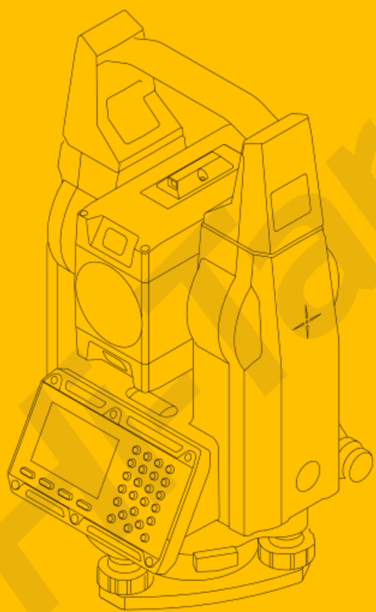
Hi-Target



HTS-521^{L10}(L) Series Instruction Manual

Preface

Thanks a lot for purchasing our total station!

This manual is your good helper, please read it carefully before using the instrument and keep it safely.

Product affirms:

In order to get the best service from our company, please feedback your instruments' version including number, purchasing date and your suggestions to us after the purchasing of the product.

We will attach great importance to any piece of advice from you,
We will be very concerned about any detail of our products,
We will make great efforts to provide better quality.

Notice: Our Company has the right to upgrade and improve the technical parameters of instruments, which may not be announced in advance. The pictures in the manual are only for reference and kind prevail.

Features:

Rich Feature: Our Total Station is equipped with a wealth of measurement applications including data storage, parameter settings and etc. It’s suitable for all kinds of professional measurements.

1. Absolute coded dial

With absolute digital dial, instruments can be measured directly when it powers on. The measured azimuth angle result will not be lost even when the instrument shut off.

2. powerful memory management

Large-capacity EMS memory, easy to manage the file system, serving to add, delete and transfer data.

3. No prism ranging

The series Total Station with laser ranging No-Prism is capable of surveying for long distance, fast and precise measurements with various materials and different colors of objects (such as building walls, poles, wires, cliff wall, mountain, mud, stakes, etc.). For those which are hard or impossible to be reached, the application of Prism features can be a good measurement task.

4. special measurement procedure

The series total station is equipped with the basic surveying function as well as special measurement procedures, undertaking REM, offset measuring, stakeout, Resection, area measurement and calculation, road design etc. to meet the needs of professional measurement.

5. eyepiece changeable

The instruments’ eyepiece can be changed, and equipped with a diagonal eyepiece, serving to observe zenith and high buildings.

6. An optional laser plumb

The site features are easy to instruct and set up stations.

NOTE:

1. Avoid look directly into the sun with the eyepiece when measuring. Recommended to use solar filter to reduce the impact.
2. Avoid extreme temperature when storing equipment and sudden changes in temperature when using the instrument.
3. The instrument should be loaded in box placed in dry and ventilated place and prevented from shock, dust and moisture when it is not in use.
4. In order to get good accuracy, you should leave the instrument in the box if the instrument temperature has large difference between working and storing you may unpack the box and employ the instrument until the instrument reaches the temperature at the working field.
5. If the instrument is not used for a long time, the battery should be unloaded and stored separately and charged once a month to prolong battery life.
6. The instrument should be installed in box when it is transported. Extrusion, collision and violent vibration need to be carefully avoided during the transport process. The soft mat May be placed around the box on the long-distance transportation.
7. It is better to use high quality wooden foot stool to make sure the stability of measurement and improve its accuracy, when setting up the instrument.
8. Only use absorbent cotton or lens paper to wipe the instrument gently if exposed optical device need to be cleaned.
9. Use flannelette or hairbrush to clean the instrument after using. Do not electrify and start up after the device got wet in a rain. Using clean soft cloth to wipe it dry and put it at ventilated place for a period of time to make the instrument fully dry before using or packing.

10. Inspect instrument carefully and comprehensively to ensure its indicators, function, power supply, initial setting and correction parameters meet the requirements before operating.
11. If the function is abnormal, non-professional maintenance persons are not allowed to dismantle the device without authorization in case of any unnecessary damage.
12. The emitted light of the no-prism total station is laser, do not direct to eyes.

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Security Guide

Pay attention to the following safety matters when you use the laser ranging free of prism.

Warning:

Total station fit out laser level 3R/ⅢIa which is recognized by the loge, which is above:

the vertical locking screw saying: “3A laser product ”.This product belongs to Class 3R level laser .According to the following standards IEC 60825-1: 2001Class 3R/ⅢIa laser product can reach five times of emission limits of the Class 2/Ⅱ in the wavelength between 400nm-700nm.

Warning:

Continuous stare into the laser beam is harmful.

Prevention:

Do not stare at laser beam or point to others. The reflected beams is the effective signal of the instrument. It’s safety to observe by eyepiece.

Warning:

When the laser beam is irradiated reflected by prisms, plane mirrors, surface of metal and windows, it’s dangerous to look straight into the reflected beams.

Prevention:

Don’t stare at the reflected beams. When the laser is switched on (distance mode), do not obstruct optical path or stand near the prism. Target at a prism with total station telescope only.

Warning:

It’s dangerous to use the Class 3R laser device improperly.

Prevention:

To avoid injury, each user must carry safety prevention measures and operate the instrument within the safety scope according to standard IEC60825-1: 2001).

The following is the explanation of the main part of the standard:

Class 3R level laser products are used outdoors and in construction (surveying with No-Prism).

A: Only trained and certified persons are allowed to install, adjust and operate the laser equipment.

B: Set up appropriate laser warning sign within the operating field

C: To prevent anyone from looking into the laser beam use an optical instrument to observe.

