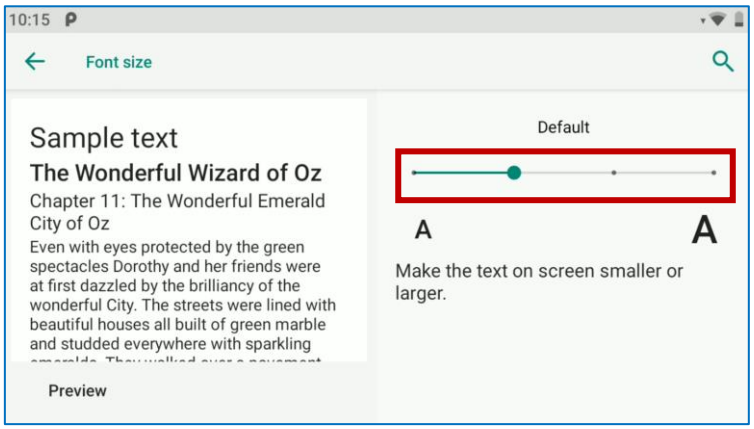
c. Single Screen Mode

Enter in *Settings -> Display* to enable/disable single screen mode. In this way, it's possible to using one screen, reducing battery consumption. The active screen will be the one touched by the user.



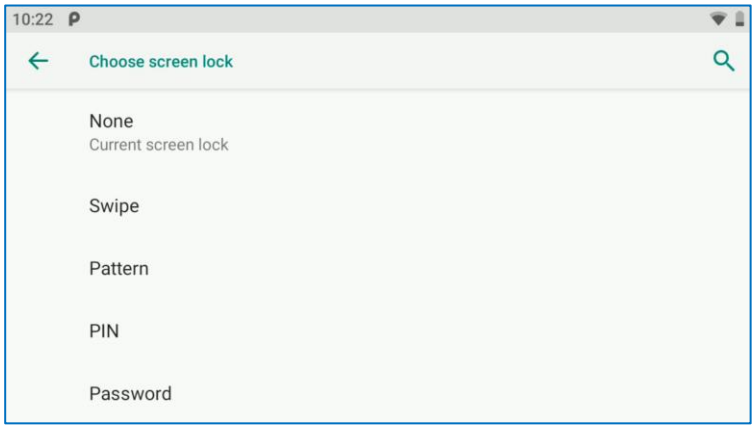
d. Change Font Size

Enter in *Settings* -> *Display* -> *Font size* to change the dimensions of the apps and the words in the device. Scrolling the bar in the red rectangle, it's possible to increase/decrease font size choosing between "Small", "Default", "Large" and "Largest". In the left box, there is a preview about the different font that can be selected.



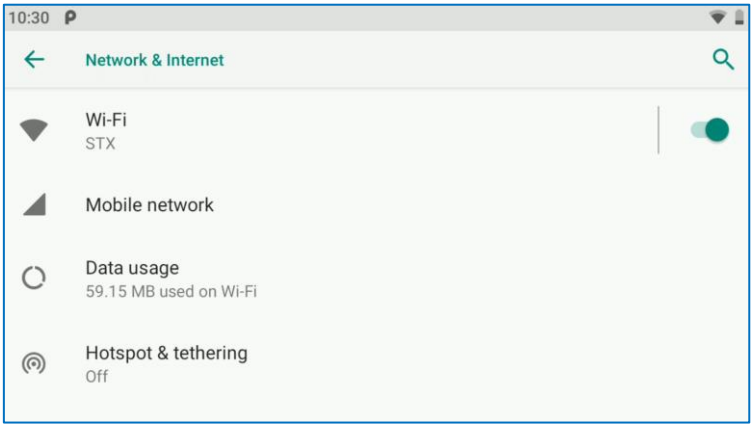
e. Set a screen Password

Enter in *Settings* -> *Security & location* to set a screen password, like in a Smartphone. The user can choose between different options ("None", "Swipe", "Pattern", "PIN", "Password") to protect the access to the device.



f. Web Internet Connection

Enter in *Settings* -> *Network & Internet* to connect the instrument to Web Internet. It's possible to choose between "Mobile Network" if a SIM card is inserted in the instrument or "Wi-Fi" to connect the device to a Wi-Fi network.



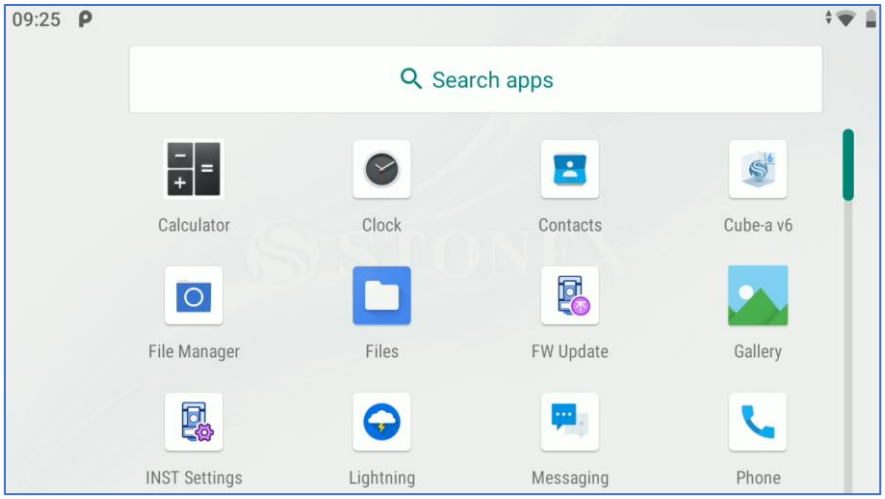
Click on *Wi-Fi* -> *Add network* to search the Wi-Fi networks available in the surrounding area. Select your Wi-Fi network and insert the password to enable the connection.

4.2. Android App

R180 has some pre-installed applications usable to manage Android Operative System and some other ones designed for total station management.

These applications can be divided in two different categories:

- Android Default App
- R180 Technical App



4.2.1. 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.

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

Contacts -> App for contact list management.

File Manager -> 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).

Messaging -> This application allows the user to send and receive messages (***Note***. It's necessary to insert a SIM card in the instrument to use this application)

Phone -> This application allows the user to call a mobile phone number and receive phone calls (***Note***. It's necessary to insert a SIM card in the instrument to use this application)

Settings -> App for Android settings system management.

