Thank you for choosing ZTS-120/120R. As your handy construction tool, it will provide you with the most efficient and economic solutions to your job. To fully utilize the potential of your instrument and protect your investment, you need to, as we strongly suggest, thoroughly read this manual before starting any operations. Should you run into any problems, Hi-Target's technical support team will be happy to assist you

.

Contents

1. Precautions for Safety

1.1 NOTE

◆ **Do not look directly into the sun with instrument**

Avoid exposing to direct sunlight. Do not look into the sun directly to protect your eyes and instrument.

◆ **Avoid exposing the instrument to vibrations**

When transporting, keep the instrument in the case and try your best to avoid unnecessary vibrations.

◆ **Carry the instrument**

When carrying the instrument handle must be held tight.

◆ **Check the battery power**

Before using it, you should ensure the battery is fully charged.

◆ **Take out the battery**

It is not suggested to take out the battery when the instrument is on, otherwise, the stored data may be lost. Be sure to power off the instrument before removing battery.

◆ **Set up the instrument on the tripod**

When using it please insure the connection between tripod and instrument is firm. It is better to work with wooden tripod for the measurement accuracy.

◆ **Assemble the tribrach on the instrument**

The setting of tribrach would influence the accuracy. The tribrach should be check frequently, the screw which connects the tribrach

and alidade must be locked tightly. And the central fixing screw should be tight.

◆ **High temperature condition**

Don't put the instrument in high temperature conditions (50C/122F and up) for a long time, it is bad for the instruments performance.

◆ **Temperature changing sharply**

The sharp temperature changing on the instrument or prism will shorten the distance measurement range, for example, after taking the instrument out from a warm car to a cold condition, wait for some time, it can be used when it adapts the surrounding condition.

◆ **The noise from the instrument**

When the instrument is in work mode, it is normal to hear noise from the motor.

◆ **Stored data responsibility**

ZTS-120/120R should not be held liable for the lost data because of wrong operation.

1.2 Definition of Indication

For the safety of your product and prevention of injury to operators and other
persons as well as prevention of property damage, be sure to read this manual.

The definitions of the indication are listed below. Be sure you

understand them before reading the manual's main text.

⚠ WARNING:	Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.
⚠ CAUTION:	Ignoring this indication and making an operation error could possibly result in personal injury or property damage.

⚠ WARNING

- Do not disassemble. Fire, electrical shock or burns can occur. Only ZTS-120/120R authorized distributors can disassemble or rebuilt.
- Do not look directly into the sun. Eye injury or blindness can occur.
- Do not cover the charger. Fire can occur.
- Do not use power cable, socket or plug. Fire or electric shock can result.
- Do not get battery wet. Fire or electric shock can result.
- Do not expose the instrument to burning gas or liquid and do not use the instrument in coal mine. Blast could be result.
- Do not put the battery in the fire or high temperature condition. Explosion, damage could result.
- Do not use the battery which is not specified by ZTS-120/120R. Fire, electric shock or burn could result.
- Do not use the power cable which is not specified by

ZTS-120/120R. Fire could result.

- Do not short circuit of the battery. Fire could result.
- When this product encounters disturbance of severe Electrostatic Discharge, perhaps it will have some degradation of performance like switching on/off automatically and so on.

CAUTION

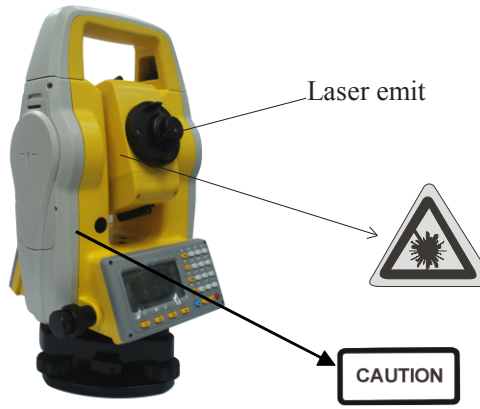
- Do not touch the instrument with wet hand. Electric shock could result.
- Do not stand or seat on the carrying case, and do not turn over the carrying case arbitrarily, the instrument could be damaged.
- Be careful of the tripod feet when setup or move it.
- Do not drop the instrument or the carrying case, and do not use defective belt, agraffe or hinge. Instrument damage could result.
- Do not touch liquid leaking from the instrument or battery. Harmful chemicals could cause burn or blisters.
- Please assemble the tribrach carefully. If the tribrach is not stable, serious damage could result.
- Do not drop the instrument or tripod, series damage could result. Before using it, check the central screw is tight.

1.3 Safety Standards for Laser (ZTS-120/120R series)

The ZTS-120/120R total station abides by the class of Laser Product according to IEC Standard Publication 60825-1 Amd. 2:2001. According this standard, EDM device is classified as Class 3R Laser Product when reflectless measurement is selected, when the prism and reflective sheet is selected as target, the output is equivalent to the safer class 1. Follow the safety instructions on the labels to ensure safe use.

CAUTION: CLASS 3R LASER RADIATION WHEN OPENAVOID DIRECT EYE EXPOSURE.

CAUTION: CLASS 2 LASER RADIATION WHEN OPENDO NOT STARE INTO THE BEAM



Note for Safety

⚠	WARNING

● Never point the laser beam at other's eyes, it could cause serious injury.
● Never look directly into the laser beam source, it could cause permanent eye damage.
● Never stare at the laser beam, it could cause permanent eye damage.
● Never look at the laser beam through a telescope or other optical devices, it could cause permanent eye damage.

1.4 About User

1. This product is for professional use only!
The user is required to be a qualified surveyor or have a good knowledge of surveying, in order to understand the user manual and safety instructions, before operating, inspecting or adjusting.

2. Wear required protectors (safety shoes, helmet, etc.) when operating.

1.5 Exceptions from Responsibility

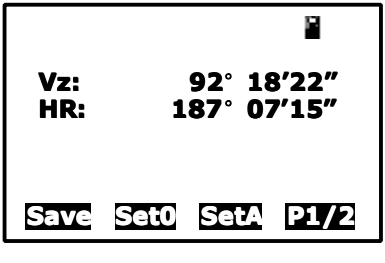
1. The user of this product is expected to follow all operating instructions and makeperiodic checks of the product's performance.

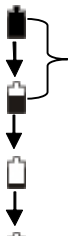
2. The manufacturer assumes no responsibility for results of a faulty or intentional usage or misuse including any direct, indirect, consequential damage and loss of profits.
3. The manufacturer assumes no responsibility for consequential damage and loss of profits by any disaster (an earthquake, storms, floods etc.).
4. The manufacturer assumes no responsibility for any damage and loss of profits due to a change of data, loss of data, an interruption of business etc., caused by using the product or an unusable product.
5. The manufacturer assumes no responsibility for any damage and loss of profits caused by usage except for explained in the user manual.
6. The manufacturer assumes no responsibility for damage caused by wrong transport, or action due to connecting with other products.

2. Preparation before Measurement

2.1 About Battery

2.1.1 Battery Power Symbol





Measurement is possible

The battery is lower, it is better to replace

Measurement is impossible, it is necessary to replace

NOTE:

◆The working time of battery will be effected by many factors, such as ambient temperature, recharging time, recharging and discharging times. On the data safe side, we suggest the users 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.

◆ The symbol only indicates the supply power but not the instantaneous power change. And if the measurement mode changes, the symbol will not show the power's decrease or

increase immediately.

◆It is suggested to check every battery power before field work.

2.1.2 Replace the Battery

1. Remove the battery

①Press the button downward as shown left

②Remove the battery by pulling it toward you

2.1.3 Recharge the Battery

2. Mount the battery

①Insert the battery to the instrument

②Press the top of the battery until you hear a Click.

As above figures show, connect the charger and the battery, then plug the charger into the outlet of 110V-220V AC power supply, recharging will begin.

NOTE:

◆The indicator light on the charger will illuminate three separate colors for varies mode conditions:

Solid Red Light—indicates that the charger is working;

Solid Green Light— indicates that the charge has finished;

Flashing Red Light—indicates 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 min.

2.2 Setting Up the Instrument

Mount the battery in the instrument before performing this operation because the instrument will tilt slightly if the battery is mounted after leveling.

I. Set up the tripod first: extend the extension legs to suitable lengths and tighten the screws on the midsections. Make sure the legs are spaced at equal intervals and the head is approximately level. Set the tripod so that the head is positioned over the surveying point. Make sure the tripod shoes are firmly fixed in the ground.

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

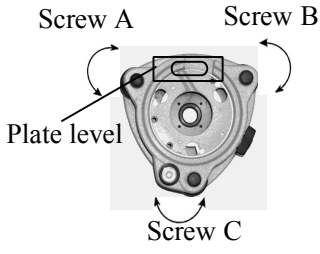
2.3 Centering and Levelling-Up

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.

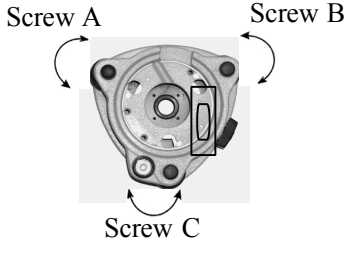
2. Turn three footscrews of the tribrach till the center of reticle exactly coincides with the surveying point in any position.

3. Move the tripod legs to centre the circular level. The instrument is now roughly leveled-up.

4. Center the bubble in the circular level



Loosen the horizontal motion clamp, and turn the instrument till 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.



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

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

5. Center the surveying point again

Loosen the centering screw slightly. Looking through the optical plummet eyepiece, slide the instrument over the tripod head until

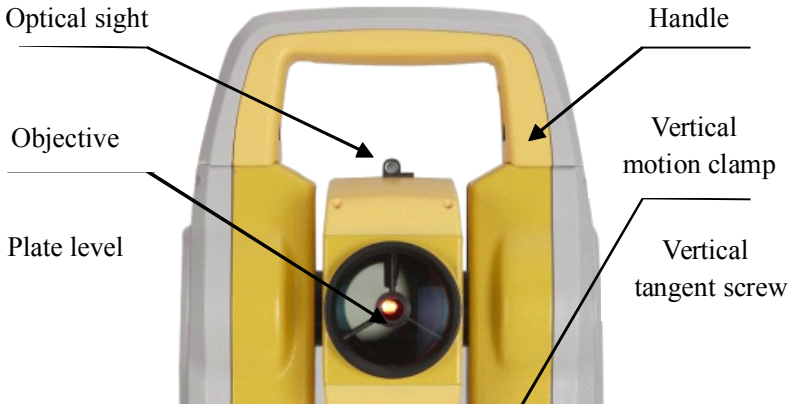
the surveying point is exactly centered in the reticle. Re-tighten the centering screw securely.

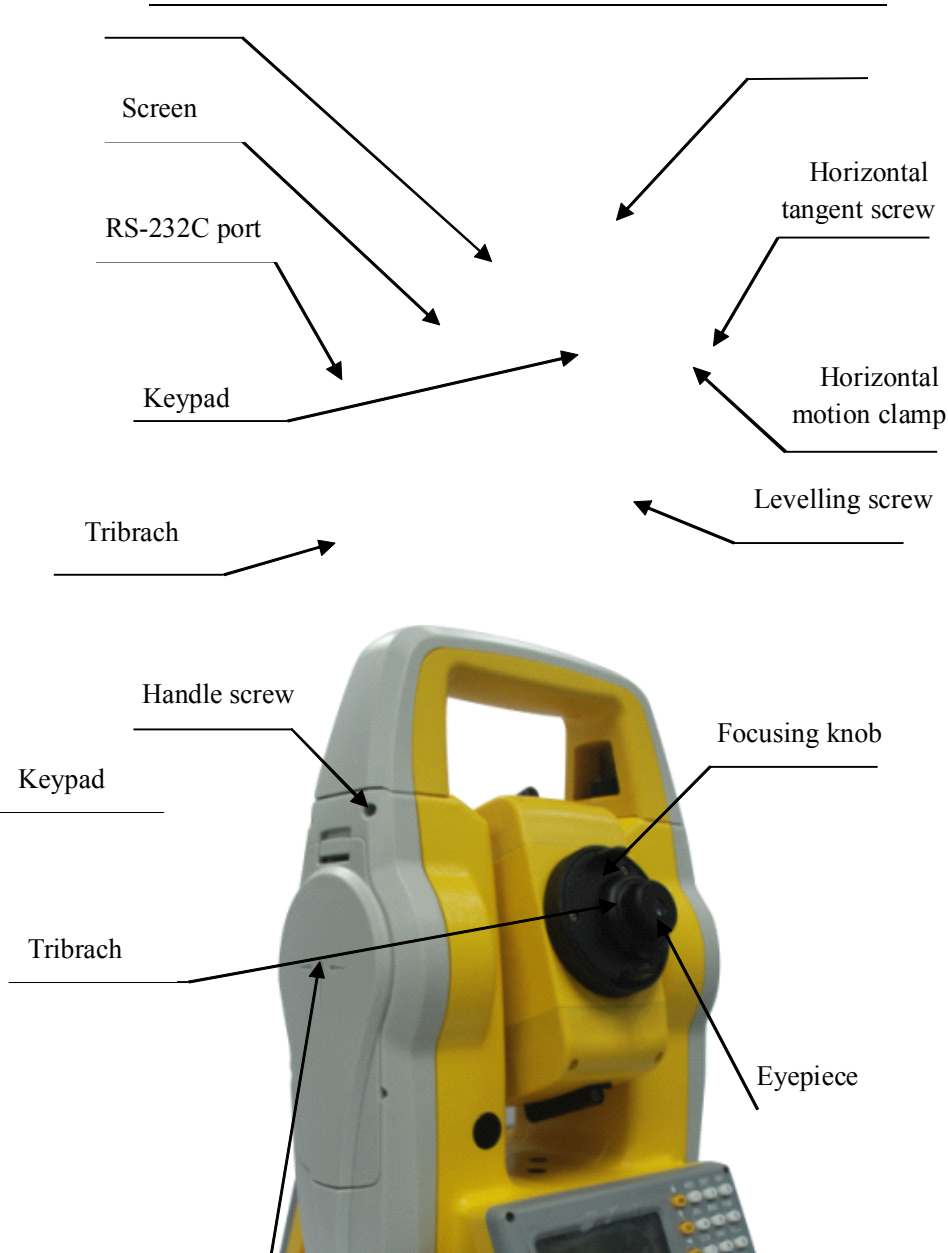
6. Check again to make sure the bubble in the plate level is centered.

