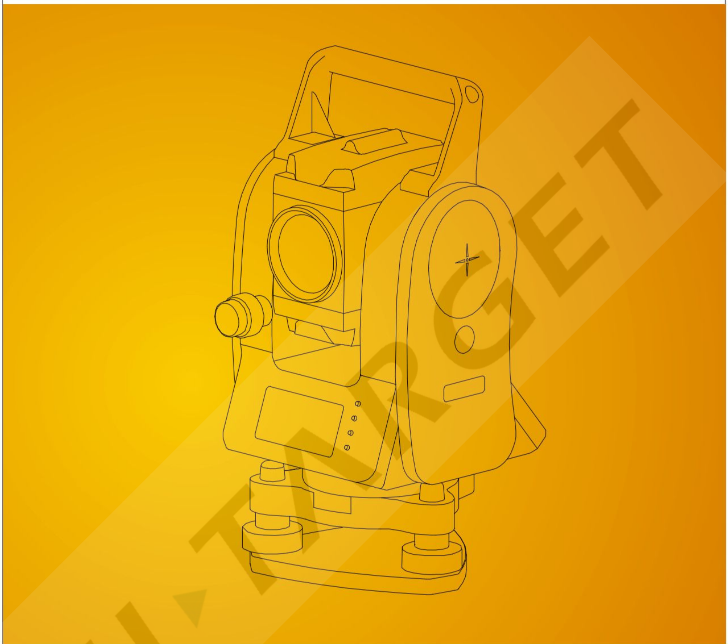
HI·TARGET



ZTS-360 Mini Series Total Station Manual

Preface

Thank you for purchasing our ZTS-360 Mini series total station! This manual is your good helper, please read it before operating the instrument and keep it properly.

Product Validation

In order to get our best service, please give the feedback about the version, number, purchasing date of the instrument and your valuable suggestions to us after you purchase our product.

We will attach great importance to every piece of advices from you!

We will pay much attention to every detail of our products！

We will make great efforts to provide better quality!

Notice: We reserve the right to change the technical parameters during updating and improving our products and we may not announce you in advance. The Pictures in this manual is for reference only, please in kind prevail.

Features

Rich Features--our total station carries abundant surveying application, at the same time has the functions of data storage, parameter settings and etc. It's suitable for all kinds of professional measurements.

Absolute code disc

Equipped with absolute code disc, the instrument can measure after switched on .Even if reset the battery halfway, the azimuth information will not be lost.

A high-capacity RAM Management

It serves an easy management for file system, including the increase, deletion and transmission of data.

Non-prism distance measuring

With non-prism distance measuring, this series total station can be directly to all kinds of material, different colors of objects (such as the structure of the walls, poles, wires, cliff wall, mountain, clay, wood, etc.) for long, fast, high precision measurement .This function is especially for the measurements of targets that cannot be accessed.

Special measurement program

Our total station is equipped with some special measurement program to meet the needs of professional measuring, such as Remote Height (REM) Measurement, Offset Measurement, MLM (MLM Measurement), Resection, Area measurement calculation, Roadway design and staking out.

Changeable eyepiece

As the eyepiece is changeable, it is convenient to be equipped with diagonal eyepiece, which makes it easy to observe the zenith direction high-rise buildings

Laser plummet

Easy to direct the station point and free station

Notice:

Don’t look directly into the sun with the objective lens;

Do not leave the instrument at extreme temperatures (too high or too low) or use it when thermal shock;

When you don’t use the instrument, should load it in the box and place it well-ventilate and dry place,and pay attention to the shock-proof ,dust-proof and damp-proof;

In order to get good precision, you should leave the instrument in the box to make it adapt the environment when there is a great difference in temperature between working environment and storage environment

The battery should be unloaded and charged once a month for extending its life. If not ， the instrument will not be used for a long term.

When transporting the instrument, you should store it in box and be careful to avoid extrusion, collision and violent vibration. A soft mat around the boxes is required for long-distance transport.

When setting the instrument, it’s better to work with high-quality wooden tripod for stability and measurement accuracy.

In order to improve the precision of Non-Prism measurement, please keep the object lens clean. When cleaning exposed optical devices, please wipe them gently with absorbent cotton or lens paper only.

After using instrument, please sweep away the surface dust with flannelette or hairbrush. Do not switch on the device when it has got wet by rain. Please wipe it dry with clean soft cloth and put it in ventilated place for a period time to make the equipment fully dry before using and packing.

Please check out that the indicators, functions, power supply, initial setting and correction parameters of the instrument meet the requirements before operating.

If discovering the abnormal function of the instrument, non-professional maintenance personnel are not allowed to disassemble the instrument without authorization, in case of any unnecessary damage.

As a safety precaution, do not aim at eyes directly when using the instrument.

Security Guide

Please pay attention to the following security matters when using the instrument with non-prism.

Warning:

Total station is equipped with rangefinders with laser level 3R/IIIa，which is recognized by the following logo recognition at the horizon-axis locking knob" of the instrument, saying "Class 3A Laser Product". The Total Station is classified as Class 3R Laser Product and abides by the class of Laser Product according to IEC Standard Publication 60825-1:2001.

For Class 3R/IIIa Laser Product, its emitted laser with wavelength between 400nm and 700nm can be at most 5 times of that of Class 2/II.

Warnings:

Never star at laser beam constantly, it could cause permanent eye damage.

Precautions:

Do not see directly into laser beams nor point laser to persons.

The reflected beams is the necessary for the instrument measurement signal.

Warnings:

It's dangerous to use Class 3R Laser instrument improperly.

Precautions:

In order to avoid causing damage, the proper precautions should be taken for you and control well the distance (in accordance with the standard "IEC60825-1:2001") that may occur hazards.

The following is the main part of the explanation of the IEC Standard Publication:

Class 3R Laser Products are used in outdoors and on building site (with non-prism measurements).

The personnel who are specially trained, qualified and authenticated are allowed to stall, adjust and operate these laser instruments.

b. Set up corresponding laser warning signs in the use of area range.

c. Prevent anyone from looking directly into laser beams or watching the laser beams with optical device.

d. In order to prevent laser damage to people, the laser beams should blocked at the end of the working route. In the limited area (★Hazardous distances) where the laser beams through ,the laser beams should be terminated when there are some activities.

e. the route which laser beans through must be set higher or lower than the sight of people.

f. When the instrument not in use, please make it safekeeping and storied. Unauthorized person should not use it.

g. To prevent exposure to laser beam accidentally, such as mirrors, metal surfaces, windows, be careful as the flat surface of the mirror and concave mirror.

*The hazardous distance refers to the maximum distance which is from beginning of the laser beams to the laser beam weaken until it does not harm people. The built-in rangefinder products equipped with Class 3R/IIIa laser whose hazardous distance is 1000 meters (3300feet),and in the distance, the strength weakens to a Class 1 laser (sightseeing beam eyes couldn't hurt).

Content

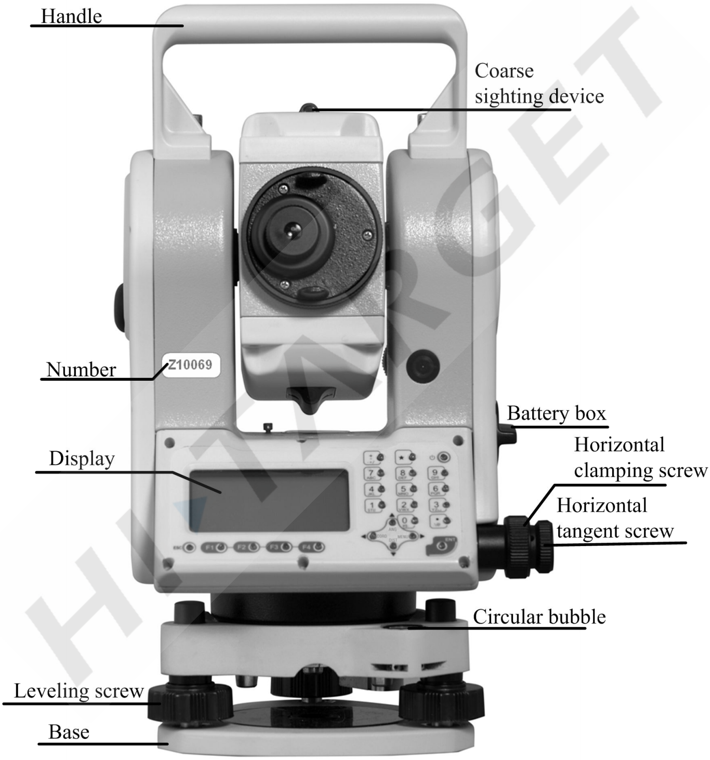
1. Use of instrument

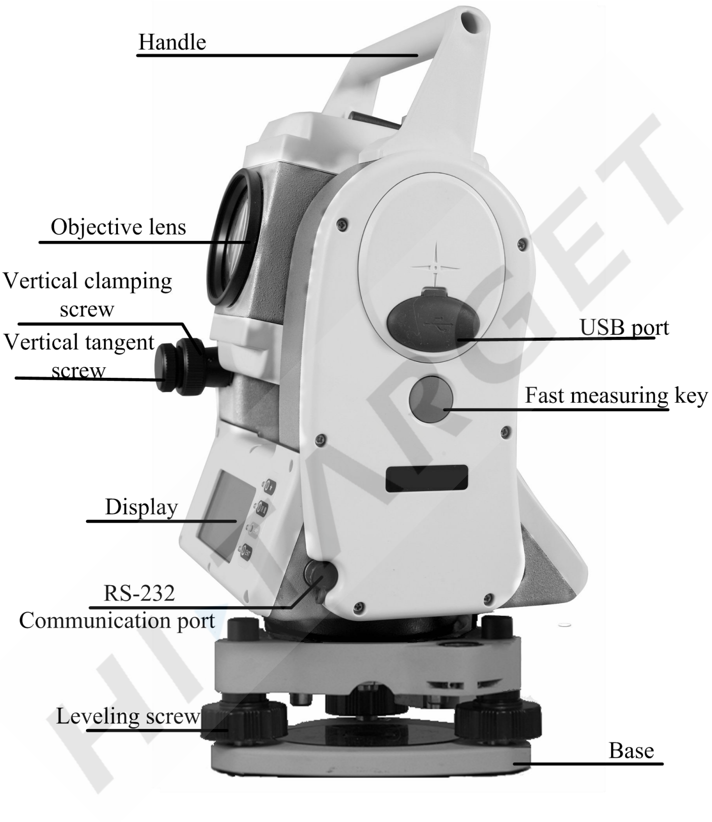
The total station is such an instrument that measures the azimuth and distances to destination and can calculate the destination point coordinates automatically. It plays an important role in the economic construction and national defense construction. General Survey, exploration and mining of minerals, the construction of railways, roads, bridges, irrigation, urban planning and construction is driven by electronic total station measurements. In the building of national defense, such as battlefield preparations, harbor, forts, airfields, bases and military construction projects, and so on, must be based on a detailed and accurate geodetic. In recent years, electronic total station is a large precision engineering, shipbuilding and aviation industries and other aspects of effective tools for precise positioning and installation.

The series total station is equipped with absolute code dial system, integrated-circuit-control-board ranging item and microcomputer for measurements of angle and distance and for calculation, display, depositing and etc. It can exhibit horizontal and vertical angle, slope and horizontal distance and altitude difference simultaneously. Furthermore, it can be set to measure under different mode (e.g. Angle mode, Distance mode).It is even designed for you specializing in construction projects with non-prism ranging. The non-prism ranging can be comprehensively used in measuring three-dimensional coordinates, position determination, remote elevation measurement (REM), verticality, pipeline positioning, cross-section measurement etc. It also meets requirements for trigonometrical control survey, topographic survey, cadastre and real estate survey.

2. Names and functions of the components

2.1 Names of the components




Handle
Objective lens
Vertical clamping screw
Vertical tangent screw
Display
RS-232 Communication port
Leveling screw
USB port
Fast measuring key
Base

2.2 The information of the displays

The sketch of display and keyboard in face left

The sketch of display and keyboard in face right

Symbols on the keyboard

Keys	Name	Function
ANG	Angle measurement	In the basic interface， enter the angle measurement . Under other modes, move the cursor up or up to select the options.
DIST	Distance measurement	In the basic interface， enter the distance mode； In the other modes，Move the Cursor down or down to select the options.
CORD	Coordinate measurement	In the basic interface， enter the coordinate mode； In the other modes, move the cursor left or page up.
MENU	Menu key	Under the basic measurement interface， down to the menu interface. Under the other modes ,move the cursor right or page down
⏻	Power key	Power on/off
F1~F4	Soft Keys	The characters at the bottom line of the display indicate the meaning of the soft keys.
0~9	Number keys	Input numbers or characters or choose the menu
★	Star key	In any measurement interface, you can enter the star key interface .You can set the contrast, lighting compensator , parameters of distance measuring and file selecting .etc.
The side key	Enter	Receive and save the data input in the dialogue and end the dialogue. Save the current measurement data under

		the basic measurement interface.
ESC	Exit /quit	End the dialogue box without saving the input, and return to the previous step
◀▶	Left /right	change the option in the select box Data list page
▲▼	Up /down	Move the Cursor up and down in order. Turn the page under the basic measurement.
0～9	Number	Input number and characters and select one of menu. "0": Enter the electronic bubble interface under the basic measurement.
·～ -	Symbols	Enter symbols, decimals and signs; Enter the interface for input height.
The side key	Fast measurement key	This function is equal with it of the key [MSR1]. It works just in the measurement interface, and does not work in the others.

Symbols on the display

Symbols	Indication
Vz	Zenith Mode
Vo	The mode that the vertical is displayed as zero when the telescope is level in normal
Vh	Vertical angle Mode (it is 0°00′00″when the telescope is level. The angle of elevation is positive and the angle of depression is negative.)
V%	Slope Mode
HR	Horizontal angle (right angle). dHR means the angle difference of setting out.
HL	Horizontal angle (anticlockwise increment)
HD	Horizontal distance. dHD is to stake out horizontal

	distance difference.
VD	Elevation difference. dVD is to stake out difference between elevation differences.
SD	Slope distance. dSD is to stake out differences between slope distances.
N	Northing. dN is to stake out differences between north-coordinates.
E	Easting. dE is to stake out differences between East-coordinates.
Z	Elevation. dZ is to stake out differences between Z-coordinates
	EDM(Electronic Distance Measurement) is in progress.
m	Unit in meters (metric units)
ft	Units in feet
fi	Units in American feet
M	Units inMIL
X	The magnitude of which is along the baseline in a point projection measurement. The positive direction is from the starting point to the terminal.
Y	The magnitude of which deviates from the base line horizontally in a point projection measurement.
Z	Altitude of the target in a point projection measurement.
MdHD	Maximum error of evaluated distance

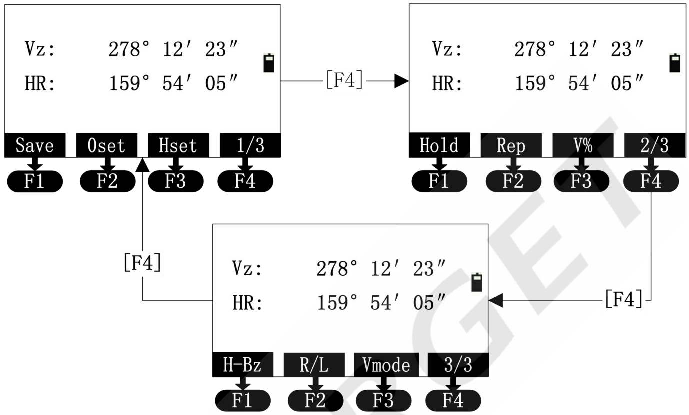
Reference functions of common soft key

Soft key reference	**Functions**
B.S	(Backspace)Delete one last character on the left of the inserter in the edited column.
Clear	Delete all typed in the edited column.
Enter	End up the input in the current edited column and the

	inserter goes to the next column. If there's only one or no edited column in the dialogue box, the soft key 'Enter' is also used to accept the input and exit the dialogue box.
Input	Go to Coordinate dialogue box and enter the coordinates with keyboard
M.Pt	Retrieval coordinates of points from measured file
K.Pt (Known)	call coordinates of points from coordinate file
Search	List the points in the current coordinate file to provide to select the number for you.
View	List out details of the current record
Info.	Displays the name, code and coordinate of the current station and back-sight station.
Settings	Set the height of the instrument and the target
STA	Enter coordinates of the station where instrument is placed.
BBS	Enter coordinates of the point where the target is.
Meas	Start rangefinders to measure distance
Save	Start rangefinders when being under the Coordinate and Distance mode. Then save the result of this measurement and name of point which is added by one automatically. The result cannot be saved when the compensator is over .(Tilt over)
Comp.	Display the inclination (tilt) of the vertical axis
Light	Turn on or off the backlight and the illuminating brightness of reticle (at the same time).
Para.	Set the atmospheric parameters, prism constant and signals.

2.3 Functional keys under the basic measurement mode

2.3.1 Angle mode (including three pages)

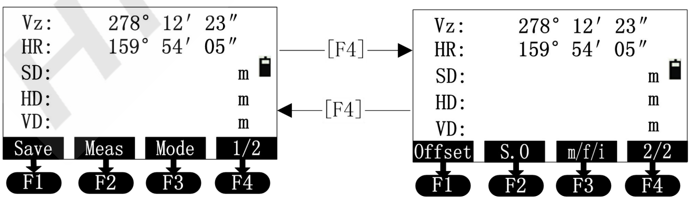


Page	Soft key	Reference	Function
1	F1	Save	Record the measured angle to the selected file.
	F2	0set	Set the horizontal angle as 0°
	F3	Hset	Set your desired horizontal angle by inputting ,but the angle should not be greater than 360°
	F4	1/2	Display the second page of the soft key functions
2	F1	Hold	Lock the horizontal angle readings.
	F2	Rep	Repeat to measure the horizontal angle

	F3	V%	Switch between Vertical angle and slop
	F4	2/3	Display the third page of the soft key functions
	F1	H-Bz	Set the beep on or off when the horizontal angle is 0°, 90°, 180°, 270°
	F2	R/L	Switch between HR (horizontal right/ clockwise) and HL (horizontal left/ anticlockwise) mode
	F3	VA	Vertical Angle Mode (altitude angle（Vh）, Zenith（Vz）
	F4	3/3	Display the first page of the soft key functions.