D: In order to prevent laser damage to persons, the laser beams should be blocked at the end of the working route, and also should be cut off when people work in the restricted area (harmful distance) where laser beams crossing are harmful.

E: The route of the laser beam must set to be higher or lower than the human eye.

F: Properly store and safe keep the laser products when they it is not used, unauthenticated personals are not allowed using it.

G: Do not point laser beams at surfaces such as plane mirror, metal surface, window, especially the surface of plane mirror and concave mirror.

Harmful Distance is the maximum distance from the starting point of the laser beams to where people are right safe. The built-in harmful distance of the Class 3R/IIIa laser is 1000m(3300ft) and the laser intensity will reduce to that of Class 1 products (which does not harm eyes) if people is out of this range.

Content

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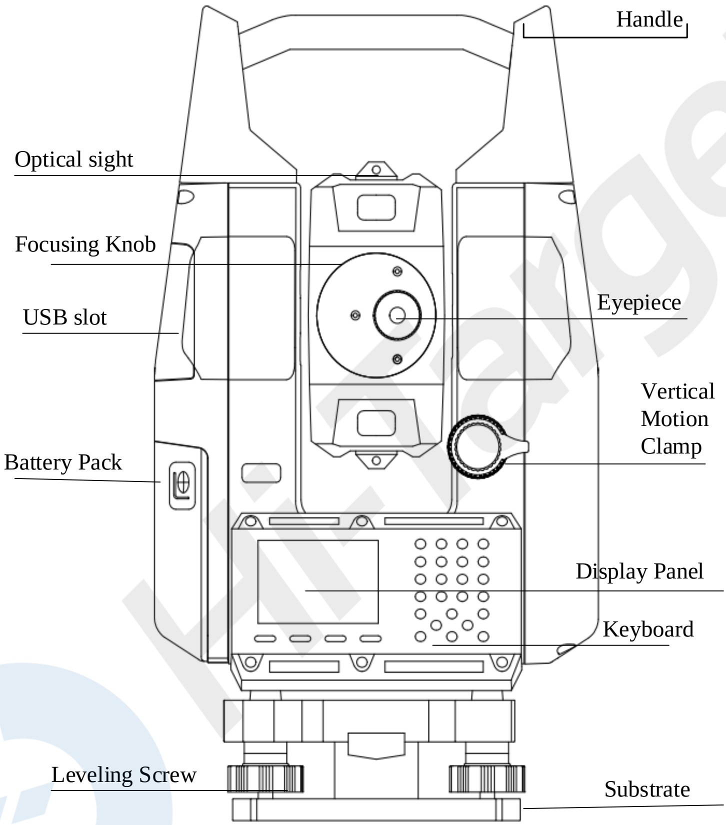
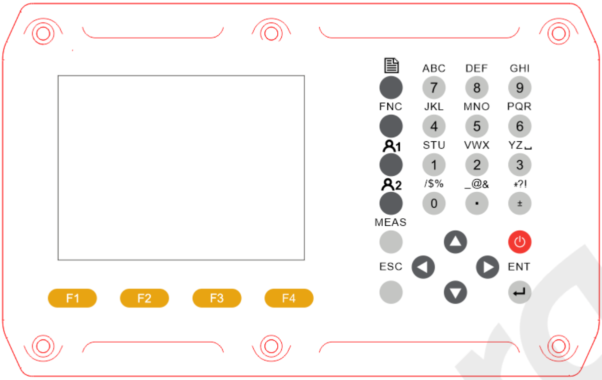
1 Name and function of each part

1.1 Name



1.2 Keys Functions and information display



Key	Function
	Power ON/ Power OFF.
MEAS	Trigger key, depends on setting, maybe disting & save, disting or none.
ESC	Cancel or exit.
ENT	Confirm or commit editing.
	Page turning
FNC	Hot key to enter function menu in measuring interface.
	User defined function key 1.
	User defined function key 2
▲	Move cursor up or go to previous.
▼	Move cursor down or go to next.
◀	Move cursor left or go to left.
▶	Move cursor right or go to right.
STU GHI	Entering letters A-Z.

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1 ~ 9	
0 ~ 9	Entering number or choose menu item.
F1 ~ F4	Soft keys to choose screen bottom function.

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2 Preparation before measurement

2.1 Unpack and store instrument

- Unpack

Put down the box gently and turn up the cover then turn on the lock, open the cover and take out the instrument.

- Deposit

Cover up the telescope mirror and make the vertical motion of alidade upwards then put the instrument horizontally (keep the objective upwards) into box. Then screw vertical motion gently. Cover up the box cover and lock the box. Loose horizontal and vertical axis as much as possible to reduce the shock damage to instrument.

2.2 Setting up the instrument

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

- Reference for operation:

1. Centering and levelling

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

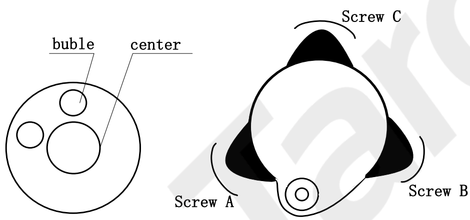
Mount the instrument on the tripod head. Support it with one hand,

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

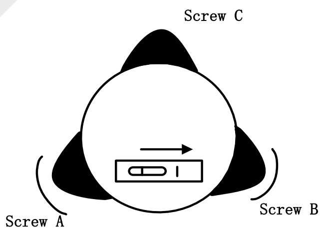
① Twist and adjust the two leveling screw A and B on the bottom of the instrument until the bubbles of the circular level moves to the line perpendicular to the center line the screw A and B;

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

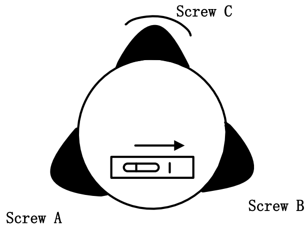


4) Using the plate level to level the instrument precisely

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.