Google Play Store -> use this application to access to Google Play Store and download useful application. (*It's strongly suggest downloading only applications useful for your work).*

4.2.2. R180 Technical App

This group contains the applications necessary to manage R180 total station in all its functions (***Note***. These apps are necessary for instrument use, configuration, update and management, please don't unistall them). There are six pre-installed applications on the total station: FW Update, INST Settings, TS Connector, TS Command Service, TS Calibration and Cube-a. Below their description.

a. FW Update

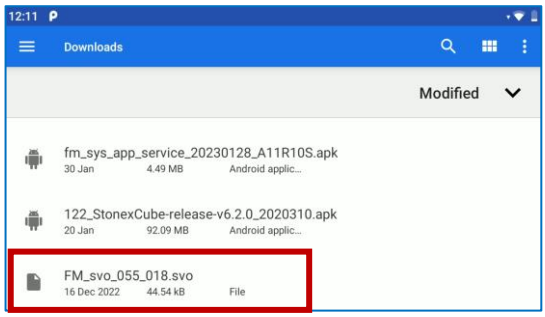
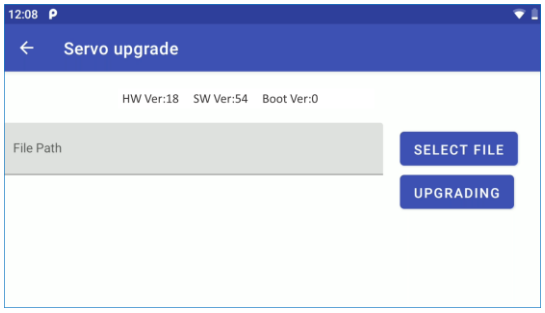
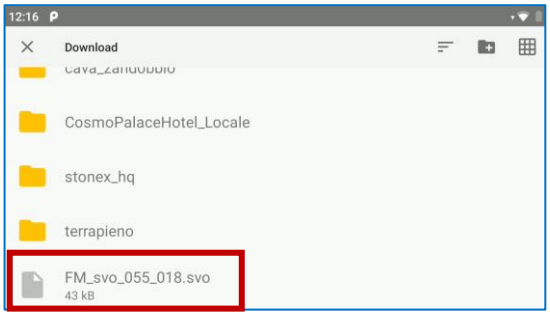
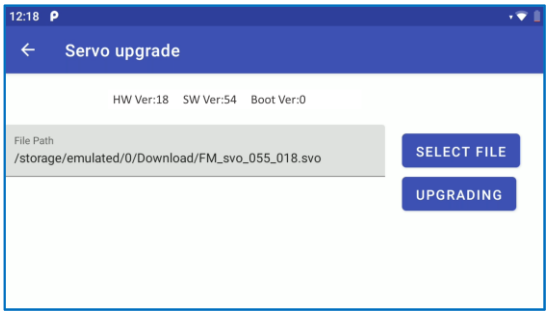
"FW Update" app is dedicated to R180 FW update. Clicking on the icon, the user can enter in the application, as visible in the image below (application version squared in red in the image below).

FW Update

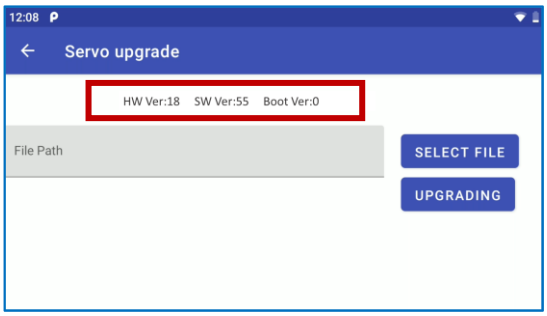
As visible in the image above, there are several sections dedicated to FW update. Each one is configured to update the FW of a specific sensor or technology of R180. In the table below there is a resume about R180 internal FW.

Menu	**Sensor**
Angle	Angle MCU
	Angle FPGA
EDM	EDM Sensor
Tilt	Tilt Sensor
Servo	Servo Controller
Drive User	Drive User
Search	MCU Update
	FPGA Update
Drive User	Drive User
Config	Drive Configure
Driver	Driver Firmware

The procedure for updating different total station FW is the same one for each section. Here below the description of the procedure for FW updating (in the example, update of "Servo" FW):

FW Update Procedure	
a. Copy new FW file (in the example *FM_svo_055_018.svo*) in R180 internal memory in "Downloads" folder (see chapter 4.3 Android Data Exchange Mode for an overview about data transfer between R180 and other devices).	
b. Open "FW Update" app and select the section to update (in the example below: "Servo").	
c. Click on "Select File" and select the FW update file from R180 internal memory.	
d. Click on "Upgrading" to update FW version.	

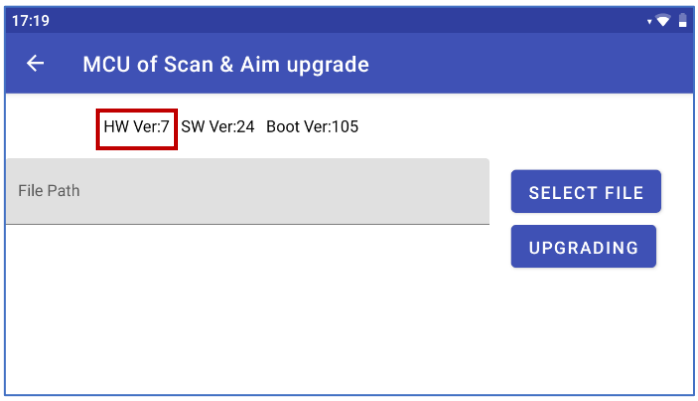
e. A pop-up message informed the user about the success of the update. Contemporary the information included in the red square in the right image, is updated in accordance with the new FW file.



Note 1. Check that the battery level is at least 70% before FW updating.

Note 2. FW update procedure may require some minutes for some components. During FW update is not possible to use the stations, don't exit from "FW Update" application, don't click on the touchscreen, don't turn off the instrument or remove the battery during this procedure.

Note 3. Be careful to select the correct FW file in accordance with your sensor HW. You can read it in FW update pages, as visible in the image below (example for SEARCH -> MCU Update page).