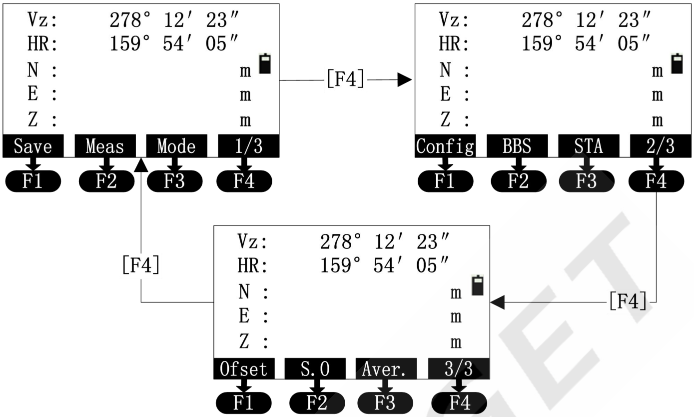
- The key [★] is used to set contrast, light, compensator, parameters of distance measurement and file selection. It can work under the basic modes.

2.3.2 Distance measurement mode



Page	Soft key	Reference	Function
1	F1	Save	Start distance measurement and record the measured data into the selected files (measurement file 'File(.MEA)' and coordinate file 'File(.COO)'are selected in surveying function or by star key).
	F2	Meas	Start Distance Mode
	F3	Mode	Switch between four distance measurement mode (single accurate measuring (sngl)/ repeated accurate measuring (rept)/ continue accurate measuring (cont)/ tracking (track))
	F4	P1/2	Display the second page of the soft key functions
2	F1	Offset	Start offset measurement (eccentric measurement)
	F2	Stake	Start staking out
	F3	m/f/i	Switch distance units between meters, feet, feet&inch.
	F4	2/2	Display the first page of the soft key functions

2.3.3 Coordinate measurement mode



Page	Soft key	Reference	Function
1	F1	Save	Start coordinate measurement and record the measured data into the selected files (measurement file 'File(.MEA)' or coordinate file 'File(.COO)' are selected in surveying menu or by star key.
	F2	Meas	Start coordinate measurement
	F3	Mode	Switch between four distance measurement mode [single accurate measurement (sngl)/ repeated accurate measuring (rept)/ continue measuring (cont)/ tracking (track)]
	F4	1/3	Display the second page of the soft key functions
	F1	Setting	Set target height and instrument height
	F2	BBS	Set coordinates of BBS (back-sight point) and back-sight angle

2	F3	STA	Set coordinates for station
	F4	P2/3	Display the third page of the soft key functions
3	F1	Ofset	Start offset measurement (eccentric measurement)
	F2	S.O	Stake out coordinates
	F3	Aver.	Set the times of average measurement
	F4	3/3	Display the first page of the soft key functions

2.3.4 Explanation of saving data

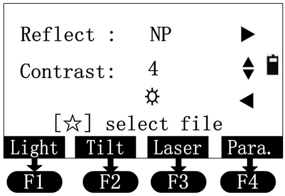
If you have never selected the measurement file and your first time to use the [Save] soft key, a dialogue box of ‘Select file’ would appear to the screen. Mention that this is a good chance for you to select all files that the instrument may use.

When finishing single measurement, a dialogue box asks you to save the measured point and you may rename and code the points or set target height. The key ‘ENT’ will save the coordinates into measurement files, and the key [★] save the coordinates in the measurement file and coordinate file at the same time (according to the mention of the display).

If you choose not to edit points, the points would be saved with the present name, elevation and code .After saving, the name of the point is added by one.

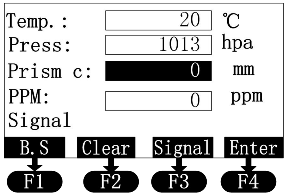
2.4 Star key [★] mode

On the measurement interfaces, pressing the key [★](star key) can lead to a page as shown below.



Settings from the star key(★) are as followed:

- Adjust contrast : press [▲] and [▼];
- Adjust background light of the screen : press [F4] to open the backlight ,then press [◀] to adjust light;
- Comp.: press [F2] to enter the display of electric bubble , then press [F2] to set the compensator on or off; pressing [◀] [▶] can adjust the light of laser plumb;
- Reflect: Press [▶] to set the reflector. The options of reflector are switched between Prism ,Non- prism(NP) and reflector board(RB);
- Laser: press [F3] to on or off the laser;
- Para.: Press the key [F4] to select ‘parameters’. You can set settings of prism const, PPM value and temperature and pressure, and view the signal. (The setting of the distance measurement. After you input the temperature and pressure, pressing [F1] can automatically calculate the value of PPM, if you are not satisfied with the value, you can input and save it). The interface of picture as shown below:


Temp.:
20
℃
Press:
1013
hpa
Prism c:
0
mm
PPM:
0
ppm
Signal
B.S
Clear
Signal
Enter
F1
F2
F3
F4

3. Initial setup

3.1 On & Off

Press the power key until the screen displays pictures. The instrument is now switched on.

After self-checking, the instrument enters Angle Mode automatically (see Angle Mode for details)

Pressing power key will leads to a dialogue box. Press [ENT] to turn off the instrument.

3.2 Set up the tilt correction of horizontal and vertical angles

When the tilt (inclination) sensor is on, the instrument will display the automatic correction value for the vertical angle caused by not strictly level. In order to ensure the accuracy of the angle measurement, try to use tilt sensor whose display can be used to level the instrument better.

If displaying ‘Tilt over!’ in the ‘Vz’ column, it indicates that the instrument beyond the range of the automatic compensation, and needs to be leveled by adjusting foot screw.

- Our series total station can correct the error of the vertical angle reading caused by the tilt on the direction of X axis and Y axis;
- Settings of compensator: On and Off
- When the instrument is under unstable condition or in a windy day , you should close the compensator ,because the vertical is unstable .Only this ,can avoid the compensator beyond the scope of work caused by the

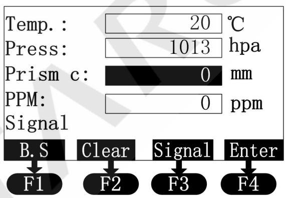
jitter and stop measuring .You can turn off the compensator by the using star key(★) functions.

3.3 Set up the target Type

Our series total station has three reflectors to be selected, which are prism, non-prism (NP) and reflect board (RB). You can set by job. You can set it by star key [★].

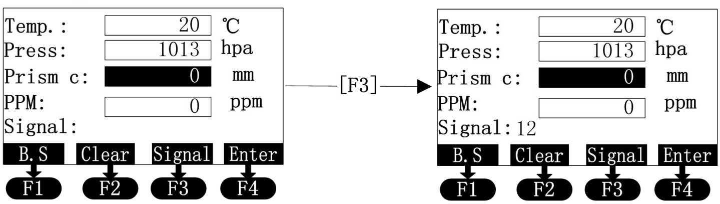
3.4 Set up the Reflecting Prism Constant.

As a prism is selected as a reflector, a prism constant should be set before any measurement. If the constant is entered and set, it is saved and will not be erased after switching off the instrument. After pressing [Para.] key under star key (★) mode, a dialogue box would appear as followed.



3.5 Signal

The function of signal is to display the intensity of signal of EDM (Electrical Distance Measurement). It can help achieve ideal aiming result under poor conditions. If it is too difficult to be found, using signal can easily aim at the target.



Continuing with the explained operation in 3.4, you may press [Signal] and the intensity of signal is displayed in the 'Signal' column above. The minimum measurable intensity should be 1. Being less than 1 indicates that the target cannot be aimed and measured. You can press any other keys to quit signal detection.

3.6 Set up the Atmospheric Correction

When measuring distance, the measured value will be influenced by the atmosphere. In order to reduce the influence, a atmospheric correction parameter is needed.

Temperature: the surrounding atmospheric temperature

Atmospheric pressure: the surrounding atmospheric pressure

PPM: the calculated and predicted atmospheric correction

The standard atmospheric value of our series Total Station (i.e. the atmospheric conditions when the correction is zero)

Atm: 1013 Pa

Temp:20℃

The calculation of atmospheric correction

$$\Delta S = 277.825 - 0.29434P/(1+0.003661T) \text{ (ppm)}$$

In the formula:

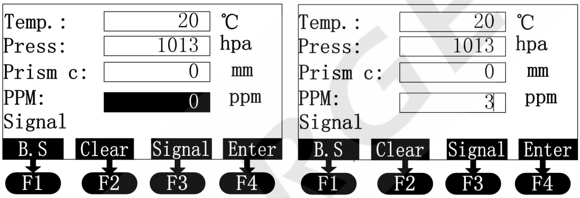
ΔS: correction coefficient (unit: ppm)

P: atmospheric pressure (unit: hPa)

T: temperature (unit: ℃)

3.6.1 Set up the Atmospheric Correction value (ppm) directly

You may measure the temperature and pressure to find out the atmospheric correction (ppm) through the correction formula or from the atmospheric correction chart. Continuing with the operations in 3.5, press soft key [Enter] to move inserter down to the ‘PPM’ column to enter the value.



3.6.2 Calculate the Atmospheric Correction out with temperature and pressure sensor

First, measure the temperature and pressure around the station in advance.

e.g. Temp: +25℃ atm:1017.5

Press soft key [Enter] to move inserter to the ‘Temp’ column and type in ‘25.0’;

Press soft key [Enter] to move inserter to the ‘Press’ column and type in ‘1017.5’;

Press soft key [Enter] to move the inserter to the [prism c] column;

(the‘PPM’ column now displays 3)

Press [ENT] to save the parameter. Our system will display ‘Record: ***(name of the point)’ and exit the dialogue box. The point is saved now.

3.7 The Correction of the Atmospheric refraction and the Earth Curvature

When measuring horizontal distance and elevation, our instrument corrects the atmospheric refraction and the earth curvature automatically.

The formulas of two corrections about our instrument are as followed:

Corrected Horizontal Distance :

$D=S\times[\cos\alpha+\sin\alpha\times S\times\cos\alpha(K-2) / 2Re]$

Corrected Elevation :

$H=S\times[\sin\alpha+\cos\alpha\times S\times\cos\alpha(1-K) / 2Re]$

If the Atmospheric Refraction and the earth curvature are not corrected, the formula for calculating horizontal distance and elevation are as followed:

$D=S\times\cos\alpha$

$H=S\times\sin\alpha$

In the formula:

K=0.14----------- Atmospheric refraction coefficient (can be selected according to actual)

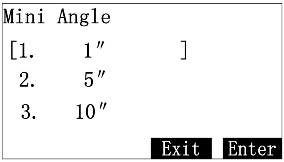
Re=6370 km---Radius of the earth curvature.

α(or β)-----------------The vertical angle (counted from the horizon)

S------------------Slope distance

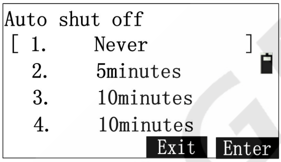
3.8 Set up the minimum reading of the angle

Refer to the operation “Menu→5.Options→3.Other options →1.Mini Angle”. The interface as shown in picture below:



3.9 Setup of Automatic Shutdown

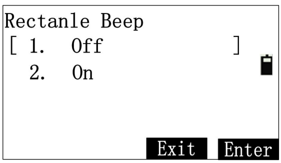
Refer to the operation “Menu→5.Options→3.Other options →2. Auto shut off” . The interface as shown in picture below:



You may choose ‘Never’ to cancel the auto shutdown. When choosing 5, 10, 20 minutes opts, the instrument will shut down automatically if there is no key pressed. Use the [▲] or [▼] keys to move indicator ‘[]’ up and down to the option wanted. Press soft key [Enter] or [ENT] to save the setting. Pressing [ESC] will result in no changes of settings.

3.10 Set rectangle beep

Refer to the operation “Menu→5.Options→3.Other options →2. Rectangle Beep”. The interface as shown in picture below:



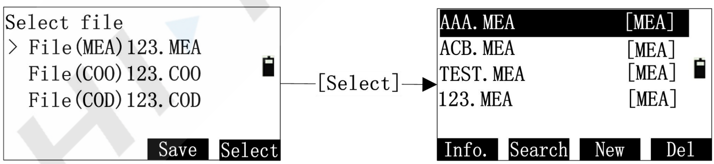
3.11 Set up the Addictive Constant and the Multiplying Constant

Refer to the operation “Menu → F4 → 2.Config → 1.Add const→2.Mul.const”.

The constants are already set through strict measurement when being sold. You don’t need to adjust the setting. You may alter the constant after strict measurement (e.g. in standardization site for baseline being measured by authenticated units).

3.12 Selecting Data File

The instrument needs large data and creates large data when it is operated. This data needs to be storied in the system files of the instrument as a file form. It’s a good habit that selecting the measuring working files before working. Refer to the chapter 9.12 or press [★] twice to select file. Under the interfaces which are ‘Setup STA’ (Menu→1.Surveying→2.Station) or ‘Setup BBS’ (Menu→1. Surveying→3.Setup BBS” or (Menu→2.Stake→3. Stake out).



Use [▲] or [▼] keys to move indicator ‘>’ to the wanted type of the file and press [ENT] soft key to enter the File list as shown above.

The file types are listed as below:

MEA= Measurement File, working for storing data.

COO= Coordinate File, used for retrieving coordinate.

COD= Code File, used for retrieving code.

LSH/LSV = Defined horizontal /vertical alignment file, working for staking out roadway.

4. Preparations before measurements

4.1 Unpacking and storing instruments

Unpacking

Lay down the box gently with the top side facing up. Open the lock and take out the instrument.

Storage

Cover the telescope cover. Make sure that the vertical clamping screw and the level bubble face upwards. Lay down the instrument into the box (with objective lens of the telescope facing downwards.). Tighten the vertical clamping screw gently and cover the box, then Lock the box.

4.2 Set up the instrument

Reference for operation:

Install the instrument onto the tripod gently, then level and center the instrument to ensure the accuracy of the measurement result.

4.2.1 Using plummets to center and level (align)

1) Set up the tripod

   ① Position tripod legs so that the plummet is aimed to the ground mark point. Turn the focusing ring of the optical plummet to focus;

   ② Make sure that the center of the tripod top is right above the station;

   ③ Stamp the tripod on the ground with your feet.

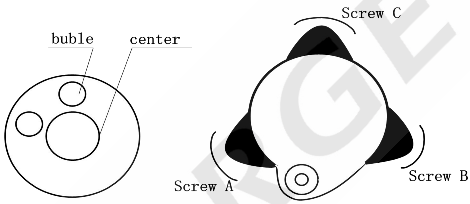
2) Install the instrument onto the tripod

   Mount the instrument on the tripod head. Support it with one hand, and tighten the centering screw on the bottom of the unit to make sure it is secured to the tripod.

3) Using the circular level to level the instrument coarsely

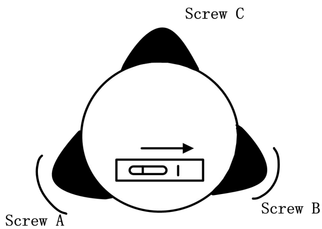
① Twist and adjust the two leveling screw A and B on the bottom of the instrument until the bubbles of the circular level moves to the line perpendicular to the center line the screw A and B;

② Twist and adjust leveling screw C to move the bubble to the center of the circular level.

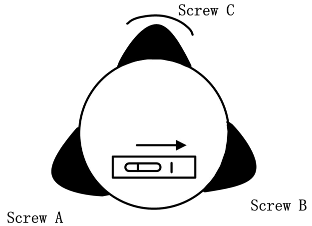


4) Using the plate level to level the instrument precisely

① Loosen the horizontal locking screw and turn the instrument around until the plate level is perpendicular 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;



② Turn the instrument approximately 90° and adjust screw C until the bubble in the center of the level;



③ Turn around the instrument 90°again. Repeat above steps until the bubble remains in the center of the plate level even though the instrument is rotated to any position.

4.2.2 Using centering device to center

1) Set up the tripod;
   ① Open the tripod. Make sure that the three feet of the tripod are approximately equal in distance from the center and that the top is leveled. Screw up the three locking screw;
   ② Make sure that the center of the tripod top is right above the station;
   ③ Stamp one foot on the ground with your feet.
2) Install the instrument gently on the top of the tripod and screw up the screw connection. Open the laser plummet through star (★) key to aim at the station precisely;
3) Using circular level to level the instrument coarsely;
4) Using tubular level to level the instrument precisely;
5) Precise centering and leveling;

According to the observation of center device, loose the connection screw slightly and shift the instrument horizontally (mention that do not turn around the instrument)until the instrument aims at the station precisely.

Repeat the steps above until the instrument aims at the station precisely.

4.3 Loading and unloading of battery

The information of the battery

--Full battery, operation is available.

--Just appearing this information which means the battery can support the instrument for another 4 hours.

--The battery is lower, and it’s better to replace.

--Measurement is impossible, and it’s necessary to replace and recharge battery.

Notes:

◆ The working time of battery will be effected by many factors, such as ambient temperature, recharging time, recharging and discharging times. For safety, we suggest you recharge the battery full or prepare several full batteries before operation.

◆ The battery symbol only indicates power capability for current measurement mode. The power consumption in distance measurement mode is more than in angle mode, if the instrument enters into distance measurement mode from angle mode, the power maybe auto-off because of lower battery.

Notes for loading/ unloading batteries:

▲You should switch off the instrument before unload the battery.

Notes for charging:

▲Though the charger is designed with overcharge protection circuit, one must unplug the charger after finished charging.

▲Suitable temperature range for charging is between -45℃

and +45℃. Charging process may be abnormal if being over the temperature range.

▲A battery can be recharged for 300-500 times.

▲A monthly recharging is required if the instrument is not used for a long time.

4.4 Reflecting Prism.

When measuring distance with prism mode, a reflecting prism must be set at the target site. You can connect the prism to the base, and then connect the base onto the tripod .you can also set the prism onto the centering rod. There are single-prism group and three prism group available on the market, so you can select them according to your requirements.

4.5 Loading and unloading of the pedestal

Unloading

Unload the base by loosening the locking screw on the base with a screw driver and anti-clockwise turn the screw around 180°.

Loading

Put the three fixed feet of the instrument into the corresponding holes to make the instrument on the base. Turn the clamping screw clockwise 180° to lock the instrument. Then tighten the screw with a screw driver.

