

Preface

Thank you for purchasing our ZTS-320 series total station! This manual is your good helper, please read it before operate the instrument and keep it properly.

Product Validation

In order to get our best service, please give the feedback about the version, number and 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 advice 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 ZTS-320series total station carries abundant surveying applications ,at the same time has the functions of data storage, parameter settings and etc .It's suitable for all kinds of professional measurements.

1. **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.

2. **A high-capacity RAM Management**

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

3. **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.

4. **Special measurement program**

Except for the basic functions, it also has 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 .

5. **Changeable eyepiece**

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

6. **Laser plumb**

Easy to direct the station point and free station

Notice:

- a) Do not look directly into the sun with instrument.
- b) Do not leave the instrument in extreme temperatures (too high or too low) or use it when temperature shock.
- c) The instrument when not in use, should be loaded in the box , placed in well-ventilate and dry place ,and pay attention to the shockproof ,dustproof and damp-proof.
- d) When there is a great difference in temperature between working environment and storage environment , you should leave the instrument in the box to adapt to the environment temperature ,in order to obtain good precision.
- e) If the instrument will not be used for a long term, the battery should be unloaded and charged a month for extending its life
- f) When transporting the instruments, please store them in boxes and avoid extrusion, collision and violent vibration .A soft mat around the boxes may be required for long-distance transport.
- g) When setting the instrument, it's better to work with high-quality wooden tripod for stability and measurement accuracy.
- h) 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.
- i) After using instrument, please sweep away the surface dust with flannelette or a 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.
- j) Please check out that the indicators, functions, power supply, initial setting and correction parameters of the instrument meet the requirements before operating.
- k) If discover 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.
- l) As a safety precaution,, do not aim at eyes directly when using the instrument, because the light emitted of the Non-Prism Total Station ZTS-320(R) is laser.

Security Guide

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

Warnings:

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 stare at laser beam constantly, it could cause permanent eye damage.

Precautions:

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

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

Warnings:

It's dangerous to use Class 3R Laser instruments 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).

- a. The personnel who is 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 beams 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).

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1.Uses of Total Station

The total station is such an instrument that measures azimuths 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, harbour, 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 ZTS-320 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, cadastral and real estate survey

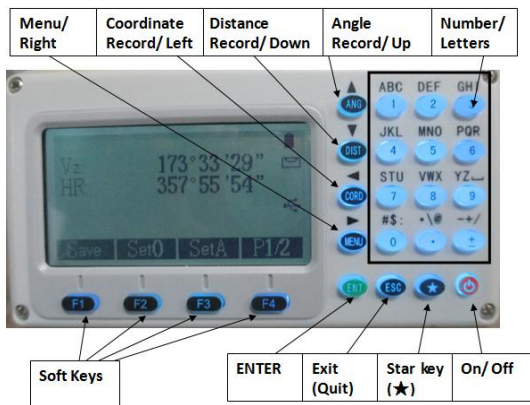
2.Names and functions of the components

2.1 Names of components





2.2 Functions of keyboards and the display of information





Symbols on the keyboard

Symbol	Name	Function
ANG	Angle Measurement	Enter Angle Mode (Move the Cursor up or select the item up under the other mode)
DIST	Distance Measurement	Enter Distance Mode (Move the Cursor up or select the item up under the other mode)
CORD	Coordinate Measurement	Enter Coordinate (Move the Cursor left or page forward and help to input characters under the other mode)
MENU	Menu key	Enter Menu Page (Move the Cursor right or page backward and help to input characters under the other mode)
ENT	Enter	Receive and save the data input in the dialogue and end the dialogue. There is also a function that open and close the rectangular buzzer under the basic measurement modes(ANG, DIST, CORD, MENU)
ESC	Exit/ quit	End the dialogue box without saving the input.

ON/ OFF	On/ Off	Control the power on/off
F1~F4	Soft Keys	The characters at the bottom line of the display indicates the meaning of the soft keys.
0~9	Number keys	Enter numbers or characters or choose the menu
~ -	Special Symbols	Enter symbols, decimals and signs
★	Star key	It is used to operate the common function of the instrument, and can enter all the measuring interface .It displays the dialog of the contrast, lighting compensator , parameters of distance measuring and file selecting.

Symbols on the display

Symbol	Indication
Vz	Zenith Mode
V0	The mode that the vertical is displayed as zero when the telescope is level in normal .
Vh	Vertical angle Mode (it is $0^{\circ} 00' 00''$ 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 meas 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	North coordinate. dN is to stake out differences between north-coordinates.
E	East coordinate. dE is to stake out differences between East-coordinates.
Z	Elevation coordinate. dZ is to stake out differences between Z-coordinates
 	EDM(Electronic Distance Measurement) is in progress.
m	Unit in metres (metric units)
ft	Units in feet

fi	Units in feet and inches. Figures on the left of decimals represent feet and those on the right represents feet in percentile.
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.
Inter Feet	International feet
Us Feet	American feet
MdHD	Maximum error of evaluated distance (used in resection measurement)

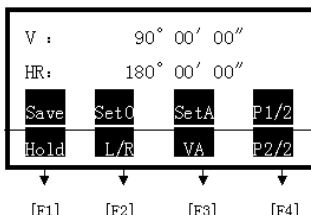
Reference functions of common soft key

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 measuring mode

2.3.1 Angle Mode(including 2 menu pages)



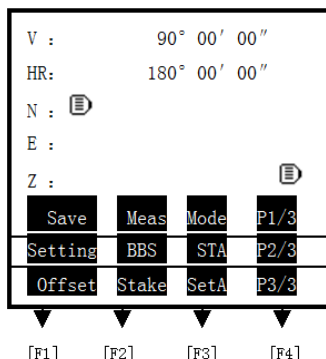
Page	Soft key	Reference	Function
1	F1	Save	Record the measured angle in the selected file.
	F2	Set0	Set the horizontal angle as 0°
	F3	SetA	Set your desired horizontal angle by inputting ,but the angle should not be greater than 360°
	F4	P1/2	Display the second page of the soft key functions
2	F1	Hold	Lock the horizontal angle readings.
	F2	L/R	Switch between HR (horizontal right/ clockwise) and HL (horizontal left/ anticlockwise) mode
	F3	VA	Vertical Angle Mode (altitude angle, Zenith, Horizontal '0', slope)
	F4	P2/2	Display the first page of the soft key functions.

2.3.2 Distance Mode(including two menu pages)

Vz:	90°00'00"		
HR:	180°00'00"		
SD: S	m		
HD:			
VD:			
Save	Meas	Mode	P1/2
Offset	Stake	m/f/i	P2/2

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 operating menu 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	P2/2	Display the first page of the soft key functions

2.3.3 Coordinate Mode(including three menu pages)



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	P1/3	Display the second page of the soft key functions
2	F1	Setting	Set target height and instrument height
	F2	BBS	Set coordinates of BBS (back-sight point) and back-sight angle
	F3	STA	Set coordinates for station
	F4	P2/3	Display the third page of the soft key functions
3	F1	Offset	Start offset measurement (eccentric measurement)
	F2	Stake	Stake out coordinates
	F3	SetA	Set azimuth (the same as setting horizontal angle under the Angle mode)
	F4	P3/3	Display the first page of the soft key functions

2.3.4 Explanation of Saving of data

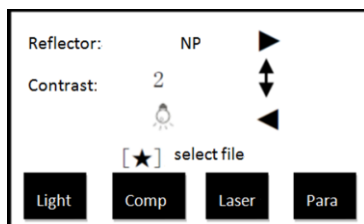
If you have never selected the measurement file and your first time to use the [Save] soft key, then a dialogue box of 'Select file' would appear to the screen. Mention that this is a good chance for you to select all files that the instrument may use.

When finishing single measurement or repeated measurement under each mode, a dialogue box 'information' asking you to save the measured point, 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

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



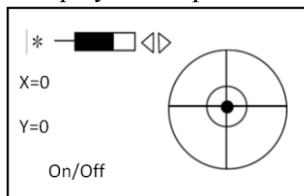
Settings from the star key(★) are as followed:

Adjust the contrast by pressing '▲' and '▼'.

Adjust the background light of the screen with '◀' and '▶'.

Turn on or off the background light of the screen by pressing Key 'F1'.

Turn on or off the display of compensation by pressing 'F2'.



Adjust reflector by pressing '►'. Each time pressing the key '►', the reflectance target is switched between prism (Prism), non-prism (NP) and reflector board (RB).

Pressing key 'F3' to switch on or off the visible laser beams.

Pressing the key 'F4' to select 'parameters', you can set settings of prism const, PPM value and temperature and pressure. If the instrument is equipped with temperature and pressure sensor, pressing [F1] can automatically collect the current temperature and pressure values and display the updated data such as temperature, pressure, PPM, otherwise you can view the signal strength.

The measurement parameters about distance measuring are shown below: (After entering the temperature and pressure data, the instrument would calculate PPM value automatically. If the calculated PPM value is not favored, please reenter your expected value.)

Temp:	20.0 °C
Press:	1013.0 hpa
Prism C:	0.0 mm
PPM :	0.0 ppm
Signal:	[]
B.S	Clear
Signal	Enter

Temp= Temperature

Press= Atmospheric pressure

Prism c= Prism constant

PPM= PPM value

B.S= Backspace

Clear=clear up all typed in characters in the current column

Signal=Detect and display the intensity of laser signal.

Notice that the laser will be on automatically, even if you haven't set it on. Take care that your sight are not in the scope of the laser path .

Enter=Move inserter to the next column.

Press ENT to save the settings.

3. Initial Setup

3.1 On & Off

Press and hold the key 'On/Off' (the buzzer remain buzzer) until the screen displays pictures as below. The instrument is now switched on.

(The picture is for reference. Please in kind prevail!)



After self-checking is accomplished and the instrument enters Angle Mode automatically (see details in [5. Angle Mode](#) for details)

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

Enter->Shut off
ESC->Quit
Quit after three seconds

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 it needs to be leveled by adjusting foot screw.

The ZTS-320 series Total Station can corrects the vertical angle readings caused by the tilt of vertical axis in the X direction.

It has two states of the 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

The ZTS-320(R) Total Station has three options of reflectors: prism, non-prism and reflector board. ZTS-320, however, has only two: prism and reflector board. You may set up their favored type with star key(★) functions.

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 'parameters' key under star key(★) mode, a dialogue box would appear as followed.

Temp:	20.0 °C
Press:	1013.0 hpa
Prism C:	0.0 mm
PPM :	0.0 ppm
Signal:	[]
T-P	Clear Signal Enter

Press the soft key "Enter" to move inserter down to the 'Para.' column of prism constant.

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 distances, the measured value can 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 ZTS-320 series Total Station (i.e. the atmospheric conditions when the correction is zero)

Atm: 1013 Pa

Temp: 20°C

The calculation of atmospheric correction

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

In the formula:

ΔS : correction coefficient (unit: ppm)

P: atmospheric pressure (unit: hPa)

T: temperature (unit: °C)

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°C 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 -----The vertical angle (counted from the horizon)

S-----Slope distance

Alternative values for K are 0, 0.14, 0.2.

3.8 Set up the minimum reading of the angle

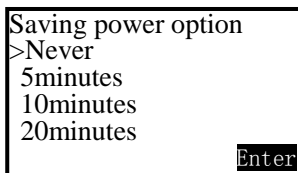
See 9. Operating Menu.

The operation on the instrument follows "MENU→5. Options→6. Mini readout (Angle)"

3.9 Setup of Automatic Shutdown

See reference in 9. Operating Menu.