Note 4. After FW updating, restart the instrument.

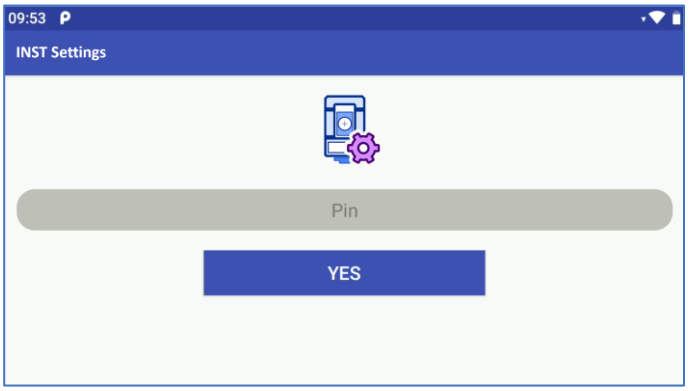
Note 5. Don't connect any cable when updating.

Note 6. When "FW Update" app is opened (also in background), the instrument is in a particular condition on which its not possible to use it with Cube-a. This configuration was added to avoid possible problems during FW updating due to external softwares. To restore the correct communication between the total station and Cube-a, it is necessary to close or exit from "FW Update" application. For this reason, **remember to close or exit the "FW Update" application each time you access it and after each FW update operation.**

b. INST Settings

"INST Settings" app is dedicated to service, debug and calibration procedures. Clicking on the icon, the user can enter in the application.

INST Settings



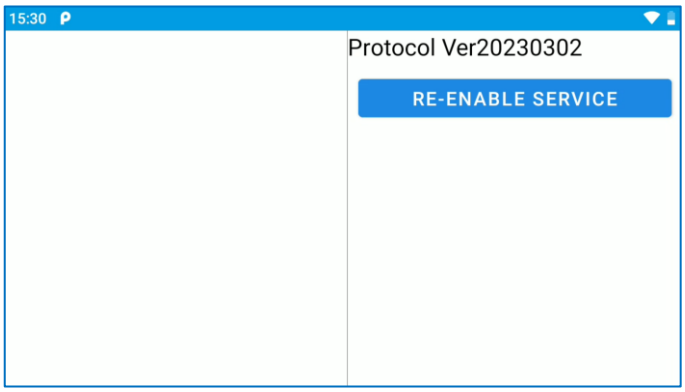
The access to the app is protected by a password.

Note. The use of this application is restricted to expert and professional users. For any doubts or questions refer to your local dealer or contact Stonex Technical Support.

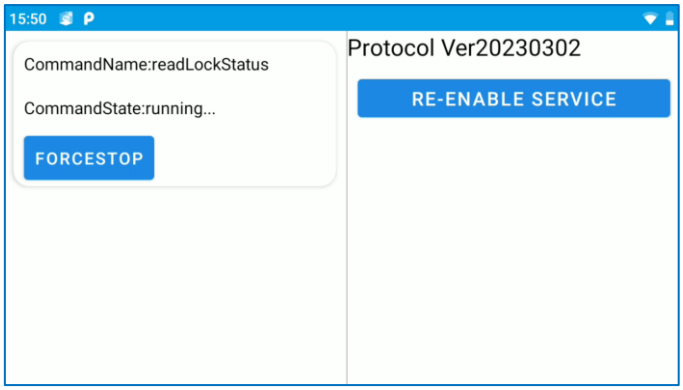
c. TS Command Service

"TS Command Service" app is necessary to guarantee the right communication between the instrument HW and the software (Cube-a). Clicking on the icon the following screen appears.

TS Command Service



Entering in the application, it's possible to read the app version (eg. Ver20230302 in the picture above) and if necessary, re-enable the connection between the software and the hardware clicking on "Re-enable Service". When the communication is correctly setted, the commands send by Cube-a to the hardware are visible in the left part of the screen, as visible in the photo below.



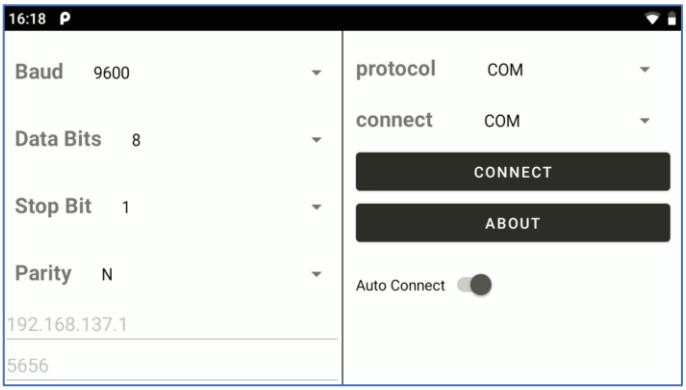
Note 1. This application is necessary to guarantee the communication between Cube-a and the HW, but **it's NOT necessary to launch it every time**. In fact, when the user enters in Cube-a, "TS Command Service" app is automatically launched in background mode. In this way, opening Cube-a, "TS Command Service" is automatically launched and the correct communication between instrument and software is established.

Note 2. The use of "TS Command Service" app is suggested only to re-launch the communication between HW and software in presence of connection problems, for example when the user doesn't see the angular readings in Cube-a. This command forced the connection between HW and software, restoring the correct communication. Use this option only if necessary.

d. TS Connector

"TS Connector" is an application dedicated to the configuration of the different communication methods available for R180. Clicking on the icon the following screen appears.

TS Connector



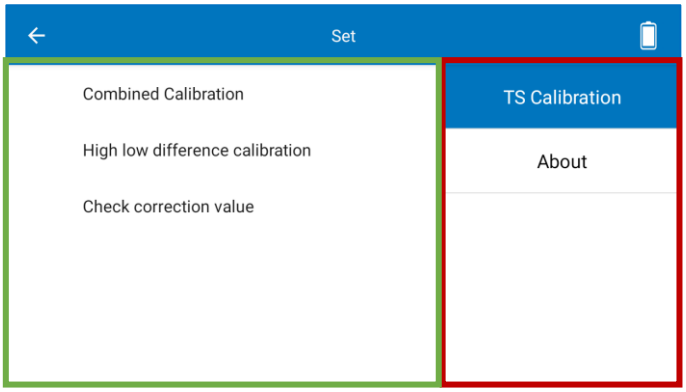
Note 1. **Don't modify the "TS Connector" configuration respect the default one** (visible in the image above). Cube-a is already configured to manage the different communication methods available for the instrument. For this reason, is not necessary to change the connection method passing from a on-board configuration to a remote one, because Cube-a automatically manages this passage.