2. Centering by centering tool (optional or laser)

1)Set up a tripod

Extend a tripod to the appropriate height 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. Brace tripod on the ground and keep one leg fixed.

2)Set up instrument and spotting

Put instruments on a tripod carefully, and tighten the center connection screw. Adjust the optical centering tool to make reticule clear (open instrument and laser centering if it’s a laser centering tool). Handle another two unfixed legs, and adjust their position through the observation of the optical plummet. Make the three legs of the tripod fixed on the ground when the optical plummet is aligned to the station approximately. Adjust three feet screws of total station and keep the optical centering tool (or laser centering) aiming at the station accurately.

3)Leveling instrument roughly by circular level

(Same as the section above that discusses centering and leveling with plumb bob)

4)Leveling instrument accurately by tubular level

(Same as the section above that discusses centering and leveling with plumb bob)

5)Centering and leveling accurately

Loosen center connection screw slightly and move instrument horizontally (Don't rotate instrument) through observation to optical plummet, making the instrument aim at station accurately. Tighten the center connection screw and leveling instrument accurately again.

This operation should be repeated till the plumb aims at station accurately.

2.3 About the battery

- **Mounting the battery**

☆Fully charge the battery before measurement.

☆Cut off the power before removing the battery.

▸Step mounting the battery

1. Insert the battery to the instrument.
2. Press the top of the battery until you hear a click sound.

▸Step Remove battery

1. Press the button downward.
2. Remove the battery by pulling it toward you.

- Battery information

▮——Power is adequate, operating available.

▮——The battery can be used for 4 hours when this symbol first appears. If you cannot master the consumed time, you should prepare a spare battery or charge the battery before using.

▯——End of the operation as soon as possible and replace the battery and charge if running out of power.

▯——It takes several minutes for the instrument to shut down when this symbol first appears. The battery has few power now and should be replaced an recharged.

Notice:

① The operating time of battery depends on environmental conditions such as ambient temperature, time and times of charging and so on the battery is suggested to be prepared or charged ahead before operation to keep it safety.

② The battery symbol only indicates power capability undercurrent measurement mode. The remained capacity of the battery shown under current mode does not guarantee its capacity under other modes .Because consumption of power in distance measurement mode is more than that in angle measurement mode ,the instrument may end ranging sometimes due to insufficient capacity of battery (when switching between modes).

Notice in charging:

- Though overcharging protection is installed in the instrument, please plug off the battery immediately after finishing charging.
- Charging range from 0°~±45℃. Abnormal responds of instrument occurs over this range.
- Rechargeable for300—500 times, it may shorten Service time of the battery completely.
- Charge the battery once a month no matter if it is used to prolong its longevity.

2.4 Reflecting prism

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

2.5 Loading or unloading the base

- Loading

Put the three fixed feet in the corresponding bases, make the instrument in a triangular base, clockwise lock the button by 180° to lock the base, and then fix screw with a screwdriver to screw it out at a fixed lock knob.

- Unloading

If necessary, the triangle base can be removed from the instrument (including the same base of reflection prism base connector) by loosening the lock knob base fixed screw with a screwdriver, and anticlockwise locking button about 180° , then separate the instrument from base.

2.6 Adjust telescope objective and aiming target

Aiming method (reference)

① Rotate the telescope and point it to the bright sky and focus reticule clearly (by rotating eyepiece in own direction and focusing reticule slowly).

② Aim at the target with the crosswire in optical sight , and keep an appropriate distance when aiming (about 200mm).

③ Use telescope focus screw to make target clear.

It means that focus or eyepiece diopter is not adjusted when there is a parallax with eye moving up and down, thus focus carefully and adjust eyepiece to reduce parallax.

2.7 Input Mode

Total station keyboard includes alpha/digit keys. User can input letters and numbers directly.

- **Input box:**

Each digit key defines 3 letters and 1 number. Depends on the properties of input box, input process varies.

Number input box:

In number input box, user can only input numbers, include “1-9”, “.”, “-+”. Number will appear in box when user presses the key.

Text input box:

In text input box, user can input numbers and letters. Repeat pressing same key to get proper letter, such as A->B->C->7.

When right-bottom of screen display icon ␣A, user can input number/letter; when display icon ␣1, user can only input number. User can press soft-key [F4] to switch input mode between Number and Text when input box been active.

- **Letters:**

  Letters that total station can input includes “A-Z/$%_@&*?!+-.”. When wildcard queries, you need to use the "*" character and press the ± key twice in the character input mode of the total station.

- Arrow key ← → move inputting cursor.
- Pressing ENT enters editing; pressing ENT confirms input after editing.
- When editing distance, angle, temperature and pressure values that