The setup of automatic shutdown on the instrument follows "MENU→5. Options→9. Auto shut down. Opts displayed are as followed.



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 opt wanted. Press soft key 'Enter' or 'ENT' to save the setting. Pressing ESC will result in no changes of settings.

3.10 Set up the Addictive Constant and the Multiplying Constant

See reference in 9. Operating Menu.

The setup of additive and multiplying constants on the instrument follows “MENU→6. Calibrate &config→3.Add 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).

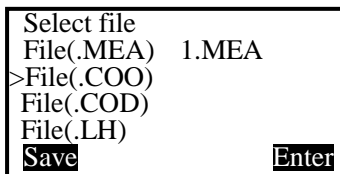
3.11 Selecting Data File

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 select the measuring working files before working.

To select data file, see reference in 9. Operating Menu.

Selecting data file on the instrument follows “MENU→1.Surveying→1.Select file”. It can be also done by using star (★) key function.

Besides common measurement mode (Angle, Distance, Coordinate), you may also enter 'select file' page by star key (★) under 'Set up station' (Menu→1.Surveying→2.Station) or 'Set up BBS' (Menu→1. Surveying→3. Orientation(BBS)) or 'Stake out XX' (Menu→2.Stake out→5.Stake out) pages.



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

Use '▲' or '▼' keys to move indicator '>' to the wanted type of the file and press 'Enter' soft key to enter the File list as followed:

F I L E	A123,COO				
	TST1,MEA				
	A.COD				
<table border="1"><tr><td>New</td><td>Del</td><td>View</td><td>Select</td></tr></table>		New	Del	View	Select
New	Del	View	Select		

Move the indicator to wanted file and press 'ENT' or soft key 'Enter' to select it.

4. Preparations before measurements

4.1 Unpacking and storing instruments

Unpacking

Lay down the tool box gently with the top side facing up.
Open the lock and unpack 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 tool 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 plumbs 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.

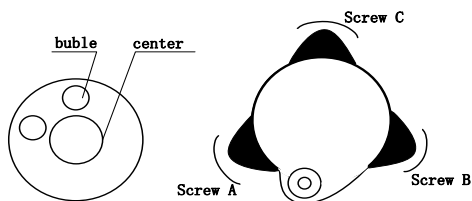
2) Install the instrument onto the tripod

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

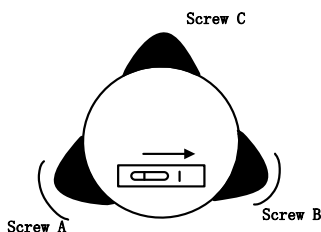
① Twist and adjust the two leveling screw A and B on the bottom of the instrument until the bubbles of the circular level moves to the line perpendicular to the center line the screw A and B.

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

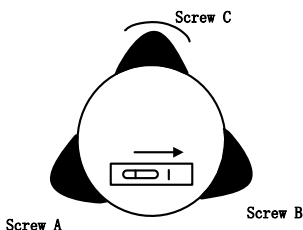


4) Using the plate level to level the instrument precisely

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 centre

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 plumb 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

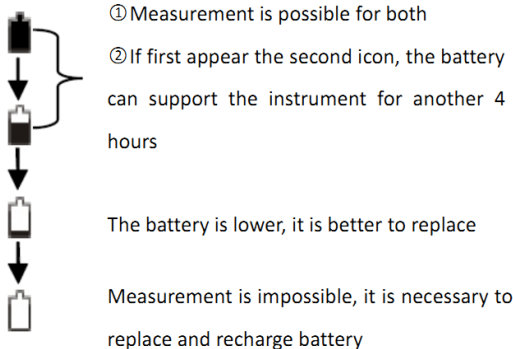
5) Precise centering and leveling

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 the instrument aims at the station precisely.

4.2.3 Loading and unloading of battery

Unloading , charging and information of the 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 the 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.

▲ When loading the instrument with a battery, first insert the battery to the battery case. Then press the top of the battery until you hear a 'click'.

▲ Please press the button on the top of the battery case and release it as the case is inserted in.



Notes for charging the battery:
plug the charger into the outlet of 110V-220V AC power supply, recharging will begin.

▲ The indicator light on the charger will illuminate three separate colors for various mode conditions:

Solid Red Light—the charger is working;

Solid Green Light—the charging has finished;

Flashing Red Light—no battery on charging, poor connection or some problems exist.

▲ It is recommended to continue charging for 1 or 2 hours after the light turn green.

▲ Once the red light flashes constantly after the charger is plugged into the outlet of 110V- 220V AC power supply, please remove the battery and reconnected it after 3 or 5 minutes.

▲ 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°C and $+45^{\circ}\text{C}$. 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 ,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. you can select them according to your requirements .

4.5 Loading and unloading of the pedestal

Unloading

Unload the pedestal by loosening the locking screw on the pedestal 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 pedestal. 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 a target (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

You can enter the letters and numbers directly ,because our total station is equipped with keyboard.

The page for 'Setup Station'
(Menu→1.Surveying→2.Station→Softkey F1[input]) can involve entering letters and numbers. Assume that the Pt. name is 'SUN1A' and STN is '-123.456'

Setup station			
PT.name	<div></div>		
STN:			
STE:			
STZ:			
B. S	Clear	Num	Enter

The black box indicates that this column of information is selected and numbers and letters will be entered into this column only.

Press soft key 'Num.' (F3) to switch between Numbers and Alphabet.

Setup station	
PT.name	<input type="text"/>
STN:	<input type="text"/>
STE:	<input type="text"/>
STZ:	<input type="text"/>
B. S	Clear Alph. Enter

Press key '7' for once ,displaying 'S' in the column
Cease the operation for at least 0.4 seconds
Press key '7' for once again, displaying 'ST' in the column
Press key '7' for three times, displaying 'SU' in the column
The interval of pressing the key "7" twice is not over 0.4 seconds .If over ,you can use the key "▲" or "▼" to correct it.
Press key '5' displaying 'SUN' in the column as followed

Setup station	
PT.name	<input type="text" value="SUN"/>
STN:	<input type="text"/>
STE:	<input type="text"/>
STZ:	<input type="text"/>
B. S	Clear Alph. Enter

Press soft key 'Alph.' (F3) to switch between letters and numbers.

Press key '1' displaying 'SUN1' in the column

Switch to 'Alph.' again

Press key '1' for once displaying 'SUN1A' in the column

Setup station	
PT.name	<input type="text" value="SUN1A"/>
STN:	<input type="text"/>
STE:	<input type="text"/>
STZ:	<input type="text"/>
B. S	Clear Alph. Enter

Press soft key 'Enter' to move inserter down to the STN column. The system switches to the number mode automatically and no letters can be inserted in at all. The page is as followed.

Setup station	
PT.name	SUN1A
STN:	
STE:	
STZ:	
B. S	Clear Alph. Enter

Press keys '±' '1' '2' '3' '.' '4' '5' '6' one by one.

Also, you can finish entering numbers first and then press '±' to alter its nature.

Now press 'ENT' to save the information entered.

Note : If the information exists in the column already, the first number or letter you enter will clear up the column and be the first character of the column.

5. Angle Mode

The instrument would enter the Angle Mode automatically when starting. You can also enter this Mode by pressing 'ANG' under basic measurement mode. This Mode involves two pages switched with soft key 'F4'. Their functions are explained as followed:

On the first page

Save: save the current angle to the selected file.

After pressing soft key 'F1', A dialogue box of 'Information' appears to the screen asking you to enter 'Point name', 'Code' and 'Target Height'. The natural name of the point is to add '1' to the previous point name. The code entered depends on your requirements and the target height depends on facts. Press 'ENT' to save measurement. P.S. If having not selected file at first when pressing 'Save' under Angle Mode, a dialogue box of 'Select File' will be on the screen before 'information'. You may now select file for saving.

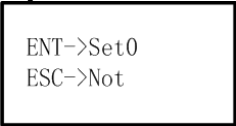
When the measurement is out of the scope of compensator, the instrument will display 'Tilt over!' and the measurement can't be saved.

If the measurement is saved successfully, the instrument displays box of 'Record:*****' for 0.5 second and switch back to the Angle Mode.

Set 0: set horizontal angle to zero

Press soft key 'F2'

The instrument displays:



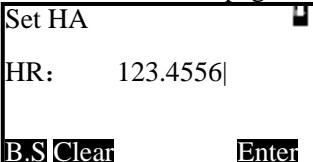
```
ENT->Set0
ESC->Not
```

Now press 'ENT' to set zero or 'ESC' to quit.

SetA: Set horizontal angle as desired degree

Press soft key 'F3' and the instrument enters page of 'Set HA'

If need to enter 123°45'56" under "°'" (degree minute and second) mode, then enter 123.4556. The page is as followed:



```
Set HA
HR:      123.4556|
B.S|Clear      Enter
```

Now press 'F4' to save the settings or 'ESC' to quit. If the set angle is greater than 360° , the instrument will display 'HA overtop!'

On the Second Page:

Hold: used to set horizontal angle

Turn around the alidade to the wanted horizontal angle and press soft key 'F1' and the readout of horizontal angle is 'hold' and not changing with turning the alidade again.

After turning the alidade to aim at the target, you may press soft key 'F1' again to set horizontal angle at a new position.

When the horizontal angle is hold, any key beside 'Hold' will don't work on the instrument.

L/R:

Press soft key 'F2', the horizontal angle column is switched between HR and HL modes.

HR indicates that the angle increases as turning the alidade clockwise.

HL indicates that the angle increases as turning the alidade anti-clockwise.

VA:

Press soft key 'F3', the vertical angle column is switched between Vz, Vo, Vh and V%

Vz is Zenith Mode

Vo indicates that when the telescope is leveled, the vertical angle is displayed as $0^{\circ}0'0''$ at face left.

Vh is vertical angle Mode (being 0 and has a positive angle of elevation and a negative angle of depression)

V% is Slope Mode. The range for slope that can be displayed is between -99.9999% and 99.9999%. If the slope is over the range, 'Overtop!' is displayed in the vertical angle column. When setting the horizontal angle, the angle is the azimuth angle of the target. The instrument may be switched to display coordinate azimuth through these operations.

6. Distance Mode

Press the key 'DIST' to enter the Distance Mode. There are two pages for Distance Mode switched by soft key 'F4'. The functions explanations are as followed:

On the First Page:

Save: save measurement

After pressing soft key 'F1', a dialogue box of 'Information' appears on the screen to ask you to enter 'Point name', 'Code' and 'Target Height'. The natural name of the point is to add '1' to the previous point name. The code entered depends on your requirements and the target height depends on facts. Press 'ENT' to save measurement. If having not selected file at first when pressing 'Save' under Distance Mode, a dialogue box of 'Select File' will be on the screen before 'information'. You may now select file for saving.

When the measurement is out of the scope of compensator, the instrument will display 'Tilt over!' and the measurement cannot be saved.

If the measurement is saved successfully, the instrument displays box of 'Record:*****' for 0.5 second and switch back to the Distance Mode.

Meas:

Measure the distance and display SD, HD, VD

Quit distance measurement with key 'ESC' under continue or tracking mode

Mode: used to select the working mode of the distance measuring device.

Sngl Rept 5 Cont Track

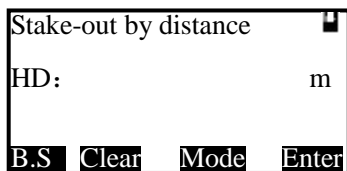
Use keys ▲ ▼ to move the indicator '>' to the wanted opt. Press 'ENT' to save setting. When selecting Rept (repeated), move the indicator '>' to it and use keys ◀ ▶ to choose the times for repeated measurement. The number of times can be between 3 and 9.