Note 2. The use of "TS Connector" application is limited to extraordinary activities that require the communication between the instrument and external devices not passing from Cube-a. For any questions contact your local dealer or Stonex Technical Support.

e. TS Calibration

"TS Calibration" is an application dedicated to R180 user calibration. Clicking on the icon the following screen appears.

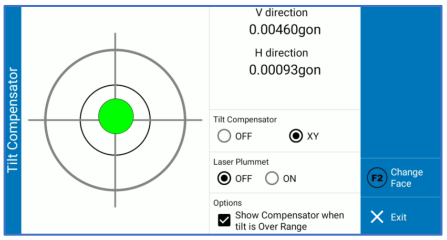
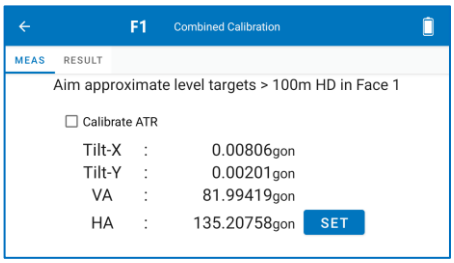
TS Calibration



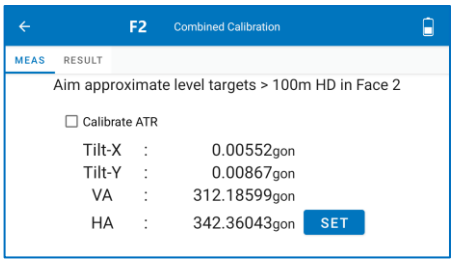
The application interface can be divided in two parts: the right column (red squared in the image above) containing different user menus and the central section (green squared in the image above) containing the functions included in each menu.

In the right column there are two specifical menus: "TS Calibration" and "About".
Clicking on "TS Calibration", the user can access to the instrument calibration functions. Here below their description:

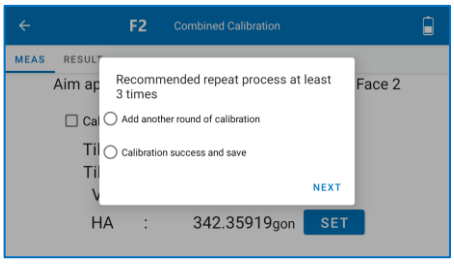
- *Combined Calibration* -> in this page the user can calibrate HA, VA, TILT X, TILT Y and instrument APC. See chapter 6 Calibration for a detailed description about the importance of instrument calibration and when its necessary to calibrate the total station. Follow these instructions for Combined Calibration:

Combined Calibration	
a. Set up and level the instrument following the indications included in chapter 3 Preparation & instrument setting up.	
b. Aim a target located at about 100 meters far from the station in Face 1 and click on "Set".	

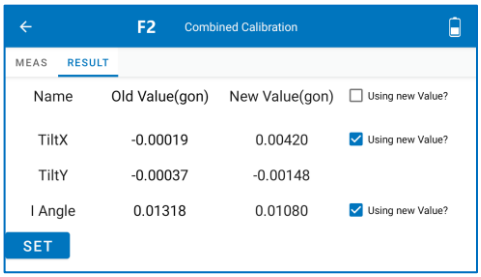
c. After clicking on “Set”, the total station automatically rotates in Face 2. Aim the same previous target and click on “Set”.



d. The instrument asks to the user if he wants to repeat the calibration or confirm and save the performed calibration. Clicking on “add another round of calibration”, it’s possible to repeat the procedure described in point b and c to perform an accurate calibration (suggested number of repetitions: 3); clicking on “Calibration success and save” to confirm the calibration.



e. After completing the calibration, the page in the right image appears. Clicking on “Set” the user can confirm the calibration with the possibility to choose if calibrate both angles or tilt or only one of them.



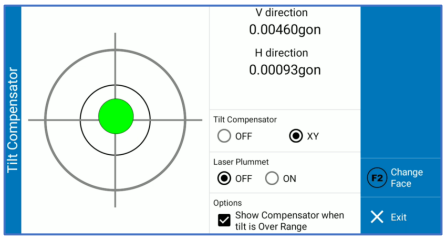
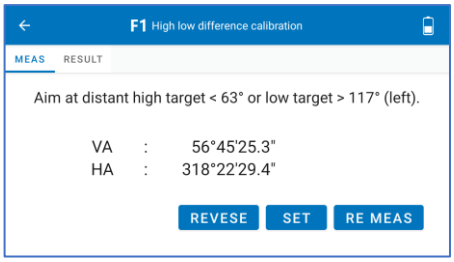
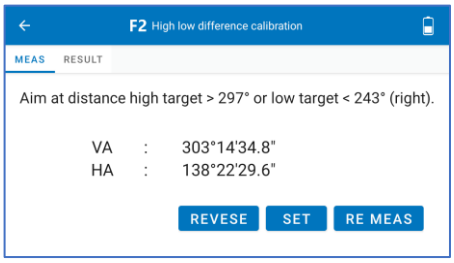
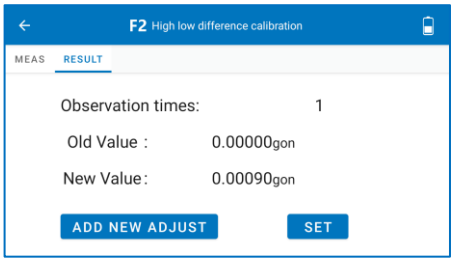
Note 1. Selecting “Calibrate APC” window, it’s possible to calibrate simultaneously the APC. In this case it’s mandatory to aim a prism for instrument calibration.

Note 2. Before measuring, the instrument must be set up and levelled on a stable surface.

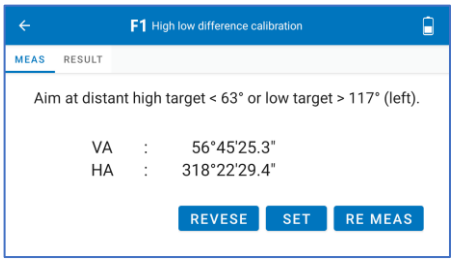
Note 3. “Combine Calibration” function modifies total station EDM settings. Please refer to the user manual for instrument calibration or contact your local dealer/Stonex Service for every doubt or question.