If not, repeat procedure 4.

3. Basic Functions

3.1 Nomenclature




Screen
RS-232C port
Keypad
Horizontal tangent screw
Horizontal motion clamp
Levelling screw
Tribrach
Handle screw
Keypad
Focusing knob
Tribrach
Eyepiece

Battery

3.2 Basic Key Operation

Keys	Description
F1 ~ F4	Select the functions matching the softkeys
0 ~ 9	1. Input number when numeric input 2. Input characters when alphabetic input
.	Input a decimal point
±	Input plus / minus sign
Power	Power On / Off
★	Enter into setting mode directly
ENT	End dialog and save setting to file
ESC	Escape to the previous menu or mode;end dialog and not save
ANG	1. Enter into angle measurment mode(under basic measurement mode) 2. Up arrow
DIST	1. Enter into dist and angle measurment mode(under basic measurement mode) 2. Down arrow
CORD	1. Enter into coordinate and angle measurment mode(under basic measurement mode) 2. Left arrow
MENU	1. Enter into menu mode(under basic measurement mode) 2. Right arrow

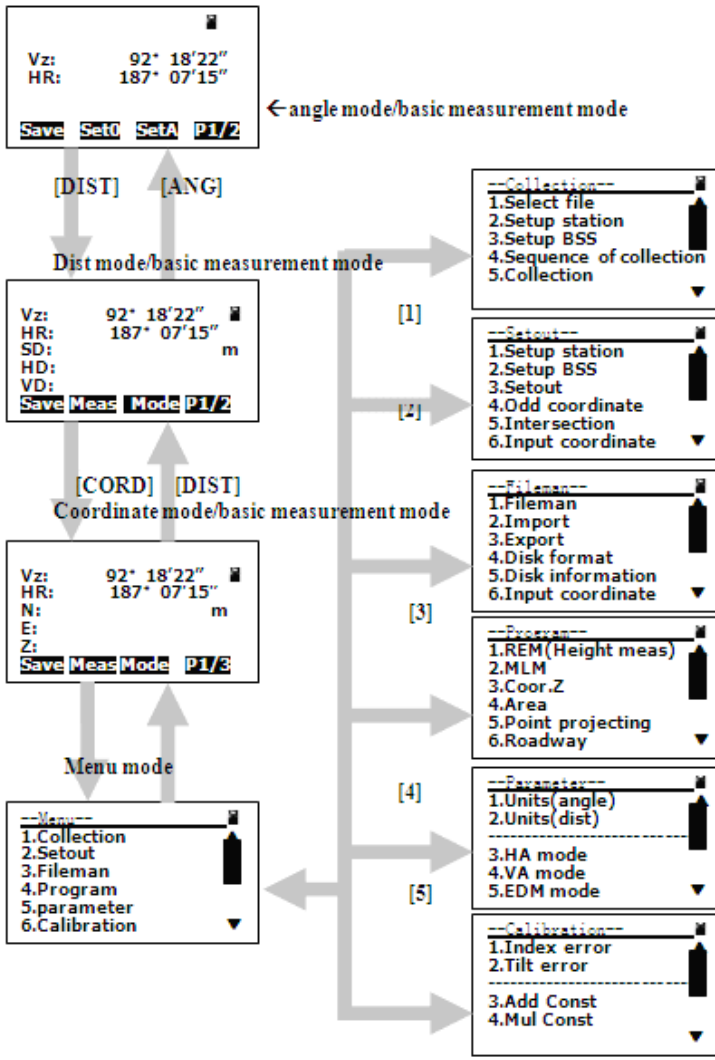
Note: 1. "Power" indicate 

2. Basic measurement is composed of angle and dist and coordinate measurement mode

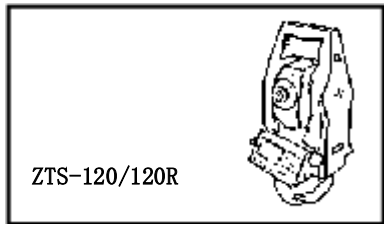
3.3 Display

The LCD could display 6 lines with 24 characters per line. In measurement mode, it displays some common information in above 5 lines and displays soft functions in the last line.

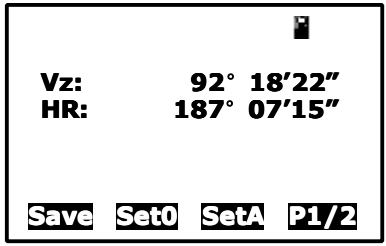
3.4 Mode Diagram


Vz: 92° 18′22″
HR: 187° 07′15″
Save Set0 SetA P1/2
←angle mode/basic measurement mode
[DIST] [ANG]
Dist mode/basic measurement mode
Vz: 92° 18′22″
HR: 187° 07′15″
SD: m
HD:
VD:
Save Meas Mode P1/2
[CORD] [DIST]
Coordinate mode/basic measurement mode
Vz: 92° 18′22″
HR: 187° 07′15″
N: m
E:
Z:
Save Meas Mode P1/3
Menu mode
--Menu--
1.Collection
2.Setout
3.Fileman
4.Program
5.parameter
6.Calibration
[1]
--Collection--
1.Select file
2.Setup station
3.Setup BSS
4.Sequence of collection
5.Collection
[2]
--Setout--
1.Setup station
2.Setup BSS
3.Setout
4.Odd coordinate
5.Intersection
6.Input coordinate
[3]
--Fileman--
1.Fileman
2.Import
3.Export
4.Disk format
5.Disk information
6.Input coordinate
--Program--
1.REM(Height meas)
2.MLM
3.Coor.Z
4.Area
5.Point projecting
6.Roadway
[4]
--Parameter--
1.Units(angle)
2.Units(dist)
3.HA mode
4.VA mode
5.EDM mode
[5]
--Calibration--
1.Index error
2.Tilt error
3.Add Const
4.Mul Const

3.5 Power On/Off

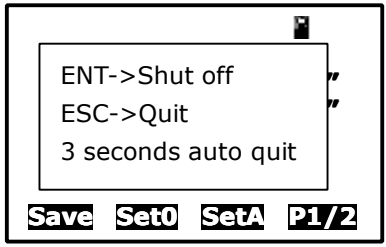


1. Confirm the instrument is leveling, press the red key [POWER].



2. Release [POWER],the instrument will display the angle mode screen.

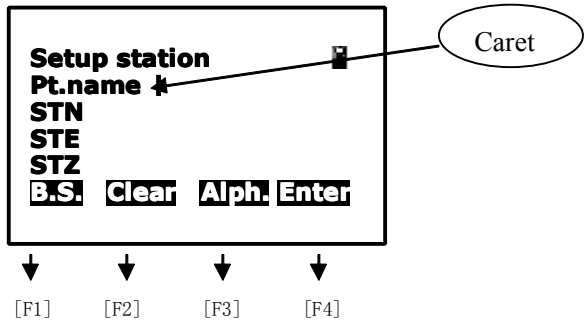
II. Power off



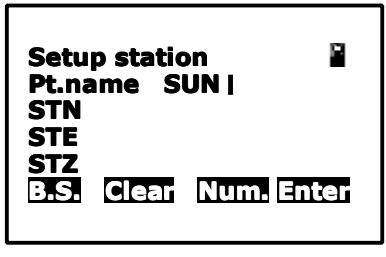
3. Press the key [POWER], the instrument will pop up “power off” dialog box,[ENT] key will shut down.

3.6 How to Input Number and Alphabet

All Number and alphabet inputing must be carried out in a dialog box. for example, input point name SUN1A and STN -123.456 in “Setup station” dialog box



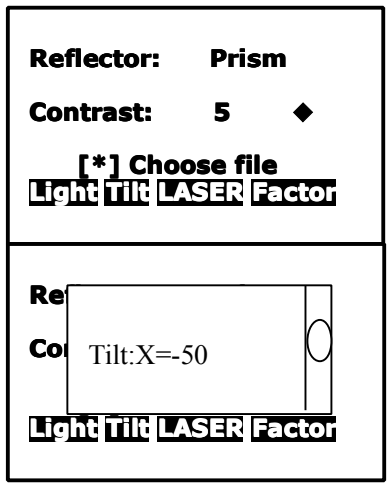
1. Press [F3], the soft key prompt will switch “Alph.”.
2. Press [7],’ S’ will present in inputbox and the caret shift to next position
3. Pause about 0.4 second, because the next alphabet ‘U’ is relational with [7]. click [7],’ SS’ will present in inputbox, click [7] again ‘ST’ will present in inputbox, click [7]again,’ SU’ will present in input box.
4. Click [5], ’ SUN’ will present in input box.



5.Press [F3],switch into Number input mode
6.Press [1],'SUN1' will present in input box
7. Press [F3],switch into Alphabet input mode
8.press [1],'SUN1A' will present in input box
9.press [F4],the cerat will shift into STN input box,because the STN coordinate is Number attribute,the prompt "Alph." automatically switch into "Num.",
10. input [±],[1],[2],[3],[.],[4],[5],[6] in turn,
11.press [ENT]，end dialog

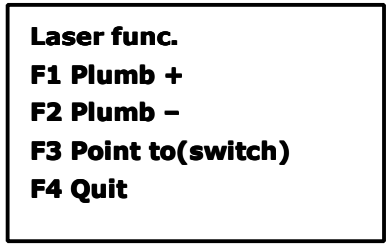
3.7 How to Configure

Press key {★} directly to enter into in any status, and do some basic settings.



1.Backlight
Press [F1], the backlight will be switched on or off
2.Tilt
Press [F2],the tilt sensor status will be present
Press [F2] again the tilt sensor will be switch on or off

[ESC] will quit tilt sensor status display



3.Laser

Press [F3],the “laser func.”dialogbox will appear,press [F3]again the laser beam will emit from object lens or sewitch off by turns.[F1]&[F2] can adjust the brightness of the plummet laser.

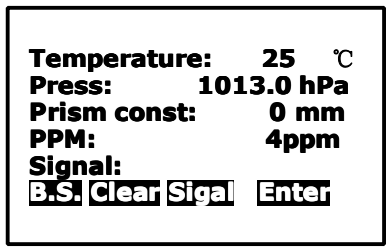
4.Reflecting object

Press ▶the EDM mode will be switched between “prism”,”no prism” and “reflector board”

5.LCD contrast

Press ▼▲,will increase or decrease the value of contrast

6.factor



Press [F4], pop up “atmosphere parameter setting” dialog box,after you input temperature and atmospheric pressure,the PPM value will be calculated automatically.when you press [F3] the EDM will return current EDM signal.[ESC] will quit signal show;

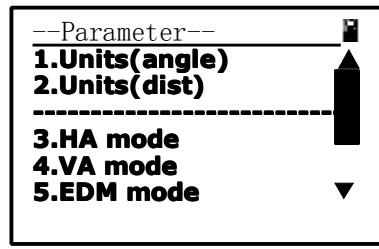
Another setting and config is operated by main menu—“parameter”

able 3-1 List of measurement condition setting

Item	Options
1. Unitsoption	DMS*/GON/MIL; Meter*/feet/feetinch; ℃*/℉ hPa*/mmHg
2. Unitsoption（dist）	InterFeet*/US Feet
3. K option	0 * /0.14 / 0.20
4. VA display	Zenith * / Horizon 0 / V90 / slope
5. HA display	HAR * / HAL
6. Auto shut off	Never*/5min/10min/20min
7. Coord	N-E-Z * / E-N-Z
8. EDM mode	Single*/repeat/Continue/Track
9. mini readout	1"*/5"/10"
0.Language	English*/spaish/portuguese

NOTE:

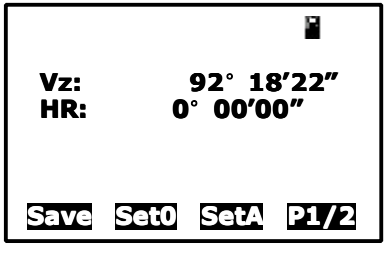
- Every first options with the symbol " * "are the factory setting.



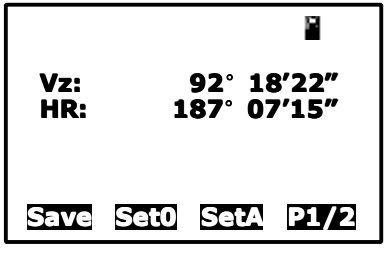
Through the menu function ,you can config the instrument.Press [MENU],pop up main menu then select [5],the config menu is shown as follow:
You can config all instrument options according to your appliction

4. Angle Measurement

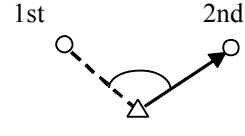
4.1 Measure a Horizontal Angle of Two Points



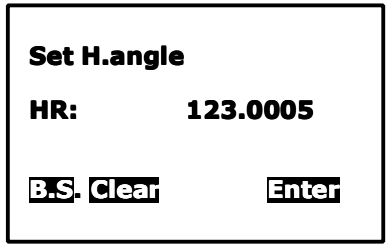
1. Sight the 1st target. Press F2: [**SET0**] to set the 1st target as 0° at P1 in the measure mode.