4.6 Adjusting eyepiece lens of the telescope and aiming the target.

How to aim at targets?(only for reference)

1) Aim at the bright sky with the telescope and adjust the eyepiece to focus until a sharp image of the cross wire forms;

2) Aim at the target with the cross center in the coarse sighting device on the top of the lens. Your eyes should keep a proper distance (about 200mm) away from the sighting device;

3) Obtain a sharp image of the target on the reticule with the focusing screw. If optical parallax appears when angle of view changed, the focus or the diopter of the eyepiece may be unadjusted. For precision concerns, please adjust the eyepiece focus to eliminate the optical parallax carefully.

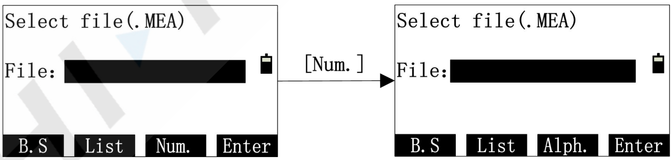
4.7 Entering letters and numbers

This series total station has been equipped the key [Mode], which can be convenient to switch the input mode between letters and numbers.

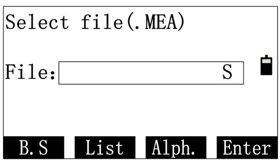
● Input letters

Example 1: Take inputting file name in the surveying mode for example, which needs to input "SUN1A" in the edit box

1) Press [Num.] to switch to the mode of inputting letters.



2) Press [1], then, "S" displays in the edit box;

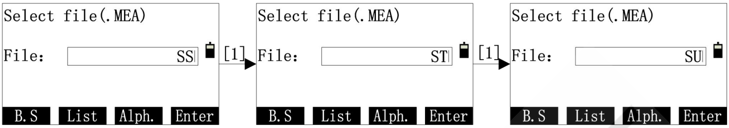


3) Wait 0.4 seconds,

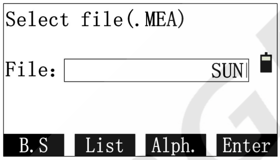
4) then press [1] again, “SS”displays in the edit box;

5) Press [1] again, “ST”displays in the edit box;

6) The interval of pressing the key [1] twice is not over 0.4 seconds .If over, you can press [▲] or [▼] to correct it;



7) Press [5] , “SUN” displays in the edit box;

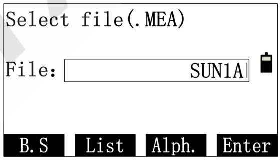


8) Pressing [Alph.] to switch to [Num.];

9) Press [1];

10) Pressing [Num.] to switch to [Alph.];

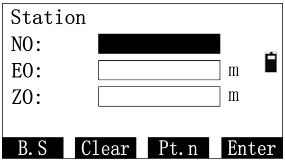
11) press [7],as shown below:



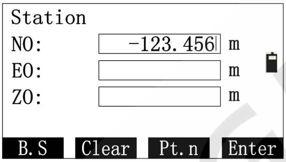
● Input numbers

Example 2: Take Inputting the station in the surying mode for example, which needs to input “-123.456” in the edit box.

1) Because the edit box “NO” can’t be letter, the inputting mode will default to “Alph.”, and can’t be switched to “Num.”. The interface is as follows;



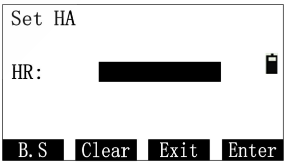
2) The order of the keys:[-]→[1]→[2]→[3]→[.]→[4]→[5] →[6] ;
3) The result is shown below:



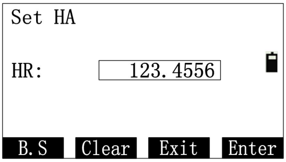
4) Of cause, you can input "-" finally to complete the input;
5) After completing the input, press [ENT] to record the input and end the edit box;

● Input angles

Example 3: Enter the "Set HA" interface, which needs to input "123°45′56" in the edit box of "HR".



1) The order of the keys:[1]→[2] → [3] → [·]→[4]→[5]→[5]→[6];
2) The result is as shown below:



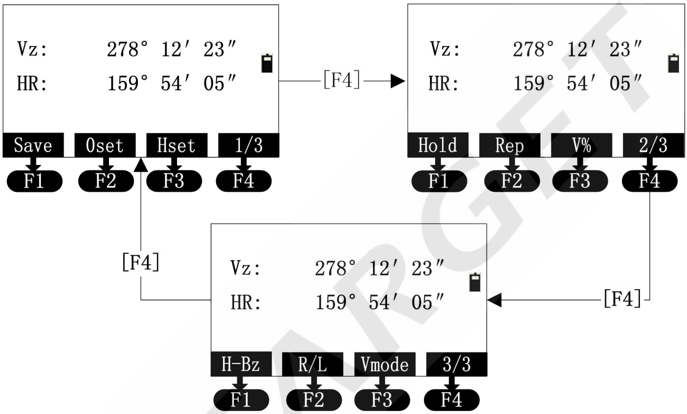
3) After completing the input, press [F4] to confirm the input or press [ESC] to cancel it. If it is over “360°”, a prompt box will appear “Overtop!”.

4.9 Notice for using U disk

When running the program, don’t insert or pull out the U disk. If you pull out the U disk when the instrument checking it, the subsequent operations may cause error!

5. Angle mode

The instrument would enter the Angle Mode automatically after switched on. You can also enter this Mode by pressing [ANG] under basic measurement mode. This Mode involves three pages switched by the key [F4]. Their functions are explained as followed:



5.1 Save

Function: Save the current angle to selected measured file.

- After press [F1], the interface of "Information" appears (if you haven't select measured file, there will be a interface of "Select file (.MEA)" to let you select file.), which needs you the point name (Pt.N) ,Code and target height (T.H). The number of "Pt.N" defaults to added 1. The code is input according to your need, but the target height according to actual situation. You can press [ENT] to save data to measured file.

When the compensation value is over, the instrument tips "Tilt over!", and the angle data can't be saved.

- The number of point name in the system is added 1 automatically. If you want to modify point mane, code, and target height, just press [Num.] or [Alph.], if don't just press [ENT] to save.
- The system saves the record with a prompt "Finished", which disappears automatically after 0.5 seconds.

5.2 0set

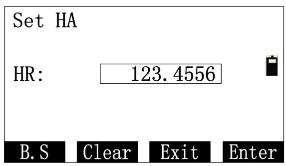
Function: set the horizontal angle as 0 °00′00″.

- Press [F2](0set);
- Asking "Set 0?", press [ENT] to set 0 or [ESC] to exit this operation. In order to make sure the accuracy, you may press [ENT] lightly.

5.3 Hset

Function: Set the horizontal angle as wanted angle.

- Press [F3] to enter the interface of "Set HA" to set horizontal angle ;
- In the "DMS" of angle unit mode, if you want to input "123°45′56″", just input "123.4556" in the input box. In the other angle unit mode , input normally, as shown in picture below:

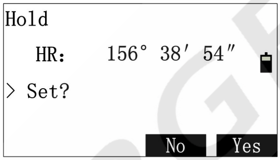


- Press [ENT] to confirm the input, or [ESC] TO to cancel. When over 360°, it will tip "Overtop!"

5.4 Hold

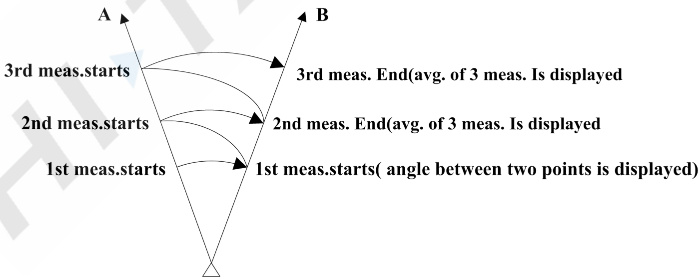
Function: Another method to set horizontal angle.

- Turn around the alidade to the wanted horizontal angle and press soft key [Hold], the turn around the alidade a and the readout of horizontal angle is 'hold' and not changing with turning the alidade again, the horizontal angle remain the same.
- After turning the alidade to aim at the target, press the key [F1] to set horizontal angle at a new position.

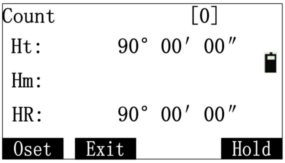


5.5 Angle by repetition

Function: Under right horizontal angle mode, you can measure angle repeatedly.



- Enter the interface of angleoby repetition

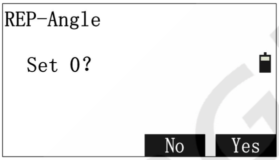


Count: The times of the measurement;

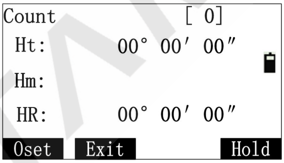
Ht: The sum of angle;

Hm: The average value of angle

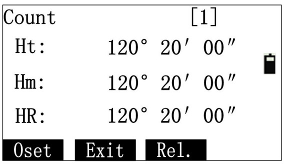
- Aim at point 'A', then press [F1] (0 set);



- Press [F4](Yes);



- Aim at point 'B' by horizontal motion and tangent screw



- Aim at point 'A' again by horizontal motion and tangent screw and press [F3](Rel.);

```
Count                [ 1]
 Ht:        120°  20′  00″
 Hm:        120°  20′  00″
 HR:        120°  09′  30″
 Oset   Exit            Hold
```

- Aim at point ‘B’ again by horizontal motion and tangent screw and press [F3](Hold);

```
Count                [ 2]
 Ht:        240°  40′  00″
 Hm:        120°  20′  00″
 HR:        120°  18′  00″
 Oset   Exit   Rel.
```

- Repeat the steps above until the measurement times wanted;
- If want to exit this function ,just press [F2](Exit),then press [F4](Yes) to return the basic measurement**;**
- **Notice: if the angle value compared with the fist measured is over ±30″, the error massage will appear.**

5.6 Slope (V%)

Function: vertical angle switched with slope (V%).

Every time you press [F3] (V%),the display mode of vertical angle will be switched each other. When the slop is over 45°， it will tip “Over! ”(Over measurement range).

5.7 H-Bz

When horizontal angle is in the range of 0°(90°,180° or 270°) ± 4′30″, the buzzer will beep.

5.8 L/R

Press [F2] to make the horizontal angle mode switched between right angle (HR) and left angle (HL).

HR: Right angle mode .When the alidade is rotated clockwise, the horizon angle is increscent;

HL: Left angle mode. When the alidade is rotated anticlockwise, the horizon angle is decreasing.

5.9 V mode

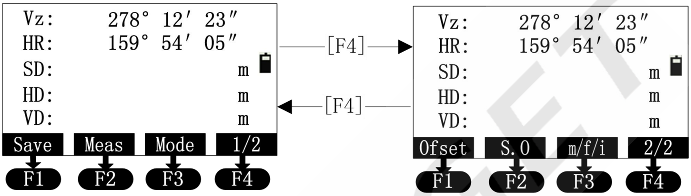
- Vz: Zenith Mode;
- Vh:Vertical angle Mode (it is 0°00′00″when the telescope is level. The angle of elevation is positive and the angle of depression is negative.)

Other instructions:

- If the compensator is over the range of ±210″, then the vertical angle display box will tip you “Over!”;
- When setting horizontal angle, which is azimuth of target point, so you can set the displayed angle as azimuth.

6. Distance mode

Press [DIST] to enter the distance measurement mode, which has two interfaces . The functions of first interface are "Save", "Meas." and "Mode"; The functions of the second interface are "Ofset", "S.O" and "m/f/i". The two interfaces shown as below:



6.1 Save

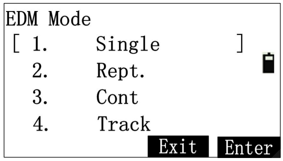
- After press [F1], the interface of "Information" appears (if you haven't select measured file, there will be a interface of "Select file (.MEA)" to let you select file.), which needs you the point name (Pt.N) ,Code and target height (T.H). The number of "Pt.N" defaults to added 1. The code is input according to your need, but the target height according to actual situation. You can press [ENT] to save data to measured file.
- When the compensation value is over, the instrument tips "Tilt over!", and the angle data can't be saved.

6.2 Meas.

Measure distance and display slop distance, horizontal distance, and elevation difference. Under the "cont" and " track", you can press [ESC] to stop measuring.

6.3 Mode

This function is used for the work mode of EDM. These modes are “Single”, “Rept”, “Cont”, “Track”.



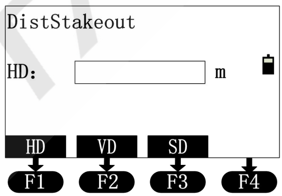
Press [▲] or [▼] to move the “[]” the wanted option , then press [ENT] to save.

6.4 Offset

Press [Ofset] to enter the interface of offset (will described in the offset function).

6.5 Stake out (S.O)

Enter the distance stakeout function



The keys [F1]->[F3] is to select the stakeout mode. After select the mode, input distance (HD), then press [Enter] to enter the distance stakeout mode, and you can press [F2] to get the result of stakeout.

dsd : is to stake out differences between slope distances measured and it expected . A positive result indicates that the measured slope distance is great than the expectation value. The lens should be shifted to the instrument.

dhd: is to stake out the difference between horizontal distance measured and it expected . A positive result indicates that the measured horizontal distance is greater than the expectation value. The lens should be moved to the instrument.

dvd: is to stake out the difference between elevation difference measured and it expected. A positive result indicates that the measured elevation difference is greater than the expectation value. The lens should be moved downwards (excavation).

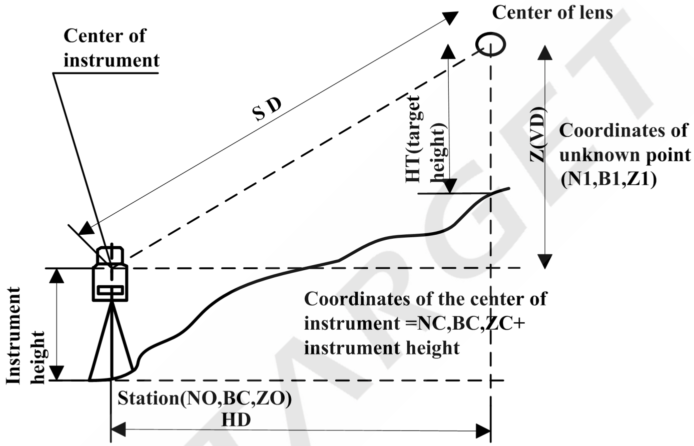
Every time finishing the stakeout, press [F4] to enter the second page , and you can press [F2] to continue staking out or press [DIST] to return to the distance measurement mode.

m/f/i: switch the units of the distance displayed between “meter”, “ feet”, “feet .inch”.

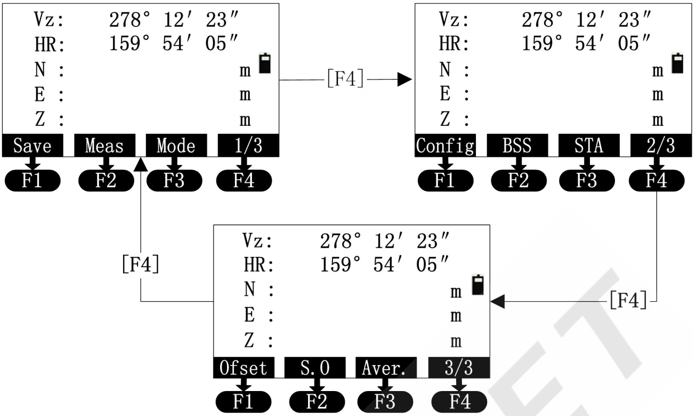
Other instructions: “ ” is the current distance measurement mode. Among them, the “ ” indicates measuring with prism, and the “ ”indicates measuring without prism.

7. Coordinate mode

Press [CORD] to enter the coordinate measurement mode. According to the diagram below, please set up the coordinates station, azimuth, target height and instrument height before coordinate measurement.

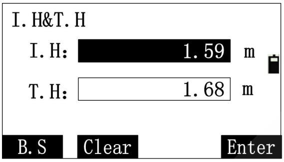


There are three interfaces, which can be switched each other by pressing [F4].The functions of the first interface are “Save”, “Meas”, “Mode”; The functions of the second interface are “Config”, “BBS”, “STA”; The functions of the third interface are “Ofset”, “S.O”, “Aver.”. as shown in picture belown



- **Save:**After press [F1], the interface of "Information" appears (if you haven't select measured file, there will be a interface of "Select file (.MEA)" to let you select file.), which needs you the point name (Pt.N) ,Code and target height (T.H). The number of "Pt.N" defaults to added 1. The code is input according to your need, but the target height according to actual situation. You can press [ENT] to save data to measured file.
  When the compensation value is over, the instrument tips "Tilt over!", and the angle data can't be saved.
- **Meas:** Press [F2] to start rangefinder. The instrument will calculates and display the result. If the measurement mode is "Cont" or "Track", you can press [ESC] to stop measuring or press [ANG] of [DIST] to switch to angle or distance mode with the measuring stopped automatically.
- **Mode:** It is same as distance mode.
- **Config:** On the second interface, press [F1] to enter the interface of inputting instrument height and target height. After input the height, press [ENT] to receive

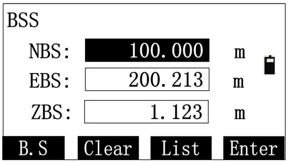
them, or [ESC] to exit the input interface. If you want to view instrument and target height, just refer to this operation. The input interface is as shown below:



The range of instrument height and target height is “±999.999”. If the input value is over, the instrument tips “Overtop!”.

If you want the input value is worked when turn on the instrument next time, just press [ENT] or [Enter] to save them into the system file.

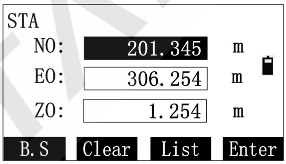
- **BSS:** In the second interface , press [F2] to enter the interface of input the coordinates of backsight (as shown in picture below).Setting up “BBS” is to establish the relationship between the earth coordinate and x coordinate of instrument (being used together with “ STA” Function). After setting the “BSS” and pressing ‘ENT’,you need to aim at backsight point. After pressing [ENT], the instrument will calculate the azimuth angle of the backsight point, which is displayed in the HA (horizontal angle) column. The coordinate of the instrument is now related to that of the earth station, which is called as ‘set station’).In order to avoid repeated operation, please first operate the function of ‘STA’ (‘Station’) then set the BBS and orient. When orientation, please aim at the BS (target) precisely. Orientation can be done with [0set], [Hset] and [Hold] under Angle Mode. If the orientation is already done under Angle Mode, you don’t need to set BBS again under Coordinate Mode.