Note 4. It’s suggested to calibrate the instrument after long trip in order to guarantee its quality and reliability.

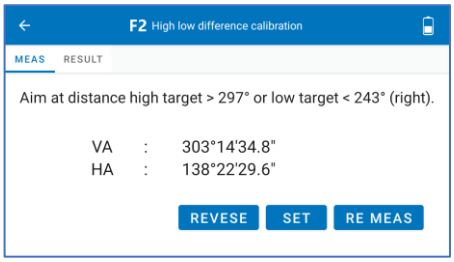
- *High Low difference calibration* -> in this page the user can calibrate the error on the horizontal angle due to the vertical movement of the telescope. Follow these instructions for High Low difference calibration:

High Low difference calibration	
a. Set up and level the instrument following the indications included in chapter 3 Preparation & instrument setting up.	
b. Aim a target located in a vertical range area < 63° in Face 1 and click on "Set".	
c. Click on "Reverse" to change face and aim at the same target located in a vertical range area > 297° in Face 2. Click on "Set" to confirm the calibration.	
d. The results page will appear showing the calibration calculation. Click on "Add new Adjust" to continue the calibration or "Set" to confirm the calibration. We suggest continuing the calibration aiming a "low target".	

e. Aim a target located in a vertical range area >117° in Face 1 and click on “Set”.



f. Click on “Reverse” to change face and aim at the same target located in a vertical range area < 243° in Face 2. Click on “Set” to confirm the calibration.

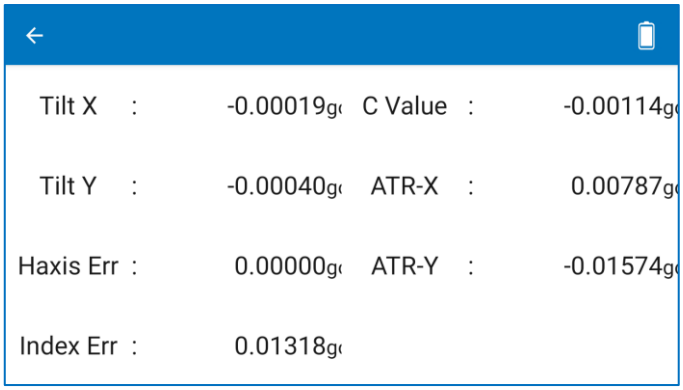


Note 1. Before measuring, the instrument must be set up and levelled on a stable surface.

Note 2. “High Low difference calibration” function modifies total station EDM settings. Please refer to the user manual for instrument calibration or contact your local dealer/Stonex Service for every doubt or question.

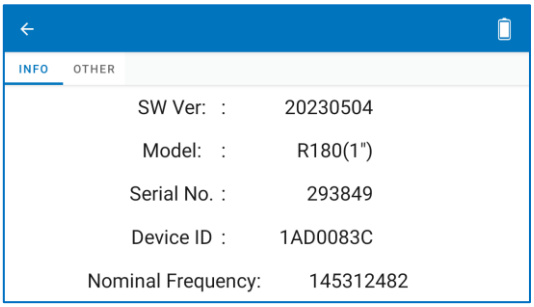
Note 3. It’s suggested to calibrate the instrument after long trip in order to guarantee its quality and reliability.

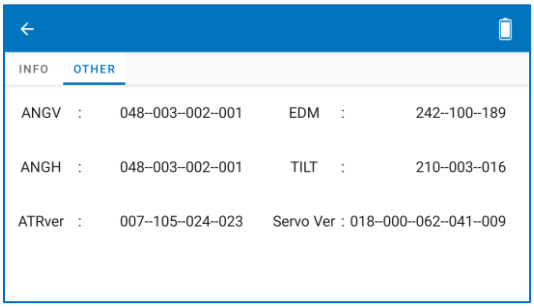
- *Check Correction Value* -> in this page the user can check the calibration correction values.



Clicking on "About", it's possible to access to R180 resume page divided in two sections:

a. *Info* -> containing some instrument information like SW version, Model and R180 Serial Number (left image below).
b. *Other* -> containing a resume about FW version installed on the total station (right image below).



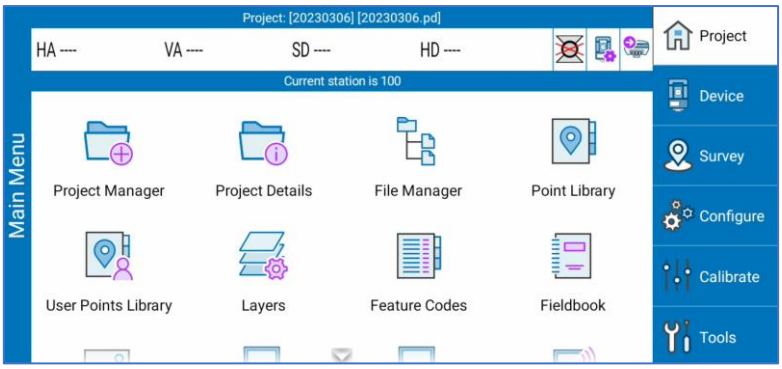


f. Cube-a

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.

Cube-a First Access

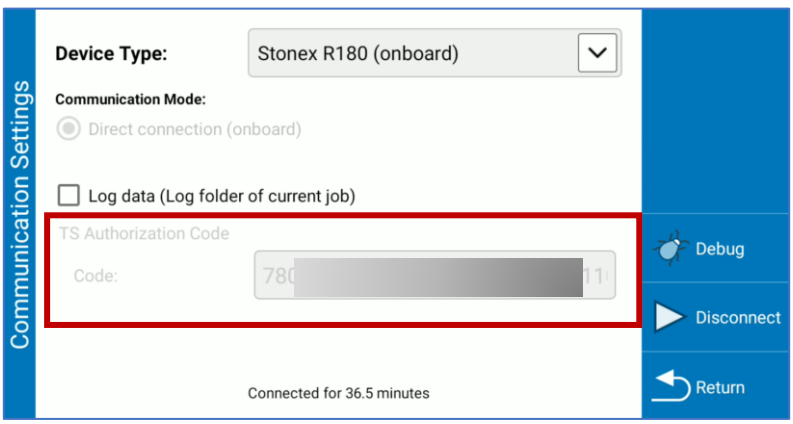
After software activation (refer to Cube-a user manual), the following screen appears. As visible in upper status bar, the station is not connected to the software because the angle readings are not visible.