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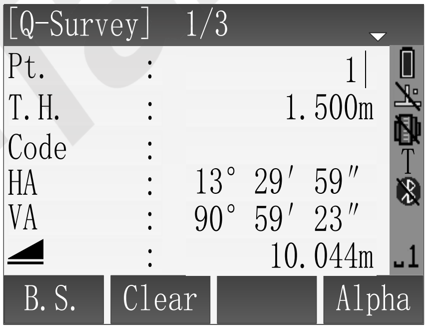
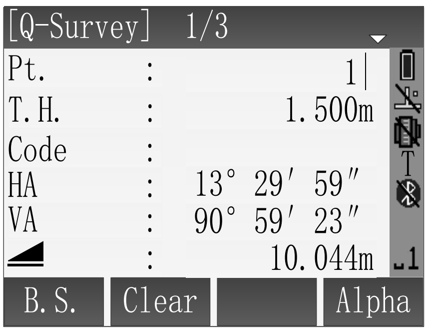
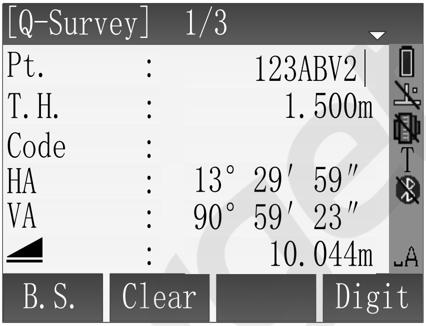
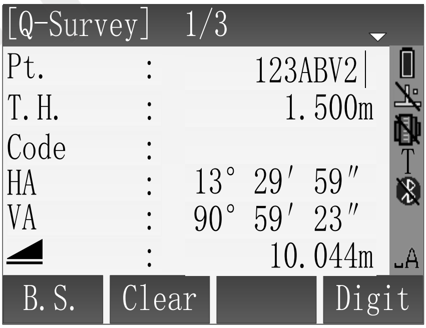
contain unit format, input box’s text will convert into text without unit format. Such as angle 29° 32′ 56″ transforms into 29.3256; Distance 115.321m transforms into 115.321. When finish editing, the text will automatic convert back.

2.7.1 Input characters

Each digit key defines 3 letters and 1 number. In text input mode, each time pressing the key, one character appears at cursor position. Number appears when pressing 4 times.

Example: input 123ABV2

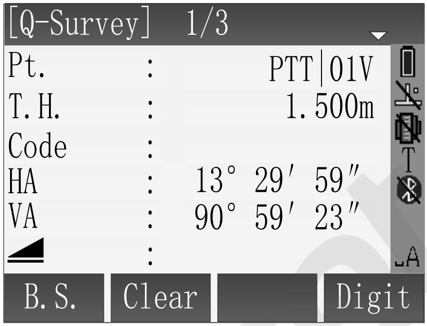
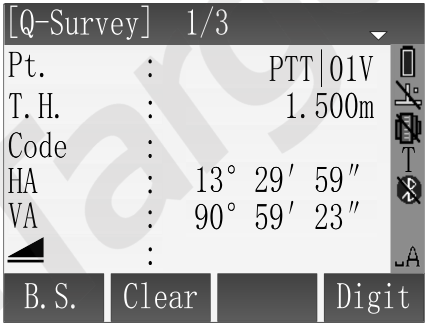
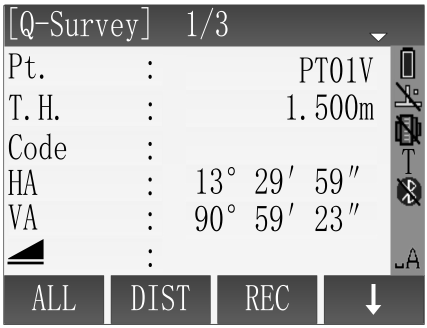
Steps	Key	Display
①Pressing key to start inputting. Right-bottom screen displaying icon ⅃1 means in number input mode.		
②Press key 1, key 2, key 3. Then press key F4, active text input mode. Icon ⅃A should appear in right bottom screen.	[1],[2],[3],[F4]	

③Press key 7, display letter ‘A’, wait about half second, press key 7 twice, display letter ‘B’, then press key 2, display letter ‘V’, wait about half a second, press key 2 four times, display number ‘2’. Then finished text ‘123ABV2’ input.	[A],[B],[V],[2]	
④Press key ENT to finish editing, cursor will move down to next input box.	[ENT]	

2.7.2 Delete characters

Delete or clear input characters.

Steps	Key	Display

①Press key ← to move cursor to right side of the character that to be deleted.	←	
②Press key F1(Delete).	[F1]	
③Press key ENT to confirm input. Press Key ESC to undo changes.	[ENT] / [ESC]	

2.8 Point Search

Point search is a function used by applications to find measured or fixed points in the jobs.。

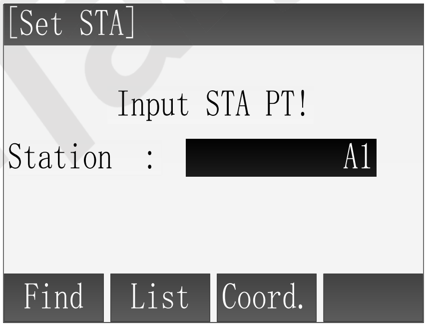
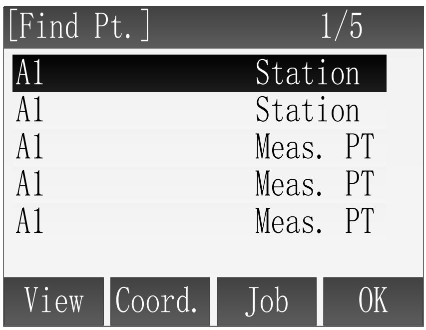
Point search is limited to a particular job.

If several points meet the search criteria, then the results are ordered according to the date.

2.8.1 Direct search

By entering an actual point number (for example ‘A1’), and pressing key SEARCH, all points within the selected job and with the corresponding point number are found.

Here is an example for searching fix point in function ‘Set STA’.