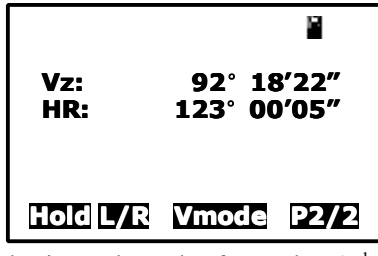


2. Sight the 2nd target. The displayed value is the included angle between two points.



4.2 Set the Horizontal Angle to a Required Value





1. Take your instrument sight the 1st target.
Press F3: [**SETA**] at P1 in the measure mode.
2. Input the required value, then press {ENT} to save the value. And it displays as the horizontal angle.
The range and format of the input value:
gon: 0 ~ 399.9999
degree: 0 ~ 359.5959
mil: 0 ~ 6399.999
3. Sight the 2nd target. The horizontal angle from the 2nd target to the value set as the horizontal angle is displayed.

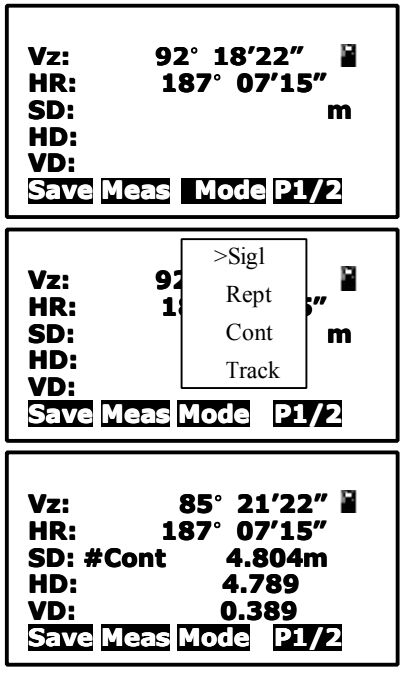
NOTE: Pressing [**HOLD**] performs the same function as above. The horizontal angle is in hold status when "**HOLD"** is present. Press [**HOLD**] again to releasse the holding status.

5. Distance Measurement

Please set the following items before distance measurement：

- Prism constant
- PPM
- Grid scale(if need)
- K option(if need)
- Select reflector
- EDM mode setting by the application

【Procedure of distance measurement】



1. Aim at the target. Press F2: [**MEAS**] at P1 in the measure mode.
Press F1:[**Save**]will start measuring and save the result
2. According to the application, you can select one of "single" "repeat" "continue" and "track" to measure distance
Press [F3]:[**Mode**],pop up a little window for your selection
3. Press [**ESC**] to finish

measurement. The “ SD ” , ” HD ”, and ” VD ” will display as shown left.
“# “indicate “no prism”or “reflector board” mode
“*” indicate “prism” mode

NOTE:

◆Make sure that the target setting in the instrument matches the type of target used.

◆ If the objective lens is dirty, it will affect the accurate of measured results. Dust it off with your special brush and wipe it with your special cloth (in your carrring case) before putting away.

◆If an object with a high reflective factor (metal, white surface) exists between the instrument and the target when measuring, the accuracy of the measured results will be affected.

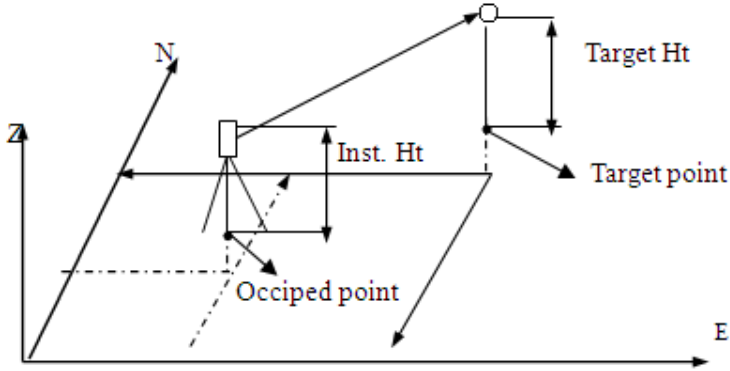
◆ An angle is also able to be measured when distance measurement.

◆# or * means measuring distance,at end of ”single”,”repeat” mode measuring ,the symbol will disappear automatically. you can press [**ESC**] finish measurement then the symbol also disappear.

6. Coordinate Measurement

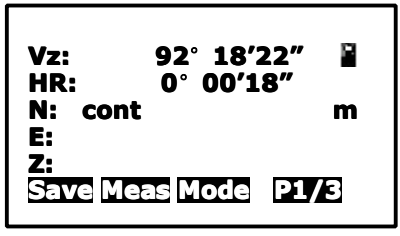
It is possible to find the 3D coordinates of a target by coordinate measurement. Please input the Station coordinate, instrument

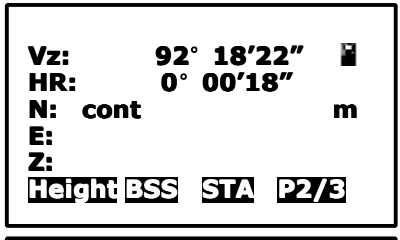
height, target height, backsight coordinate (or azimuth angle) and azimuth before coordinate measurement.

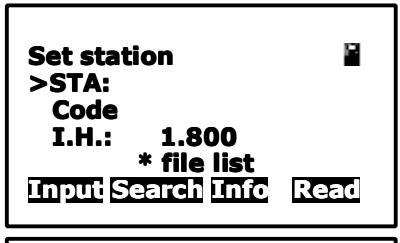


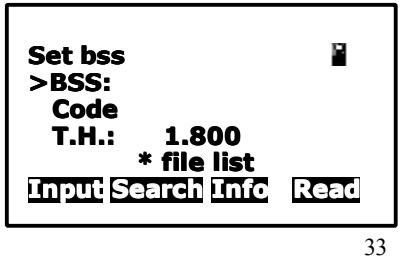
6.1 Input the Occupied Point Data

【Procedure of inputting occupied point data】



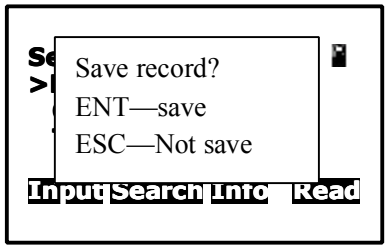


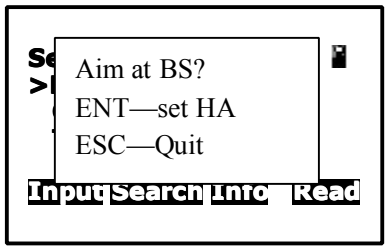




1. Measure the height of target and instrument with a tape, etc.
2. Press F4: [**P1/3**] at P1 in the measurement mode to next page
3. Press F3:[**STA**] to setup station.
4. Press F1:[**Input**] the station coordinate,note to input a point name.if the station is a known point whose information have been saved in current coordinate file,then you can press F2:[**Search**] to call a point (coordinates) information for the station.if you cannot remember the point name in current coordinates file then you can press F4:[**Read**] to browse the coordinate file and find out the point that

you need.Press F3:[**Info**] you can see all the information of the station if you have got the point.





5. Press [**ENT**] to receipt the station data.

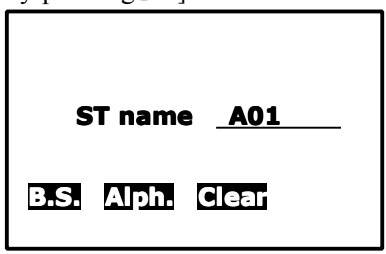
6. in like manner you can get a BSS coordinate

7. Press [**ENT**] ,the instrument will prompt if you need to save the record or not.

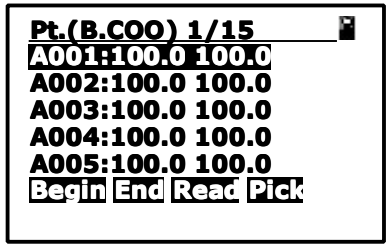
8. and then prompt if you need to setup a azimuth using the BSS data or not.if you select [**ENT**] then the instrument will display the horizontal angle as Azimuth evermore.

How to obtain the existed data:

Known point data is in the current coordinate file. If the coordinates data is in another coordinate file then you have to select the file as current coordinate file.in this time you can do it by pressing[★]



1. press F2:[**Search**] to get a point (coordinates) information for the station.if you can remember the point name,input the point name



shown as the picture on the left:

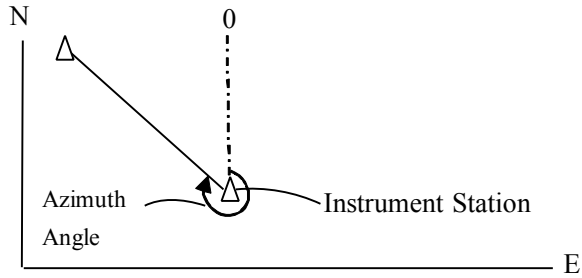
2. press [**ENT**] The list of existed coordinate swill be got;if the point name is error then system prompt "cannot find"

3. if you cannot remember the point name in current coordinate file then you can press F4:[**Read**] to browse the coordinate file and find out the point that you need

- Press keys {▲} / {▼} to move one by one.
- Press keys {◀} / {▶} to turn the previous/next page.
- [**Begin**]: Press it and the first point on the first page will display.
- [**End**]: Press it and the last point on the last page will display.
- If more than two points with the same point name exist in the current Coordinate file, the instrument finds the first pointname data as recorded by coordinate date.

6.2 Azimuth Setting

The azimuth of backsight could be inverse calculated by the coordinates of instrument station and backsight station.



see " § 6.1 Input the occupied point data".

NOTE:

◆You can input the azimuth angle directly in angle measurement mode.

6.3 3D Coordinate Measurement

The target coordinate could be measured after the setting of occupied point and backsight azimuth.

The formular used to calculate:

$N1 = N0 + S \times \sin Z \times \cos Az$

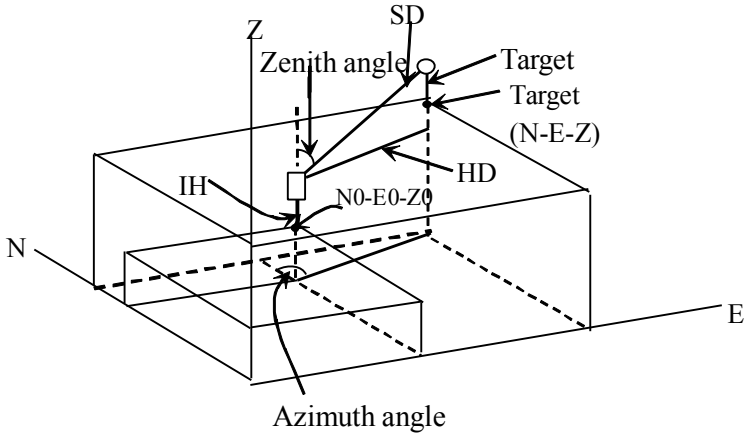
$E1 = E0 + S \times \sin Z \times \sin Az$

$Z1 = Z0 + S \times \cos Z + IH - TH$

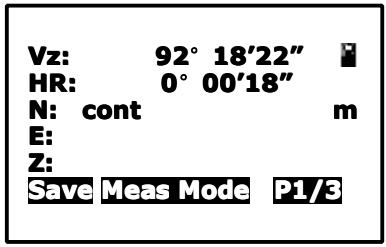
Where:

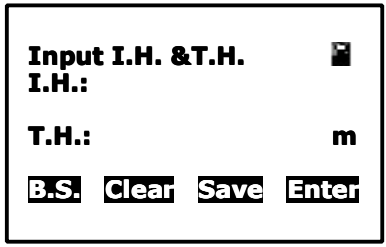
N0-E0-Z0: occupied point coordinates

S：SD　　Z：Zenith angle　　Az：Azimuth angle
IH：Instrument height　　TH：Target height



【Procedure of 3D coordinates measurement】





1. Aim at the target point.
2. Select F2:[**Meas**] to start. The coordinate value of the target is displayed.
3. Press F2: [**STA**] @ P2/3 to re-input the occupied data if necessary, see " § 6.1 Input the occupied point data".
4. Press F1:[**Height**] @ P2/3 to re-input the target height and instrument height if necessary, and press F1: [**MEAS**] to continue. Follow this operation till all targets have been measured.
5. Press key [ESC] to stop EDM measuring, when EDM mode is"Continue","Repeat"or "Track"

7. Stake out Measurement

Setout measurement is used to Setout the required point. The difference between the previously inputted data to the instrument （the Setout data）and the measured value can be displayed by measuring the horizontal angle, distance or coordinates of the sighted point.

The horizontal angle difference and distance difference are calculated and diplayed using the following formulars:

Horizontal angle difference

dHA=Horizontal angle of Setout data – measured horizontal angle

Distance difference

Distance Displayed item

SD: S-O SD=measured slope distance – slope distance of Setout data

HD: S-O HD=measured horizontal distance – horizontal distance of Setout data

VD: S-O VD=measured height difference – height difference of Setout data

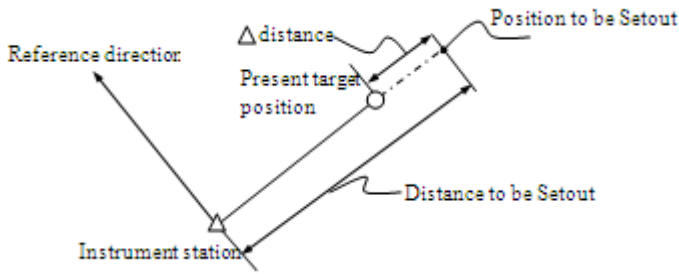
NOTE:

◆ Setout data can be input in various modes: SD, HD, VD, coordinates and REM measurement.