Click on "Device" -> "Total Station Communication" to check the status of the connection. Configure the instrument communication as in the photo below selecting R180 as "Device Type" and inserting the TS Authorization Code in section "Code". This code is fundamental to guarantee the right communication between R180 and Cube-a and must be inserted only after Cube-a first access. After the first entry, the software stores the code for subsequent accesses.

Note. During Stonex checks and tests before the instrument shipment, we insert the TS authorization code into Cube-a. For this reason, the user will find the code already stored in Cube-a.

Click on "Connect" to connect the instrument to Cube-a.



If the angle readings are visible in the upper status bar, the station is correctly connected to the software.

Note. If after pressing "Connect", the angles are not visible close and re-open Cube-a. If the problem persists, turn on/turn off the total station and re-open Cube-a.

R180/Cube-a initialization

Each time the user opens Cube-a after R180 turning on, he needs to wait about 1 minute for instrument initialization. This operation is automatically executed by Cube-a and it's necessary to ensure proper operation of the total station. When the station produces a sound like a ticking sound, it means that the initialization of the instrument is almost finished. After this step, the angle readings appear on Cube-a screen and the user can start to work.

Note 1. The initialization is necessary each time the user opens Cube-a after R180 turning on. If the user exit and re-enter in Cube-a after initialization, this procedure is not necessary, because already performed.

Note 2. If the initialization failed, enter in "TS Command Service" and click on "Re – Enable Service" (see TS Command Service). After the tick sound, re-open Cube-a. If the angles are visible the initialization is completed, unless restart R180 and repeat the procedure above.

If the problem persists, contact your local dealer.
See Cube-a user manual for more details and information about the software.

4.3. Android Data Exchange Mode

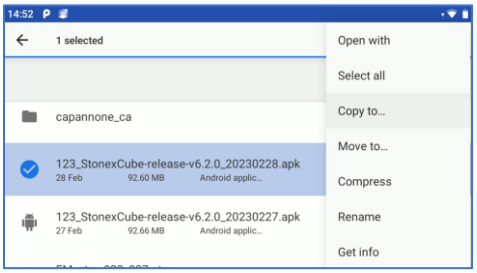
Android Operative System offers to the user different Data Exchange modes from which to choose. These methods can be divided in two categories:

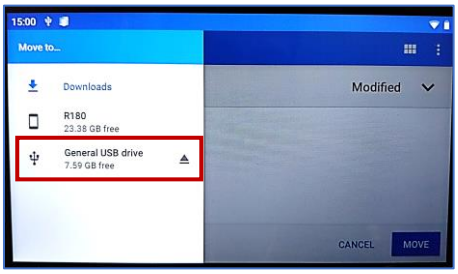
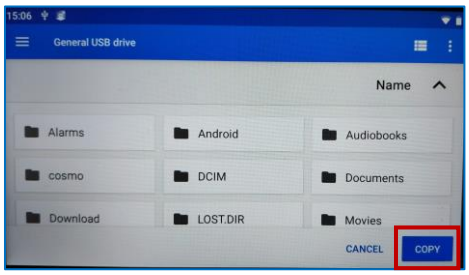
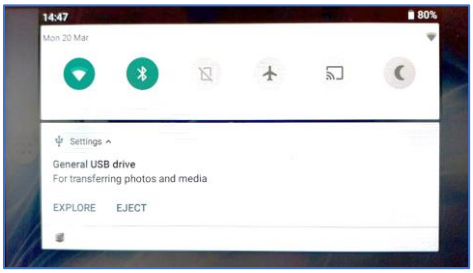
- External Devices
- Wireless

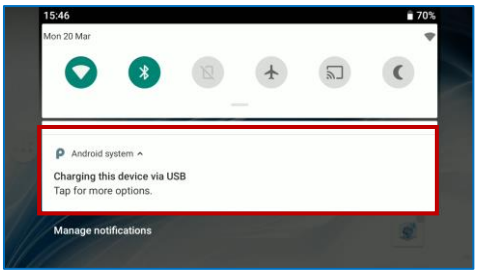
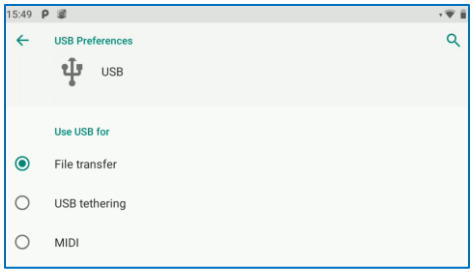
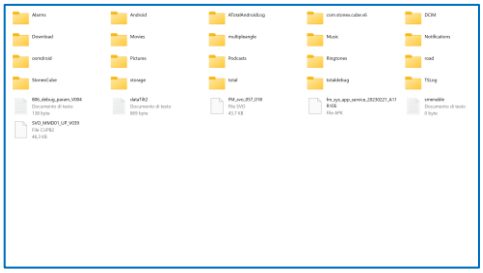
External Devices

R180 is configured to transfer data via an external device using:

- USB Key
- Cable

USB key	
a. Insert the USB key in the total station	
b. Press and hold the file to copy it on USB key from R180 internal memory (***Note***. If you don't see R180 internal memory, click on the three dots and select "Show internal memory").	
c. Click on the three dots and select "Copy to".	

d. Select USB memory.	
e. Copy the file in the USB key.	
f. Pull down the drop-down menu and click on “Eject” to remove safetly the USB key.	

CABLE	
a. Connect the instrument to the PC using the cable (MicroUSB port in R180).	
b. Pull down the drop-down menu and click on “Charging this device via USB”.	
c. Selet “File Transfer” to transfer data to the PC using the cable. In this way the user can access to R180 memory from the PC.	
d. Transfer data from R180 to the PC.	

Note. Follow the procedures above also for transfer data from a PC/external device to R180 internal memory.