On the Second Page:

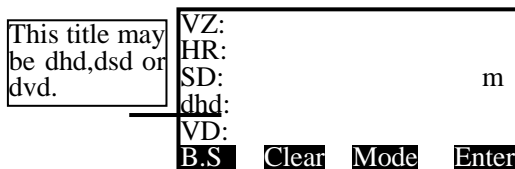
Offset: Enter the off-center (eccentric) measurement

See reference in 8. Offset

Stake: Stake out distances:



The key 'Mode' under this page is to switch the type of distance between HD, VD and SD. The default mode is HD. When finishing entering, press the soft key 'Enter' to enter 'stake-out by distance' mode as followed.



>dhd is to stake out horizontal distance difference. A positive result indicates that the measured horizontal distance is greater than the evaluated one. The lens should be moved to the instrument.

>dvd is to stake out difference between elevation differences. A positive result indicates that the measured elevation difference is greater than the evaluated one. The lens should be moved downwards (excavation).

>dsd is to stake out differences between slope distances. A positive result indicates that the measured slope distance is greater than the evaluated one. The lens should be shifted to the instrument.

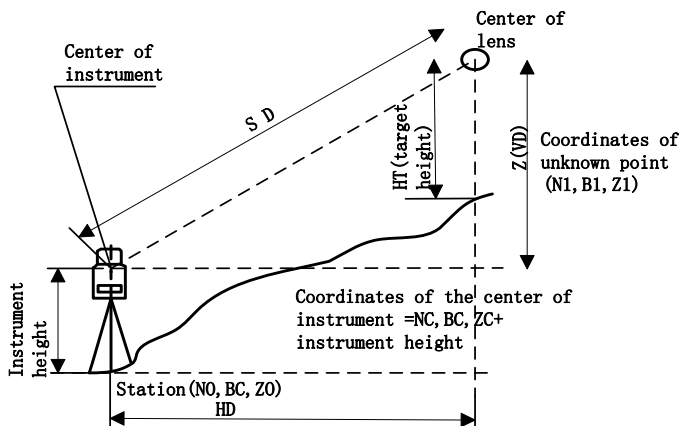
Every time a stake-out is finished, then go to the second page with soft key 'F4' and press 'F2' [Stake] to repeat the process, otherwise press 'DIST' to switch back to Distance Mode.

m/f/i: switch the units of the displayed distance between meters, feet, feet & inches

Notes: " " indicates that the distance measurement is in progress. Now pressing 'F1' or 'F2' appears " " or " " on the screen, which indicates that the distance measurement is in progress and displays the current measuring mode (S, R, C, T). When quitting distance measurement with 'ESC', the " " disappears. The " " indicates distance measurement with prism. " " indicates distance measurement without prism.

7. Coordinate Mode

Press the key 'CORD' to enter Coordinate Mode. According to the diagram below, please set up the coordinate of the station, azimuth angle, target height and instrument height before coordinate measurement.



Coordinate measurement diagram

There are three pages for the coordinate mode, being switched with soft key 'F4'. The functions explanation are as followed:

On the First Page:

Save: save measurement

After pressing soft key 'F1', a dialogue box of 'Information' appears to the screen to ask you to enter 'Point name', 'Code' and 'Target Height'. The natural name of the point is to add '1' to the previous point name. The code entered depends on your requirements and the target height depends on facts. Press 'ENT' to save measurement. If having not selected file at first when pressing 'Save' under Coordinate Mode, a dialogue box of 'Select File' will be on the screen before 'information'. You may now select file for saving.

When the measurement is out of the scope of compensator, the instrument will display 'Tilt over!', and the distance measurement don't work and the coordinate data can't be stored.

If the measurement is saved successfully, it displays box of 'Record:*****' for 0.5 second and switch back to the Coordinate Mode.

Meas:

Press soft key 'F2' to start EDM. The instrument will calculate out the coordinate of the target point and display the result. If the current distance measurement mode is continue or tracking mode, you may press 'ESC' to quit distance measurement, otherwise press 'ANG' or 'DIST' to stop distance measurement and switch to Angle or Distance Mode.

Mode: The same as the key 'Mode' under Distance Mode

On the Second Page:

Settings:

Press soft key 'F1' to enter the Settings of 'Height of Ins. & Target'

Height of Ins.&Target		
I.H:		
T.H:		m
B. S	Clear	Save Enter

After finishing entering, press 'ENT' or the soft key 'Save' to save the settings. However the settings will be erased when shutting off if using 'ENT' to save; inversely, using soft key 'Save' will remain the setting forever providing that there is no change of the setting. Press 'ESC' to quit without saving. If you want to check view the instrument height and target height ,you can go to the page above.

The range for I.H and T.H is between -99.999m to 99.999m. If over the range, a box of 'I.H overtop!' or 'T.H overtop!' will appear on the screen.

If you want the settings of height is effective for the next boot ,press soft key 'Save' to record the instrument height and target height into system file.

BSS:

Press soft key 'F2' to enter page of 'BBS' as followed:

Setup BBS			
PT.name			
BSN:			
BSE:			
BSZ:			
B.S	Clear	Alph.	Enter

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 “BBS” and pressing ‘ENT’, you need to aim at the “BS” (target point). After pressing ‘ENT’, the instrument will calculate the azimuth angle of the BBS, 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 [Set 0], [Set A] and [Hold] under Angle Mode or Coordinate Mode. If the orientation is already done under Angle Mode, you don’t need to set BBS again under Coordinate Mode.

you may enter the coordinate of BBS with keyboard or by pressing [M.Pt] to transfer from the measured file or from the file of known points [Known] as shown in the picture above.

Press the soft key ‘F3’ to select known points. Select a desired point from the current file and enter the list of points.

(A.COO)1/	
COOR: 1	
COOR: 2	
Begin	End View Search

Select the points with the keys ‘▲▼’ and press ‘ENT’ to save your choice. If cannot get the point, the coordinate will remain its origin and the instrument will display ‘Can’t be get!’.

Press ‘M.Pt’ to select coordinate data from the measurement file. Similar operation for using the soft key ‘Known’.

When pressing ‘ENT’ to end the dialogue, the system will ask you to aim at the BBS for concerns of orientation.

Tip: for your convenience to changing files when transferring the coordinate, We suggest you to establish a sub file for well categorized coordinate files and code files. It will help

you to remember the point names and to speed up the process of searching for points.

STA: The operation of entering “STA” is the same as that of setting 'BBS'. you must first operate 'STA' before setting 'BBS'

On the Third Page

Offset:

Press soft key 'F1' to operate 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 is divided into Angle Offset, Single/ Double- distance Offset, Plane Offset and Column Offset. See reference in 8. Offset Mode.

Stake:

Press soft key 'F2' to operate staking-out function. With this function, you may put designed data onto earth points. See reference in 9.2 Staking out

Set A:

Press soft key 'F3' to enter the current azimuth angle of 'BBS'. Mention that you must aim at the BBS to set up the angle.

8. Offset Mode

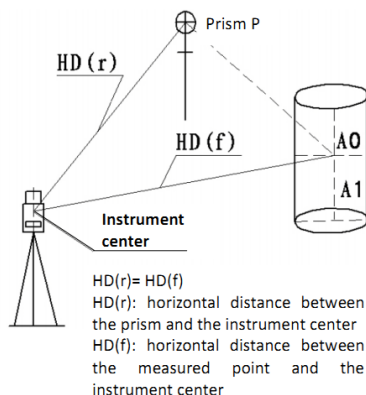
Offset function is designed to obtain coordinate information of the measured point when prism cannot be placed at the measured point or when distance measuring cannot be done. It includes five functions which are Angle Offset, Single/ Double-distance Offset, Plane Offset and Column Offset.

Before operating these functions, please set 'STA', orientation, instrument height and target height firstly.

Mention that when selecting any measurement mode including repeated, continue or tracking mode (beside single mode) for offset, you must first press the key 'ESC' to stop measuring before any followed operations.

8.1 Angle Offset Mode

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). Enter the page '1.Offset (Angle)' which is as followed:

Offset(angle)-Prism		
HR:		
SD:		m
HD:		
VD:		
Meas	T.H	Mode

Press
"Meas"

Offset(angle)-Prism		
HR:	200° 54' 21"	
SD:	11.775	m
HD:	11.773	
VD:	0.190	
Meas	Mode	Enter

The height of target(H.T) indicates the point where prism is placed. You may use the soft key 'T.H' to re-set the target height before measurement if needed. Press 'Meas' to start measuring. After measuring, press 'ENT' to enter the 'Offset (Angle)-Result' interface: The offset points here indicate 'A0' or 'A1'.

Offset(angle)-Result		
HR:	200° 54' 21"	
SD:	-10.998	m
HD:	-4.201	
VD:	0.190	
Next P	Record	

Now turn around the alidade to aim at the offset point.

After the steps above, the coordinate of the point is obtained, then press soft key 'Next P' to enter the offset measurement of the next point or press the key 'Record' to save the coordinate of the offset point.

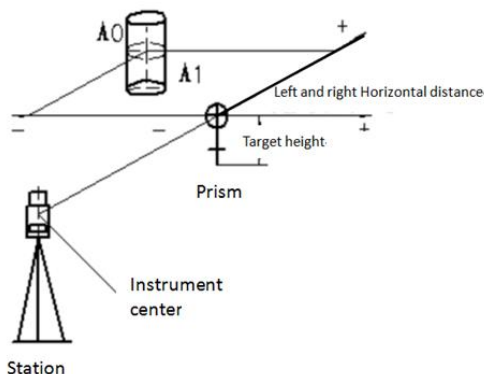
Finally, press the key 'ESC' to quit Angle Offset measurement

8.2 Single-Distance Offset Mode

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.

In order to measure the coordinate of 'A0', enter the offset distance 'oHD' as shown below and measure 'A1' under distance offset mode. The coordinate and the horizontal distance of the 'A0' can be displayed on the screen.

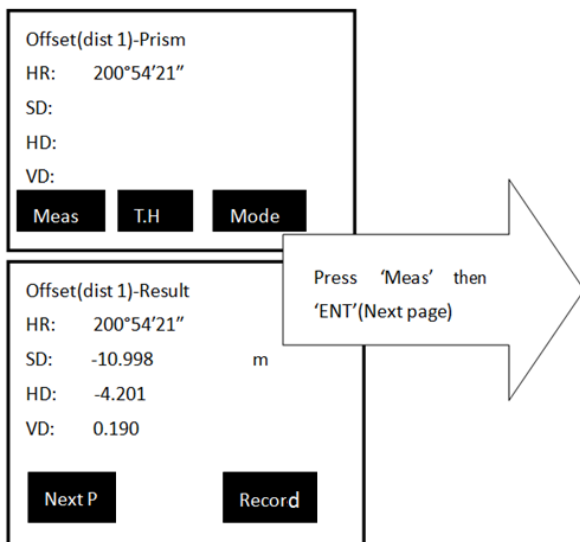


Enter the interface of '2. Offset (Dist 1)' from the offset menu.

Offset(dist 1)-Distance		
Left (-)/Right (+) OSD:		
<input type="text"/>		m
Front(-)/Behind (+) OSD		
<input type="text"/>		
B. S	Clear	Enter

See the meaning of '+' and '-' in the diagram of single-distance offset.

After entering the known offset distance, you can press 'ENT' to save the settings and enter the interface of 'Offset (Dist 1)—point'



Press 'Meas' to start measurement.