Steps	Key	Display
①Choosing ‘Survey’ in application menu, then choose function ‘Set STA’. Entering point number, for example ‘A1’, pressing ENT to finish input, then pressing F1 to search.	[F1]	
②In searching result window, using arrow key ↑↓ to move cursor to select point number. Press key F4 or ENT to confirm selecting.	↑ ↓ + [F4] / [ENT]	

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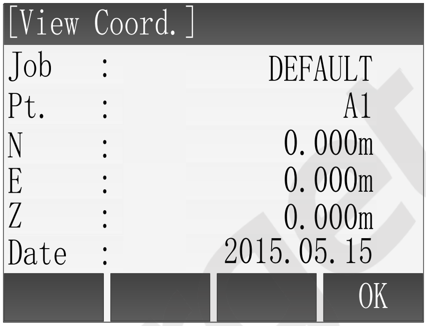
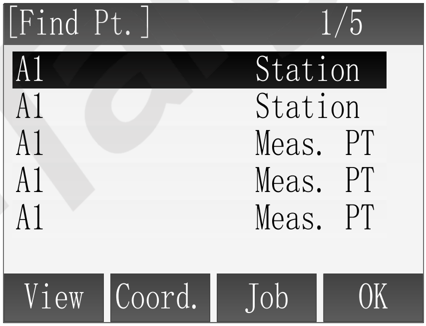
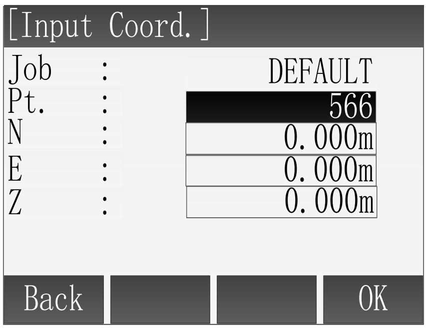
Soft key's introduction:

[View] Show the coordinate of selected point.

③Using arrow key ↑ ↓ to move cursor and select point number. Press key F1 to show the coordinate details of selected point.	[F1]	
④Press ESC or F4 back to previous screen.	[ESC] [F4]	

[Coord.] Input point manually.

③If required point not exists in the job, user can manually input it by pressing key F2. by pressing ENT to input box.	[F2]	

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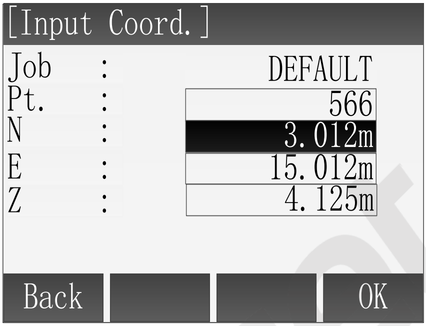
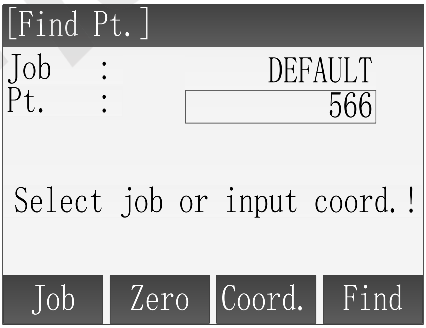
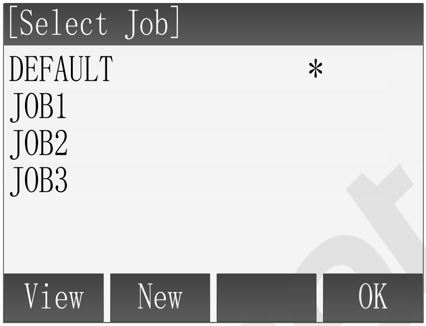
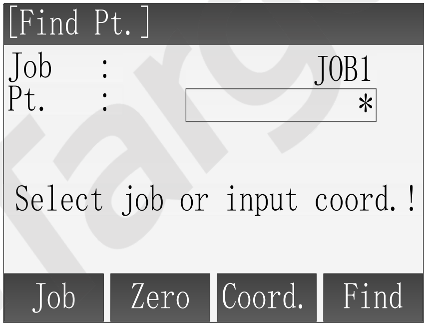
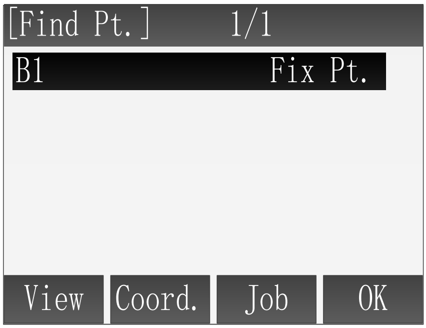
<table>
<tr>
<td>④Input point number and N, E, Z values, by pressing ENT to move cursor to next input box.</td>
<td>[ENT]</td>
<td>
</td>
</tr>
<tr>
<td>⑤After all values finishing input, pressing key F4 to save the point to the job.</td>
<td>[F4]</td>
<td></td>
</tr>
</table>

[Job]Choose another job's points.

<table>
<tr>
<td>③ If required point not exists in the job, user can choose another job's points.</td>
<td>[F3]</td>
<td>
</td>
</tr>
</table>

④ Entering job list by pressing key F1, choose the particular job and press ENT or F4 to commit choosing.	[F1] [F4] [ENT]	
⑤ Entering searching point number. If using input point, press key F2 (Zero) or F3 (Coord.)※[1]	[ENT]	
⑥ Press key F4 to search the point in the selected job.	[F4]	
※[1][F2](Zero): Set N, E, Z to 0. [F3](Coord.): Input point manually.		

[OK] Commit selected point.

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2.8.2 Wildcard search

The wildcard search is indicated by a “*”. The asterisk is a place holder for any following sequence of characters. Wildcards should be used if the point number is not fully known, or to search for a batch of points.