◆EDM settings could be set in this mode.

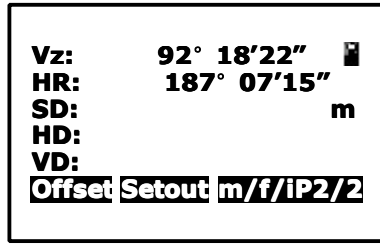
7. 1 Distance Setout

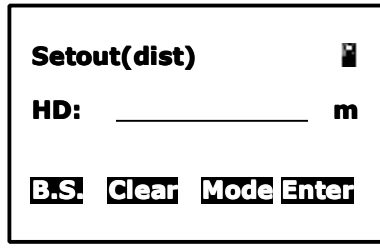
The point to be found based on the horizontal angle from the reference direction and the distance from the instrument station.

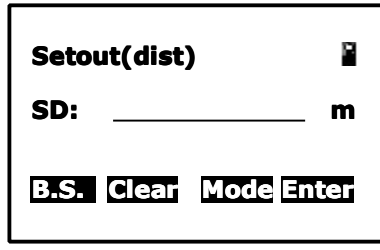


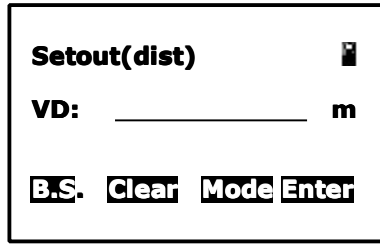
【Procedure of distance Setout easurement】

1. Press F2: [**Setout**] at P2 in the distance measurement mode.

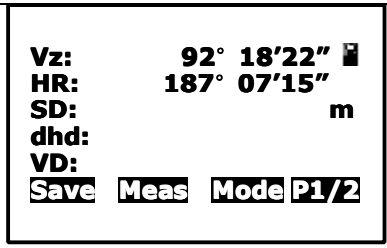








2. Select one of the distance setout modes(HD,SD,VD) by pressing F3:[**Mode**]
Press [**ENT**] to accept the selection

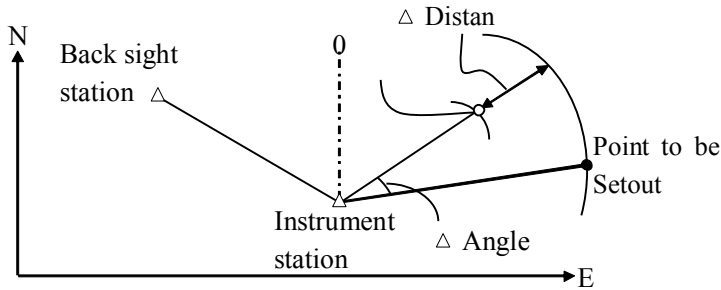


3. Press F2:[**Meas**] to Start EDM,when the error is less than 0.002mm then the EDM will stop measuring automatically.

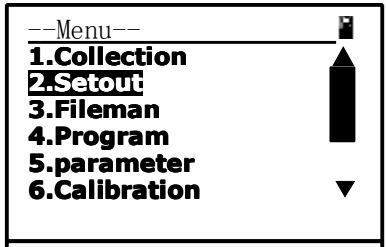
7.2 Coordinates Setout Measurement

After setting coordinates for the point to be Setout, the instrument calculates the Setout HA and HD. By selecting the HA and then the HD Setout functions, the required coordinate location can be Setout.

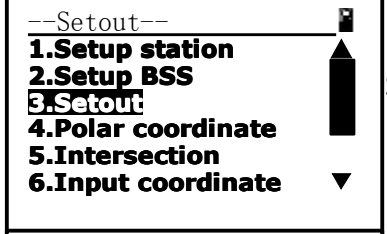
To get the Z coordinate, attach the target to a pole etc, with the same target height.



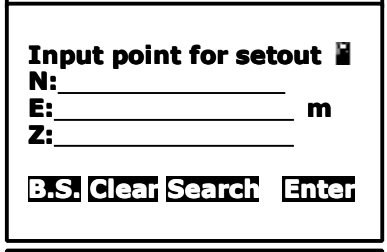
【Procedure of coordinate Setout measurement】



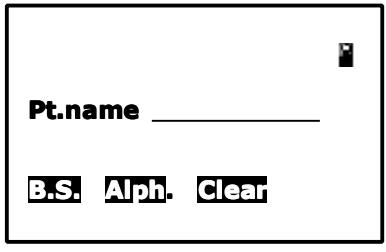
1. Press [**MENU**] in the basic



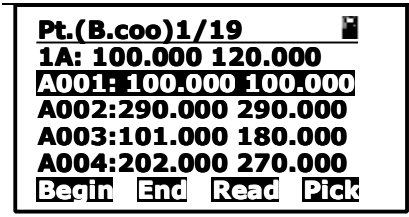
2. Select " **3.Setout**".

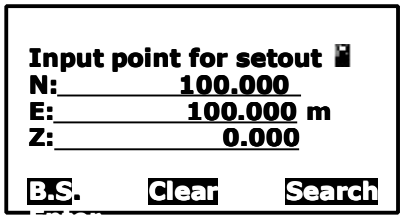


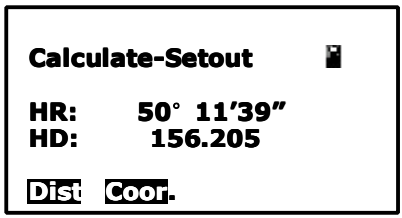
3. Input point coordinate that you need to setout.if the point is in current coordinate file then you can press F3:[**Search**] to obtain a known coordinates.

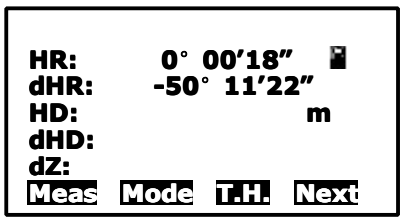


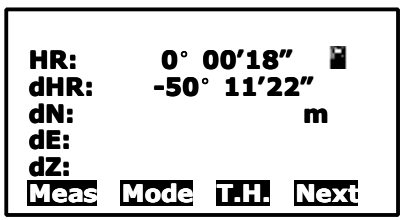
4. If you can remember the point then you input the pointname,else you can press directly [**ENT**].











5. The point list will appear.you search the point that you need in the list,if you find the you press F4:[**Pick**] to get the coordinate.else you press [**ESC**],system will recommend another coordinate file for you to get the coordinate.

6.The coordinate information will appear in the dialog box.Press [**ENT**] system accept your input.

7.System calculate Azimuth **DR** horizontal distance **HD**,then you can select one of two setout mode—distance or coordinate

8.Distance setout mode, we expect that dHR and dHD tend to zero.

9.Coordinate setout mode, we expect that dHR and dN,dE,dZ tend to zero.

8. Area

Calculate an area shaped with several points. The coordinate data of the points could be either measured or input by hand.

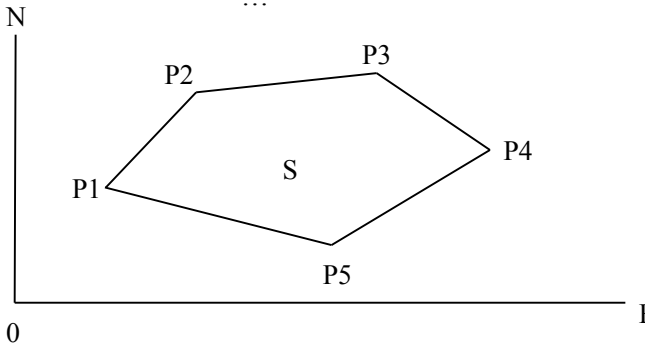
Input: Output:

Coordinates: P1 (N1, E1) Area：S

P2 (N2, E2)

P3 (N3, E3)

…

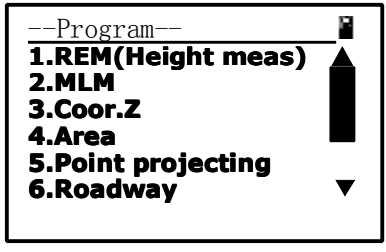


NOTE:

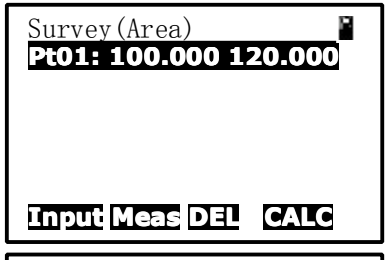
- ◆The number of points: 3 ~ 20.
- ◆Make sure these points must be measured or listed clockwise or anticlockwise, or mistake will result.

8.1 Area Calculation by Measured Data or Input Data

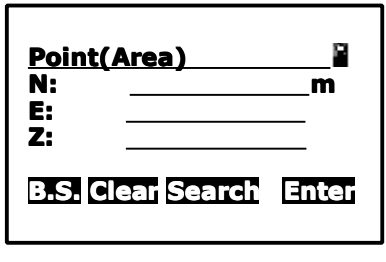
【Procedure of area calculation】



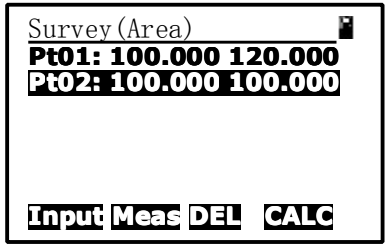
1.Select “Program” menu [4] enter into Area measurement



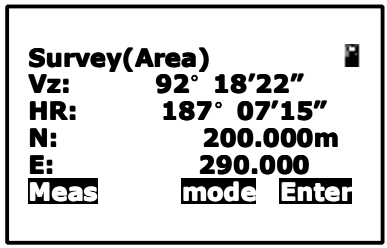
2.Area measurement interface is shown as the picture on the left.you can press F1:[**Input**] a point or call an existing point



3.Input a point coordinate or you can press F3:[**Search**] to call an existing coordinate.

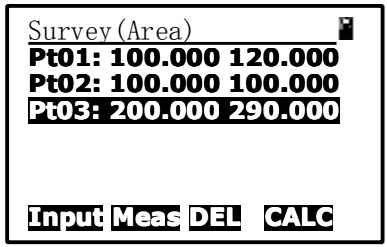


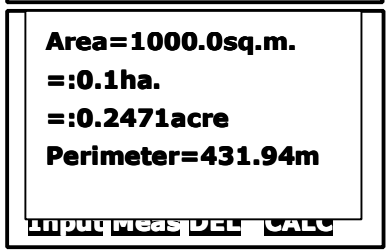
4.After inputing the coordinate.the coordinate always is inserted behind the last select bar,and current coordinate turn into a selected bar.



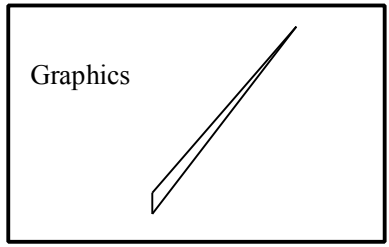
5.You can press F2:[**Meas**] to abtain a unknown point coordinate.this time you have to start EDM.after distance measurement the unknown point coordinate is shown as the picture on the left.

6.Press F4:[**Eneter**] to accept the measured point coordinate.





7.After the numbers of points is more than 2,the calculation is possible.then you can press F4:[**CALC**]the Area and Perimeter of the shape that is surrounded by the points in list box;



8.To obtain a result these points must be measured or listed clockwise or anticlockwise.this time you can press [★]to check it.the shape is shown as the picture on the left.

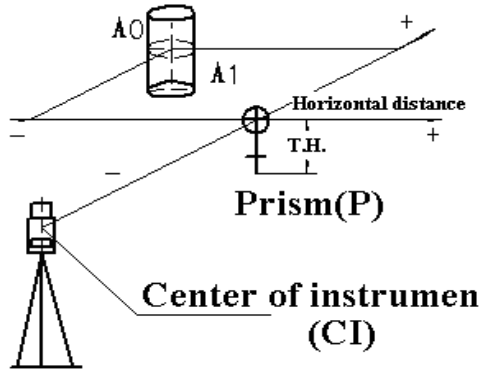
9. Offset Measurement

Offset measurement are performed in order to find a point where a target cannot be installed directly or to find the distance and angle to a point which cannot be sighted.
It is possible to find the distance and angle to a point you wish to measure (target point) by installing the target at a location (offset point) a little distance from the target point and measuring the distance and angle from the surveying point to the offset point.
The target point could be found in the following four ways.

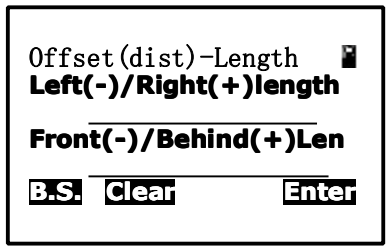
9.1 Distance Offset Measurement

Sometimes we need to measure a coordinate of a point such as A1 whose position cannot place a prism .assum that we know the horizontal distance from prism to A1. the Distance offset

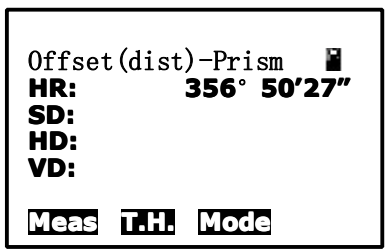
measurement can be used.



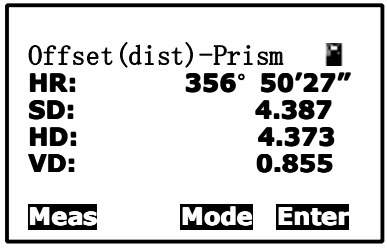
【Procedure of distance offset measurement】



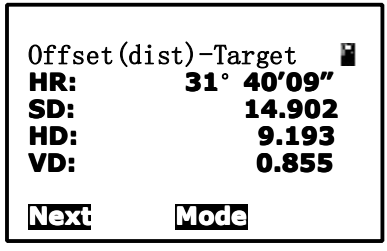
1.Input the known offset distance



2.Aim at the prism to start EDM, 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.