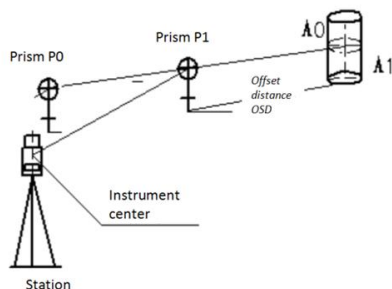
After measuring, press 'ENT' to enter the 'Offset(Dist1)-result' interface.

The result of the coordinate of the offset point will be displayed on the screen, if you want to measure next point ,press 'NextP'.If you want to save the result , press 'Record'.

Finally, press the key 'ESC' to quit Distance Offset measurement.

8.3 Double-Distance Offset Mode

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.



Enter the 'Offset(dist2)—distance' page through the offset menu.

Firstly, enter the offset distance (OSD). If the directions of 'P1-A0' and 'P0-P1' are the same, the distance is positive, otherwise it is negative.

Press 'ENT' or the soft key 'Enter' to save settings and enter the page of 'Offset(dist2)-begin'. To measure the point, you must aim at P0 as shown above.

After the measurement, press 'ENT' to end the dialogue and enter the page of 'Offset(dist2)—End'

After the measurement, press 'ENT' and the instrument is now displaying the coordinate of the measured point.

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

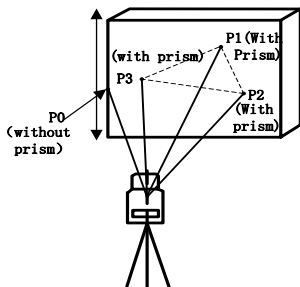
◆ If you need the coordinate of 'A1', you should set the height of prism to the real height.

8.4 Plane Offset Mode

Sometimes we wish to obtain the coordinate of some points where we cannot measure distance directly. Fortunately, we can measure the distances of another points, and all these points are in a plane. At this time the plane offset measurement can be used.

Firstly, you can 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.



Enter '4. Offset (Plane)' from the offset menu

Offset(Plane)-Pt.1		
HR:		
SD:		
HD:		
VD:		
Meas	Mode	Enter

Press the soft key 'Meas' to measure the first point 'P1'

After measurement, press 'ENT' to accept the result.

Mention that the target height is set to be zero automatically.

After pressing 'ENT', you can enter the interface of 'Offset (plane)—Pt.2'. Repeat the process for P2 and P3 as for P1.

After the three points are measured, enter the interface of 'offset (plane)—Result'

Offset(Plane)-Result	
HR:	195°20'16"
N:	-12.909
E:	-3.541
Z:	3.016
Meas	Record

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.

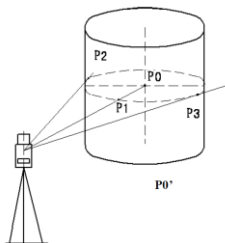
The result of the coordinate of the offset point will be displayed on the screen, if you want to measure next point ,press 'NextP'. If you want to save the result , press 'Record'.

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

8.5 Column Offset Mode

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.



Enter '5.Offset(column)' from the offset menu.

```
Offset(column)-Prism
HR:      181° 14' 01"
SD:
HD:
VD:
Meas T. H Enter
```

Press 'Meas' ->

```
Offset(column)-Prism
HR:      181° 14' 01"
N:        4.570
E:        4.458
Z:        1.004
Enter
```

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

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

Then press 'Meas' to start measurement. Press 'ENT' to accept the measurement result and enter the interface of 'Offset(column)—Left edge'

Offset(column)-left edge	
HR:	178° 54' 04"
SD:	4.570
HD:	4.458
VD:	1.004
Enter	

Press 'Enter' ->

Offset(column)-Right edge	
HR:	183° 58' 31"
SD:	4.570
HD:	4.458
VD:	1.004
Enter	

Aim at the left edge and press the soft key 'Enter'.

Enter the interface of 'Offset(column)—Right edge'. Aim at the right edge and press the soft key 'Enter'

Enter the interface of 'Offset(column)—Center' which displays the result of the Offset(column) measurement.

Offset(column)-Center	
HR:	181° 02' 16"
N:	-4.663
E:	-0.117
Z:	-1.004 m
B. S	Clear Enter

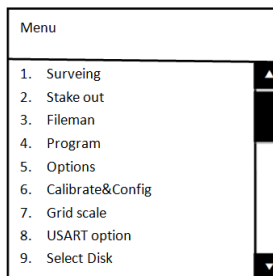
The result of the coordinate of the offset point will be displayed on the screen, if you want to measure next point ,press 'NextP'.If you want to save the result , press 'Record'.

Finally, press key 'ESC' to quit column Offset measurement

9. Operating Menu

Notes: The option 9 of the menu is not fully displayed. Please in kind prevail.

After Pressing 'MENU' under the basic measurement mode, a page appears as followed on the screen:



The available keys under the menu page :

‘▲’ Shift upwards by one column

‘▼’ Shift downwards by one column

‘◀’ Shift upwards by five columns

‘▶’ Shift downwards by five columns

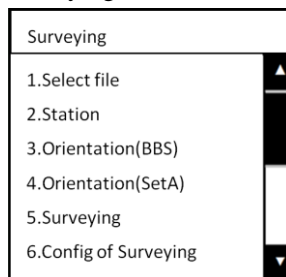
‘ENT’: Select the current column of function and enter its dialogue.

‘ESC’: Quit the menu

Numbers 1~9: be Pressed to enter the corresponding column of function. Each column are marked with a number. e.g pressing the key ‘7’ leads to an entrance to the interface of ‘Grid scale’.

9.1 Surveying

The functions of surveying are as followed:



9.1.1 Select files

The function ‘Surveying’ includes a sum of all preparation work before a survey, such as:

Select a measurement file to store and record the measured result, obtain the coordinate file for the known point, and search the code file for the code quickly, etc. As to the alignment file, it is specifically for staking out roadway.

The dialogue box of ‘select file’ is as followed:

Select file	
File(.MEA)	A.MEA
>File(.COO)	
File(.COD)	
File(.LH)	
Save	Enter

MEA= Measurement File, working for storing data

COO= Coordinate File, used when calling coordinate

COD= Code File, used when calling code

LH= LS= Defined alignment File, working for staking out roadway.

Use ▲ ▼ keys to move the indicator ‘>’ to the wanted type of file and press ‘Enter’ to enter the interface of the File list as followed:

F I L E	A.MEA
	TST1.MEA
	A.COD
New Del View Select	

Move the indicator to wanted file and press ‘ENT’ or the soft key ‘Enter’ to select it.

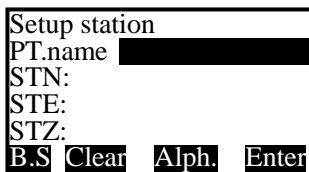
9.1.2 Setup station

The dialogue box followed includes all information about the station, which needs to be entered.

Setup Station	
>STA:	
Code:	
T.H:	0.000
[★]Select file	
Save	K.Pt Info. M.Pt.

You can enter the coordinate of the station with the keyboards or obtain from the coordinate files by pressing 'K.Pt'(Known points).

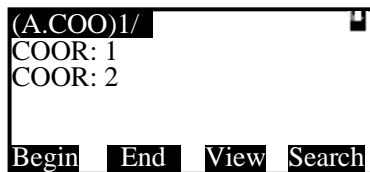
Press 'Input'(soft key F1) to enter the coordinate of a station manually.



Setup station
PT.name
STN:
STE:
STZ:
B.S Clear Alph. Enter

See the reference in 4.7 entering numbers and letters to set station.

Press 'K.Pt' (Soft key F2) to enter the interface of a coordinate file. Select the desired point and enter the list of points.



(A.COO)1/
COOR: 1
COOR: 2
Begin End View Search

Select the points with the keys '▲▼' and press 'ENT' to save your choice. If can't find the point, the coordinate will remain its origin value and the instrument will display 'Can't be get!'.

Press 'M.Pt' (Soft key F3). The operation is the same as that of 'K.Pt'

9.1.3 Setup BBS(back sight point)

Setting up BBS is to establish the relationship between earth coordinate and instrument coordinate.

The way to call the coordinate of the backsight point from the files is the same as that of setting up station under this function. After entering the coordinate of the BBS, you have to aim at the BBS to determine the azimuth. When finishing the set of BBS, the horizontal angle column on the screen is the earth azimuth angle.

After entering or call the coordinate of the BBS, a dialog box appears that 'Aim the BBS', and you can press 'Enter' to orient, otherwise, press 'ESC' to exit.

After pressing 'ENT', the coordinate of BBS is displayed on the screen. You can press 'Check' to measure the BBS and check the result.

HR:			
dHR:			
HD:			
dHD:			
dZ:			
Meas	Mode	Coord.	Save

After the measurement, the instrument displays the difference between the theoretical distance and the measured distance. Press the soft key F3 'Coord.' to display the coordinate of the current BBS. You can compare it with the entered value.

Press 'Save' to save the measured record.

9.1.4 Set azimuth

Setting the azimuth angle as same as to set up BBS, which is also to relate earth coordinate with the instrument coordinate. However, setting up azimuth angle is impossible when the azimuth angle of BBS is unknown. Please aim at the BBS and input the BBS azimuth angle first.

You can choose one of them, which are 'Orientation (BBS)' and 'Orientation (SetA)', because they both work for the orientation of BBS.

9.1.5 Surveying

T.H:	0.000m	
Pt.name:		
N: S	m	
E:		
Z:		
Offset	Save	EDM

If the instrument has be set 'survey first', it starts the coordinate measurement after pressing 'EDM'. As soon as the measurement is done successfully, the soft key 'record' appears. You can press 'Record' to enter the page of 'information' to edit the name and code and save the result.

If the instrument has be set 'edit first', after pressing soft key F4 'EDM', you may enter the 'Information' page firstly, then measurement. The operations are similar.

Press the soft key F2 'Offset' to enter the offset menu. Select one mode and start offset measurement.

Press the soft key F3 'Save' to start distance measurement. After a successful measurement, the coordinate will be saved automatically.

9.1.6 Config of Surveying

Use '◀▶' to select

Sequence

You can choose the 'survey first' or the 'edit first' under surveying mode.

Check the same name of point

you may choose to check or not to check if there is a duplicate of name in the list.

If choose to check, the instrument will first search for the duplicated name in the file when save the point. If a duplicated name is found, a box of 'duplicated name found!' will appear on the screen. Press 'ENT' to overlay or 'ESC' to quit and go back to the previous page.

If choose not to check, the instrument will directly save the coordinate of the point.

Edit point

You may choose it if need to edit the information of points when auto saving after measurement. If choose to edit 'manually', then the system will enter the page of 'Information' when pressing the soft key 'Save'. If choose to edit 'Auto', then the system will save the measurement automatically with point name added by one.

Record

It indicates whether to display the coordinate by sequence 'NEZ' or 'ENZ' when surveying.

9.2 Staking 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.

- 4.Input the coordinates of stakeout point ,then start to stake out

The Menu for staking out is as followed:

Stake	
1. I.H&T.H	▲
2. Station	
3. Orientation (BBS)	
4. Orientation (SetA)	
5. Stake out	
6. Fast station	▼

The ‘Setup Station’ and ‘Orientation (BBS)’ are the preparation work for staking out. If you have already setup station and orientation of ‘BBS’, re-setting them are not necessary.