There are two way to get backsight coordinates, which are inputting by keyboard and retrieving from files;

If you select inputting, just input by keyboard. If you press [List] and remember the point name, using [List] is best choice. If you don’t remember the name, just press [Search] to search the point. And you can press [ESC] to back to “BSS” interface.

- **STA:**In the second interface ,press [F3] to enter the interface of inputting station. Input station point name, coordinates and instrument height**;**



Refer to the input of backsight

- **Ofset:** In the third interface, press [F1] to enter the offset function. Offset function is designed to obtain the coordinate of measured point when prism cannot be place at the measured point or when distance measuring cannot be done. Offset function includes “Offset(Angle)”, “Offset(Dist1)”, “Offset(Dist2)”, “Offset(Plane)”, “Offset(Column)”. See reference in Chapter 8. Offset Mode;
- **S.O:** In the third interface, press [F2] to enter the

staking-out function. With this function, you may put designed data onto earth points. See reference in “9.2 Staking out”;

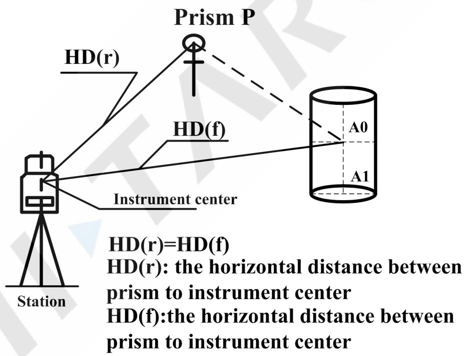
- **Aver.:** In the third interface, press [F3] to set the times of measurement.

8. Offset mode

It includes five functions which are “Offset(Angle)”, “Offset(Dist1)”,“Offset(Dist2)”,“Offset(Plane)”,“Offset(Column)”. These functions help for coordinate measurement, and can get the coordinates of the point which the prism can’t be at. Before operating these functions, please set ‘STA’, orientation, instrument height and target height.

8.1 Offset (Angle)

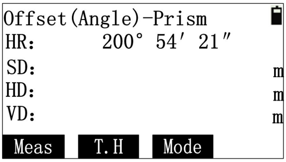
This mode is specifically useful when setting up prism difficultly, e.g. in the center of a tree. Set up the prism at the point ‘P’ which is the same horizontal distance away from the instrument .The diagram for angle offset is as followed.



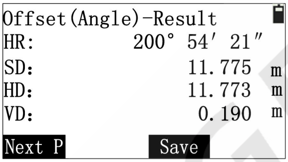
When measuring the coordinate of the earth point‘A1’ which is the projection of ‘AO’, set up the height of instrument and the height of target.

When measuring the coordinate of ‘AO’, set up the height of instrument only (and the height of target should be set to 0).

In the menu of “Offset”, select “1. Offset (Angle)” to enter the interface of “Offset (angle)-Prism”:



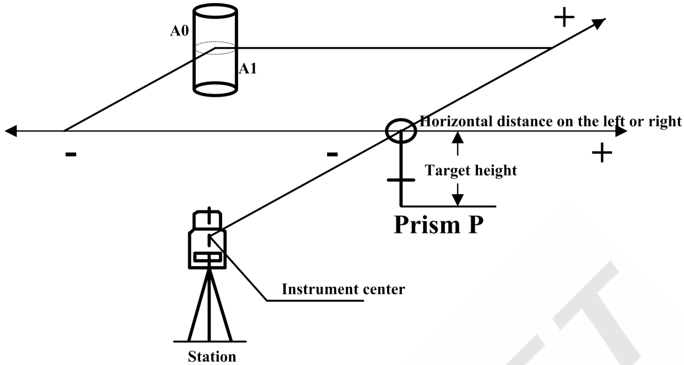
If you want to re-input the target height, press [T.H] to re-input. Press [Meas] to start measurement. After measuring, press [Enter] to enter the interface of "Offset (angle)-Result":



Then, aim at offset point, you can get its coordinates. Pressing [Next P] to measure next point; press [Save] to save the coordinates of offset point; press [ESC] to exit.

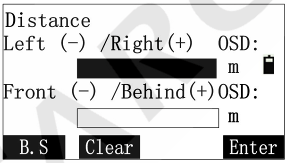
8.2 Offset (Dist1)

If have already known the front &behind and left & right offset along the direction of observation which from measured point 'A0' to target point 'A1' , you may measure the coordinate of A0 through distance offset.

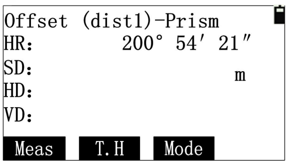


The diagram of angle offset

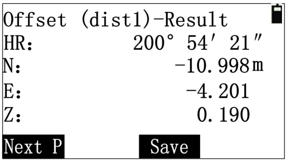
In the menu of “Offset”, select “2. Offset (Dist1)” to enter the interface of “Distance”:



The relation between “+” and “-” is referred to the diagram of angle offset. After input the known distance, press [ENT] to enter the interface of “Offset (dist1)-Prism” :



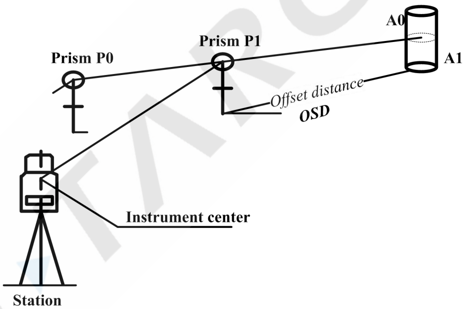
After measuring, press [Enter] to enter the result interface:



Display the coordinates or offset point. Pressing [Next P] to measure next point; press [Save] to save the coordinates of offset point; press [ESC] to exit.

8.3 Offset (Dist2)

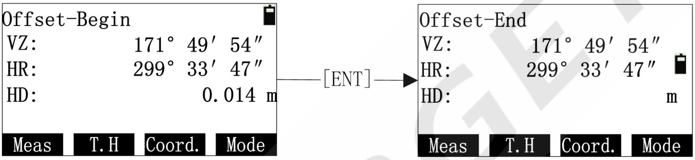
It is specifically useful when the measured point is exactly on the line of the two measurable points, as well as the distance between measured point and the two measuring point is known.



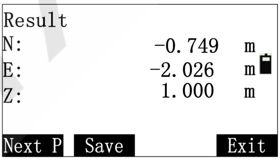
Firstly, input the offset distance. If the directions of “P1-A0” and “P0-P1” are same, the distance value is positive, otherwise it is negative.

In the menu of “Offset”, select “3. Offset (Dist2)” to enter the interface of “Offset (Dist2)”:

Input the distance, and press [Enter] to enter the interface of "Offset -Begin". You must aim at point "P0" to measure.After measuring, press [ENT] to exit the interface to enter the interface of "Offset-End".



Aim at the end point, and press [ENT] after measuring. The coordinates of measured points are displayed, as shown in picture below:



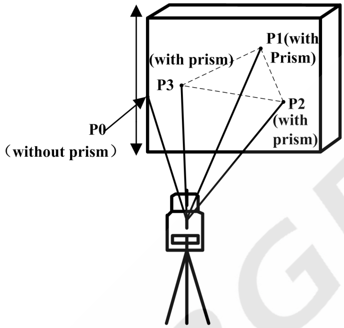
◆If you need the coordinate of 'A0' ,you should set the height of prism as zero.

◆ If you need the coordinate of 'A1' ,you should set the height of prism as the real height.

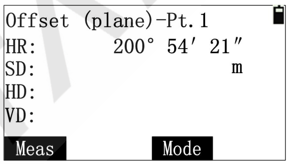
8.4 Offset (Plane)

This function is used to measure the point which can't be measured directly, such as the point on the edge of the plane.

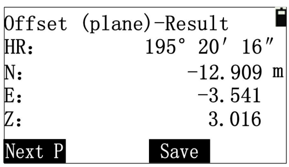
Firstly, you should measure any three points (P1, P2, P3) to define the measured plane. Then, you can aim at the measuring point ‘P0’, and the instrument will calculate and display the coordinate of intersection of the defined plane and the collimation axis. i.e the coordinate of “P0”. **Mention that the target height under this mode must be zero.**



In the menu of “Offset”, select “4. Offset (Plane)” to enter the interface of “Offset –Pt.1”:



Press [Meas] to measure point 1, and press [Enter] to receive the measured data and enter to the interface of “Offset (plane)-Pt.2”. Refer to the operation of measuring point 1 to get the data of point 2 and point 3 to enter the interface of “Offset (plane-Result)”;



Now turn around the alidade to aim at the offset point. Mention that the offset point must be on the defined plane but not below the prism bar, otherwise the result will not be correct. The value of coordinate is being refreshed in process of aiming.

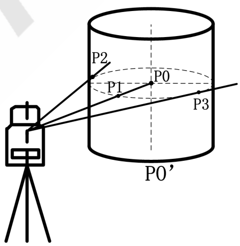
Press [Next P] to enter the offset measurement of next point and press [Save] to record the result.

Finally, press key ‘ESC’ to quit the Plane Offset measurement.

8.5 Offset (Column)

Firstly, you should measure the azimuth angle and coordinate of ‘P1’ on the cylinder under this mode. Then calculate the horizontal distance, azimuth angle and coordinate of the cylinder by measuring the surface points of tangency P2 and P3.

The average value of P2 and P3 is the azimuth angle of the cylinder.



In the menu of “Offset”, select “5. Offset (Column)” to enter the interface of “Offset (Column) –Prism”:

```
Offset (Column)-Prism
HR:       181° 14′ 01″
SD:                      m
HD:
VD:
Meas   T.H   Mode
```

After measuring→

```
Offset (Column)-Prism
HR:          181°  14′ 01″
SD:                4.570  m
HD:                4.575
VD:                1.004
Meas   T.H   Mode
```

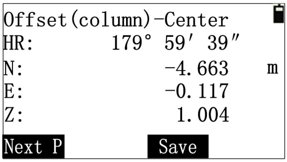
If you want to point ‘P0’, please input its height as zero before measuring it. If you want to measure “P0’”, input the real height value, then press [Meas] to start measure. After measuring, press [Enter] to receive the measured data and enter the interface of “Offset (Column) –L.edge”:

```
Offset (Column)-L.edge
HR:          181°  14′ 01″
SD:                4.570  m
HD:                4.575
VD:                1.004
                     Enter
```

Press [Enter] →

```
Offset (Column)-R.edge
HR:          181°  26′ 16″
SD:                4.570  m
HD:                4.575
VD:                1.004
                     Enter
```

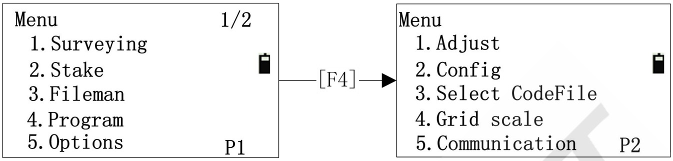
After aim at the left edge, press [Enter] to enter the interface of “Offset (column)-L.edge”. After aim at the right edge, press [Enter] to enter the interface of “Offset (column)-Center”, as shown in picture below:



Press [Next P] to enter the next offset, measurement. Press [Save] to exit.

9. Menu

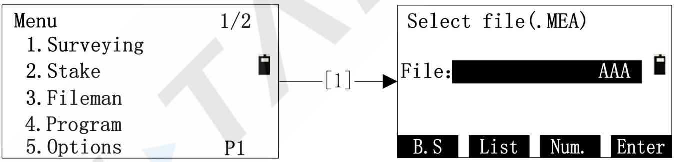
In the basic measurement interface, press [MENU] to enter the menu interface, then, press [F4] to enter the next page.



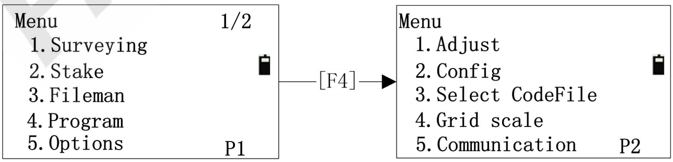
On the every page of menu, you can press number key to select. For example, if you press [1], the first option "1.Surveying" will be done.

9.1 Surveying

Operation: press [MENU] to enter the first page of menu, then press [1](Surveying):



Press [F4] to enter the interface of "Surveying", then press [F4] to turn to the second page.



9.1.1 Operation

1) Select file for surveying to save the surveying data;

2) Select coordinate file for retrieving data and saving the surveyed data;
3) Set station including name, coordinate and instrument height;
4) Set backsight by measuring backsight or azimuth angle.
5) Set the target height of measured point and start to survey and save data.

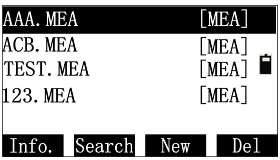
9.1.2 Preparation

9.1.2.1 File selection for surveying

Firstly, you must select a file for surveying. When staring surveying, it appears a dialog for select file.

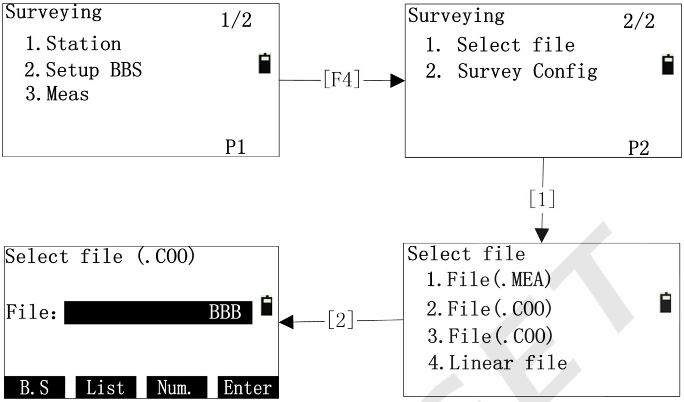
Press [F2] (List) to enter the interface of “Select disk”. If you have inserted the Udisk, it would be displayed.

After selecting a disk, press [ENT] to enter the interface of file list. You can press “[F1]~[F4]” to create , view , search, and delete file.



9.1.2.2 Select coordinate file

The data surveyed can be transferred storable data into the specified file. The coordinate file selection is as below:



Refer to "9.1.2.1 File selection for surveying".

9.1.3 Station and backsight

The station and orientation of backsight point in the surveying mode and coordinate measurement mode is common. You can input or change the station point or orientation angle.

The two methods of setting station are as followed:

1) Set station by using the data in memory;
2) Input directly by keyboard;

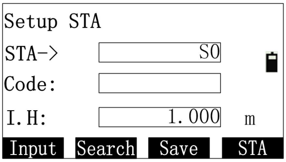
Three methods of the orientation angle of backsight point are followed:

1) Set backsight point by coordinate in memory;
2) Input the coordinate of backsight point directly;
3) Input the orientation angle directly;

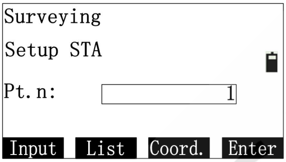
9.1.3.1 Example for set station

The operations of set station by using the data in memory:

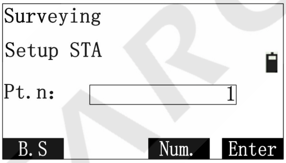
1) Enter the interface of "Set STA" with original data displayed;



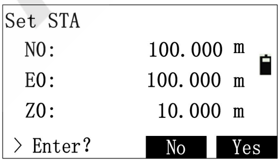
2) Press the key [F4](STA);



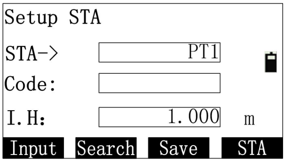
3) Press [F1](Input);



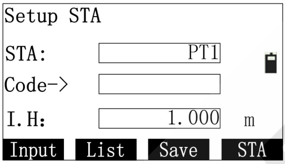
4) Input point name, and press [F4];



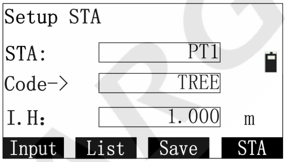
5) The system checks the current coordinate file,if checks it ,then display the coordinates and you can press [F4] (Yes) to confirm the coordinates of station and exit to the interface of “Setup STA”;



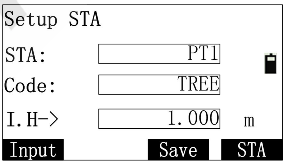
6) Press [▼] to move the "->" to "Code" column;



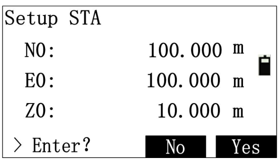
7) Press [F1] to input code , then press [F4] to confirm it;



8) Move the "->" to "I.H" column , then input the instrument height and press [F4] [Enter];



9) Press [F3] (Save) with the station coordinates displayed;



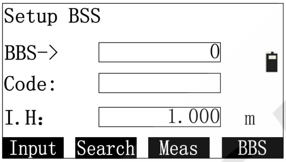
10) Press [F4](Yes) to finish setting station;

9.1.3.2 Example for setting angle

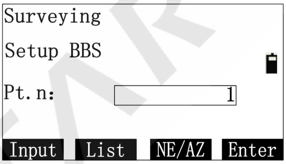
The azimuth angle must be confirmed by measuring.

You can save the data of orientation angle of backsight point by the following method.