3.The result is shown as the picture on the left.Press F4:[**Enter**] to accept the result.

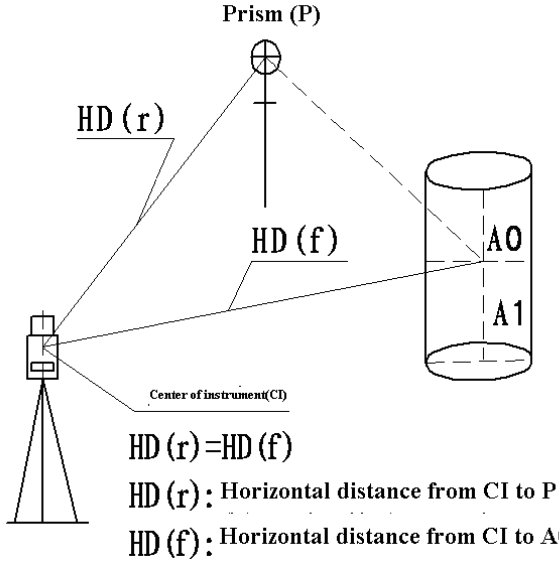


4.The result of target point is shown as the picture on the left.if you wish to display coordinate then you must press [**CORD**],or if you wish display distance then you must press [**DIST**].

5.When you press F1:[**Next**] ,you will be informed to save the result, if nessary you can press [**ENT**] to save the result.

9.2 Angle Offset Measurement

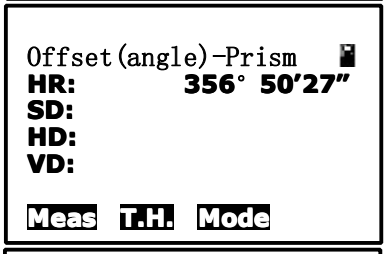
Sometimes we need to measure a coordinate of a point such as A1 whose position cannot place a prism. Assume that we know that the horizontal distance from CI to A1 and the distance from CI to prism are equal. The angle offset measurement can be used.the figure is shown as follow.



Note: 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.

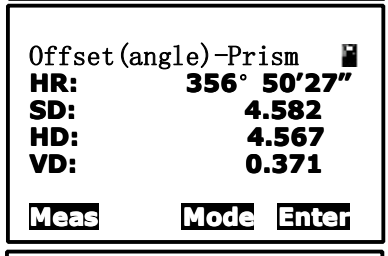
【Procedure of angle offset measurement】

1. Select the function of **angle offset measurement**
.

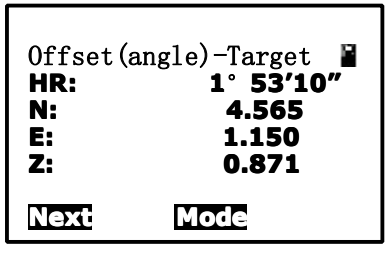


2. Start EDM , if you need the coordinate of A0 you should set the height of prism to zero. if you need the coordinate of A1 you should set the height of prism to the real height.

3. The result of the point positioned prism is shown as the picture on the left. Press F4:[**Enter**]



4. The result of the target point appear. If you wish to display coordinate then you must press [**CORD**],or if you wish display distance then you must press [**DIST**].

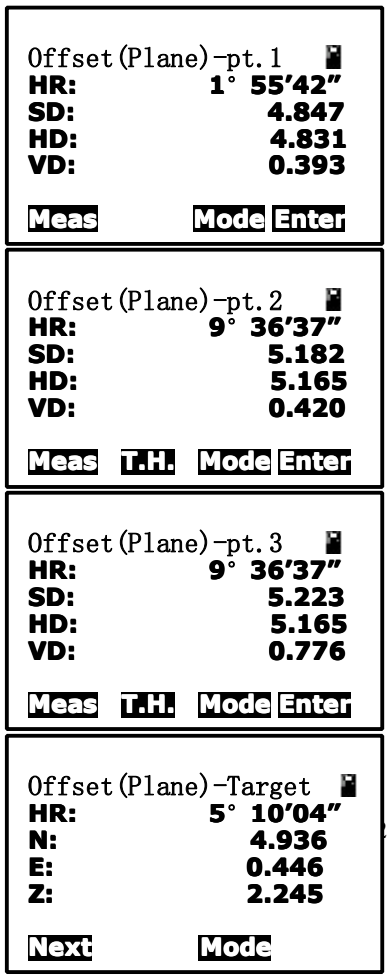


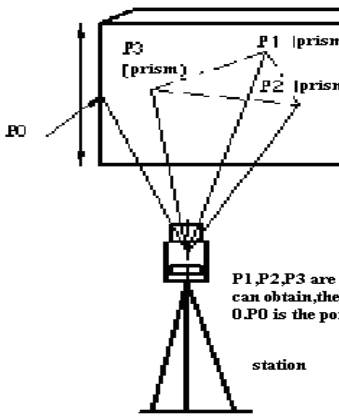
.5.When you press F1:[**Next**] ,you will be informed to save the result, if nessary you can press [**ENT**]

to save the result.

9.3 Plane Offset Measurement

Sometimes we wish to obtain the coordinate of some points where we cannot measure directly distance. 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. The figure is shown as follow:





【Procedure of Plane offset measurement】

1.Press F1:[**Meas**],start EDM to obtain the Azimuth and distance of P1.Press F4:[**Enter**] to accept the datas

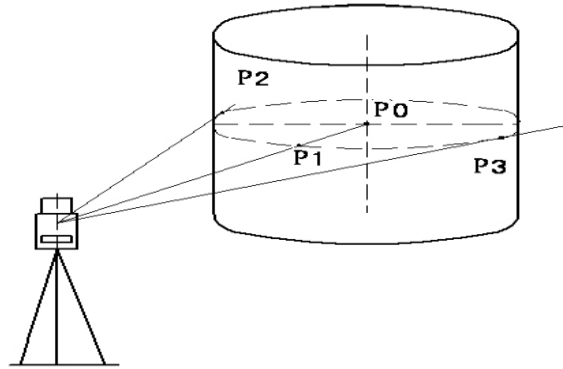
2.In like manner as step 1,obtain the datas of P2

3.In like manner as step 1,obtain the datas of P3

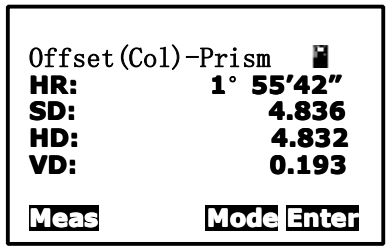
4.When you aim at the point located in the plane,the coordinates is calculated.

9.4 Column Offset Measurement

Sometimes we wish to obtain the coordinate of column center where we cannot find out directly. Fortunately, we can measure the distances of another points on the column. At this time the plane offset measurement can be used to find out the coordinates of the center.the figure is shown as follow:

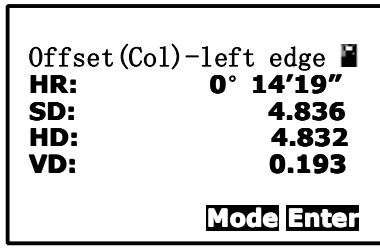


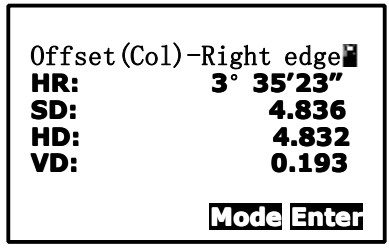
【 Procedure of Column offset measurement】



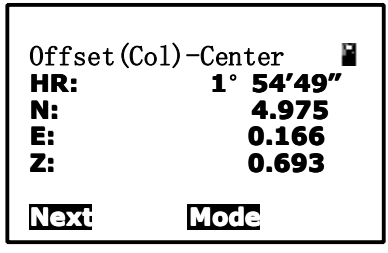
1. Press F1:[**Meas**] to start EDM then you can obtain the data of a point on the column which is shown as the picture on the left.

2 Aim at the left edge of the column, get its data





3. Aim at the left edge of the column, get its data

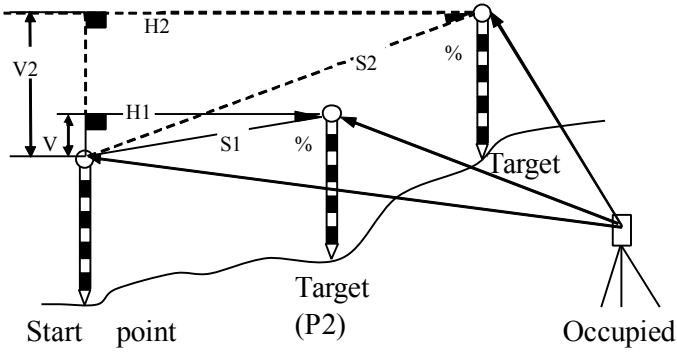


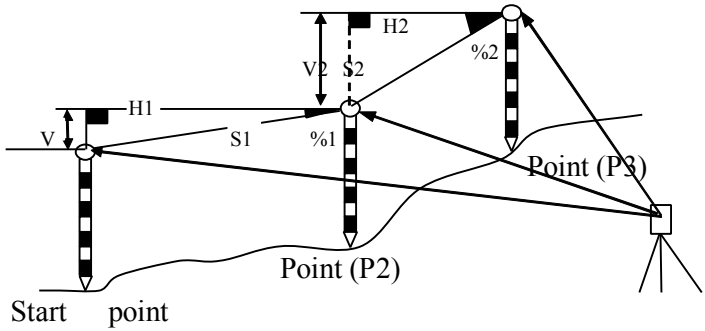
4. The coordinates of the column center is calculated and shown as the picture as the left.

10. MLM

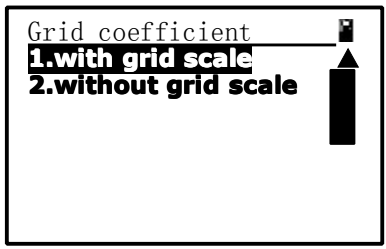
MLM is used to directly measure slope distance, horizontal distance and the height difference from one base point to other points without moving the instrument.

MLM have two mode, One is MLM(A-B,A-C), the other is MLM(A-B,B-C),the two modes are shown as follow.

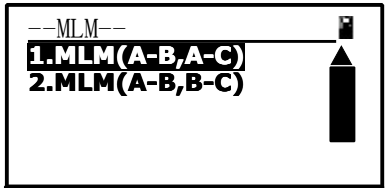




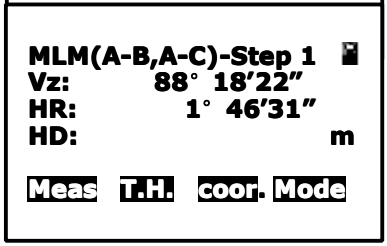
【Procedure of MLM measurement】

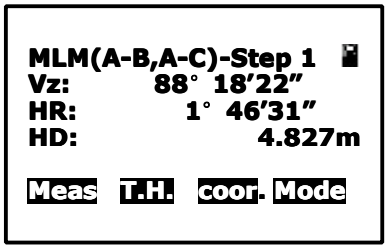


1. If considering the effect of grid scale you should select menu item 1,else you should select menu item 2;

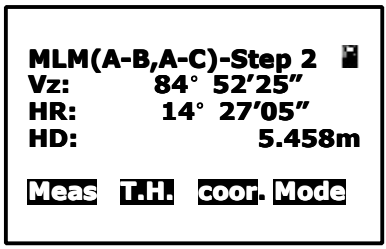


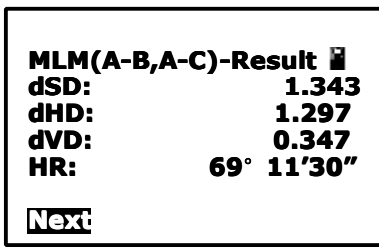
2. Select one of two modes





3. Press F1:[**Meas**] to start EDM then you can obtain the coordinates of the base point,or Press F3:[**Coor.**] then you can call an existing coordinate from current coordinate file.



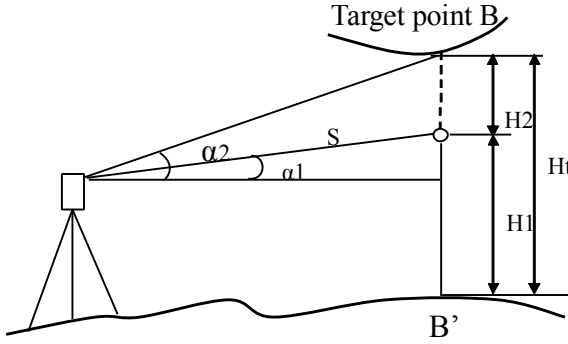


4. The data of the base point is shown as the picture on the left.

5. Press F1:[**Meas**] to start EDM then you can obtain next coordinates,or Press F3:[**Coor.**] then you can call an existing coordinate from current coordinate file.
6.There are dSD (slope distance),dHD(horizontal distance),dVD(difference of height) and azimuth attributes between two points.these attributes are shown as the picture on the left.

11. Height measurement (REM)

REM is a function used to measure the coordinate and height to a point where a target (prism) cannot be directly installed such as power lines, overhead cables or bridges, etc.