9.2.1 Staking out points

Stake out XX point

Stake out:XX	
N:	m
E:	
Z:	
B.S	M.Pt.
Known	Enter

The coordinate point can be defined manually with keyboard entering. It can be also defined by calling coordinates from Measured points or Known points, which requires you to select a file in advance ,otherwise the system will go to page for selecting file automatically. You may also select file under this ‘Stake out: XX’ page by using starkey(★) function. If you have called coordinates once, the system will enter the page which the you have called coordinates from.

stakeout measurement

After defining the staking out coordinate, press ‘ENT’ to enter the interface of stakeout measurement.

HR:
dHR:
HD:
dHD:
dZ:
Meas
Mode
Coord.
Next.P

dHR: a negative value indicates a clockwise rotation of the alidade. Inversely, positive value indicates a anticlockwise rotation.

dHD: a positive value indicates that the lens should shift to the instrument. Inversely, a negative value indicates that it should shift away.

dN: a negative value indicates that the lens can reach to expected stakeout point if moving north. Inversely, it should move south.

dE: a negative value indicates that the lens can reach to expected stakeout point if moving east. Inversely, it should move west

dZ: a negative value indicates that the lens can reach to expected stakeout point if moving downwards (excavation). Inversely, it should move upwards (fill).

Nex.P: press it to stake out the next point. You may find the coordinate of the next point in the selected file and go back to the page of 'Stake out: XX'. Press 'ENT' to stake out the next point directly.

9.2.2 Fast station

When the current control station and the staking out point are not intervisible, you may have to set a new point as a control station. The fast station function is now helpful to you.

VZ:	90°12'22"
HR:	200°54'12"
N:	-10.756m
E:	8.607
Z:	-0.004
T.H	Mode Meas

Press 'Meas' to measure the coordinate of the new control station. Save it into proper file. 'Sequence', 'same point' and 'edit point' functions under 'Config of survey' is valid here as well.

9.2.3 Resection .

Enter the coordinate of the first point:

Resection-N0.1	
>Pt.name:	
Code:	
T.H:	1.000
[★]Select file	
Save	K. Pt
Info.	M. Pt.

To input, see reference in 'STA' of 'Coordinate measurement'. Press 'ENT' to enter the measurement page of 'Resection-No.1'

Resection-N0.1	
VZ:	77°18'30"
HR:	180°00'01"
HD:	4.978 m
T.H:	1.000
Mode	Angle Dist

Choose the method of angle or distance for the resection. If choosing distance mode, the instrument will start to measure. After a successful measurement, the system will display 'Next P'

Press soft key 'Next P'. Repeat the process above. After measuring three points, soft key 'Calc' will appear on the screen.

Resection-N0.3	
VZ:	17°18'30"
HR:	10°00'01"
HD:	4.978m
T.H:	1.000
Mode	Angle Dist

If do not need resection, then pressing 'Calc' to display the result of resection.

Resection-N0.3	
VZ:	77°18'30"
HR:	180°00'01"
HD:	4.978m
T.H:	1.000
Next P	Calc

Now press soft key 'F1' to setup station and record. After setting up station, you may find that the name of station becomes 'RESSTA' and the coordinate is the resection one. Press 'F4' to switch between 'Coord.' and 'dCoord.' (difference between coordinates).

Resection-result	
dN:	0.002
dE:	0.005
dZ:	0.005m
MdHD:	0.020
Record	dCoord

Coord.— the displayed coordinate is the NEZ coordinate of the instrument station.

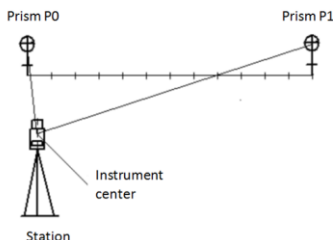
dCoord—the error of 'NEZ' coordinate when redundant observation exists in resection.

MdHD—the maximum error of evaluated distance. A large value of it indicates that an inaccurate coordinate of resection point or a error of BBS coordinate exists.

NaN—the calculation error. The maximum number of resection points is 5.

9.2.4 Equidistant stake-out

Sometimes you may need to stake out N points on a line uniformly. An equidistant stakeout is adequate in doing such work.



When undertaking equidistant stakeout, you may first measure the coordinate of the origin/begin (prism P0), then that of the terminal/end (prism P1).

After the measurement, the system enters a interface of 'Equidistant-input' as followed.

Equidistant-input	
Stakes:	
Space:	
B.S	Clear Enter

The 'stakes' must be set while the space can left blank.

If setting the stakes to be 12 with space left blank, then the middle points can be staked out uniformly during the following equidistant stakeout.

Space is the number of points staked out uniformly from the begin to the end.

The equidistant stakeout page is as followed:

HR:	
dHR:	
HD:	
dHD:	
dZ:	
Meas	Mode T.H N01

9.2.5 Entering coordinates

Sometimes, you may call a few of coordinate files when undertaking the following measurement. You may also input the coordinate and other information of the point manually and save them into the coordinate file for possible calling later on.

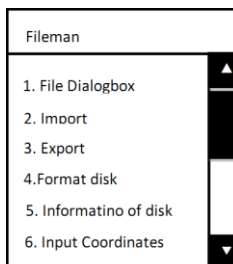
P.name:		
Code:		1
N:		◀
E:		▶
Z:		
BS	Clear	Num. Enter

The keys '◀▶' is to help you to scan the data of the points.

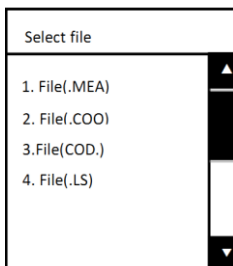
e.g '1' indicates the number of the point when it is recorded or scanned. After recording one record, press 'ENT' to accept the setting and enter the setting page of the next record. If you do not need the record any more, press 'ESC' to quit 'Input coordinates' function. The system will now ask you to save the record. After choosing 'save', the record will be saved into coordinate files.

9.3 File Management

The menu of 'fileman' is as followed:



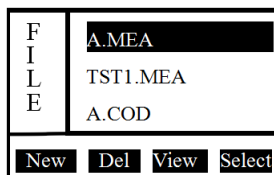
9.3.1 File dialogue box



Each file involves the operations of 'establish new files' (New), 'delete files' (Del) and 'view'(View), which is called File management here.

After choosing a tye of file, you may enter the file list which displays the names of files. Now take a measurement file as an example:

Select 'A001. File(.MEA)' and enter its page.



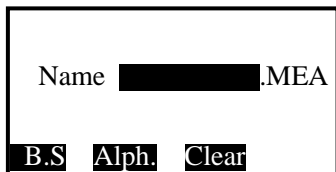
Now use ▲▼◀▶ keys to shift the indicator column to the wanted file.

Select: Press soft key 'Select' to select the current working file of the instrument. You may select your file repeatedly and the selection can be checked in the 'Select file' dialogue box.

MEA= Measurement File, working for storing data
COO= Coordinate File, used when calling coordinate
COD= Code File, used when calling code
LS= LH =Defined alignment File, working for staking out

roadway

New: create a new file in the instrument. After pressing soft key 'New', you will be asked to enter the file name.



The file type is the same as the file selected (under which you press 'New'). If the new file exists in the instrument, the system will not create the new file. Mention that the instrument will not warn you for duplicated name when establishing a same name file.

Del: delete the file which the indicator column indicates. A dialog box of 'Delete will lose data' appears on the screen when pressing soft key 'Del'. Press 'ESC' to quit or 'ENT' to delete.

View: when pressing soft key 'View' under coordinate file, then the system will display the coordinates one by one; under code file, the system will list out all codes in the file; under measurement file, the system displays the measured data under the current indicator column one by one. You can use ▲▼ keys to view the former or latter record. If you want to edit the data, press 'Edit' to edit the angle, distance, coordinate, point name, code and the height of target. Mention that the LS file cannot be viewed under the 'Select file' page. You can only 'view'[.LS] files by lining when staking out roadways.

9.3.2 Import

There are two ways to import files: One is importing from PC, another is importing from USB.

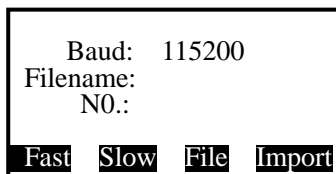
All files in the instrument are binary. To import data from the external into instruments, you must import the files. The import function supports transformation of ASCII code coordinate files, code files and LS files into binary files.

The files are categorized by their suffixes.

Thus, please pay attention to the file types when importing files, otherwise a failure in importing may occur. e.g when importing code files, you must select files with suffix '.COD' and import .COD files into PC machine.

Importing from PC

Press the "MENU" button to enter the menu screen, and select "Import file" option, then enter the interface of file import to select the "Import from PC" option, the window as shown below:



The screenshot shows a rectangular window with a black border. Inside, the text is as follows:
Baud: 115200
Filename:
NO.:
At the bottom of the window, there is a row of four buttons: 'Fast', 'Slow', 'File', and 'Import'. Each button has a black background and white text.

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. This bauds can be set with soft keys 'Fast' and 'Slow'. Usually, 115200 Baud is adequate for importing.

File: to be used to select a file for storage of the imported data. After pressing 'File', a box that asks you to select file will appear to the screen. Shift the indicator '>' to the wanted file and press 'ENT' to select. You may establish a new file if not finding an adequate file.

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 codes and defined line files will refresh all records automatically.

Import from USB disk

The imported file which from U disk must be a a text format file and only it is saved in the "ts_prj \ import" directory of the U disk can be identified. The format of the text file is "PT, E, N, Z, CODE". Each line of the data from text file ends with "Enter+Linefeed " and the last line of the data must be coupled with a " Enter+Linefeed ", or it will be missed in the last line. In the USB interface, you should insert U disk and turn on the instrument. Press the "MENU" button to enter the menu screen, then select "File Import" to enter the file imported menu, select "Import from a USB " to enter the importing function interface, which is shown below:

From:	
Filename:	
No.:	
From	File Import

If the current coordinate file is saved in the flash memory of the instrument, the name of it is the "filename" by default. Press the "From", and then press the "Select" to select ".txt" file under the corresponding directory, which is desired to be imported in the file list of U disk. For example, if we select the file of '0712.txt', press the "File" button to choose file of coordinates which you want to import (there you can create a new file) such as SVY.COO, then the interface is shown below:

From:	0712.TXT
Filename:	SVY.COO
No.:	
From	File Import

Press the "Import" button, the coordinates data in "0712.txt" will be imported to the SVY.COO file of Total Station, then you can view the data in the menu of maintenance file.

9.3.3 Export

There are two ways to export the file: one is exporting to PC, another is exporting to USB.

1.Export to PC

Press "MENU" to enter the menu screen, select "File Export" to enter the file export screen, then select "Export to PC" option, the export window as shown below:

From:	115200
Filename:	A.MEA
NO.:	
From	File Export

The only files able to be exported are the measurement files. See references of the soft keys in [9.3.2](#)

The connected computer may be ready to receive files when exporting without special operations. The exported file will be in the format of ASCII. See explanations for forms in [Appendix B](#).

2. Export to USB

AT the USB port of instrument, Connect U disk and turn on. Press "MENU" button to enter the menu screen, and select "Export " to enter the menu of export file, then select "Export to USB " , the exporting window as shown below (the file exported is defaulted to be measurement file , and you can re-select).

Filename:	455.MEA
Exported:	455.TXT
No.:	
<div><div>File</div><div>Export</div></div>	

Select "File" button to choose the file you want to export, and the file name exported is defaulted to be a text format file which is the same name of measurement file. Press the "Export" to export the data of a measurement file in the U disk "ts_prj \ import" directory. The format of data exported is text ,and it can be processed by transfer software on PC.