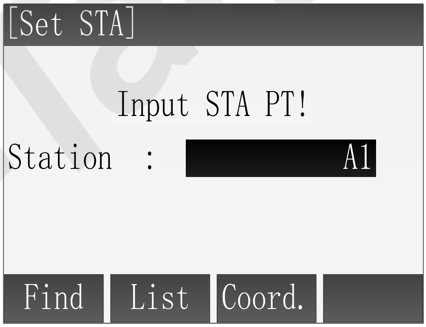
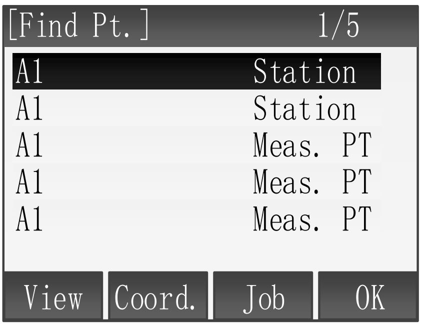
Examples:

* All points are found.

A All points with exactly the point number “A” are found.

A* All points containing “A” are found, for example, A1, A2, 1A.

Steps: (For example “*”)

<table>
<tr><th>Steps</th><th>Key</th><th>Display</th></tr>
<tr><td>① Choosing ‘Survey’ in application menu, then choose function ‘Set STA’. Entering “*”, pressing ENT to finish input, then pressing F1 to search.</td><td>[F1]</td><td>
</td></tr>
<tr><td>② In searching result window, using arrow key ↑ ↓ to move cursor to select point number. Press key F4 or ENT to confirm selecting.</td><td>↑ ↓
[F4] [ENT]</td><td>
</td></tr>
</table>

3 Q-Survey

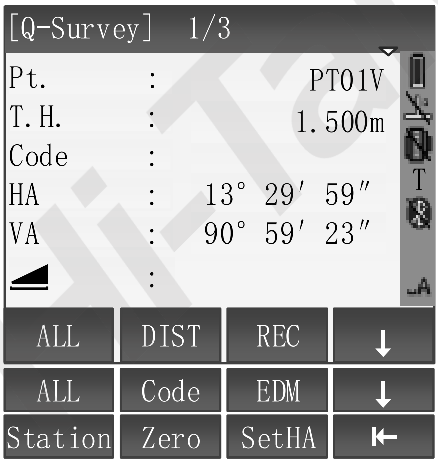
3.1 Notes in the distance measurement

After the placement of instrument and turned on the power, total station is ready, can start measuring.

In measurement display, user can call the function of set key, the function keys and hotkey.

The show is an example. Localized version may be slightly different.

The example of Q-Survey show:



F1-F4 Start the corresponding functions

Notes:

Measurements to strongly reflecting targets such as to traffic lights in Reflector EDM mode without prism should be avoided. The measured distances may be wrong or inaccurate.

When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment.

If e.g. people, cars, animals, swaying branches, etc. cross the laser beam while a measurement is being taken, a fraction of the laser beam is reflected and may lead to incorrect distance values.

Avoid interrupting the measuring beam while taking reflector less measurements or measurements using reflective foils.

- No Prism Ranging
- Ensure that laser beam is not reflected by any object with high reflectivity and close to the light path.
- When start the distance measurement, EDM will measure distance for the object in the light path. If there are temporary obstacles in the light path (such as by car, or the heavy rain, snow, or filled with fog), the distance measured by EDM is the distance to the nearest obstacle.
- When a long distance measurement, laser beam deviation of collimation line will affect the accuracy of measurement. This is because the divergence of the laser beam reflection point may not be with the crosshair sighting points coincide. It is recommended that the user accurately adjust to ensure that is consistent with laser beam collimation.(Please refer to "20.10 NO Prism Ranging" in the Chapter 9)
- Don't use two instruments to measure the same target at the same time .
- Red light cooperates with reflective pieces to measure distance

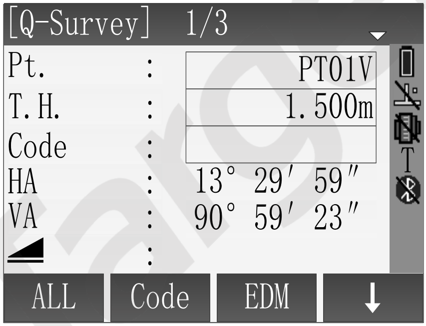
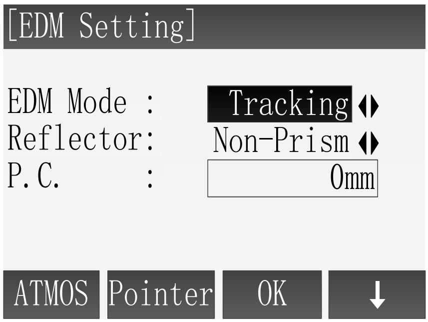
  Laser can also be used to measure distance for reflective pieces. To guarantee the accuracy of measurement, the laser beam is perpendicular to the reflector plate, and through accurate adjustment.(Please refer to "3.10 NO Prism Ranging" in the Chapter 9)

Ensure proper additive constant of different reflection prism.

3.2 EDM Setting

3.2.1 Set the mode of EDM

Select the mode of distance measurement, there are 6 modes : Single,Repeat,Tracking,3 Times,4 Times,5 Times.