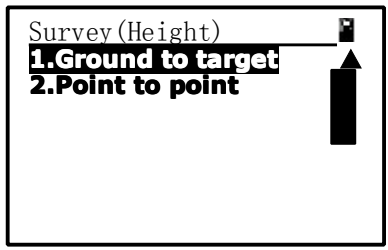
Here is the equation used to calculate the data presented in above

figure:

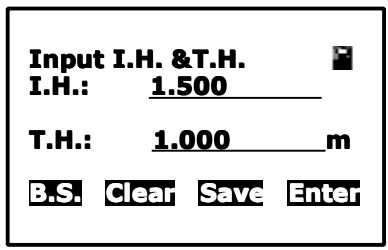
Ht=H1+ S*cosα1*tgα2-S*sinα1

H2= S*cosα1*tgα2-S*sinα1

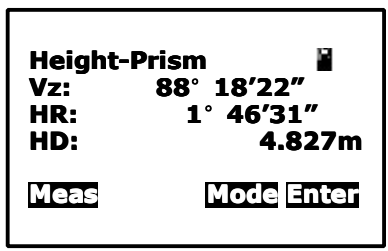
【Procedure of REM(Ht—Ground to target)】



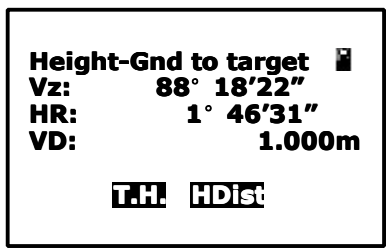
1. Select menu item 1 when you need the height between the target and ground.



2. Setting height of instrument and the height of prism

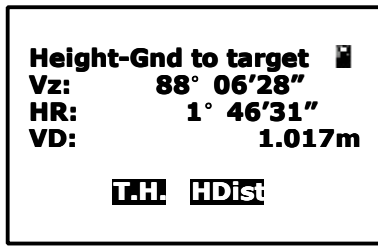


3. Press F1:[**Meas**] to start EDM then you can obtain the horizontal distance between the instrument and the target.Press F4:[Enter] to accept the measurement data



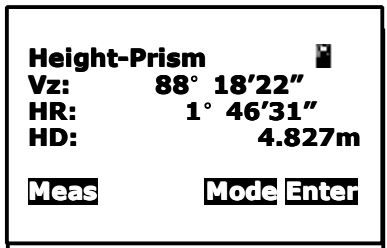
4. Then VD(difference of height) appear,first display the height of

prism.

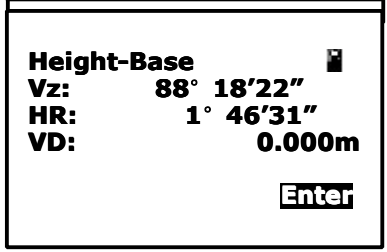


5.If you rotate the telescope then VD will change, when you aim at the target the VD is the difference of height between the target and ground.

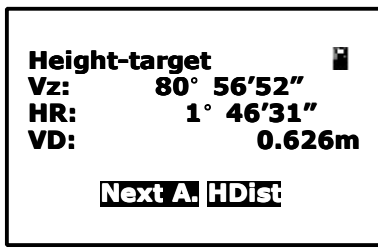
【Procedure of REM(H2—point to point)】



1. Select menu item 2 when you need the difference of height between any two points



2. Press F1:[**Meas**] to start EDM then you can obtain the horizontal distance between the instrument and the target.Press F4:[Enter] to accept the measurement data



3. At this time, the point where posite prism is base point.

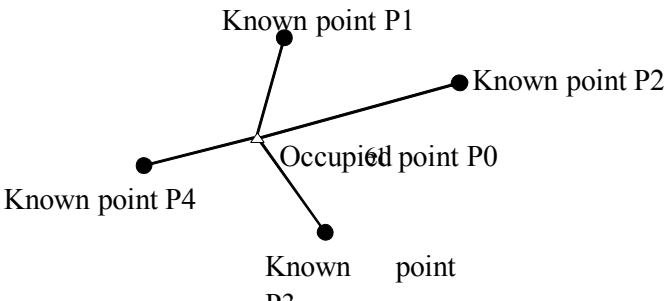
4.The VD will change when you rotate telescope. If you need setting another base point then you can aim at another base point and press F2:[**Next A**].

12. Intersection

Intersection program is used to determine the coordinates of an instrument station (unknown) by measuring several known points. Coordinate data in memory could be read.

Input
Coordinates of known points: Xi, Yi, Zi
Measured HA: Hi
Measured VA: Vi
Measured distance: Di

Output
Coordinate of occupied data: Xo, Yo, Zo



NOTE:

◆ All N, E, Z value or only Z value of the occupied point is calculated by measuring known points.

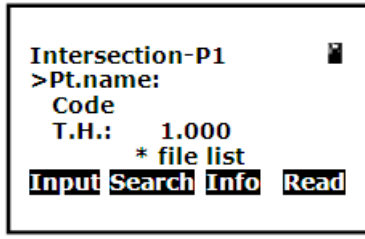
◆ Coordinate intersection measurement overwrite the N, E, Z data of the instrument stattion,

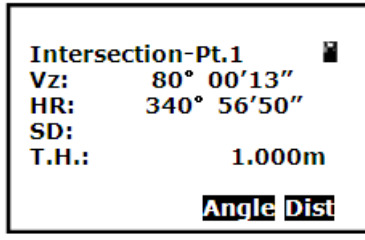
◆ Inputted known coordinate data and calculated data could be recorded in the current coodinate file.

◆Max number of known points is 5

12.1 Coordinates Intersection

【Procedure of Intersection】

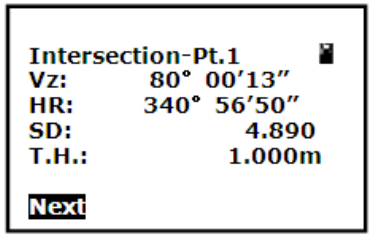


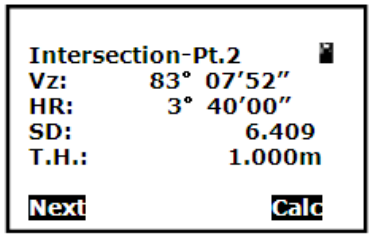


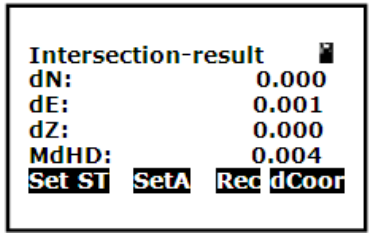
1. Input a known point.you can press F1:[**Input**] to input the point coordinate by coordinate,or you can press F2:[**Search**] to call an existing coordinates for current coordinates file.

2.Aim at the point that you

have inputed its coordinates.then you can select one of angle and distance mode to do Intersection measurement.



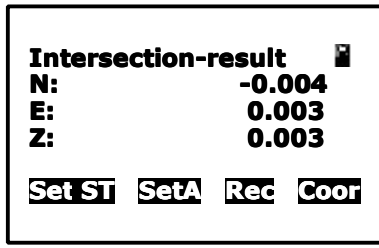




3. If you have selected the distance mode then you need to press F1: [**MEAS**] starting EDM and obtaining the slope distance. after measuring distance, you press F1:[Next] to measure next point.

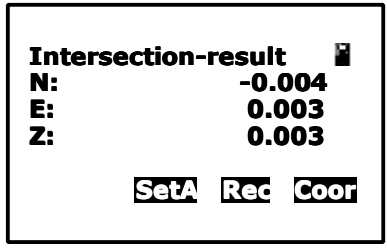
4. If you have measured two or more distance the prompr "Calc" will appear.in another way,if you have measured three or more then the prompr "Calc" will appear.in this time you can press F4:[**Calc**]to obtain the coordinates of instrument station.

5. The result of calculated instrument station is shown as the picture on the left. This is the error of the station coordinates

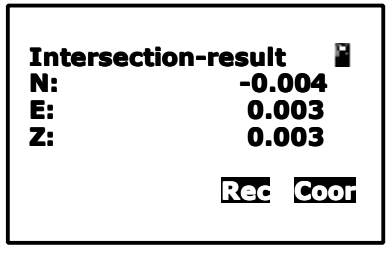


6. Press F4:[**dCoor**] the coordinate of intrument

station will be shown.you can Press F1:[**Set ST**] to setup station and press F2:[**Set A**] to setup the Azimuth of the instrument.



7. Setup station.

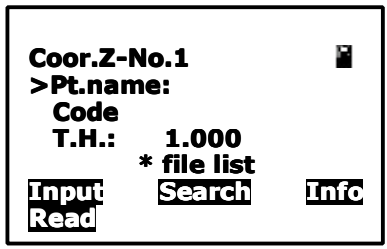


8.Setup the azimuth of the instrument.and you can press F3:[**Rec**] to save the coordinates to current measurement file.

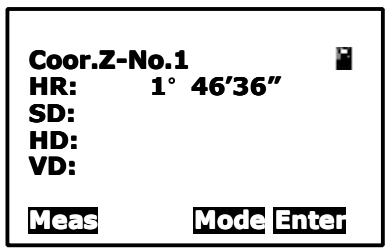
12.2 Elevation Intersection—Coor.Z

Only Z (elevation) of an instrument station is dertermined by this measurement. Between 1 and 5 known points can be measured by distance measurement only.

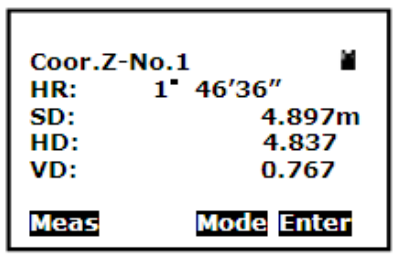
【Procedure of elevation resection】



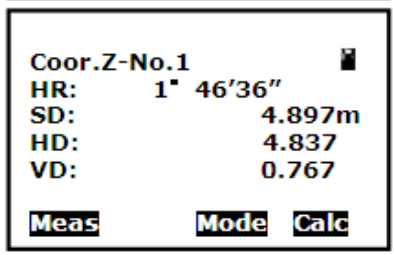
1. Input a known point.you can press F1:[**Input**] to input the point coordinate by coordinate,or you can press F2:[**Search**] to call an existing coordinates for current coordinates file



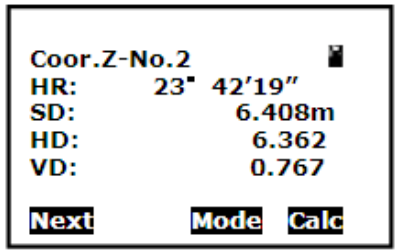
2.Press F1: [**MEAS**] starting EDM and obtaining the slope distance.



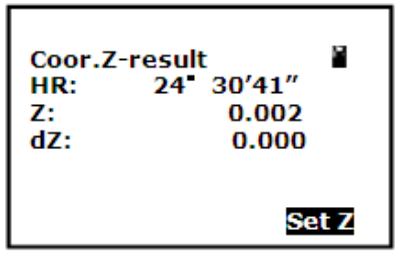
3.Finished measuring,you can press F4:[**Enter**] to accept the data.



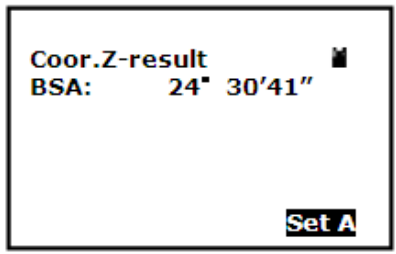
4.One or more known point can calculate the coordinate Z



5.Another known point will be measured



6.Calculate the coordinate Z of instrument station,if you need this coordinate Z as coordinate Z of station,then you press F4:[**Set**]



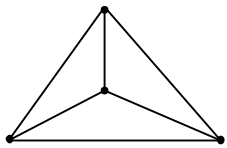
7.The azimuth of the instrument is also calculated.you can press F4:[**Set**] to set the Azimuth of the instrument.

12.3 Precautions When Performing Intersection

In some cases it is impossible to calculate the coordinates of occupied point if the unknown point and three or more known

points are arranged on the edge of a single circle. It is also impossible to calculate if the included angle between the known points is too small. It is difficult to imagine that the longer the distance between the instruments occupied and known points, the narrower the included angle between the known points. Be careful for the points can easily be aligned on the edge of a single circle.

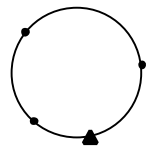
An arrangement such as shown below is desirable.



△▲: unknown point

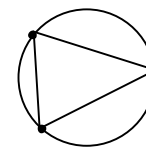
○●: known point

It is sometimes impossible to perform a correct calculation such as shown below.



When they are on the edge of a single circle, take one of the following methods:

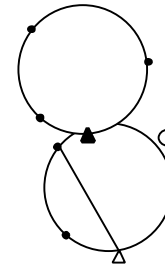
(1) Move the instruction station as close as possible to the center of the triangle.



△

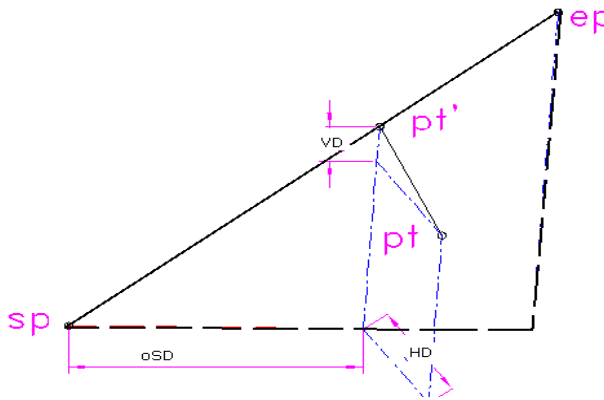
(2) Measure one more known point which is not on the circle.

(3) Perform a distance measurement on at least one of the three points.



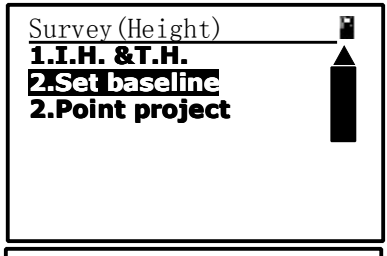
13. Point Projection

Point projection is used for projecting a point to an established baseline. By measuring a point,its offset to start point,the horizontal distance and vertical distance between the point and baseline can be calculated.the figure is shown as follow.