9.3.4 Format disk

After pressing '4.Format disk', a dialog box of 'Warning! Formatting will lose data. Export data first.' will appear on the screen. Press 'ENT' to continue formatting, otherwise 'ESC' to quit.

After formatting, all record in the instrument will disappear. Please pay special attention to it.

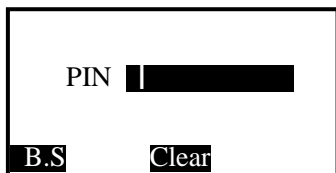
9.3.5 Information of disk

A dialog box which displays the space available in unit KB of the electrical disk in the instrument will appear on the screen when entering the interface of "Information of disk". The measurement data of ten points approximately occupy 1KB.

9.3.6 Entering coordinates

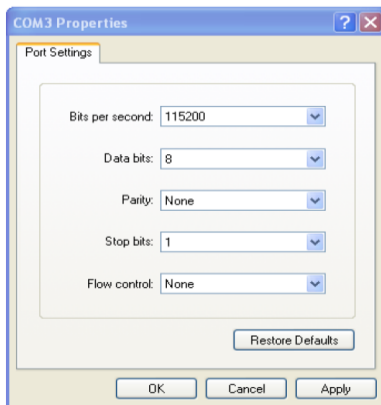
See reference in [9.2.5](#)

9.3.7 Update



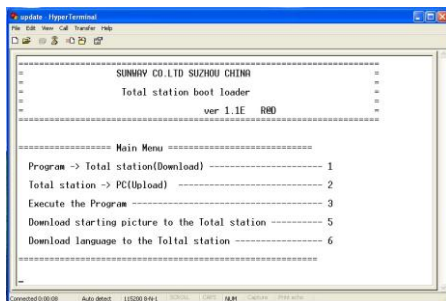
1. Enter PIN code (82543) and press 'ENT'. The instrument will power off automatically.

2. Connect the instrument to the computer through serial port connector. Open the hyper terminal software and 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.

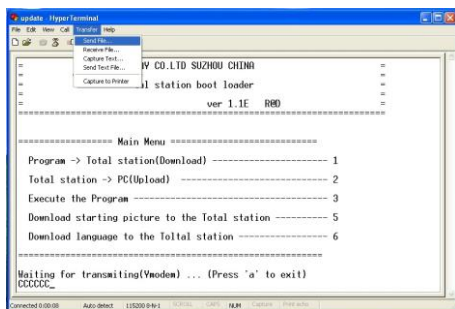


3. Press key 'On/Off' on the instrument. The page of hyper terminal is as followed:

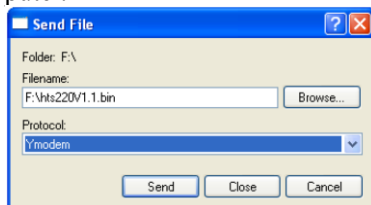
Note: you must be specifically cautious when updating. As soon as you choose to update, the instrument will enter updating mode. If pressing key '3' under the page shown below, the previous program may be resumed.



4. Press key '1' on the instrument. The instrument enters wait 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, please close the hyper terminal. Before starting and operating the instrument, please first unload the battery of it and then load it with battery again. The instrument is successfully updated now.

7. Press **【6】** button to upgrade the language file and the operating method is similar with upgrading the application. The **【5】** button is useless.

9.3.8 The instrument as a memory disc

You can use Mini USB connector to connect the instrument to PC machine. The USB port is below the SD card port. Start the instrument after connection.

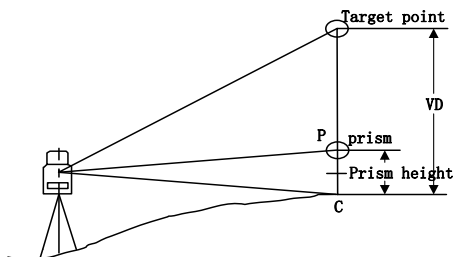
The total station is now recognized as a memory disc by PC machine. After opening the instrument file on PC machine, you can view the files saved in the instrument. Also, you can copy files to PC machine. Disconnect the PC machine to operate the instrument normally.

Note: never delete or alter the two '.sys' files in the instrument. Do not copy senseless files that have nothing to do with the total station measurements.

9.4 Programs

9.4.1 Remote height (REM)

REM is adequate for measuring the height of target 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: 'with TH' and 'without TH'. You can select 'with 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.

With TH:

1. Enter the height of instrument and the height of target firstly.
2. Press 'ENT' to enter the interface of 'REM-Prism'

REM-Prism	
VZ:	77°18'30"
SD:	169°11'14"
HD:	4.351m
Meas	Mode

3. Aim at the prism and press the soft key 'Meas' to obtain the horizontal distance of the target from the instrument. Then, press the soft key 'Enter' to enter the interface of 'REM-Ground to target'

REM-Ground to target	
VZ:	77°18'30"
SD:	169°11'14"
HD:	0.000m
T.H	HDist

4. 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.

5. 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.

Without TH

1. The system goes to 'REM-prism' page directly.

REM-Prism	
VZ:	77°34'50"
SD:	169°11'14"
HD:	4.357m
Meas	Mode
Enter	

2. Aim at the prism and press the soft key 'Meas' to measure the horizontal distance of the prism from the instrument. Press the soft key 'Enter' to enter the interface of 'REM-Base'.

REM-Base	
VZ:	77°29'53"
SD:	169°11'14"
HD:	0.000m
Select	

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

REM-Altitude	
VZ:	93°35'08"
HR:	169°11'14"
VD:	-1.081m
Set VA HDist	

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

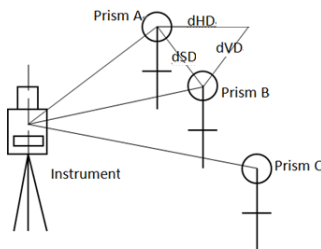
5. After the measurement, you have three opts:

'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



Measure the horizontal distance (dHD), slope distance (dSD), elevation difference (dVD) and azimuth angle (dHD) between two target. You may also enter the coordinate or call 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 'Considering 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'.

MLM(A-B,A-C)-Step1	
VZ:	69°12'13"
HR:	170°12'21"
HD:	4.358m
Meas	T.H Coord. Mode

2. You may measure the coordinate of the starting point by pressing soft key 'Meas' under this page, or you may enter its coordinate manually by pressing soft key 'Coord.'

Press 'ENT' to enter the interface of 'MLM(A-B,A-C-Step 2)'. Please enter the height of target before measurement.

MLM(A-B,A-C)-Step2	
VZ:	69°12'13"
HR:	210°58'15"
HD:	5.268m
Meas	T.H Coord. Mode

3. Enter the coordinate as the same way of the process on 'step-1' page. Then, press 'ENT' to enter the interface of 'MLM(1-B,A-C)-Result'.

MLM(A-B,A-C)-Result	
dSD:	-3.852
dHD:	-3.836
dVD:	0.344m
HR:	90°30'35"
Next P	

4. Then, it displays the result of MLM measurement. You can press soft key 'Next P.' to continue MLM Measurement, and repeat the 'Step-2' and 'Result' pages.

The measuring process under MLM(A-C,B-C) is all the same as that of MLM(A-B,A-C). See reference above.

9.4.3 Polar Coord. Measurement

The Polar coordinate measurement helps you to export polar coordinates . The operate is below:

1. Select the 'Polar Coord. Measurement' in Program menu.
2. Enter the information of station. Mention that the station name must be defined while code can be left blank. Then, enter the height of target and press 'ENT' to save the settings ,after that above,you can enter the interface of 'Setup BBS'
3. Enter the information of BBS. Mention that the BBS name must be defined while code can be left blank. Enter the height of target and press 'ENT' to continue.

4. Aim at the BS following the prompt on the screen. As soon as pressing 'ENT' to finish setting up station, the instrument will undertake a measurement automatically. Horizontal Angle is set zero and a piece of data for edge and angle is saved.

5. After setting up station, you may stimulate process in surveying to survey polar coordinates.

See process of setting up station and BBS in surveying.

Note: If right-angle buzz is on currently, it will buzzes constantly after orientation. You can turn the instrument around to close the buzz. Also you can switch the right-angle buzz off.

9.4.4 Coord.Z

Use the measured coordinate of known point to calculate and reset the Z-coordinate of station .

The coordinates of known point can be called from coordinate file or can be entered with keyboard. The operation is as followed:

1. Prompt 'Setup station' to ask you whether want to setup station. Press 'ENT' to setup.
2. Enter the 'Coord.Z-No.1' page

Coord.Z-No.1	
>Pt.name:	
Code:	
T.H:	0.000
[★]Select file	
<u>Input</u>	<u>K.Pt</u> <u>Info.</u> <u>M.Pt.</u>

To define 'Coord.Z-No.1', follow the process of defining BBS. Press 'ENT' to confirm and end the dialogue to enter 'Coord.Z-No.1' measurement page.

Coord.Z-No.1		
HR:	77°34'50"	
SD:		
HD:		m
VD:		
Meas	Mode	Enter

3. Press soft key 'Meas' to start measurement. After the measurement, the 'HR''SD''VD' are displayed on each column. Press soft key 'Enter' to accept the measurement. If accepting, soft keys 'Next' and 'Calc' will appear on the screen. Press 'Next' to define and measure the second point (Coord.Z-No.2), otherwise press 'Calc' to enter 'Coord.Z-Result' page.

Coord.Z-Result		
BSA:	170°12'23"	
Z:	1.234	
dZ:	0.001m	
		SetZ

Then you may use 'SetZ' to set the z coordinate of the station. You may also use soft key 'Set A' to set the BBS of the instrument. Press 'ESC' to quit coordinate measurement.

9.4.5 Area

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

1. Enter the interface of 'Survey(Area)'

Survey(Area)		
Pt01:	2500.000	75.000
Input	Meas	Del

2. Press soft key 'Input' to call coordinates from coordinate file or input the coordinates manually with keyboard. The coordinates are all listed in the screen and the maximum number of points when Area Surveying is 20.

The inputted or measured coordinate is inserted below the indicator column, which determine the shape of the formed area.

3. The area enclosed is the connection of line from the begin to the end (begin) 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.

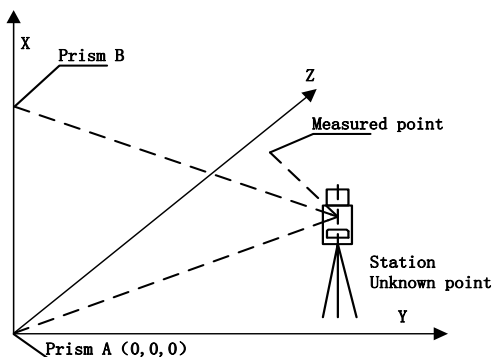
4. At any time the number of points reaches 3, the calculation is available and the soft key 'Calc' appears on the screen. Press 'Calc' to display the area and circumference of the enclosed shape. Press 'ESC' to quit the area survey.

How to input coordinates:

Press soft key 'Input' and enter 'Point/Area' page

Press 'F2' to list out all coordinates in the current measurement file. Press 'F3' to list out all coordinates in the current coordinate file. The operations above are used for all pages to input NEZ coordinates.

9.4.6 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 is: setting up the instrument height, the target height and defining the baseline.

Define baseline: Press soft key 'Meas' under the page of 'Project(Begin)' to start measurement. After the measurement of begin point, press soft key 'Enter' to measure the end point, following the steps of measuring begin. Finally, press soft key 'Enter' to end the defining of the baseline. Now you may start projecting.