Steps	Key	Display
① Press [F4](↓)and show the second soft key in the Q-Surveying. Press [F3] to enter the interface of EDM Setting.	[F4] [F3]	
② When the cursor is in EDM mode option, Press the direction key of ←→ to select the mode of measurement. Each time you press ← or →, the mode of measurement is switched.	← →	

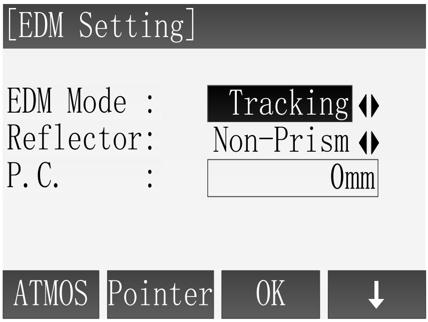
Hi-Target

③ After finishing setting, press [F3](OK) to return the function of Q-Surveying. If you want to cancel the settings, press [ESC] to ignore the changes.	[F3]	

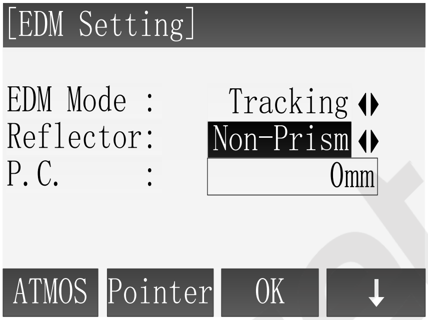
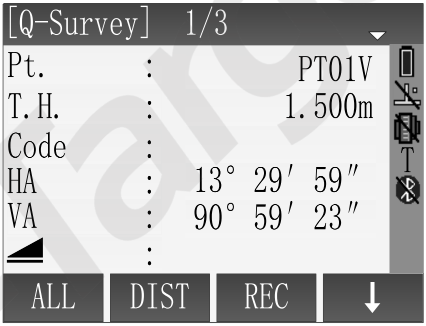
Set the reflector type

Our series total station can be set up for the red laser (RL) range and invisible infrared light (IR) range and the total station has three reflectors to be selected, which are prism, non-prism (NP) and reflect board (Sheet). You can set by job,but the prism used should be matched with prism constants.

- **About the parameters of various reflectors in distance measurement, please refer to “Technical Parameters”.**

Steps	Key	Display
① After entering to the interface of EDM Setting, using the direction of [↓] to move the cursor to the setting item of Reflector.	[↓]	

Hi-Target

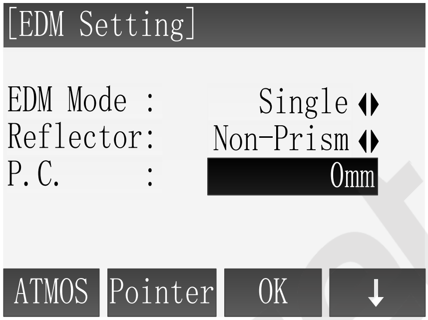
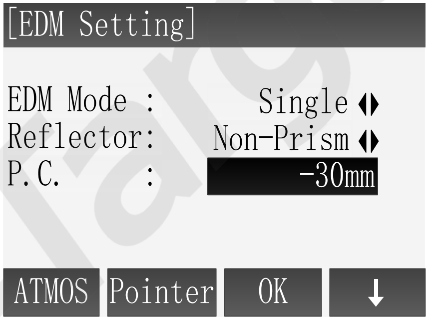
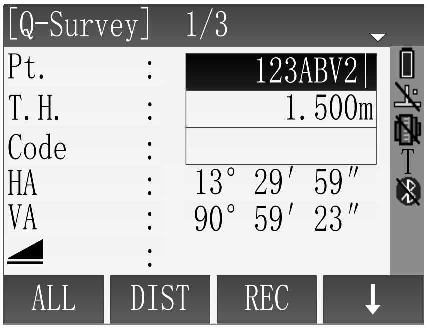
② Press ←→ to select the types of reflector. Each time you press ← or →, the type of reflector is switched.	← →	
③ After finished setting, press [F3] (OK) to return the function of Q-Surveying. If you want to cancel the settings, press [ESC] to ignore the changes.	[F3]	

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.

Example: Prism Constant is -30mm

Steps	Key	Display

<table>
<tr>
<td>① After entering to the interface of EDM Setting, using the direction of [↓] to move the cursor to the setting item of P.C.</td>
<td>[↓]</td>
<td>
</td>
</tr>
<tr>
<td>② Enter the prism constant value and press the key of [ENT]. ※1※2※3</td>
<td>[ENT]</td>
<td>
</td>
</tr>
<tr>
<td>③ After finished setting, press [F3](OK) to return the function of Q-Surveying. If you want to cancel the settings, press [ESC] to ignore the changes.</td>
<td>[F3]</td>
<td>
</td>
</tr>
<tr>
<td colspan="3">※1: Prism constant you enter is effective only when the reflector mode is Prism.
※2: The range of Prism constant value: -99mm～+99mm.</td>
</tr>
</table>

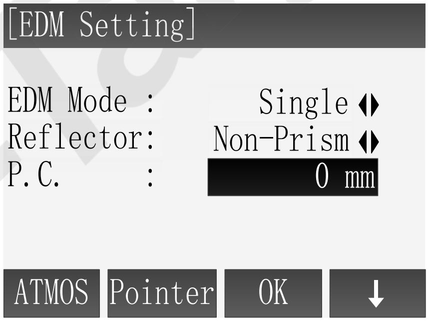
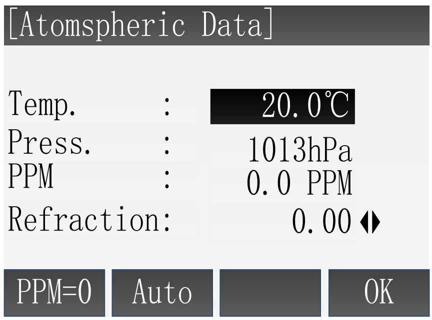
3.2.2 Atmosphere setting

Refraction:

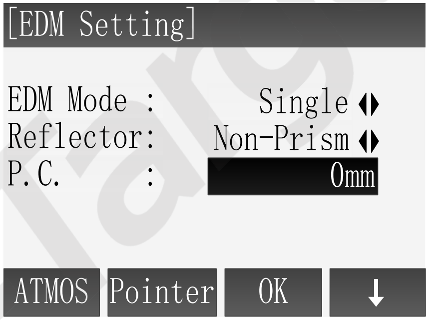
When measuring horizontal distance and elevation, our instrument corrects the atmospheric refraction and the earth curvature automatically.