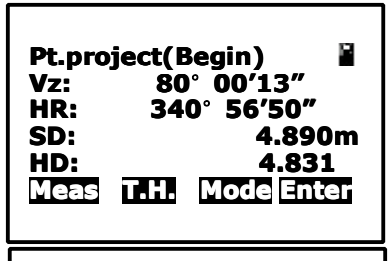


13.1 Define Baseline

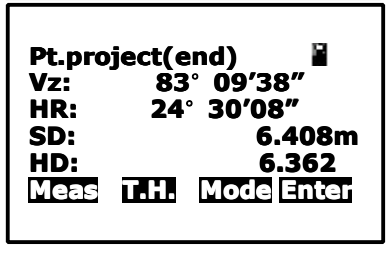
【Procedure of defining baseline】



1. Select the menu item 2 to define a baseline

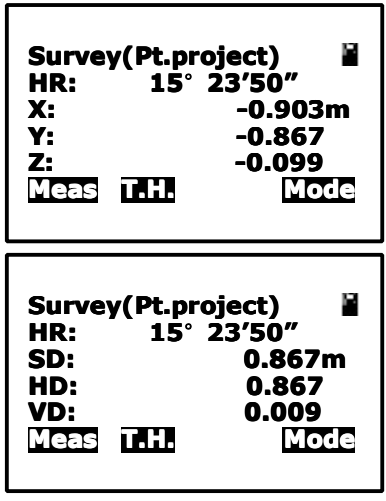


2. Measure the start point of the baseline



3. Aim at and measure the end point of the baseline.then defining baseline is over.

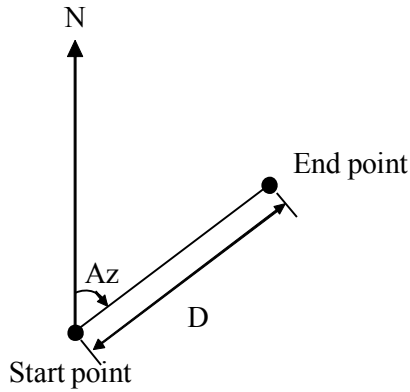
【Procedure of point projection】



14. Inverse

The distance and azimuth from a start point to an end point could be calculated according to input their coordinates.

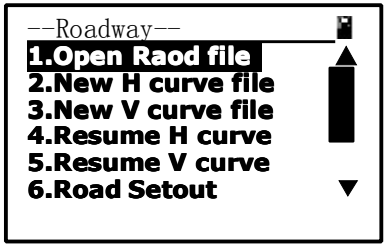
Input:	Output:
Coordiante of start point: N0,E0,Z0	Distance: D
Coordinate of end point : N1,E1,Z1	Azimuth: Az



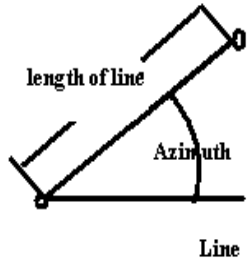
This function can be implented in **MLM** when all coordinates is called from the coordinates file.

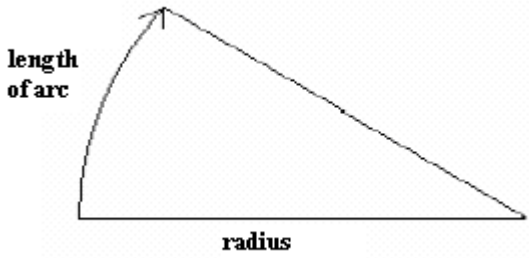
15. Roadway

Roadway application program is composed of designing and roadway setout.when you select roadway function then the menu is appeared as follow:

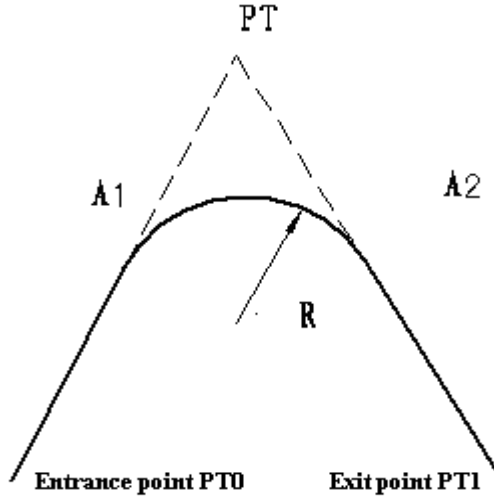


A roadway can be described as a Horizontal curve and a Vertical curve.we describe a horizontal element by Line、circle、spiral and point of intersection,these shape have some attribute as follow:





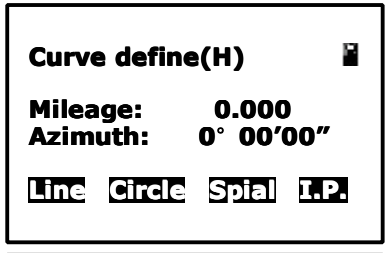
Attribute of cirle and spiral



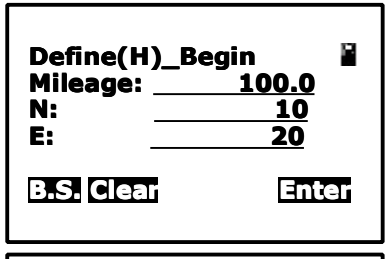
Attribute of point of intersection

15.1 Define the Horizontal Curve of Roadway

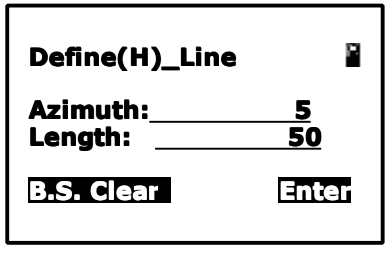
【Procedure of defining Horizontal Element】



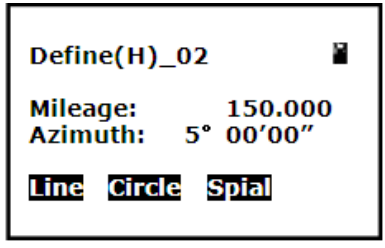
1.Select the mathod of element to define horizontal roadway.press F1:[**Line**] first.



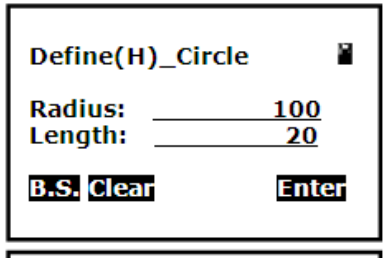
2.Input the Mileage and coordinates of start point.



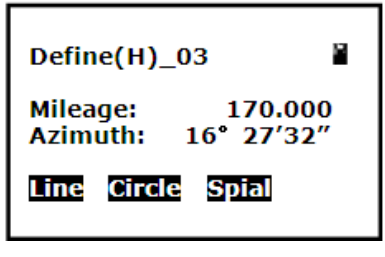
3.Input the start azimuth and the length of line



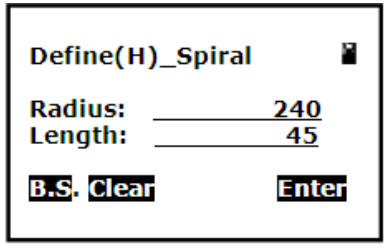
4.Calculate the mileage and azimuth of the fan-out point



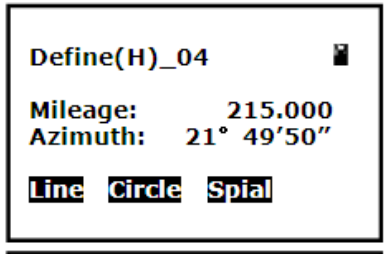
5.For example,input a circle whose radius is 100 and length is 20;



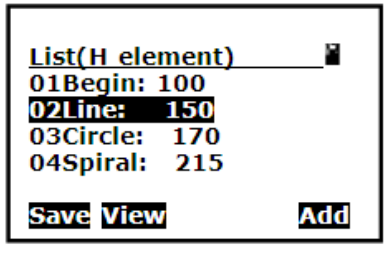
6.Calculate the mileage and azimuth of the fan-out point



7.For example,input a spiral whose radius is 240 and length is 45;

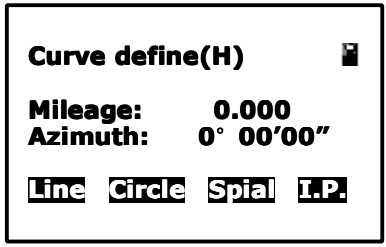


8.Calculate the mileage and azimuth of the fan-out point

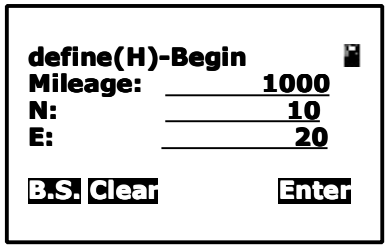


9.Max number of element is 20.press [**ENT**] to pop up the list box of all inputed element.Press F1:[**Save**] to save all element to current H-LINE-TYPE file and quit defining.Press F2:[**View**] to browse the detailed information of a element,or to edit it.

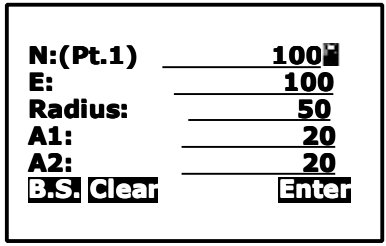
【Procedure of defining Horizontal point of intersection】



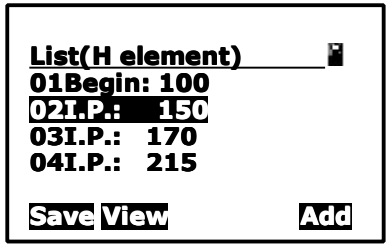
1.First pressing F4:[**I.P.**] to select the mathod of point of intersection ,then all input is I.P. latter.



2.Input the Mileage and coordinates of start point.



3.Input another I.P. one by one.press [**ENT]** to accept a dialog box.

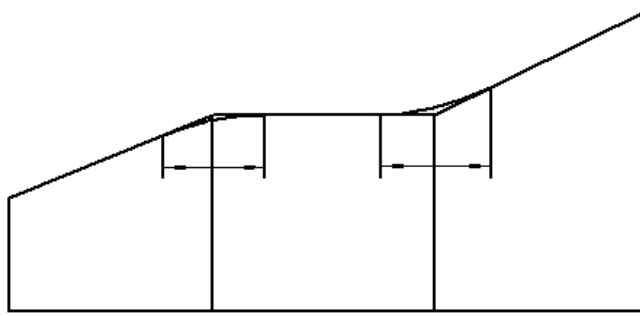


4.Press [**ESC**] to stop inputing,then pop up a list box of I.P. Press F1:[**Save**] to save all poins of intersection to current V-LINE-TYPE file and quit

defining.Press F2:[**View**] to browse the detailed information of an I.P.,or to edit it.

15.2 Defining the Vertical Curve of Roadway

The speciality of the roadway slope should be described by the vertial curve, there are three attributes on the vertical curve—mileage, altitude and length, the **mileage** is representative of the point where the slope is changed, the **altitude** is the altitude of the point where the slope is changed, the **length** indicate how much curve length is disigned to implement the slope changing.the figure is shown as follow.



mileage	0	508.306	1000.48
altitude	324.325	329.247	325.689
length	0	84.56	52.806

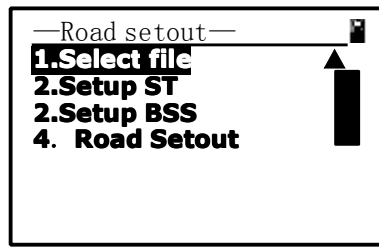
The input method of defining vertical curve is just same as the

horizontal I.P., see **【Procedure of defining Horizontal point of intersection】**

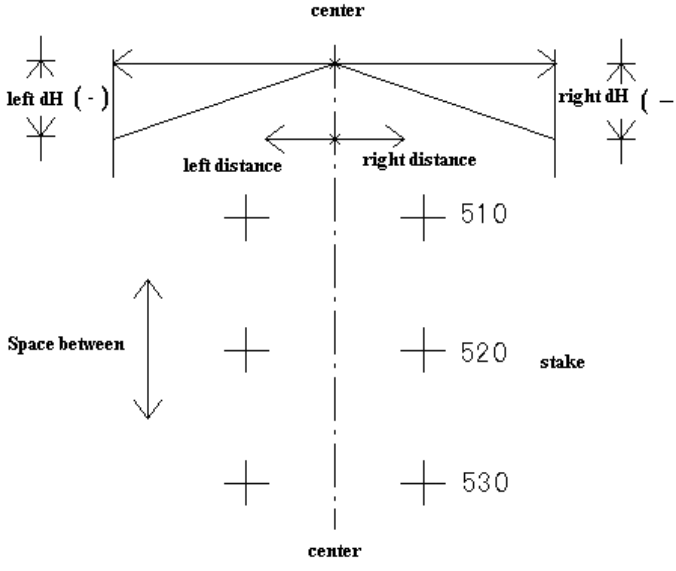
15.3 Roadway setout

When you select road-setout function ,a menu named "road setout" is poped up. Before setout, you should do something:

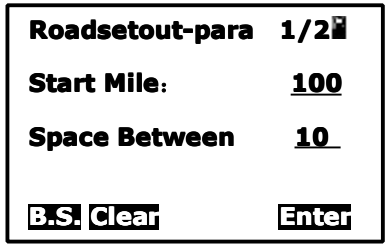
1. Load a LINE-TYPE file from file to memory using menu item 1. If you have defined a roadway just now then you cannot do it;
2. The coordinates of instrument station must be setup, you can use menu item 2
3. The azimuth must be setup, you can use menu item 3.