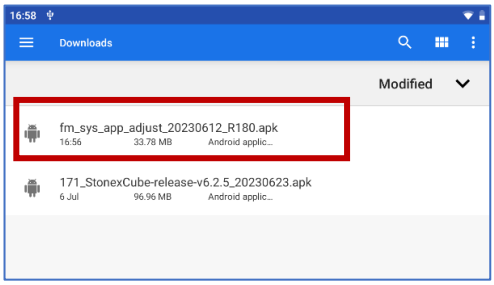
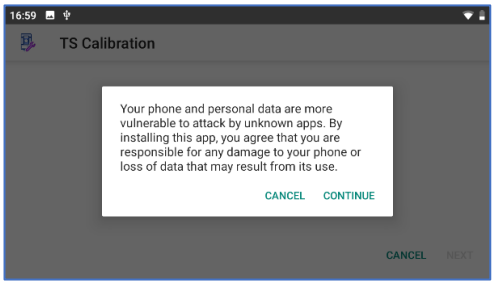
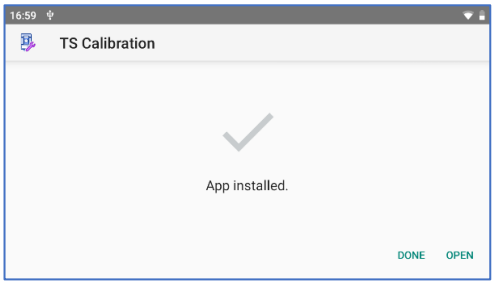
Wireless

R180 is configured to transfer data also via wireless methods. The instrument is characterized in fact by BT and Wi-Fi that can be used to share data between different devices.

See Cube-a user manual for a detailed description about data transfer using wireless methods.

4.4. App Update

The procedure for updating total station APP is the same for each application installed on the TS. Here below the description of the procedure for application update (in the table below an example with "TS Calibration" app):

APP Update Procedure	
a. Use an USB key or a cable to copy new APP in R180 internal memory in "Downloads" folder (*fm_sys_app_adjust_20230612_R180.apk* in the example).	
b. Click on the application to update and on "Continue" to start the APP upgrade.	
c. Follow the Android instructions for completing the APP updating.	

5. R180 Configurations

R180 supports three different configurations:

1. On-Board Configuration
2. Remote Configuration
3. One-Pole Solution

5.1. On-Board Configuration

On-Board configuration is the standard R180 configuration. With this solution, the user can work directly on the station, managing the instrument with the internal pre-installed applications and the survey with Cube-a. Here below the components that form the On-Board configuration:

R180/Cube-a On-Board

5.2. Remote Configuration

Remote configuration can be used to manage the instrument remotely, using an external controller connected to the total station. This solution is typical of one-man survey that needs to work alone managing the station remotely using an external tablet. R180 is already configured for Remote configuration and doesn't require any hardware modifications. For this reason, the Remote configuration can be used only purchasing another Cube-a license and activating it on an external device.
In this way, it's possible to connect the tablet to the Cube-a installed on R180 via BT and send the commands to the total station directly with the tablet. The instrument is equipped with a long-range BT module, that guarantees the communication with the tablet until 350 meters (test perfomed with UT12P).

Here below the components that form the Remote configuration:

R180/Cube-a On-Board + Controller/Cube-a

5.3. One-Pole Solution

One-Pole Solution is a surveying system that combines the high accuracy of total station with the versatility of the GNSS receiver, able to measure points not visible to the TS (Total Station). While the TS requires reference points that are visible from an optical point of view, an RTK GNSS receiver can quickly determinate its position with centimeter-level accuracy using data from satellites. Cube-a is already configured to manage both the GNSS receiver and the Total Station at the same time.
Here below the components that formed the One-Pole Solution:

R180/Cube-a On-Board + Controller/Cube-a + GNSS receiver

6. Calibration

6.1. 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 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 1. 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 (Recommended waiting time = 3 min * Δ (Δ is the temperature difference between indoor and outdoor environment)). During the whole procedure, we suggest protecting the instrument from direct sunlight which can cause overheating on one side of the instrument.

Note 2. Instrument calibration is a procedure that must be carried out in the time to guarantee the instrument precision and reliability. We suggest checking and calibrating the total station everytime the user is in one of the situations described in the list above. In the other cases, we suggest checking and calibrating (If necessary) the instrument every 3-6 months (depending by the customer's work).

6.2. 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.

6.3. 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.

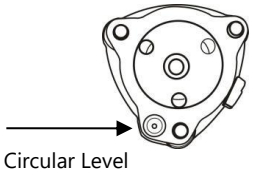
6.4. TILT calibration

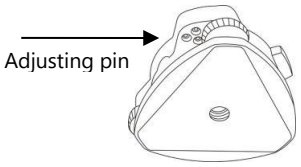
The TILT calibration is a procedure necessary for calibrating the tilt sensor.

6.5. Mechanical Check and Adjust

Check and Adjust the tribrach Circular Level

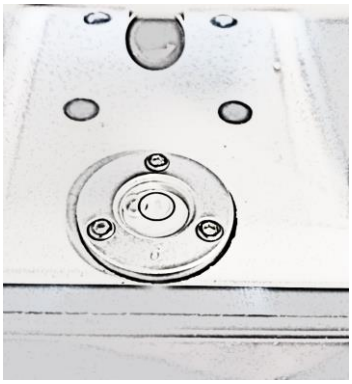
1. Set up the tripod and instrument stable.
2. Power on the instrument. Precisely level the instrument following the electronic level.
3. The circular level should stop right at the center.
4. If not, use the adjusting pins to adjust related screws till the bubble is in the center.





Check and Adjust the Instrument Spherical 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 spherical level be parallel to a line linking two leveling foot screws. The spherical 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 Cube-a -> Calibrate -> Tilt Compensator 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.