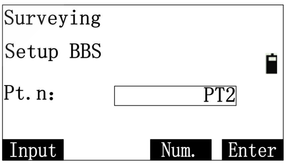
1) Enter the interface of “BBS”;



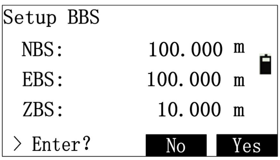
2) The screen displays the data set last time. You can press [F4] (BBS);



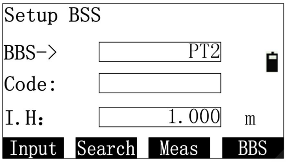
3) Press [F1](Input);



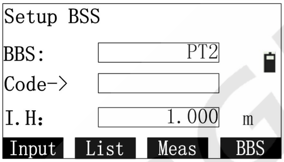
4) Input point name, press [F4];



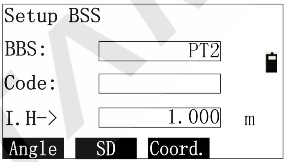
5) The system checks the current coordinate file, if checks it ,then display the coordinates and you can press [F4];



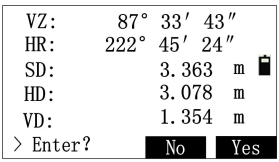
6) Input “Code” and target height “T.H”;



7) Press [F3](Meas);



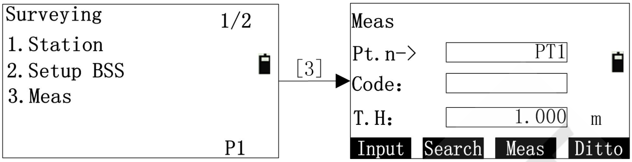
8) Aim at the backsight point, and select a key of measurement mode. For example: press [F2](SD), then measure the backsight point;



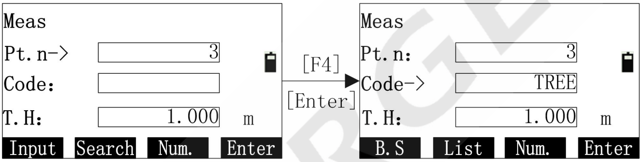
9) Press [F4] (Yes) to finish setting backsight point. The current settings will be saved in the measurement file;

9.1.4Measurement

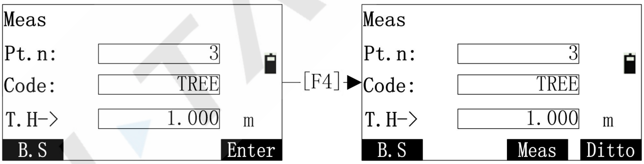
1) In the first page of surveying, press [3] to enter the interface of "Meas";



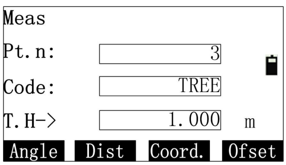
2) Press [F1](Input) to input the measurement point name ,then press [Enter] to input code;



3) Input target height (I.H) ,then press [Enter];



4) Press [F3](Meas), here,there are four methods for you to select, which are "Angle", "Dist" , "Coord.", "Ofset", as shown in picture below:



5) Aim at the target height, press one of the key "[F1]~[F3]".

For example, press [F2](Dist) to start measuring;

```
 VZ:      90° 12′ 22″
 HR:     200° 54′ 24″
 SD:         [Sgnl]<<  m
 HD:                   m
 VD:                   m
>Measuring...
```

6) After finishing measuring, press [F4](Yes) with data saved;

```
 VZ:      90° 12′ 22″
 HR:     200° 54′ 24″
 SD:          17.245  m
 HD:          17.125  m
 VD:          -1.523  m
>Enter?        No   Yes
```

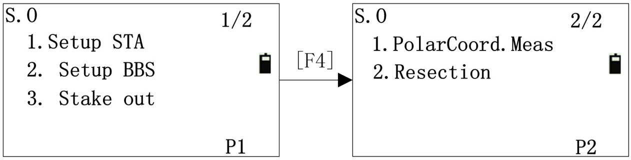
7) The point name will be added one, and you can measure next point. You can input name ,code and target height as the same way and measure as the same way of last point by pressing [F4](Ditto) or you can press [F3] to select the measurement methods;
8) Finishing measurement, the data will be saved and youcan press [ESC] to exit.

9.2Staking out

Staking out is to find the earth point for the designing point. The required process of staking out is as followed:

1) You may select files for staking out .The files can call the coordinates of station(STA),backsight(BBS) and the stakeout point etc.
2) Setup station(STA).
3) Setup backsight(BBS) to determine azimuth angle.
4) Input the coordinates of stake-out point, then start to stake out.

The Menu of staking out is as followed:



The ‘Setup STA’ and ‘Setup BBS’ are the preparation work for staking out. If you have already setup them, re-setting them are not necessary.

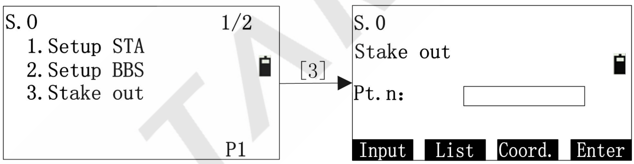
9.2.1 Staking out points

Two methods for staking out to be selected:

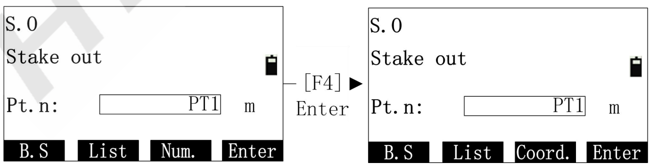
1) Retrieve the coordinates in the memory by point nane;
2) Input coordinates directly.

Example for retrieving coordinates to stake out

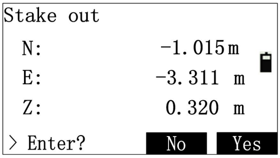
1) In the first page of staking out, press [3] (Stake out);



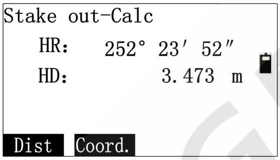
2) Press [F1] (Input) to input point name (Pt.n), then press [Enter];



3) Press [F4](Enter), if system finds this point, the coordinates of this point will be displayed, then you can press [F4](Yes);



4) Input the target height;
5) After setting the stake-out point, you can start to stake out.

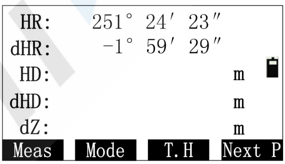


HR:The calculated angle of tak-outpoint

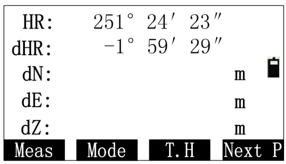
HD: the calculated distance from instrument to stake-out point;

Aim at the prism center, then press [F1](Dist) (or [F2](Coord.))

6) The rotation angle of the alidade will be calculated by the instrument;



[Dist]



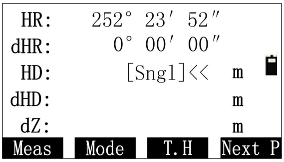
[Coord.]

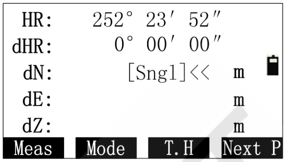
HR: measured angle

dHR: the rotation angle (when the instrument aiming at stake-out point)

When “dHR=0°00′00″”, it means you haves found the direction pf stake-out point.

7) Rotate the instrument to make the “dHR” as about 0°, then lock the horizontal motion screw and use horizontal tangent screw to make the “dHR” as “0°00′00″”. Finally, press[F1] (Meas);





[Dist] [Coord.]

HD: Measured distance

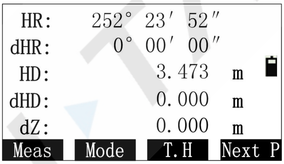
dHD: Distance difference when aiming at stake-out point

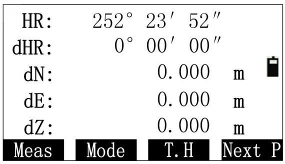
dN: measured coordinate(N)- coordinate (N) stake-out

dE: measured coordinate(E)- coordinate (E) stake-out

dZ: measured coordinate(Z)- coordinate (Z) stake-out

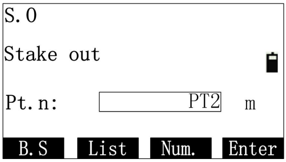
8) When the values of “dHR”, “dHD” and “dZ”(dN, dE, dZ) are zero, the staking out is completed;





[Dist] [Coord.]

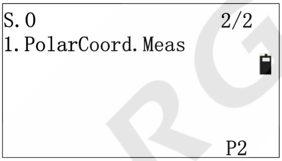
9) Press [F4] (Next P) to enter the next point stake-out. Then, the last stake-out point will be displayed. If the last point name is number, then the next point name will be added 1.



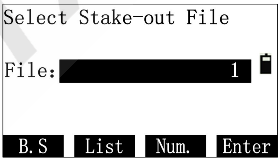
9.2.2 Polar coordinates

Set up the instrument on the known point, and use polar coordinate to measure the new point.

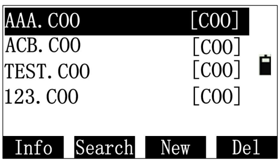
1) Enter the second interface of staking out, press [1](PolarCoord.Meas);



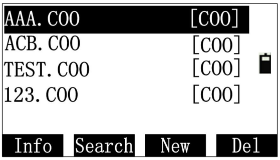
2) Enter the interface of “Select Stake-out File”,and press [F2](List);



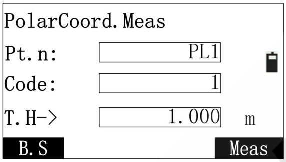
3) Press [▲] or [▼] to select a file;



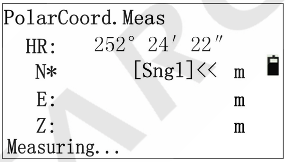
4) Press [ENT] to confirm the selected file;



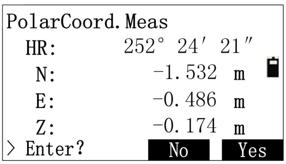
5) Input the new point name, code and target height;



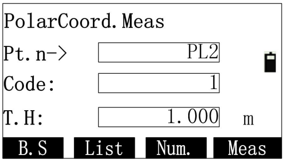
6) Aim at mew point, and press [F4] (Meas) to start measurement;



7) After measuring, the measured coordinates is displayed. You can press [F4](Yes) to save the measured value, and the point name will be added 1;



[Yes] →



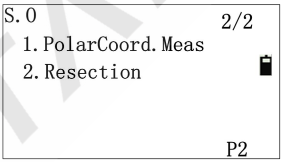
9.2.3 Resection

Set up instrument on a new point, and measure at most 5 known points to calculate the coordinates of this new point, the measurement of resection is as following:

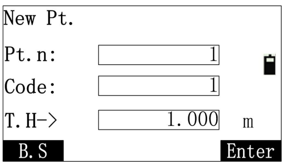
●Resection by distance measurement：Measure at least two known points.

●Resection by angle measurement：Measure at least three known points.

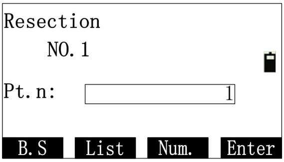
1) Enter the second interface of staking out and press [F2](Resection);



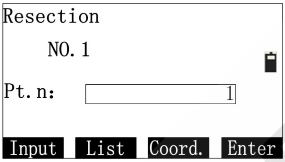
2) Input the new point name (Pt.n),code and target height (I.H);



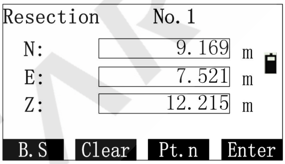
3) Press [F1](Input) to input point "1"(Here, you can retrieve points) and press [F4];



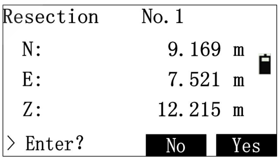
[Enter]→



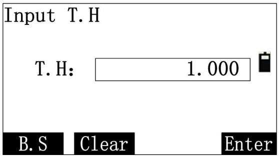
4) If the point doesn't exist in this file, tips "None Pt.n". You can press [F3](Coord.) to input coordinates, then press [F4] to confirm;



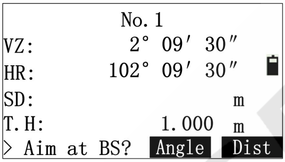
[Enter]→



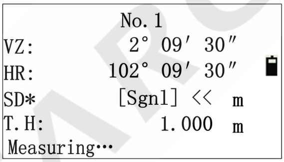
5) Press [F4](Yes) to enter the interface of "Input T.H". After input the target height (T.H) , press [F4];



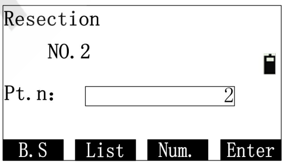
6) Aim at the known point 1, press [F3](Angle) or [F4](Dist). Press [F4](Dist) for example;



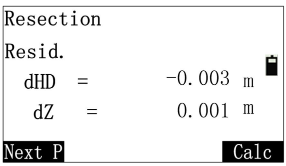
7) Start measuring;



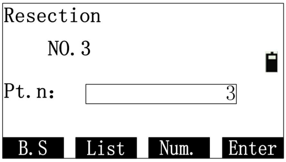
8) Enter the input interface of point 2 ;



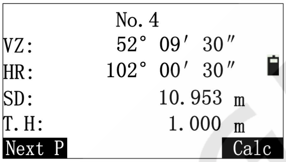
9) According to step 5)~step 8), when using [Dist] to measure, the residual will be calculated.



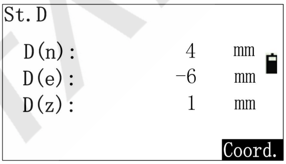
10) Press [F1] to measure other known points, which are at most five points;



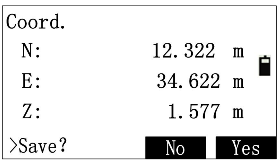
11) Press points 3 according to the step 3~ step 5;



12) You can press [F4](Calc) to check the result of resection, and the standard deviations of the coordinates is displayed. Unit (mm);

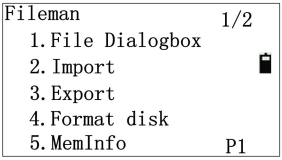


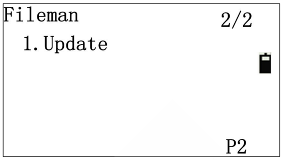
13) Press [F4] (Coord.) to view the coordinates of the new points. Otherwise, the coordinates will be saved in the coordinate file and as station coordinates.



9.3File manager

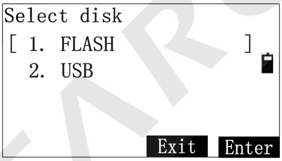
The menu of file manager is as follows:



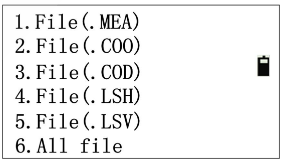


9.3.1 File Dialogbox

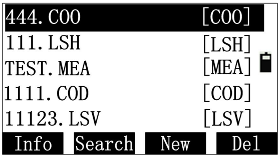
The operations of “Create a new file”, “delete file”, “view file”, and so on are called file dialogbox. These operations involve the file list. Select “File Dialogbox” to enter the interface of “Select disk”, as shown in picture below:



After selecting the disk, press [Enter] to enter the interface of file type, as shown in picture below:



You can select different file list, here, you can press [6] to view all files in the system and can press [▲][▼][◄][►] to select file.



Notice:

COO—coordinate file

COD—Code file

MEA— Measurement file

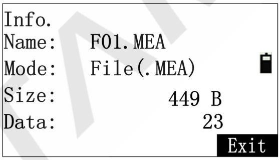
LSH—Horizontal alignment file for road stake-out

LSV—Vertical alignment file for road stake-out

Operations for files:

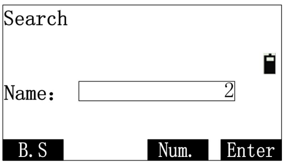
1) View the file information

   Press [Info.] to view the selected file,as shown in picture below. Press [ENT] or [Exit] back to the file list interface;



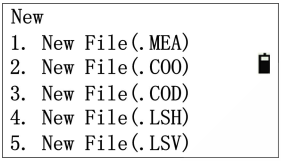
2) Search file

   Press [Search] to enter the interface of “Search”, as shown in picture below. After input the file name, press [ENT]. If found it, then back to the file list with the cursor at the file name, or tips “Has’t file”.

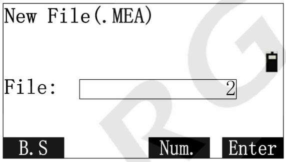


3) Create new file

Press [New] to enter the interface of file type, then you can select the type of your new file. After selecting file type, enter the interface of what you select. After inputting the file name, press [ENT] to back to the interface of selecting file, and you can continue to create new file;

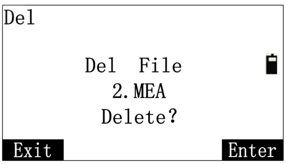


Press [1] →



4) Delete file

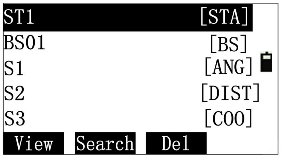
After selecting a file, press [DEL] to enter the interface of “Del”, as shown in picture below. Press [ENT] to delete file and press [Exit] to cancel to delete file and back to file list interface.



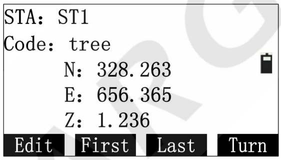
5) View file

When viewing the file data, you can just view the measurement file, coordinate file and code file. You can view the data of horizontal and vertical alignment file in the road function.

- Select a measurement file in the file list, and press [ENT] to display the data list as shown in picture below. The left side of list is point name, and right is data type.



- Pressing [View] can display the information of selected data. Here, as an example of station data, as shown in picture below. Press [F4] (Turn) to view the data in the second page.



✧ Press [Edit] to enter the interface of "Information", and you can just edit point name (Pt.n), code (Code).and target height (T.H)(Notice: can't edit the data of station and backsight), then back to the last interface;

✧ Pressing [First] can display the information of the first piece data;

✧ Pressing [Last] can display the information of the last piece data;

✧ Pressing [▲] can display the information of the previous piece data;

✧ Pressing [▼] can display the information of the next piece data;

●Press [Search] to enter the condition input interface, and you can input the point name which you want and press

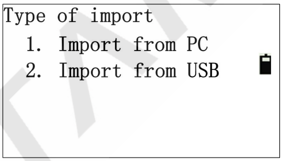
[Enter] ,then the system searches the data from the first piece (all name matched). If searching it, the cursor will be at the point , or will tip and back to the first piece data.

●press [Del] to enter the interface of “Del”,if select [Yes], the data you selected will be deleted or press [Exit] back to the data list.

9.3.2 Import

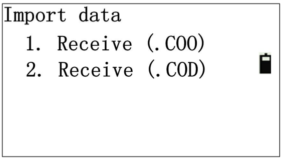
As the format of file in the instrument is binary, the External data must be imported to instrument. This function can import the external ASCII coordinate file and code file to instrument to save in binary format. The types of file you selected are distinguished each other by extension. So, you must be careful about the file type, or you will import unsuccessfully.