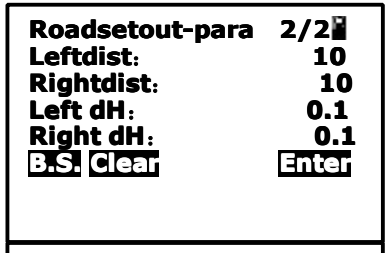
The figure for road setout is shown as follow



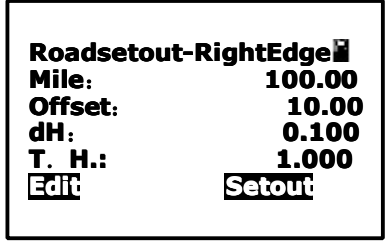
【Procedure of Road setout】



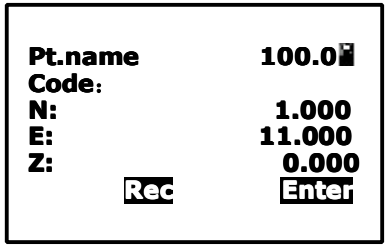
1.Input the start mile and space between



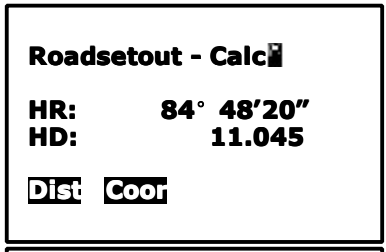
2.Input left distance,right distance etc.



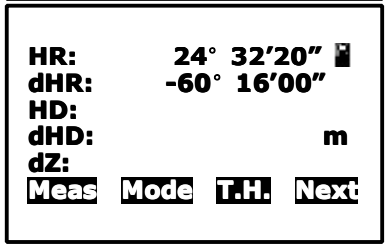
3.Use [▲][▼]to set the mile on the stake that you need to setout ,uset [◄][►] to select left edge ,center or right edge.if the mile is not found by [▲][▼], then you can press F1:[Edit] to input the mile. Then you can press F3:[Setout]



4.The coordinate of the position on the stake is calculated,in this time you can press F2:[**Rec**] to save the coordinates.press F4:[**Enter**] to setout



5.According to the point on the stake,the azimuth and horizontal distance is calculated.you can press F1:[Dist]or F2:[Coor.] to setout.



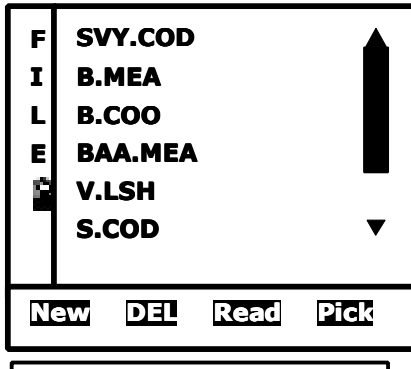
6.The mathod is same as " § 7. Setout Measurement" Press F4:[**Next**] to setout the next stake.

16. Fileman

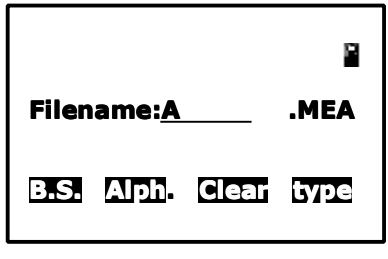
The instrument uses a FAT16 file system to manage the data. All data obtained for measuring can save to current measurement file. The extension name of measurement file is *.MEA. All

coordinates used by measurement can be picked up from current coordinate file, the extentsion name of current coordinate file is *.COO. Sometimes you need to note an attribute of a point when you measure, the code file maybe a good helper, the extension name of code file is *.COD. The extension of LINE-TYPE file for roadway is *.LSH and *.LSV, *.LSV is vertical defining file for roadway,it always is loaded after the *.LSH.

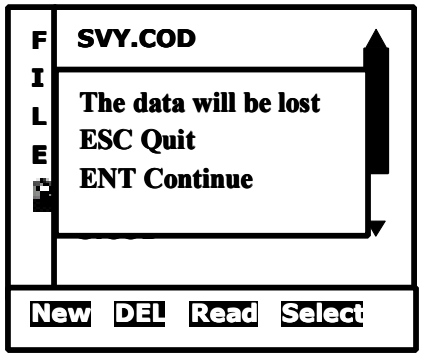
File operation is shown as follow.



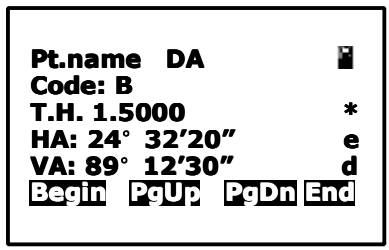
1.The file operation dialog box is shown as the picture of the left.



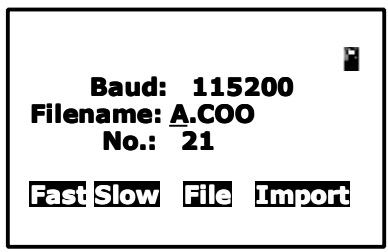
2.Press F1:[**New**] to create a new file.the type of file can be changed by pressing F4:[**Type**],after you input the filename the file will be created.



3. Press F2:[**DEL**]to delete a file for the instrument.deleting operation is dangerous ,for safty,you should export the data first.

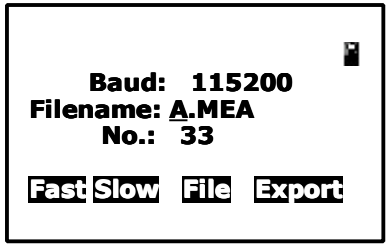


4. Press F3:[**Read**] to browse the highlight file.if the file is coordinate file or measurement file then the record is shown as the picture on the left.F1:[Begin] to show the first record.F4:[End] to show the end record.F2:[PgUp] to show the previous record.F3:[PgDn] to show the next record.[★] to edit the record if '*' is on the interface.only point name ,code and height can be edited.

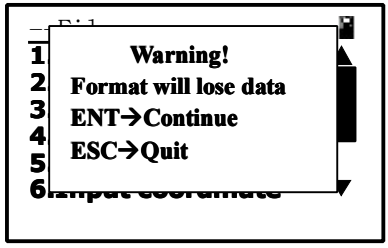


5. A coordinates file and code file can be imported from the peripheral PC through RS232 serial interface.the Baud ratio is set by pressing F1:[Fast] or F2:[Slow],the baud ration set

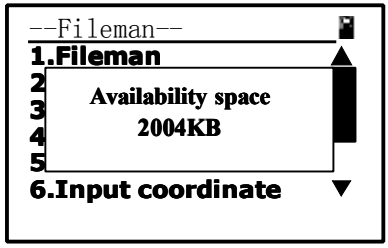
is 2400,4800,9600,19200,38400,57600 and 115200,another config is no parity ,1 start bit and 1 stop bit.after you select filename you can press F4:[Import] to perform the convection.



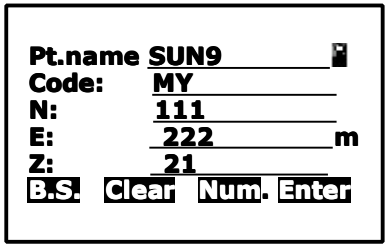
6. Measurement file can be exported from the RS232,the operation is same as the **Importing**



7. Sometimes, many files have been saved in the instrument,it will take a long time to delete these files one by one.formating the disk would be a good idea,when you format the disk,the prompt as the picture on the left will appear.so you must save all measurement data before you format.



8. Sometimes, you wish to view the fress space of the disk. You can select the menu item 5 to do it.



9. Sometimes, you need to previously input some coodinates for the subsequent using. Then you can use the menu item 6 to input data.

17. Specifications

Telescope

Image Erect
Objective aperture (EDM) Φ45mm
Magnification 30×
Field of view 1° 20′
Resolving power 3.5″
Minimum focus distance 1.5 m.

Angle measurement

Detecting system absolute encoder
Angle unit degree/gon/mil, selectable
Minimum display 1″/ 5″/10″, selectable
Detecting mode Horizontal: double, Vertical: double
Accuracy 2″ (DIN18723)

Distance measurement

Distance unit m/ft, selectable

Working distance (good condition) Single prism 2000 m, 300m @white board reflectivity 18%
Mini-reading Fine mode 1mm
Accuracy ±(2mm+2ppm • D)@prism ; ±(5mm+3ppm • D)@no prism
Measurement time Fine mode: 2 sec @single mode; 1.2sec @continue mode
Tracking mode: 0.5 sec
Temperature unit ºC/ºF, selectable
Pressure unit hPa/mmHg, selectable
Temperature input range -20ºC to +60ºC (1ºC steps)
Refraction and earth curvature correction OFF/0.14/0.2, selectable
Reflecting prism constant correction -99.9mm to +99.9mm

Level vial sensitivity

Plate level 30″ / 2mm
Circular level 8′ / 2mm

Compensation

System Liquid single axis
Range ± 3 ′
Resolving power 1 ″

Laser plummet

Accuracy ±0 . 8 m m / 1 . 5 m
Laser class Class 2/I EC60825-1
Laser wavelength 650nm

Display

LCD 6 lines×24 characters
Illumination Yes

Internal memory

Internal memory 20000 points

Data communication

I/O RS-232C

Power

Battery Li-ion Rechargeable battery

Voltage 7.4Ⅴ DC

Continuous operation tine ~9 hrs Distance & angle, ~24 hrs Angle only

Chargers 100V to 240V 50/60Hz

Charging time (at +20℃) Approx. 4 hours

Others

Working temperature -20° ～+50℃

Dimension 220×184×360mm(W×D×H)

Weight 14 lb.

Waterproof IP54 (IEC60529)

18. Prompt，Warning and Error Messages

“Tilt Over"—the tilt compensater is out of range

“Points NO.<=20”—the number of points should be less than 20

"Cannot find"—cannot find any point by the name

"Pt. first"—input the name of point first please!

"No information"—Have not got station, BSS or other coordinates,or have not input pointname

"Filename error"—illegal character in the filename

"Cannot import"—type of the file is not match, cannot import

"Choose file"—please assign a file to import or export

"None record"—there is not record in the file

"Saved"—records have been saved

"Select coor.file"—assign a coordinates file

“Overtop"—the value is out of range

"No data"—there is not record in the file

"Type not matching"—the type of file is not match with what you need

"Inexistence file"—file is not existing

"Empty file"—there is not record in the file

"Pickup 21 records"—read out 21 roadway elements from the file

"Pickup 7 records"—read out 7 roadway I.Ps from the file

"90° Beep off"—switch off Beep on rectangle position

"90° Beep on"—switch on Beep on rectangle position

"Setup station first"—please config station before seting BSS

"Open error"—cannot open file

"T.H. overtop"—the height of the prism is out of range

"I.H. overtop"—the height of the instrument is out of range

"Dist overtop"—the value of distance is out of range

"Press overtop"—the value of air pressure is out of range

"Temp. overtop"—the value of air temperature is out of

range

"Cannot calculate"—the shape is mussy,so area cannot be calculated.

"Extension error Input as follow (COD, COO, MEA, LSH, LSV)"

—system can only accept some file such as:*.cod,*.coo,*.mea,*.lsh,*.lsv

“Disk is full"—there is not enough space to save file,delete some unused file.

"Max elements should be less than 20!"—there are 20 or less elements that can be accepted by the instrument.

"Mileage overtop! "—the mileage of the start point is out of range

"Error: I.P number less than 3!"—for calculation, the

number of the intersection point should be 3 or more

"No data (V)!"—there is not data that define the roadway in vertial aspect

19. Standard Warranty Terms

Warranty period for ZTS-120/120R is 12 months from date of purchase.

Hi-Target warrants this instrument made by Hi-Target Surveying Instrument to be free from manufacturing defects in materials and workmanship. For claims to be made under this warranty, the instrument must be inspected by Hi-Target and the defect must be proven to Hi-Target's satisfaction. At the time that it is proven to the Hi-Target's satisfaction that the instrument is defective, it shall be repaired or replaced, at the Hi-Target's option and returned to the original purchaser at no cost to them. Hi-Target's sole obligation and the Buyer's sole remedy are limited strictly to repair or replacement with these provisions below:

A. The instrument is returned to Hi-Target, properly packaged with the transportation charges prepaid and insured and accompanied by proof of ownership. Receipt and previous registration is required.

B. Except for ordinary wear and tear resulting from normal usage,

the instrument, upon inspection by Hi-Target is determined to be defective in material and/or workmanship.

Under no circumstances shall Hi-Target be liable for any consequential, incidental or contingent damages whatsoever.

Limitations and Exclusions

A. This warranty does not apply to instruments subject to negligence, abuse, accident, improper operation, instruments damaged in transit or damage due to unauthorized service repairs made by someone other than Hi-Target or other Hi-Target authorized service personnel. Circumstances beyond Hi-Target Instrument s control cannot be warranted.

B. This warranty does not apply to regular required maintenance such as cleaning, adjusting, lubricating or calibrating unless required as a result of a defect in workmanship or materials. If, upon examination of the instrument, Hi-Target determines that additional repair services are required and not covered under this warranty, Hi-Target shall notify the Buyer of such repair charges and proceed only after authorization has been received.

C. This warranty does not apply to instruments damaged in transit to or from Hi-Target Instrument or any authorized repair center.

Other remedies may or may not be available for transportation damages.

These designs, figures and specifications of ZTS-120/120R are subject to change without notice. Hi-Target shall not be held liable for damages resulting from errors in this instruction manual.