Projection survey: Press soft key 'Meas' under the page of 'Survey(Projection)' to start measurement. After the

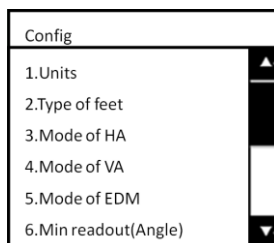
measurement, the deviated length(X), distance(Y) and altitude difference(Z) are displayed on the screen.

The soft key 'T.H' is used to reset the height of target. The soft key 'Mode' is used to switch between displaying 'rN, rE, rZ' and displaying 'SD, HD, VD' of the measured point from the baseline projection point.

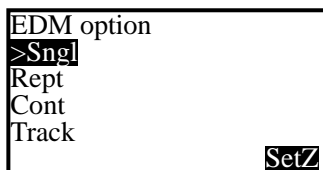
9.4.7 Roadway

See reference in 10. Roadway

9.5 Options



Take the '5.Mode of EDM' as an example:



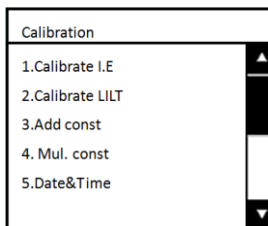
Use keys ▲ ▼ to move the indicator '>' up and down to the wanted opt. Press soft key 'Enter' to confirm your choice. The instrument will display box of 'saved' and the setting remains even after shutting down. Afterwards, the default EDM mode of the instrument will be that of your choice until next time you change the setting.

All the other settings under 'Config' menu are similar to 'Mode of EDM'. Please refer to the explanation above.

Notes: the 'NEZ' or 'ENZ' mode of coordinates are in relation to the order of the exported coordinate only.

9.6 Calibrate &config

The menu is as below:



9.6.1 Adjusting index error(I.E)

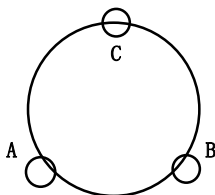
To adjust index error, the system will first ask you to 'Aim at a target F1'. You may press 'ENT' to confirm after aiming and the instrument will measure its horizontal angle automatically. The HA will be displayed for one second and the system will ask you to 'Aim at a target F2'. Following the same 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).

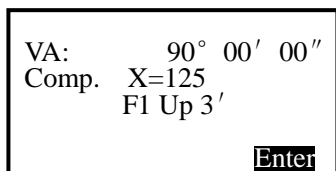
9.6.2 Calibrate TILT

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 the dialog of tilt calibration program:



1. After leveling the instrument, aim at the target F1 in the collimator with direct telescope, record the current vertical angle as V0.

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. Press 'ENT' to confirm after a stable readout appears.

3. 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.

4. Set the vertical angle to V0 with the help of vertical tangent screw. Adjust the screw C to aim at the target precisely.

5. Aim at the target F2 in the collimator with reverse telescope and record the current vertical angle as V1.

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.

7. 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.

Tips: Don't worry if cannot remember the exact order of steps. All the above will be displayed on the screen as small prompts. e.g 'F2 Up 3'.

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.

Notes: Co.k (linear coefficient) must be less than 1.5;

Co.Z (zero position) is normally between -20 and +20, otherwise the compensator(tilt) must be adjusted mechanically.

9.6.3 Add const&Mul. Const

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.

9.6.4 Date and Time

Date & Time		
Date:	130401	
Time:	161033	
B.S	Clear	Enter

The order of the entered figures is:

Date: 'two last figures of year + XXXX(date)'

Time: 'XX(hour)+ XX(minute) + XX(second)'

Press 'Enter' to save.

Notice: a '0' to occupy a place for month or days with single figures is required. e.g Second the March= 0203

9.7 Grid Factor

Formula:

1) Altitude factor= $R / (R + \text{Altitude})$

R:the earth's average curvature radius

Altitude: Altitude above the mean sea level

2) Scale factor:the measurement station scale factor

3) Grid scale factor :Altitude factor \times Scale factor

grid distance:

1)Grid scale distance(HDg)= HD \times Grid scale factor

HD= distance on the ground

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

Grid scale		
= 0.999984		
Altitude:	100	
Scale:	1.000000	
B. S	Clear	Enter

Input altitude in the 'Altitude' column and press soft key 'Enter' to calculate the Grid scale factor as shown in the picture above. Press 'ENT' to save the Grid scale and end the dialogue box. A box saying 'Saved' will flash once.

When the calculated grid factor is less than 0.99 or greater than 1.01 ,it indicates that one of the input between altitude and scale is wrong, the system cannot receive the grid scale at this moment, so you must input again. Use "ESC " button to exit without saving.

9.8 USART option

RS232C means that when two-way communication, the system will export and import through the RS232C port.

Bluetooth means that when two-way communication, the system will export and import through Bluetooth device .

9.9 Selecting disc

FLASH means that the working files and coordinate files will be saved into the internal storage.

SD means that the working files and coordinate files will be saved into the SD card.

USB means that the working files and coordinate files will be saved into USB memory disc.

After choosing a disc, the following measurement data and coordinate data etc. will be saved into the selected disc

After changing the storing disc, the system will ask you to re-select files.

10. Roadway

To open roadway program, follows 'Menu→4.Prog.→7. 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.

The menu of roadway is as followed:

Road
1.Open shape file
2.Re-define(H)
3.Re-define(V)
4.Resume H curve
5.Resume V curve
6.Stake out(road)

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 roadway', 'Resume H curve' or 'Resume V curve'.

10.1 Inputting Roadway

Roadway design requires to input horizontal alignment and vertical alignment. The input will be saved to[. LS] files. The maximum number for elements is 21 in each file and the number of intersection cannot be greater than 7.

10.1.1 Horizontal alignment

An input for roadway design.

The element method

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

Enter the 'Define (H)' dialog:

Define(H)	
Mileage:	0.0000
Azimuth:	0°00'00"
Line	Circle
Spiral	I.P

If the first time you select 'I.P' (input intersection point), then the method to input will be I.P afterwards. The first point

inputted is 'Define (H)- Begin'. Press 'ENT' to confirm and end the input box of 'Begin' point. If you have not input anything, there will be no response from the instrument. You may also quit 'Define (H)' by pressing 'ESC'.

You may define horizontal alignment with 'Line', 'Circle' or 'Spiral' alternately.

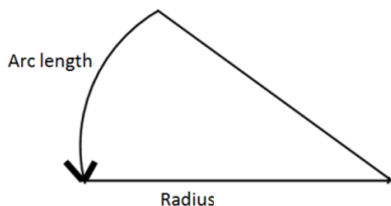
Note: Do not define the length as '0--0', which serves for ending alignment.

Input 'line':

Define(H)-Line		
Azimuth:	<input type="text" value="0.0000"/>	
Length:	<input type="text"/>	
B.S	Clear	Enter

Input 'Circle':

Define(H)-Circle		
Radius:	<input type="text"/>	
Length:	<input type="text"/>	
B.S	Clear	Enter



The input of Radius can be negative. The positive direction is the right direction along the designed roadway, and the left is negative. The length refers to Arc length.

Input 'Spiral'

Define(H)-Spiral		
Radius:	<input type="text"/>	
Length:	<input type="text"/>	
B.S	Clear	Enter

The radius and length here is the same as those in 'Define (H)- Circle' above.

After defining Line, Circle or Spiral, press 'ENT' to accept the input and end the dialogue. The system goes back to 'Define (H)' page. If you want to check or end the inputting now, press 'ENT'. The system will go to 'List of H curve'

List of H curve	
01ST:	45.000
02 LI:	45.000
03 LI:	45.000
04 CI:	123.000
Save	View Add

Now press soft key 'save' to save and quit the box.

If choosing 'view', the system lists out the information of the inputted element. e.g.

Edit-Spiral	
Radius:	255.000
Length:	314.115
Edit	PgUP PgDn

If you found errors here, you may press the soft key 'Edit' to edit it now. Check other elements one by one with the keys 'PgUp' or 'PgDn'.

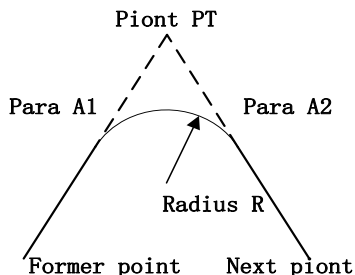
Press 'Add' to continue the input of Horizontal alignment.

The Intersection method

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

N:(Pt.1)
E:
Radius:
A1:
A2:
B.S Clear Enter

The column 'Pt.1' is in relation to your inputted intersection number.



The system will not accept negative Para. A1, Para. A2 nor Radius R. If inputting the radius, then the system will insert a arc with defined radius in between the former point and the next point. If inputting parameters A1 and A2 of the spiral, then the system will insert defined spiral in 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:

$$A1 = \sqrt{L1 \cdot \text{Radius}}$$

$$A2 = \sqrt{L2 \cdot \text{Radius}}$$

Press 'ENT' to input the next intersection now. If the coordinates of N,E and radius are not entered at all, there will be no response from the instrument. If inputting is done, press 'ESC' to quit the dialogue. The system will then goes to 'List of H curve'.

Now press 'Save' to save the information into [.LS] files.

Press 'View' to check the inputted data and edit them.

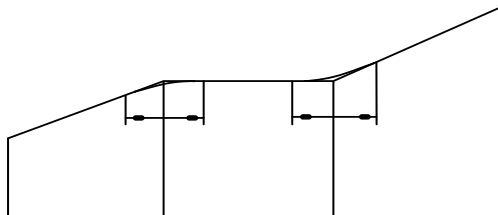
Press 'Add' to go back to the 'Define (H)' page to continue defining horizontal alignment. Repeat the steps above until the inputting are finished. Go back to Roadway Menu

If you want to continue inputting, choose '4. Resume H curve' under the roadway menu.

10.1.2 Vertical Alignment

Vertical alignment is formed by a group of intersection points. The intersection points includes 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 12 under the vertical alignment .



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

Choose 'Re-define (V)' to enter the box of 'Define(V)-Begin':

Define(V)-Begin

Mileage:

Altitude:

Length:

B.S **Clear** **Enter**

Input the mileage, altitude and length one by one and press 'ESC' to end the input and go to 'List of V curve' page. The uses of 'Save', 'View' and 'Edit' →

You may continue inputting (V) curve through '5.Resume V curve'.

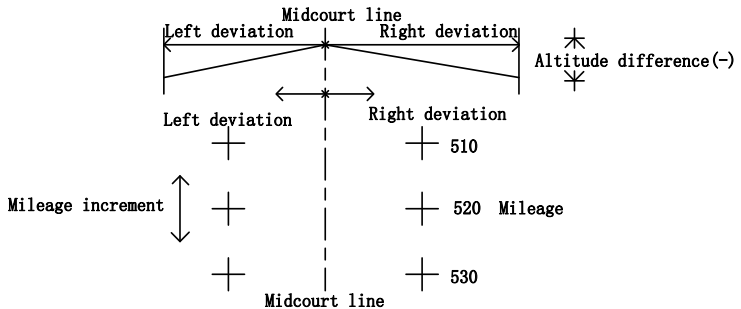
After finishing defining H and V curve, the last input will be saved in the buffer cache and will be erased when shutting the instrument down. The data can be used to staking out roadway immediately if needed.

10.2 Staking out Roadway

You can use 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 12 point of vertical alignment, because you can divide any long road into several pieces and save them into several line type files.