The interface of importing file as shown in picture below:

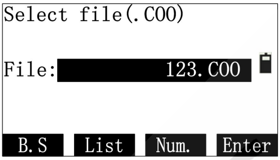


9.3.2.1 Import from PC

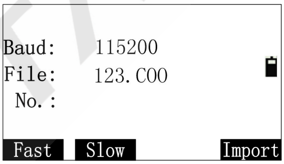
This function needs port to connect PC and instrument, but the transfer software must be installed on the PC to end data, or the instrument can’ receive. Press [Fileman]→ [2](Import)→ [1.Import from PC],then the interface of “Import data” as shown below:



AS an example of receiving coordinate data, press [1] to enter the interface of “Select file(.COO)”;



You can input the file name used to save the received data, such as “123”(.COO). If the file exists in the instrument, prompts “File Exist”. If selecting [List], you can select a file in FLASH disk. After selecting file, press [Enter] to enter the interface of importing;



The only column that can be set is the Baud. The Baud available are 2400, 4800, 9600, 19200, 38400, 57600, 115200 with respect to the RS232C serial communication bus. The bauds can be set with soft keys [Fast] and [Slow]. Usually, 115200 Baud is adequate for importing.

Import: Import data. The process of importing requires assistance of the connected computer. Firstly, the data must be imported to the computer already and waited to be received by instrument. Then press softy key [Import] to import the data.

After a success import, the coordinates will appear at the bottom of the selected file, while the number “NO.” is refreshing until the importing is finished.

9.3.2.2 Import from USB

Firstly, you must insert the Udisk to instrument. The instrument will read the text files (.TXT) in the ‘PROJECT’ folder in the Udisk. You must make sure that the imported files must be in the ‘PROJECT’ file, and the file name must be letters, numbers or together. Or, the file name can’t be displayed normally.

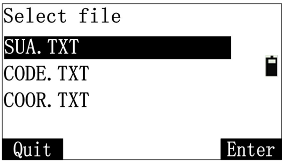
Enter the importing interface, as shown in the picture below:

```
Type of import
  1. Import from PC
  2. Import from USB
```

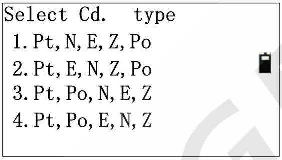
Press [2] to enter the interface of “Import data” interface, as shown in picture below:

```
Import data
  1. Import Coord.
  2. Import Code
```

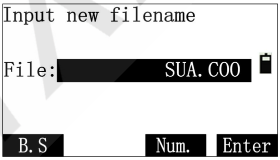
As an example of importing coordinate data, press [1] yo enter the interface of “Select file”. The files in the directory of “PROJECT” in U disk will be read.



Press [▲]or [▼] to select coordinate file edited, such as "SUA.TXT", and press [F4] to enter the interface of "Select Cd.type" to select coordinate format.



Select the coordinate format matched coordinate file, such as ,if the file "SUA.TXT" selected is saved according to the "Pt,N,E,Z,Po", you can press [1] to enter to the next interface;

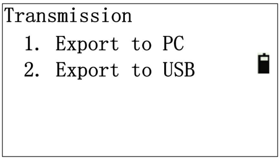


The filename extension of imported file will be changed as ".coo" automatically, which is the standard coordinate filename extension in instrument. Input the new filename after importing, and press [F4].

After pressing [Enter], there is "Transforming" displaying, and the data in the U disk will be saved in to the instrument until finishing importing.

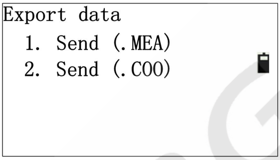
9.3.3 Export

Select [Fileman]→[3](Export), as shown in picture below:

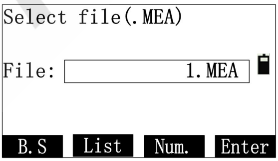


9.3.3.1 Export to PC

Select [1] to enter the interface of “Export data”, as shown in picture below:

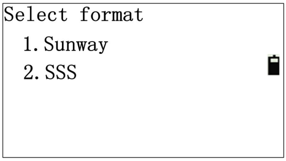


Taking an example for measured data, press [1] to enter the next interface, you need to input the measurement file you want to export or press [F2] to retrieve.(you may not input extension ,the file when exported will defaults it’s format as “.MEA”);

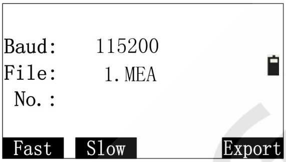


After selecting the measured file, press [Enter] or [ENT] to enter the interface of “Select format”. **The format of “Sunway” that the transmission software our instrument equipped can receive and analysis. But the format of “SSS” means the format of Topcon (GTS-7), which you can’t use the t transmission software our instrument equipped to receive. You must use “Topcon link” software or other can recognize**

"SSS" format.



After selecting the format, enter the interface of exporting, as shown in the picture below:

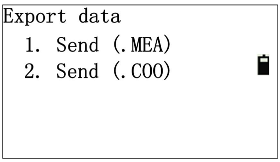


The operation of key functions, which are [Fast] ,[Slow] you can refer to the "import". You may be careful that the export file must be measurement and coordinate, or can't be exported.

When exporting file, the computer must receive firstly. The format of exported file is "ASCII". The instruction of "Sunway" which you can refer to Appendix B;

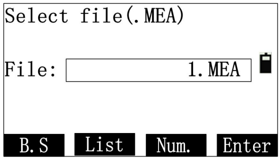
9.3.3.2 Export to USB

1) Enter the interface of exporting file to USB, as shown in picture below:

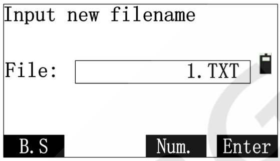


2) AS an example of measurement data, press [1] to enter to the next interface, as shown in picture below. Input the measurement file which needs to be exported or press [F2] to

retrieve;



3) After selecting measurement data, press [F4] to enter the interface of “Input new filename”, which defaults the selected file with with “.txt” extension;



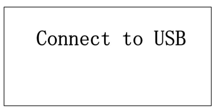
Here, input the file name for saving the exported data, which will be saved in the directory of “PROJECT” in the U disk. If there is a same name file in the Udisk , it will tip.

After you pressing [F4], the measurement file will be read and transferred to be saved with text format in the U disk.

The export of coordinate file refers to it of measurement file.

9.3.3.3 Export with Mini USB port

Connect the MinUSB cable between computer and instrument. After connecting, the interface as shown in picture below:



On the computer, the instrument is identified as a U disk and you can copy the files;

[Notice *]: The file “**eepromd.sys**” is system parameter file, which can be cut;

After copy the work file and coordinate file, you can open them by transport software directly. After ending the connecting, unplug the Mini USB cable, then press [ENT] to running the program continually.

9.3.4 Format disk

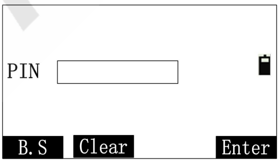
This function can re-create the file system, but can't format U disk. After format system disk, the previous data will be all lost, you must be careful.

9.3.5 Information of disk (MenInfo)

Display the available space of the system disk. The unit is KB. 1 KB can story 10 pieces of measurement data.

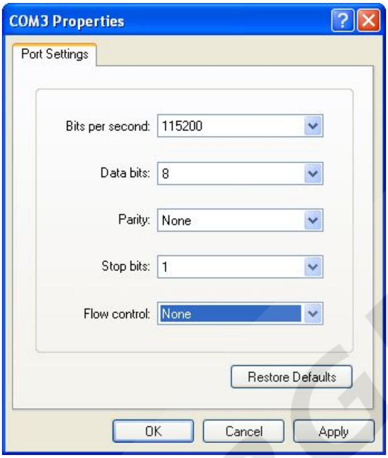
9.3.6 Update

This function is for you to upgrade the software of the instrument. Press [1] on the second page of "Fileman" to enter the interface of updating, as shown in picture below:



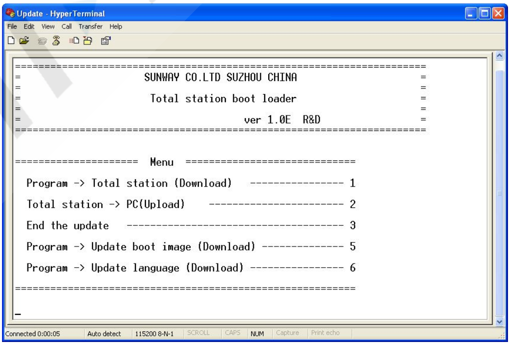
1) Input "PIN" (82543), then press [ENT] with the instrument shutdown;
2) Connect the instrument to the computer through serial port connector. Open the hyper terminal softwareand set up the correct port. Then set 'Bits per second ' to 115200 and ' Flow control ' to ' None '. Finally, when all operations above are done, press [ENT] to update.

Mention that the computer must be installed with correct drivers;

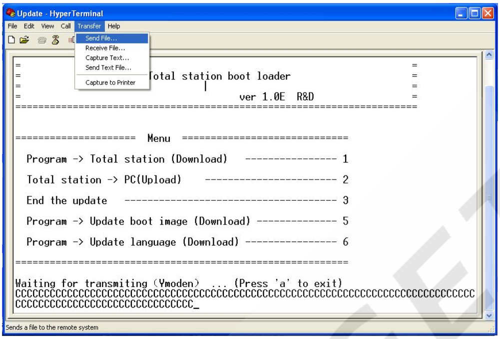


3) Press power button on the instrument. The page of hyper terminal is as followed;

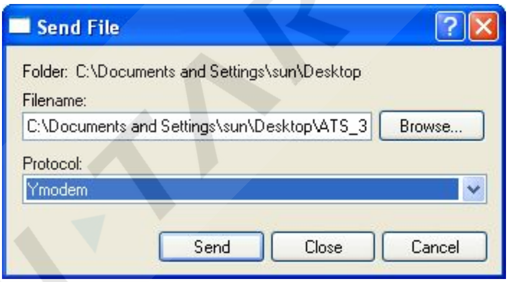
Note: you must be specifically cautious when updating. As soon as you choose to update, the instrument will enter updating mode. If pressing key ‘3’ under the page shown below, the previous program may be resumed.



4) Press key '1' on the keyboard. The instrument enters the waiting state for sending programs. After the state, click'Send File' on the computer;



5) Select the new version of total station software and click ' Send ' on the computer;



6) Then the computer displays the process of sending. After finishing updating, display the operation menu again .You can press [5] to update boot image and press [6] to update language;

7) After update program, boot image, language, press [3] to end the update and press power button to turn on the instrument to run the updated program.

9.4 Program

Press [Menu]→[4](Program) to enter the program menu, as shown in picture below:

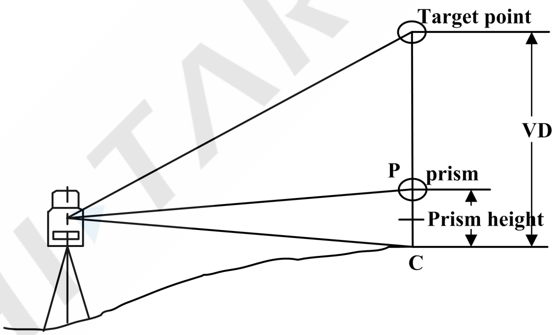
```
Program              1/2
  1.REM
  2.MLM
  3.Coord.Z
  4.Area
  5.Project             P1
```

[F4] →

```
Program              2/2
  1.Roadway



                        P2
```

9.4.1 Remote height (REM)

REM is adequate for measuring the target height when the prism cannot be placed at the target point. Under 'REM' mode, you can place the prism on any point along the plumb line of the target point to obtain the height of target.

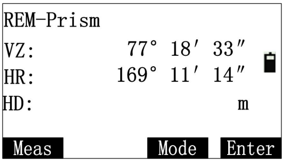


There are two modes for 'REM' measurement: 'Input TH' and 'without TH'. You can select 'Input TH' mode when you need the altitude from ground to target, otherwise 'without TH' when you need the altitude from any reference point to target.

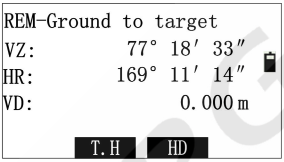
9.4.1.1 "Input T.H" Mode

Select "1. Input T.H" to enter the interface of "Height of

Ins.&Tar.” To input instrument height and target height, then press [ENT] to enter the interface of “REM-Prism”;



Aim at prism, then press [Meas] to measure the horizontal distance between target point and instrument. Press [Enter] to enter the interface of “REM-Ground to target”;



Then, turn the telescope up and down to aim at the target point. The VD column displays the elevation difference from the ground to the target point.

After measurement, you may choose from three opts:

[T.H] :to alter the target height;

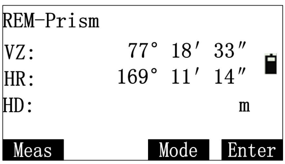
[Hdist] :to re-measure horizontal distance;

[ESC]:to quit REM measurement.

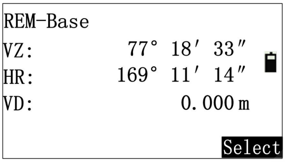
You can choice according to the actual usage.

9.4.1.2 “Without T.H”

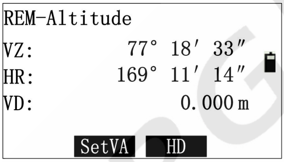
After select this mode, enter the interface of “REM-Prism”:



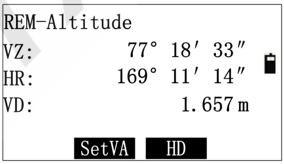
Aim at the prism, then press [Meas] to measure the horizontal distance from prism to prism and enter the interface of "REM-Base";



Aim at the reference point and press [Select] to enter the dialog of 'REM-Altitude'



Then turn the telescope up and down. The elevation difference between the target and the reference point is displayed in the VD column.



After the measurement, you have three opts:

[Set VA] :to re-enter the 'REM-Altitude' page.

[HDist] :to re-measure the horizontal distance;

[ESC]:to quit REM measurement.

9.4.2 MLM

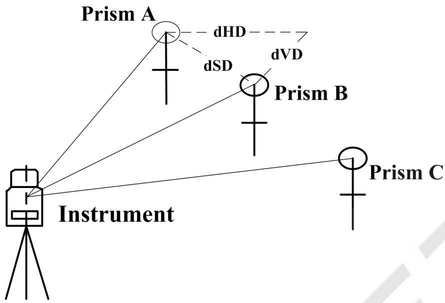


Diagram of “MLM”

Measure the horizontal distance (dHD), slope distance (dSD), elevation difference (dVD) and azimuth angle (dHD) between two target. You may also input the coordinate or retrieve coordinate from files to calculate the value.

There are two modes of ‘MLM’:

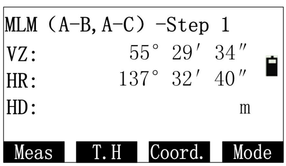
1.MLM (A-B,A-C): measure A-B, A-C, A-D…. i.e the starting point is the reference point of all following points.

2.MLM (A-B, B-C): measure A-B, B-C, C-D…. i.e the previous point is the reference point of all the other points.

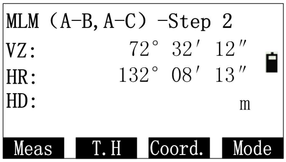
You may also have to choose ‘Consider Grid scale’ or to ‘Ignore Grid scale’ before choosing measurement mode.

MLM (A-B, A-C):

1) Enter the interface of ‘MLM(A-B,A-C)-Step 1’;



2) Press [T.H] to input coordinates , then press [ENT] to enter the interface of “MLM(A-B,A-C)-Step 2”;



3) Get the coordinates by the same way of the “Step-1”, then press [ENT] to enter the interface of “MLM (A-B,A-C)-Result”;

The result displayed is the measurement from first point to second point; If you press [Next P], you will repeat the operations of “MLM (A-B,A-C)-Step2”and “MLM (A-B, A-C)-Result”,and can get the measurement result of first point and other point;

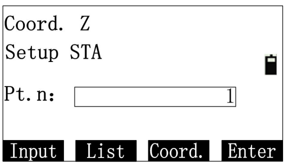
As to “MLM(A-B,B-C)” , it’s calculation of start point is different, which is the previous of the measure point, but the other operation are same as “MLM(A-B,A-C)”;

9.4.3 Coord.Z

This function is that use the measured data of known points to calculate the Z coordinate of station and reset Z coordinate.

You can get the coordinate data of known points from coordinate data or by keyboard. The operations as follows:

1) Set station, select “Setup STA”;



Here, you can press [Coord.] to input station point, or press [List] to retrieve coordinate from known files.

2) Setup datum mark. You can press [2] (Datum mark) to enter the interface of “Coord.Z-No.1”;

```
Coord. Z-No. 1
>Pt. n:
 Code:
  T. H:    1. 700        m
      [☆]Select file
 Input   List   Info.   Searh
```

Press [Input] to input the name, coordinates and target height of the first point, whose input method is same as the it of backsight point. Press [ENT] to end inputting and enter the measurement interface of “Coord.Z-No.1”;

```
Coord. Z-No. 1
HR:        170°  12′  23″
HD:                      m
SD:                      m
VD:                      m
 Meas           Mode   Enter
```

3) Press [Meas] to start measuring. After measuring, the measured value will be displayed, and you can press [Enter] to confirm this measurement, then the keys [Next] and [Calc] appears. You can press [Next] to continue the measurement , or [Calc] to enter the interface of “Coord.Z-Result”;

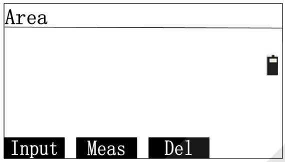
```
Coord. Z-Result
BSA:        170°  12′  23″
Z:                1. 234  m
dZ:               0. 001  m

                       SetZ
```

Then you can press [SetZ] to set the Z coordinate of station, or [Set A] to set the backsight angle, and you can press [ESC] to exit thus function.

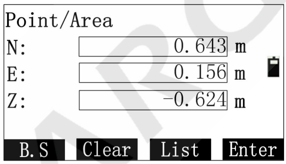
9.4.4 Area measurement

This function is to help you to calculate out the area of the plane figure formed by measured or inputted coordinates.