7. Technical Data

ANGLE MEASUREMENT	
Accuracy[1]	0.5″-1″
Reading system	Absolute four-quadrant
Display Resolution	0.1″
Angle Units	DEG 360°/GON 400/MIL 6.400

TELESCOPE	
Magnification/ Field of view	30x / 1°30′
Tube length	164.5 mm
Minimum focus distance	1.5 m
Objective aperture	Ø 45 mm
Laser pointer	Red light, coaxial

TILT SENSOR	
Type	Dual-axis liquid-electric sensor
Compensation range/accuracy	± 3.0′/1″

DISTANCE MEASUREMENT RANGE[2]	
Standard prism mode	6000 m[3]
Reflectorless[5]	1000 m[4]

DISTANCE MEASUREMENT ACCURACY[6]	
Standard prism mode	1 mm + 1 ppm
Reflectorless	2 mm + 2 ppm

MEASUREMENT TIME	
Standard prism mode (Tracking/Single)	<0.3 / 0.7 sec
Reflectorless	Typically 0.8 sec (>500 m, >5 sec)

DISTANCE MEASUREMENT	
Distance Unit	m/US ft/INT ft
Display Resolution	0.0001 m/0.001 m 0.001 ft/0.01 ft

MOTORIZATION	
Technology	Tdrive
Max rotation speed	180°/sec
APC-Target Aiming Range	1.5 - 1000 m
APC-Measurement Time	<10 sec

Fast360°-Target Aiming Range	1.5 - 300 m
Fast360°-Angle	H: 360° - V: 20°
AIM accuracy	± 1 mm @ 100 m[2]

LASER PLUMMET

Laser type	635nm semiconductor laser
Accuracy	1mm/1.5 m
Spot	±1.8mm/1.5 m

LEVEL VIAL SENSITIVITY

Circular level	8'/2mm

ENVIRONMENTAL CONDITIONS

Operating Temperature	-20° C +50° C (-4°F to 122°F)
Storage Temperature	-20° C +60° C (-4°F to 140°F)
Waterproof/Dustproof	IP65
Humidity	95% non-condensing

PHYSICAL SPECIFICATION

Dimensions	430 x 255 x 235 mm
Weight including battery and tribrach	9.5 Kg

POWER

Battery Voltage/Capacity/Type	14.4 V / 6400 mAh / Li-ion
Batteries number	2
Operating time	6 hours (one internal battery)[7]
Battery charger	100/240 V, charging time 4h

OTHER SPECIFICATIONS

CPU	MSM8953
Display	Two sides, 6" color LCD 720x1280 pixel touch screen
OS	Android
Memory	RAM: 3GB, ROM: 32GB
Interface	RS-232/Micro USB/ BT long range
Data transfer	4G (build-in), Bluetooth, WLAN, Hotspot
Camera	✓
Guide Light	✓

ONBOARD FIELD APPLICATION PROGRAMS

Cube-a TS-GPS

Specifications subject to change without

[1] Standard deviation based on ISO 17123-3

[2] Good condition: no haze, visibility about 40km, no heat shimmer, breeze

[3] Class 1

[4] Class 3R

[5] Under optimal conditions on good surface

[6] Standard deviations based on ISO 17123-4

7 Battery duration depends also on display brightness.

8. Carrying Case

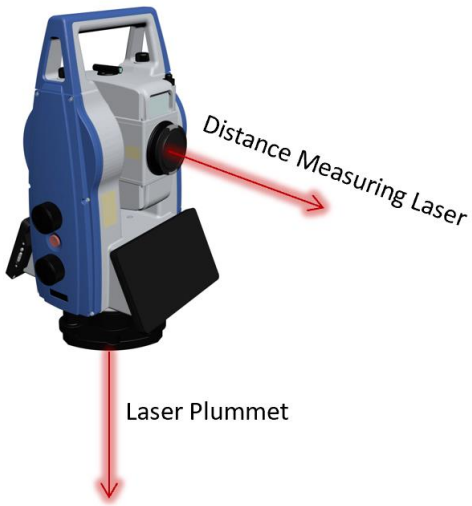
Open the transport case, remove instrument and check for completeness:

- Total Station
- Tribrach
- Battery Li-64 (x2)
- Battery case (x2)
- Silica gel
- Targets (4 sizes)
- Target NF10
- Tools bag
- Charger ZY-4SLi2A
- Strap of carrying case (x2)
- Cleaning Cloth
- Lens Cap
- Antenna BT long range
- Rain cover
- Cable EU adapter
- Cable US adapter
- Cable CH adapter

9. Precautions for safety

9.1. 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.

9.2. 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.

9.3. 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.

9.4. 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.

9.5. 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.

9.6. 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.

9.7. 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.

9.8. 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.

9.9. 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.

10. Care and Transport

10.1. 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 7 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.

10.2. 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.

10.3. 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.

11. 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

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.

12. Appendix

12.1. 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:

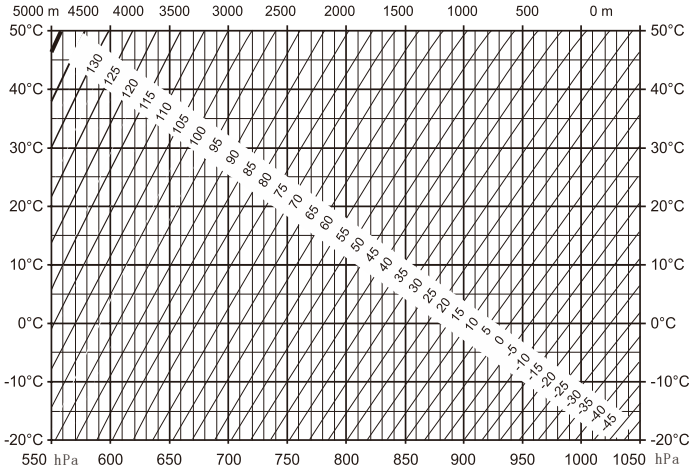
$$\mathbf{kPT} = 279.097 - 0.29528 \times \mathbf{P} / (1 + 0.0036 \times \mathbf{T})$$

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**

12.2. Refraction and Earth Curvature Correction

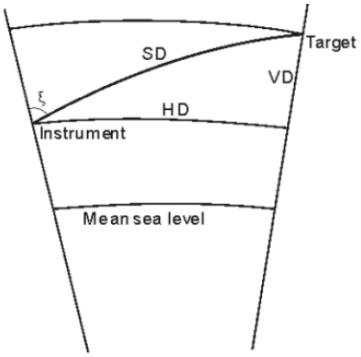
Considering the correction of refraction and earth curvature for distance measurement, the formula for SD, HD and VD applied in the instrument are as followings:

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

STONEX® SRL

Viale dell'industria, 53 | 20037 - Paderno Dugnano (MI)

| Italy

Tel : + 390278619201 | Fax :+ 390278610299

www.stonex.com | info@stonex.com