The terms of staking out roadway:



The steps for staking out road way is as followed:

1. Select [.LS] files for stake-out
2. Setup station
3. Setup BBS
4. Inputting Roadway parameters, including mileage of begin (start mileage), pile spacing, left and right deviation (Left/Right dist) and 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) Menu→4.Program→7.Roadway→1.Open shape file
- 2) Menu→4.Program→7.Roadway→6.Stake out (road)→1.Select file.

Both ways above lead to page of 'select file'. Shift indicator '>' down to the opt 'File (.LH)' and press soft key 'Enter'. The system will list out the available [.LS] files. After selecting file, press 'ENT' to load the buffer storage cache with the selected [.LS] file. If you have already open the shape file successfully and the page of 'Select file' remains, then press 'ESC' to end the dialogue. If not, then repeat the steps above until the a file is selected and opened.

10.2.2 Setting stations and BBS (back-sight points)

See reference in setup BBS and setup station.

10.2.3 Staking out Roadway

Before staking out Roadway, please first enter the parameters required for staking out. e.g starting mileage, space

between, left distance, right distance, left dV and right dV. Press 'ENT' to enter 'Roadway- Center' page. 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'

Press 'Stake' under this page:

Pt.name
Code:
N:
E:
Z:
Record Enter

Point name indicates the mileage of the selected stake. The system accepts maximum 8 characters of the point name. You may now press 'Record' to save the point to be staked out to the current coordinate file, otherwise, press 'ENT' to display the azimuth angle and horizontal distance of it.

Rodeway-Cal
HR:
HD:
Dist Coord.

You may now press 'Dist' to stake out polar coordinate or 'Coord.' to stake out coordinates. See reference in [9.4.3 Polar Coord.](#) Measurement and [9.2.1 Stake out.](#) Press 'ESC' under all pages above to go back to 'Roadway-Center/right/left' page.

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

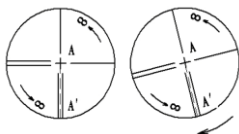
if the bubbles is not in the center, use the correction needle or six angle wrench to adjust the correction screw which under the bubble to make the bubble to the center. For calibration, you shall first loosen the calibration screw (1 or 2) which opposite to the direction of the bubble offset, then 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 Reticule of the telescope

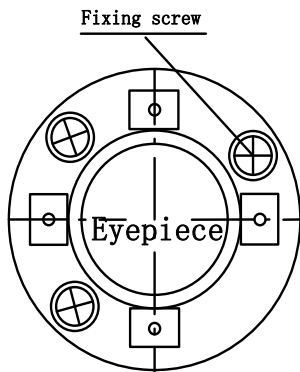
Check

1. Aim at a target A from the telescope after leveling the instrument the cross wire on the reticule. 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).
3. If '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 A point 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 reticule cover between telescope eyepiece and focusing handwheel, and you can see four fixed screw of the reticle bed (see 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 reticule.



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

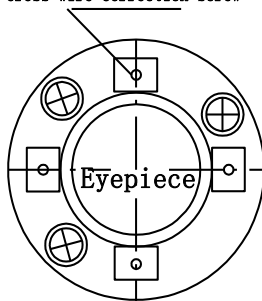
Check

1. Set a target A in about 100m away, and make sure the vertical angle of the target is within $\pm 3^\circ$. 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) = $10^\circ 13' 10''$
3. Loosen the vertical and horizontal brake handwheel, 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 handwheel and read the horizontal angle.
e.g. HA (R) = $190^\circ 13' 40''$
4. If $2C = L - (R \pm 180^\circ) = -30'' \geq \pm 20''$, 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.
 $R + C = 190^\circ 13' 40'' - 15'' = 190^\circ 13' 25''$.
2. Take down the reticule bed cover between the telescope eyepiece and focusing handwheel, 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 $|2C| < 10$.
4. Tighten the calibration screws, put the protective cover back.

Cross wire correction screw



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 handwheel 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 $i = (L+R-180^\circ)/2$ or Angle $i = (L+R-540^\circ)/2$
4. If $|i| \geq 10''$, may be you need reset the zero value of vertical index.

5. The following steps see reference in 9.6.1.

Note: Repeat the checkout steps to retest the index error again (i Angle). If the index error still can not 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

1. 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.

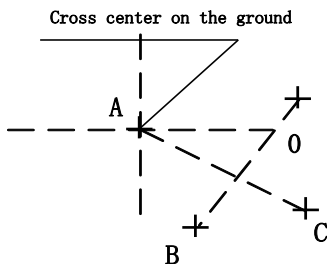
Calibration

1. Take down the screw cover between the optical plummet eyepiece and the focusing handwheel.

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 $|K| > 5 \text{ mm}$,it should be send to standard baseline field for strict checking, then 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-> 3" 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 deviate 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, will need to send it 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-320(R)
<i>Angle measurement (Hz, V)</i>	
Theory used	Absolute encoder
Minimum reading	1"
Precision	2"
<i>Telescope</i>	
Magnification	30x
Field of view	1°30'
shortest target distance	1.5m
Reticle	illuminated
<i>Compensator</i>	
System	Integrated liquid single-axis compensator
Working range	±3'
Setting Accuracy	1"
<i>Distance measurement (IR)</i>	
Ranging with single prism under fine/middling pressure	2000m/2500m
Ranging with reflector	800m
Precision (precise, coarse measurement, tracking)	2mm±2ppm
Measuring time (single/repeated/tracking)	2.4s/ 1s/ 0.6s
<i>Distance measuring with No-prism</i>	
Ranging with white target plate	350m (for short distance with no prism measurement)
Ranging with single prism	>7500m
Precision (short distance/tracking/prism)	3mm±2ppm
Time for a measurement (short distance / tracking / prism)	2~6 s
<i>Communication</i>	
Internal data storage	20000 points
Port	Standard RS232 serial port
Data format	ASCII
<i>Operation</i>	
Operating system	RTS
Display	Graphics: 192x96 pixel; Characters: 6 lines x 25

	characters; LCD
Keyboard(Optional 2nd keyboard)	Double-sided numeric keyboard
<i>Laser Plumb</i>	
Type	Laser point, brightness adjustable in steps
Accuracy	1mm (instrument height: 1.5m)
<i>Environment conditions</i>	
Temperature range (operation)	-20°C ~+50°C
Temperature range (storage)	-40°C ~+70°C
Water proof & dust proof (according to standard IEC60529)	IP54
<i>Weight</i>	
Weight including battery and tribrach	5.5kg
Battery supply	
Type	High-energy lithium battery
Voltage / capacity	7.4 V; 3000 mAh
Working duration	16 hours (under 25 °C with a fully charged battery, measuring once for every thirty minutes) Constant angle measuring mode
Number of measurements	About 12000

Appendix A: Explanation of file formats

Explanation of formats of files:

STA	ST001, 1.2050, AD
XYZ	100.0000, 100.0000, 10.0000
SS	BS001, 1.8000, BA
NEZ	200.0000, 200.0000, 10.0000
SC	A1, 1.8000, CODE1
NEZ	104.6625, 99.5679, 10.2148
SD	A2, 1.8000, CODE1
HVD	1276939, 288678, 4.7510
SA	A3, 1.8000, CODE1
HV	1276942, 288678

Every record consists of two lines:

1st line records the record type, point name, target height,
code

e.g. STA = station point

SS = BBS (backsight point)

SC = coordinate data

SD = distance measured

SA = angle measured

2nd line records the data type and the data record

e.g. NEZ = the following figures are coordinates

ENZ = the following figures are coordinates

HVD = the following figures are horizontal angle, vertical
angle and slope correspondingly

HV = the following figures are horizontal angle and vertical
angle correspondingly

Appendix B Explanation of Protocol command

Another device can operate Total station through RS232 or Bluetooth by using the commands as follow:

"\006006",0-- command correct response
"\021021",1-- command incorrect response
"C067\003",2-- measure and return the data
"N078\003",3-- stop measuring
"ZA0043\003",4--direct to close
"ZA1067\003",5-- direct to open
"Z10091\003",6--H/V
"Z12089\003",7--HR
"Z13088\003",8--HL
"Z20088\003",9--H/V
"Z31088\003",10—SD track
"Z32091\003",11--SD loose measurement
"Z33090\003",12—SD repeat loose measurement
"Z34093\003",13—SD accurate measurement
"Z35092\003",14—SD repeat accurate measurement
"Z41095\003",15--HD tracking measurement
"Z42092\003",16--HD loose measurement
"Z43093\003",17--HD repeat loose measurement
"Z44090\003",18—HD accurate measurement
"Z45091\003",19—HD repeat accurate measurement
"Z51094\003",20—VD tracking measurement
"Z52093\003",21—VD loose measurement
"Z53092\003",22—VD repeat loose measurement
"Z54091\003",23—VD accurate measurement
"Z55090\003",24—VD repeat accurate measurement
"Z61093\003",25—NE tracking measurement
"Z62094\003",26—NE loose measurement
"Z63095\003",27—NE repeat loose measurement
"Z64088\003",28—NE accurate measurement
"Z65089\003",29—NE repeat accurate measurement
"Z71092\003",30—NE tracking measurement
"Z72095\003",31—NE loose measurement
"Z73094\003",32—NE repeat loose measurement
"Z74089\003",33—NE accurate measurement
"Z75088\003",34—NE repeat accurate measurement
"Z81083\003",35—Z tracking measurement
"Z82080\003",36—Z loose measurement
"Z83081\003",37—Z repeat loose measurement
"Z84086\003",38—Z accurate measurement
"Z85087\003",39—Z repeat accurate measurement

Appendix C Explanation of format data

Total station will transmit measured data to extern device after receiving commands from the extern device.

1) SD mode (ID: 3FH)

```
?+01178481m0852030+1203040d+01174572t15+00+25099ETX(CRLF)
|  |   |   |   |   |   |   |   |   |   |   |   |   |
|  |   |   |   |   |   |   |   |   |   |   |   |   |
ID  SD   m/f   V       H d/g/m HD  t/* L   P   0   BCC
```

ID : '?' indicates slope distance (ASCII 3FH)
SD: Slope distance 1178.481m (+/-, 8 digits)
m/f : meter/feet
V : Vertical angle 85'20'30" (7 digits)
H : Horizontal angle 120'30'40" (+/-) d
/g/m-degree/grad/mil(usually 'd')
HD: Horizontal distance 1174.572m (+/-, 8 digits)
t/* : Tilt correction -- t: yes, *: no
L : EDM return signal level 15 (2 digits)
P : Don't care
0 : Don't care
BCC: Block check character 099 (3 digits)
ETX: 03H to show the end of text
CR: The optional ASCII character (0DH)
LF: The optional ASCII character (0AH)

2) V or H angle mode (ID: 3CH)

```
< 0862405 +1745545 +0127 d 082 ETX (CRLF)
|  |   |   |   |   |   |   |   |   |
|  |   |   |   |   |   |   |   |   |
ID  V       H       TILT d/g/m BCC
```

TILT : Tilt correction (usually 0)

3) N or E or Z coordinates mode

<Standard (8 digits) mode> (ID: 55H)

```
U-00596337+01011930+00095802m+1203040d 110 ETX (CRLF)
|  |   |   |   |   |   |   |   |   |   |   |   |
|  |   |   |   |   |   |   |   |   |   |   |   |
ID  N       E       Z       m/f   H d/g/m BCC
```

N : N (X) coordinate -596.337m 8 digits
E : E (Y) coordinate +1011.930m 8 digits
Z : Z coordinate +95.802m (+/-, 8 digits)