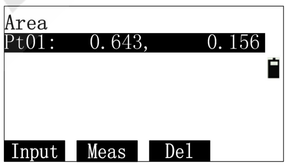
1) Press [MENU]→[4](Program) →[4](Area) to enter the interface of area measurement';



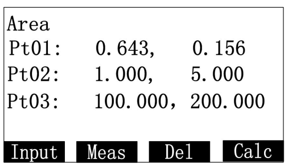
2) Select [Input] to input point information, here, you can retrieve point;



3) After pressing [Enter] , the point will be listed in the area measurement list , as shown in picture below:



4) The same way above, input the other points, which will be listed to area measurement list;



The maximum of points is 20.(The coordinates in the list may be displayed incomplete because of the screen). The inputted or measured coordinate is inserted below the indicator column, which determines the shape of the formed area. The area enclosed is the connection of line from start to end one by one in order. Thus, you may not get the correct area, if the graphic of area has crossed line. You may press [★] key to check the shape of the area.

9.4.5 Projection

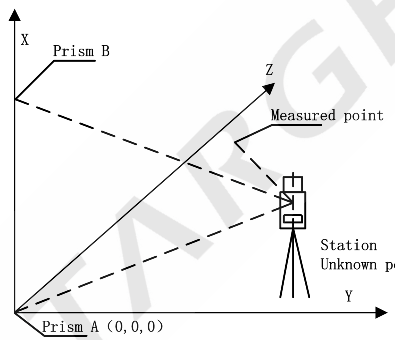


Diagram of "Projection"

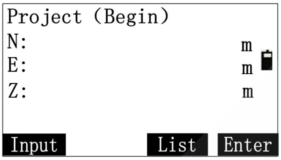
This function is used to measure the length (X) of the prism point deviation from the starting point of baseline, distance(Y) of the prism point deviation from baseline, and altitude difference (Z) of the prism point deviation from the starting point of baseline.

The preparation before measurement: setting up the instrument height, the target height and defining the baseline.

Define base line: In the interface of project, press [2](2.Baseline) to enter the interface of "Setup Baseline";

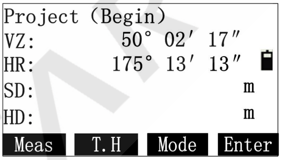
Retrieve base line point

Press [2](List) to enter the interface of “Project(Begin)”, as shown in the picture below. You can press [Input] to input coordinate, or [List] to retrieve coordinates, then press [Enter] to enter the interface of “Project(End)” . After inputting, back to the projection menu;

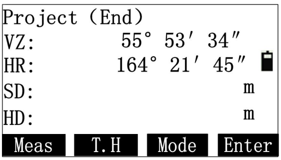


Measure base line point

In the interface of “Setup Baseline”, press [1](Meas) to enter the interface of “Project(Begin)”,as shown in picture below:



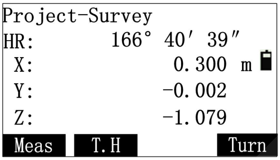
Press [Meas] to start measuring, then press [Enter] to enter the interface of “Project(End)”;



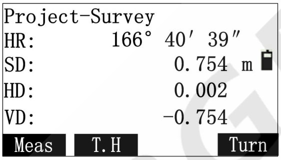
Press [Meas] to start measuring, then you can press [Enter] to return to “project” menu and press [3](Project)(3.Project) to start projection measurement.

Projection

In the project menu, press [3](project) to enter the interface of “Project-Survey”; press [Meas] to start measuring. After the measurement, the deviated length(X), distance(Y) and altitude difference (Z) are displayed on the screen.



Press [F4](Turn)→



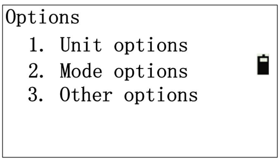
The key [T.H] is used for re-inputting target height; the key [Turn] using for switching the display between “X,Y,Z” or “SD,HD,VD”;

9.4.6 Roadway

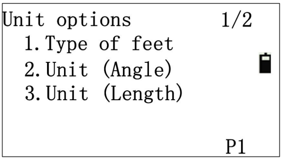
See reference in chapter 10. Roadway

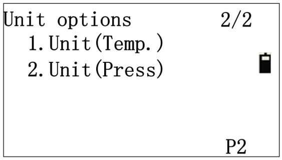
9.5 Options

Menu of options:

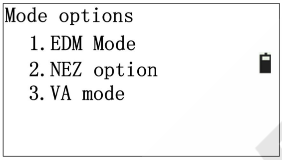


Press [1] to enter the interface of “options”

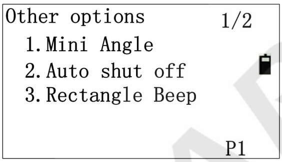


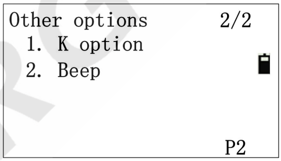


Press [2] to enter the interface of "Mode options":

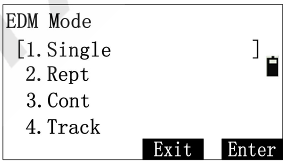


Press [3], enter the interface of "Other options":





Taking "EDM" for example, the interface as shown below:



Press [▲] or [▼] to move the ">" to the options needed, then press [Enter] to receive the select , and save it to system file. After shut on the instrument next, the mode defaults as the selected mode. The other settings are same as "EDM Mode", not tired in words here.

9.6 Adjust

Press [MENU]→[F4] →[1](Adjust) to enter the interface of

"Adjust":

```
Adjust
  1. Calibrate I.E
  2. Calibrate TILT:X
  3. Calibrate TILT:Y
```

9.6.1 Calibrate I.E

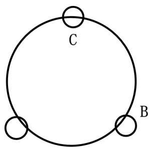
To adjust index error, the system will first ask you to 'Aim at a target F1'(face left). You may press [ENT] to confirm after aiming, and the instrument will measure its vertical angle automatically. The angle will be displayed for one second and the system will ask you to 'Aim at a target F2'(face right). Following the same steps, the instrument will then calculate the index error and display it.

Now press [ENT] to save the index error (calibration done), otherwise press [ESC] to quit (previous I.E remains).

9.6.2 Calibrate TILT:X

When calibrating tilt, please make sure that the tilt is off and the index error is little.

First, place the instrument as picture shown below with collimator facing up. This will help screw C to adjust the inclination of the instrument.



Enter the interface of tilt calibration:

```
VA:      90° 00′ 00″

 Tilt    X= 125
       F1 Up 3′

                       Enter
```

1) After leveling the instrument, aim at the target F1 in the collimator face left, record the current vertical angle as V0.Set the vertical angle to ‘V0-3′’with the help of the vertical tangent screw. Adjust the screw C to aim at the target precisely. Press [ENT] to confirm after a stable readout appears;
2) Set the vertical angle to V0+3′with the help of the vertical tangent screw. Adjust the screw C to aim at the target precisely and press ‘ENT’ to confirm after a stable readout appears.
3) Set the vertical angle to V0 with the help of vertical tangent screw. Adjust the screw C to aim at the target precisely.
4) Aim at the target F2 in the collimator with reverse telescope and record the current vertical angle as V1.
5) Set the vertical angle to V1+3′with the help of the vertical tangent screw. Adjust the screw C to aim at the target precisely and press ‘ENT’ to confirm after a stable readout appears;
6) Set the vertical angle to V1-3′with the help of the vertical tangent screw. Adjust the screw C to aim at the target precisely and press ‘ENT’ to confirm after a stable readout appears;

There are prompts which are “F1 Up 3′, “F1 Down 3′”, “F2 Up 3′, “F2 Down 3′” during the four steps.

The instrument will then calculate out and display the correction constant and the difference between the compensator axis and the vertical axis of the instrument. Press ‘ENT’ to save the new calculated parameters, otherwise press ‘ESC’ to quit and the previous correction constant remains.

9.6.3 Calibrate TILT:Y

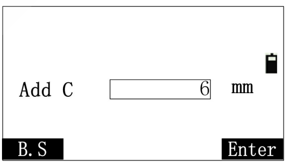
The steps of this function are same as them of calibration Tilt X, but you must turn the instrument 90 degrees before every pressing [Enter], if the reading is stable, press [Enter].

9.7 Config (Instrument constant)

Operations are permitted only when the instrument was tested strictly. We recommend you to set it after it is tested by the factory or professional verification institutions. Notice: the multiplication constant is zero.

The input operation of additive constant (Add const) is same as it of multiplication constant (Mul. const).Here, take additive constant for example.

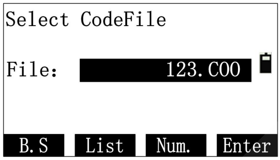
In the ‘Config’ menu interface, press [1] to enter the interface of inputting additive constant, as shown in the picture below:



After inputting, press [Enter] with a prompt “Saved” appearing, then exit the interface.

9.8 Select code file

In the second page of “Menu”,press [3](Select CodeFile) to enter the interface of “Select CodeFile”



9.9 Gird scale

Formula:

1) Altitude factor= R / (R+Altitude)

   R:the earth's average curvature radius

   Altitude: Altitude above the mean sea level

2) Scale factor

   Scale factor:the measurement station scale factor

3) Grid scale factor of coordinate

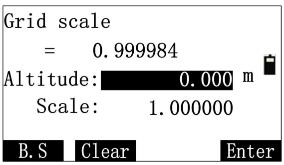
   Grid scale factor of coordinate=Altitude factor × Scale factor

Distance calculation:

1) Grid scale distance(HDg)= HD×Grid scale factor

   HD= distance on the ground

2) Distance on the ground(HD)= HDg/Grid scale factor



After input altitude, you can press [Enter] to calculate the “Scale”,as shown in the picture above. Press [ENT] to save the scale gird and exit this interface. Exceptions:

if the scale value is less than 0.99 or greater than 1.01,it indicates that the altitude input is error, and you must re-input it. If you pressing [ESC] , the scale will not saved.

9.10 Communication

If the instrument equipped Bluetooth, select “5. Communication” on the second page of “Menu”;

Press [5] on the second page of “Menu” to enter the interface of “Communication”, as shown in the Picture below:

You can set the communication as “RS232C” or “Bluetooth” .

Notice: “RS232” is used for bidirectional communication and the connector between PC and instrument for import and export.

10. Roadway

Roadway function is divided into two parts: Design Roadway and Stake out Roadway. You may stake out designed points according to the stake and deviation of the Designed Roadway.

Select "[Menu]→4.Program→[F4](P2)→1.Roadway" to enter the interface of road menu:

```
Roadway                 1/2
   1. Open Shape file
   2. Re-define (H)
   3. Re-define (V)
   4. Resume H curve
   5. Resume V curve  P1
```

—[F4]→

```
Roadway                 2/2
  1. Stake out (road)


                         P2
```

If you have already imported [.LS] files into the instrument from the external, you may open the [.LS] file through '1.Open Shape file'. You can choose the three opts after opening the LS file: 'Stake out (road)', 'Resume H curve' or 'Resume V curve'.

10.1 Inputting Roadway

The input of road design is divided two parts, one of which is the input horizontal alignment, and the other is vertical alignment. The input data will be saved in the selected files, whose maximum number of element is 21, but the number of intersection cannot be greater than 20;

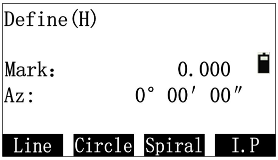
10.1.1 Horizontal alignment

The input is for road plane design.

10.1.1.1 Element method

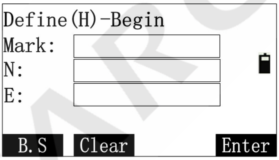
Enter this function through 'Re-Define (H)' and 'Resume H curve' under Roadway menu.

Selecting “Re-define(H)” to enter the interface of “Define(H)”:



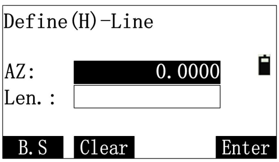
If you selecting “I.P”(intersection piont) for the first time, you will input by intersection method.

Select a line type, if you don’t input start point, enter the interface of “Define(H)-Begin”, then you can select the other lie type to input. After finishing the input, press [ENT] to enter the interface of “List of H curve”;

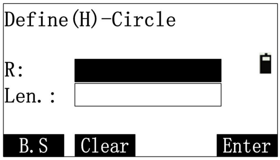


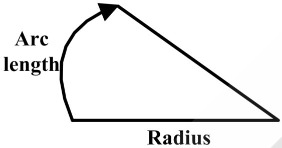
Note: Do not define the length as ‘0’, which indicates ending the alignment.

Input “Line”:



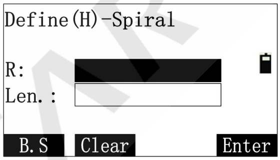
Input “Circle”:





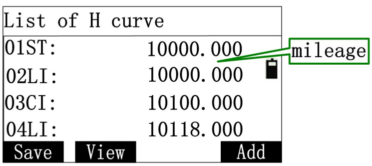
The value of Radius (R) can be negative. The positive direction is the right direction along the designed roadway, and the left is negative. The “Len.” refers to Arc length.

Input “Spiral”:



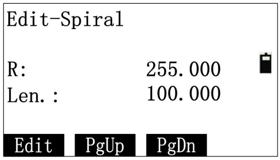
The “R”(Radius) indicates the radius of end point of spiral transition curve;

After inputting the “Line”, “Circle”, “Spiral”, press [ENT] to receive the input and exit to “Define(H)”. if you want to view the input, press [ENT] to finishing inputting and enter the interface of “List of H curve”;



- Press [Save] to save the input data;

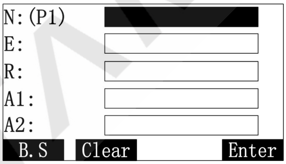
● Press [View] to display the input;

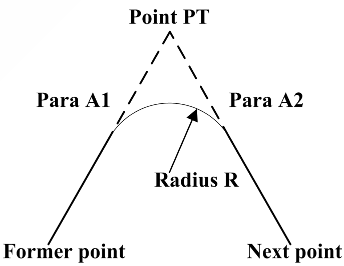


If you find some of them are wrong, you can press [Edit] to modify. You can press [PgUp](Page up) or [PgDn](Page down) to check the inputs one by one. You can press [Add] to continue inputting after pressing [ESC].

10.1.1.2 Intersection method

After choosing [I.P] and finishing inputting 'Define (H)-Begin', you can press [ENT] to enter the interface of inputting intersection as followed:





'PT' is the intersection point of road. The "x" of "Px" is the number of intersection point.

When inputting R,A1, and A2, they can't be negative. If inputting the radius, the system will insert an arc with defined radius in between the former point and the next point. If inputting parameters A1 and A2 of the spiral, the system will insert defined spiral between the line and the arc.

[Notes*]: When inputting A1 and A2 according to the length L1 and L2 of the spiral, the formula to calculate A1 and A2 are as followed:

$$A_1 = \sqrt{L_1 \times Radius}$$

$$A_2 = \sqrt{L_2 \times Radius}$$

Press [ENT] to input the next intersection point after inputting. If the ‘N’, “E”, “Z” column s are null, the key [ENT] is invalid. After finishing inputting, press [ESC] to exit, then enter the interface of “List of H curve”;

Press [View], then you can view the data input and edit data;

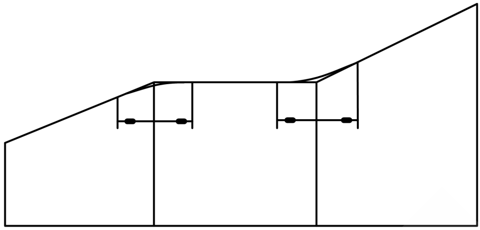
Press [Add], then you can continue alignment. Repeat the steps above until complete the input.

After complete the horizontal alignment, return to the “Roadway” menu, if you want to continue alignment, select “Resume H curve”;

10.1.2 Vertical alignment

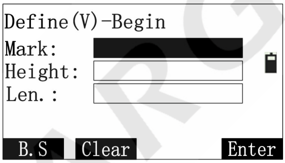
Vertical alignment is formed by a group of intersection points. The intersection points include mileage, altitude and curve length.

The beginning and ending point of the curve length must be zero and the number of the intersection points can’t be more than 20 under the vertical alignment.

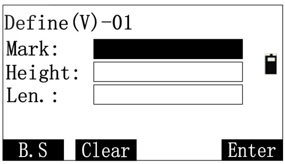


Stake	0	508.306	1000.48
Altitude	324.325	329.247	325.689
Length	0	84.56	52.806

In the "Roadway" menu, select "Re-define (V)" to enter the interface of "Define (V)-Begin":



After inputting the "Mark", "Height" and "Len." (Length), press [Enter] to confirm, and enter the interface of the point 01 input, as hown in picture below:



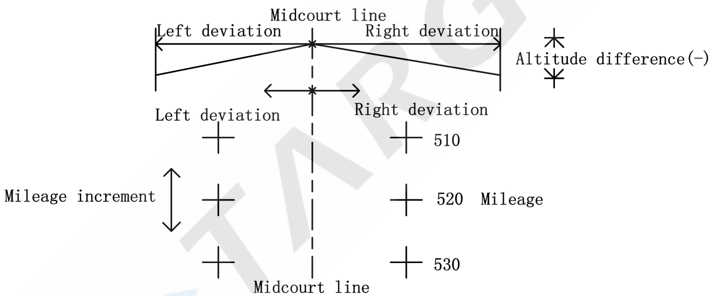
Then, you can input the "Mark", "Height" and "Len." for other points in order. Finally, press [ESC] to end inputting and enter the interface of "List of V curve". The operations of the key about [Save],[View] and [Add] refer to element method.

After finishing defining H and V curve, the last input will be saved in the buffer cache and will be erased when shutting the instrument down. The data can be used to staking out roadway immediately if needed.

10.2 Stake out (road)

You can used the inputted or imported LS files in staking road way. When staking out roadway, you can select the desired file any time for the demand so that staking out roadway with any mileage can be done easily.

You may not be worried about the problem that the capacity of 20 point of horizontal alignment and 20 point of vertical alignment, because you can divide any long road into several pieces and save them into several line type files.



The steps for staking out road way are as followed:

1) Select [.LS] files for stake-out;
2) Setup station;
3) Setup BBS;
4) Inputting Roadway parameters, including mileage of “Start” (start mileage), “Space” (pile space), “L/R dist” (left and right deviation) and “L/R dV” left and right altitude difference (Left/Right dV);
5) Then select center, left and right mileage to stake out.
6) You may choose [Dist]—polar coordinates or [Coord.]

to stake out.

10.2.1 Selecting Roadway File

There are two routes to select roadway file ([.LS] file)

1) “Roadway (menu) → “Open shape file”;
2) “Roadway (menu) → “Stake out(road)” →“Select file”;

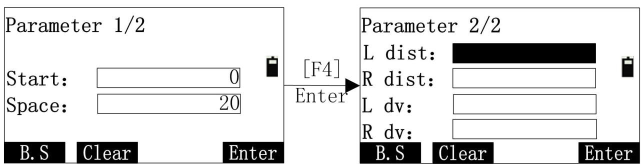
Both ways above lead to page of ‘select file’. You can select [4] (LSH\V) enter the interface of “Select File(.LSH)”,which will list the horizontal alignment file (.LSH) to be selected. After selecting the horizontal alignment (.LSH), which will be store the data of horizontal alignment, you will be prompted to select horizontal vertical alignment (.LSV), if you need it , press [ESC], if don’t need it, press [ENT]. If you have already opened the shape file successfully, press [ESC] to end the dialogue. If not, then repeat the steps above until the file is selected and opened.

10.2.2 Setting station and BBS(backsight point)

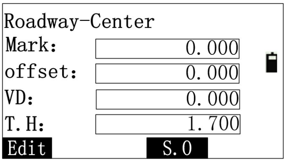
See reference in setup BBS and setup station

10.2.3 Stake out road

Before staking out Roadway, please first enter the parameters required for staking out. e.g starting mileage, space between, “L dist”(left distance), “R dist”(right distance), “L dV” and “R dV”.



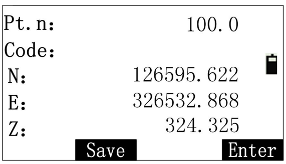
After inputting, press [ENT] to enter ‘Roadway- Center’ interface (if all deviations are zero):



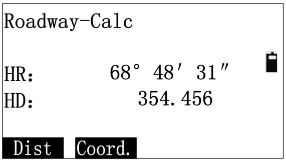
The soft key functions under this page are as followed:

Key	**Explanation**
F1	Setup any mileage and target height
F2	No use in this page
F3	calculate the coordinate of the staked out point first
▲	Current mileage minus space to obtain new mileage
▼	Current mileage plus space to obtain new mileage
◄	Switch between ‘Roadway-Right’ →’Roadway-Center’ →’Roadway-Left’
►	Switch between ‘Roadway’-Left’→ ‘Roadway-Center’ →‘Roadway-Right’

This interface displays the mileage of the mark. You can press [ESC] to exit or Press [S.O] to enter the interface setting put point information as following:



The “Pt.n” indicates the mileage of the mark selected (which system accepts the maximum of is 8 characters).then you can press [Save] to save the information of staking out to the current coordinate file. Press [Enter] to enter the interface of “Roadway-Calc”, which displays the azimuth angle and horizontal distance:



You can select [Dist] to stake out by polar coordinate or [Coord.] to stake out by coordinate, which refer to “9.2.2 Polar Coordinates” and “9.2.1 Stake out.” The key [ESC] in every interface above can return to the interface of “Roadway-Center/right/left” to help you select mark to be staked out.

11. Adjustments and Corrections

The instrument is under strict test and calibration, the quality is accord with the standard demand. But after a long-distance transportation and environment change, the small change of instrument parameter is inevitable. Therefore, the new purchased instruments should be checked and calibrated before surveying to ensure the precision.

11.1 Tubular Level

Check

See reference in using tubular level to level the instrument precisely.

Calibration

1. In the calibration, if the level bubble diverges from the center, use the foot spiral which parallels the leveling tube to adjust to make the bubble move half of the distance to the center. For the remaining, use the calibration needle to turn the level calibration screw (in the right of the water-level) to adjust the bubble to the center;

2. Turn the instrument 180° to check that whether the bubble is in the center. If the bubble is not centered, repeat step 1 until the bubble is in center;

3. Turn the instrument 90° and use the third foot screw to adjust the bubble to the center;

4. Repeat the steps of checkout and calibration until the bubble in the center in every direction.

11.2 Circular Level

Check

After the level tube is calibrated correct, if the circular level bubble also in center, so there is no need to calibrate.

Calibration

If the bubbles is not in the center, use the correction needle or six angle wrench to adjust the correction screw which under the bubble to make the bubble to the center. For calibration, you shall first loosen the calibration screw (1 or 2) which opposite to the direction of the bubble offset, then tighten the other correction screw in the offset direction to make the bubble in the center. When the bubble is in center, make sure the fastening force of the

Three calibration screws are consistent.

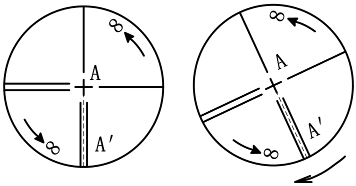
11.3 Reticle of the telescope

Check

1. Aim at a target A from the telescope after leveling the instrument the cross wire on the reticle. Lock the instrument with vertical and horizontal locking knob after aiming at A.

2. Rotate the vertical slow motion knob, move A point to the edge of the field of view (A 'points);

If point “A” moves along the vertical line of the crosshair, but is still in the vertical line as the left picture, the crosshair doesn't need to calibrate. If point “A”deviate from vertical line center, as the right picture, the crosshair is slant, so need to calibrate the reticle;



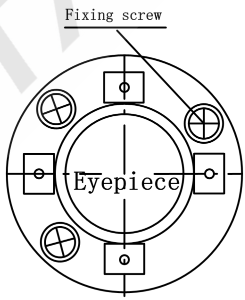
Calibration

1. First, take down the reticle cover between telescope eyepiece and focusing hand-wheel, and you can see four fixed screw of the reticle bed (sees attached figure);

2. Unscrew the three fixed screw evenly with screwdriver, rotate the reticle around collimation axis, to make A point on the vertical line of the reticle;

3. Tighten the screw evenly, test the calibration results with the above methods;

4. Cover the reticle.



11.4 The Perpendicularity of Collimation axis and Cross axis (2C)

Check

1. Set a target A in about 100m away, and make sure the

vertical angle of the target is within ±3°.Precisely level the instrument and switch on it;

2. Make the telescope focused on target A in face left, and read the horizontal angle e.g. HA (L)=10°13′10″;

3. Loosen the vertical and horizontal brake hand-wheel, turn the telescope, rotate the alidade to face right and focus on the same target A. Before aiming please tighten the horizontal and vertical brake hand-wheel and read the horizontal angle;

e.g. HA (R)=190°13′40″

4. If 2C=L-(R±180°)=-30″≥±20″, the instrument need to be calibrated.

Calibration

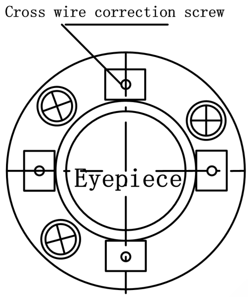
1.Use the horizontal slow motion knob to adjust the horizontal angle to the right reading which has eliminated the C.

R + C = 190°13 '40 "-15 "= 190°13' 25";

2.Take down the reticle bed cover between the telescope eyepiece and focusing hand-wheel, adjust the calibration screw of the crosshair on the left and right. First, loosen the screw on one side, and screw up the screw on the other side, move the reticle and focus on target A;

3. Repeat the test steps, calibrate it to | 2 C | < 10;

4. Tighten the calibration screws, put the protective cover back.



Note: Check the photoelectric coaxiality after calibrating.

11.5 Vertical plate index zero automatic compensation

Checkout

1. After Setting up and leveling the instrument, make the direction of the telescope consistent with the line between the center of the instrument and any of the foot screw;

2. The vertical plate index change to zero after switching on Tighten the vertical brake hand-wheel and the instrument display the current telescope vertical Angle;

3. Screw the leveling screw towards one direction for circumferential distance around 10mm, the vertical angle displayed will disappear through the process and 'Tilt over!' appears to the column. It indicates that the inclination of the instrument is over 3′, which is over the range the instrument was designed to compensate. Screw the leveling screw back towards the opposite direction, the vertical angle re-appears on the screen. It shows that the tilt works well now. Users may observe the change of the readout about the critical point.

Slowly rotate feet X to 10 mm around in one direction, the display of the vertical angle will change from changing until disappear to appear "Tilt over!" correspondingly , it indicate that the dip Angle of the vertical axis is bigger than 3 ', beyond the range of vertical plate compensator design . When rotating the feet spiral recovery in the opposite direction, the instrument shows vertical Angle again, if you can see the change when testing it again and again in critical positions, it says that vertical plate compensator works normally.

Calibration

When finding the tilt compensator abnormal, please send the instrument back to factories for checking.

11.6 Vertical index error (angle i) and set vertical index 0

Please first adjust finely the reticule of the telescope and the compensator before calibrating and checking index error.

Check

1. Turn on the instrument after placing and leveling it, and focus the telescope on a clear goals .A to get the face left reading of vertical Angle L;

2. Turn the telescope around and aim at the same target A and get the face right reading of vertical Angle R;

3. Assume that the zenith of the vertical angle is 0°, then angle i= (L+R-180°)/2 or Angle i= (L+R-540°)/2;

4. If | i |≥10", may be you need reset the zero value of vertical index;

5. For the following steps, see reference in chapter 11.6.1.

Note: Repeat the checkout steps to retest the index error again (i Angle). If the index error still cannot accordance with requirements , it should check the three steps of calibration index zero setting (in the course of zero setting ,the vertical angle showed is not compensated and corrected, it is just for reference) to see whether it is incorrect, whether the focusing of target is correct, reset according to the requirements;

6. If the index error does not meet requirements at all, you may have to send the instrument back to factories for checking.

11.7 Centering device

Check

Place the instrument onto the tripod and draw a cross on a white paper, place the paper with a cross on the ground right below the instrument;

2. Adjust the focal length of the optical plummet (for the optical plummet) or press key[★] to switch on laser plummet, move the white paper to make the cross in the center in the field of view (or laser flare);

3. Turn the feet screw, make the center mark of the plummet coincide with the cross center;

4. Rotate alidade, every turn of 90°, observe the contact ratio of the optical plummet and cross center;

5. When rotate the alidade, the center of the optical plummet always coincide with the cross center, there is no need to calibrate. Otherwise you should calibrate as the following methods.

Calibration

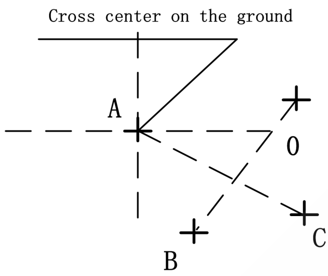
1. Take down the screw cover between the optical plummet eyepiece and the focusing hand-wheel;

2. Fix the white paper with a cross, and mark the points when the instrument rotates 90°, as the figure shows A, B, C, D points;

3. Connect the diagonal points A、C and B、D with a straight line, the intersection name of the two line is point O;

4. Use the calibration needle to adjust the four calibration

screw, to make the center mark of the plummet coincide with point O;



5. Repeat step 4, check and calibrate until it meet the requirements;
6. With the laser plummet, unbolt the laser cover, using 1 # hex wrench to adjust the three screws, fasten one side and loosen the other side, and adjust the laser flare to point O;
7. Put the cover back in place.

11.8 Addictive constant (K)

The instrument constant is inspected when it out, and correct it inside the machine, make K = 0. Instrument constant change rarely, but we suggest that check it this way for one or two times each year. The checkout should be done in the standard baseline, or you can take the following simple method.

Checkout

1. Choose a flat field A to set up and level the instrument , mark three points A、B、C in the same line ,their interval is 50m, and set up the reflection prism accurately;

2. After setting the temperature and atmospheric pressure of the instrument, measure the horizontal distance of ‘A B’ and ‘ AC’ accurately;

3. Place the instrument at point B then centering it

accurately to measure the horizontal distance of BC precisely;

4. Obtain the distance measurement constant of the instrument: K= AC-(AB+BC);

K should be close to zero, if | K | > 5 mm,it should be send to standard baseline field for strict checking.You can calibrate it based on the checking value.

Calibration

If it turns out the instrument constant does not close to 0 but changing after strict inspection, you need to calibrate it, and set the instrument additive constant according to the comprehensive constant K value. Such as: the K has been measured as ‘-5’ according to the method above, and the original instrument constant is ‘-20’, so the new value should be set as ‘-20-(5) =-15’; Input ‘-15’ through "menu-> 6->2" and then confirm.

Use the vertical line of the reticle to orientate, make A, B and C at the same line accurately. There must be a clear mark for point B on the ground to focus.

Whether the prism center of the point B coincide with the instrument center is the guarantee of checking the accuracy, so, you have better use tripod and all-purpose tribrach, for example, if you change the three-jaw type prism connector with tribrach, keep the tripod and tribrach stable, just change the prism and the part above the tribrach of instrument, and it can reduce the error of misalignment

11.9 The parallelism of collimation axis and photoelectricity axis

Checkout

1. Place a reflector prism 50 meters away from the instrument;

2. Focus on the reflecting prism center with telescope

crosshair accurately;

3.Observe the maximum signal value through starkey(★)→Para.→Signal, find the center of the launch axis;

4.Check whether the telescope crosshair center coincide with the emission photoelectricity axis center, if they coincide on the whole we can say it qualified;

Calibration

If the telescope crosshair center deviates from emission photoelectricity axis center largely, send it to professional repair and calibration department.

11.10 Non-prism ranging

The red laser beam is coaxial with the telescope, used for no prism ranging, and it is sent by telescope. If the instrument has been calibrated, red laser beams will coincide with the line of sight. The external influence such as the vibration, the larger temperature change and other factors may make laser beam and viewing not overlap.

Before precise ranging, you should check whether the direction of the laser beam is coaxial. Otherwise, it could lead to inaccuracy.

Warning:

Looking straightly at the laser is dangerous.

Prevention:

Don't look laser beams directly, or focus on others.

Checkout:

Put the gray side of the reflector towards the instrument, and put it 5 meters and 20 meters away. Start laser direction function. Focus on the reflector center by the telescope crosshair center, then check the position of the red laser point. Generally speaking, the telescope is equipped with special filter, human eyes can′t see laser point through the telescope, you can see the offset between the red laser point and the reflector crosshair center, you can observe this above the telescope or at the side face of reflector. If laser center coincide with the crosshair center, it indicates that the adjustment meet required accuracy. If the offset between the point position and the mark of crosshair is out of limit, it will need to be sent to professional department for adjustment.

If the reflector is too bright under the illumination of laser beams, the grey side can be replaced by the white side.

12. Technical parameters

Serial		ZTS-360R
Angle measurement (Hz, V)		
Method		Absolute encoder
Reading head		Diameter
Accuracy		2″
Telescope		
Image		Positive
Magnification		30x
Field of view		1°30′
Min. target distance		1.2m
Resolution		4″
The tube length		130mm
Compensator		
System		Photoelectric single or dual axis compensator
Working range		±3′
Distance measurement (IR)		
Ranging	Non-prism mode[1]	600m
	Single prism mode	3000m
Time for a measurement	Precision	0.8s
	Tracking	0.3s
Standard deviation	Non-prism mode	±（3+2ppm×D）mm
	Prism mode	±（2+2ppm×D）mm
Mini. readout		1mm
Communication		
Internal data storage		20000pionts (Standard equipped 8G Udisk)
Port		Standard RS232 serial port；

	Bluetooth；U disk；Mini-USB port
Operation	
Display	3.2 -inch , 192*96 pixels highlight LED display，3 class, adjustable brightness
Keyboard	Numeric keyboard
Laser plummet	
Type	Laser point, brightness adjustable in steps，4 class
Accuracy	1 mm (1.5m instrument height)
Environmental conditions	
Temperature range (operation)	-20℃~ + 50℃
Temperature range (storage)	-25℃~ + 70℃
Splash and dust proof (IEC 60529)	IP66
Weight	
Weight of instrument without (battery)	3.7kg
Weight of instrument box	2kg
Power supply	
Battery type	BT 30 High energy Lithium battery
Voltage / Capacity	7.4V/ 3400mAh
Working duration	16 hours (Under 25 ℃ with a new battery, measuring once for every thirty seconds)
Number of measurements	Approx. 12 000

1：Refer to the conditions of good weather and the goal of KODAK CAT NO.E1527795 (90% of reflecting surface)

The provision of the indicators with reference to the enterprise standard Q / 320507 ATS HGR01-2010 type total station"

Appendix A File format introduction (Sunway)

These following examples to instruct exported file format

STA ST001,1.205,AD
XYZ 100.000,100.000,10.000
BKB BS001,45.2526,50.0000
BS BS001,1.800
HVD 98.2354,90.2314,10.235
SC A1,1.800,CODE1
NEZ 104.662,99.567,10.214
SD A2,1.800,CODE1
HVD 78.3628,92.4612,4.751
SA A3,1.800,CODE1
HV 63.2349,89.2547
NOTE this note

Every record consists of two lines:

The information of first line: record type, name, elevation, code

Such as:

STA refers to station point
BKB refers to back sight Angle data
BS refers to back sight
SC refers to coordinate data
SD refers to distance measurement data
SA refers to Angle measurement data

The second line information: data types, data records

Such as:

NEZ refers that the following data are coordinates with the order "NEZ"

ENZ refers that the following data are coordinates with the order “ENZ”

HVD refers that the following data are horizontal Angle and vertical Angle and slope distance

HV refers that the following data are horizontal Angle and vertical Angle

Appendix B Bi-directional communication

The total station controlled by external computer can sent the information about angle and distance. The settings of communication and protocol as follow:

● Baud rate: 2400~115200 available

● Data length: 8

●Stop bits: 0

●Parity bits: none

●protocol:

●Code: STX（02），CR（13），X_ON(17)，X_OFF(19)

The angle ans diatance data are transferred by a form of fixed length of 7 byte. The unit of angle is "°′″ ", and the distance unit is "mm";

Command frame list("＋" means connection)

1. Check communication

Ask: STX+T+C+CR

Respond: X_ON

2 Set the horizontal angle

Ask: STX+S+A+HHHHHHH+CR

Respond: X_ON

"HHHHHHH" indicates azimuth angle. Example: 120°43′55″ can be explained "1204355"

3. Read angle data

Ask: STX+R+A +CR

Respond: STX+R+A+HHHHHHH+VVVVVVV+CR

"HHHHHHH" is azimuth angle

"VVVVVVV" is vertical angle

4. Read distance and angle data

Ask: STX+R+D +CR

Respond:

STX+R+D+HHHHHHH+VVVVVVV+DDDDDDD+CR

"HHHHHHH" is azimuth angle

"VVVVVVV" is vertical angle

"DDDDDDD" is slop distance

5. Start measuring

Ask: STX+D+S+CR

Respond: X_ON

6. Stop measuring

Ask: STX+D+T+CR

Respond: X_ON

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