The instrument supports of atmospheric refraction coefficient have three option, they are 0.00, 0.14, and 0.20.

Note: The refraction of instrument has been set for K=0.00 when left factory .It also can be set to other values

Steps	Key	Display
① After entering to the interface of EDM Setting, press [F1] (Atoms) to enter the interface of Atmospheric Data.	[F1]	
② Interface displays the current setting, using the direction of ↓ to move the cursor to the setting item of Refraction. Press ←→ to select the	↓ + ←→	

Hi-Target

value of refraction. Each time you press $\boxed{\leftarrow}$ or $\boxed{\rightarrow}$, the value of refraction is switched.		
③After finished setting, press [F4] (OK) to save settings and back to previous menu. If you want to cancel the settings, press [ESC] to ignore the changes	[F4]	

Atmospheric Correction:

When measuring distance, the measured value will be influenced by the atmosphere.

In order to reduce the influence, a atmospheric correction parameter is needed.

Correction value associated with the pressure and temperature in air. Calculated as follows:

PPM = 277.8 – (0.2900* the air pressure(hPa))/(1 + 0.00366* temperature(℃))

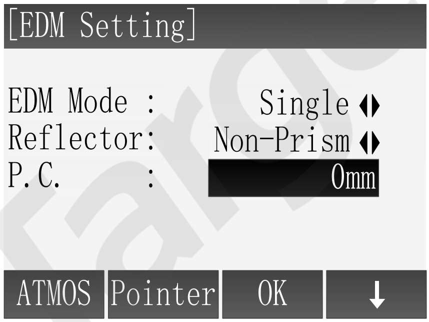
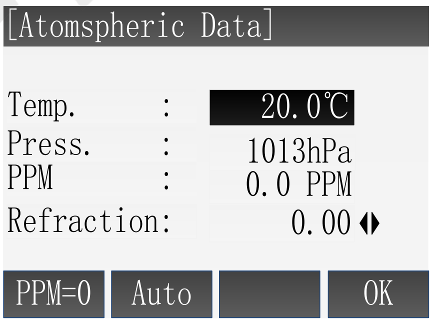
If the air pressure unit is mmHg, Make a conversion according to the formula: 1hPa=0.75mm Hg

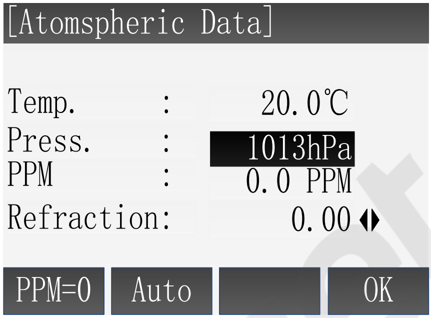
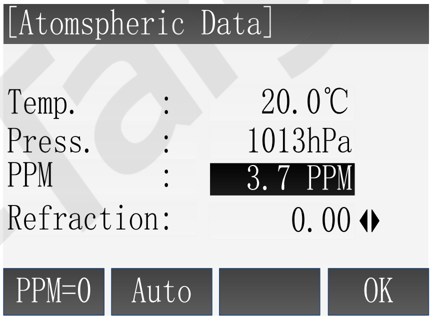
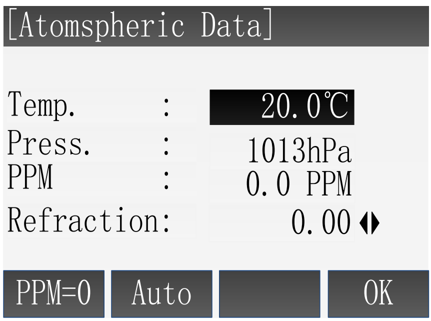
- Standard meteorological conditions (atmospheric correction value =0):

  press: 1013hPa

  temperature: 20℃

- If the atmospheric correction is not required, please set PPM to zero.

Steps	Key	Display
① After entering to the interface of EDM Setting. Press [F1] (Atoms) to enter the interface of Atmospheric Data.	[F1]	
② Interface displays the current settings.	↓	

③ Input the value of temperature. example: Enter 26℃ and press the key of [ENT]. The cursor moves to the setting item of Press.	[ENT]	
④ Input the value of atmospheric pressure. example: Enter 1020 hPa and press the key of[ENT].Program calculates the value of PPM and the cursor moves to the setting item of PPM.※1※2※3※4	[ENT]	
⑤ After finishing setting, press [F4](OK) to save settings and back to previous menu. Then press the key of [F3](OK) to save the setting of EDM and back to the function of measurement.	[F4] [F3]	

※1: The range of enter: Temp.(-30℃～60℃), Press.(500hPa～1400hPa).

※2: The instrument calculates the value of PPM according to the values of temperature and pressure you enter.

※3: Press [F1](PPM=0) can set the value of PPM to 0.

※4: If instrument supports temperature pressure sensor, you can press [F2] to receive the values of air pressure, temperature and calculate the correction value automatically.

3.2.3 Grid factor setting

When calculating the coordinates, the horizontal distance measured must multiply by the scale factor.

Computation formula

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

R: The average radius of earth

ELEV: mean sea level altitude

2.Scale factor

Scale factor: Scale factor of the station

3.Grid factor

Grid factor=altitude factor × scale factor

Distance calculation

1. Grid distance

HDg=HD × grid factor

HDg: Grid distance

HD: Ground distance

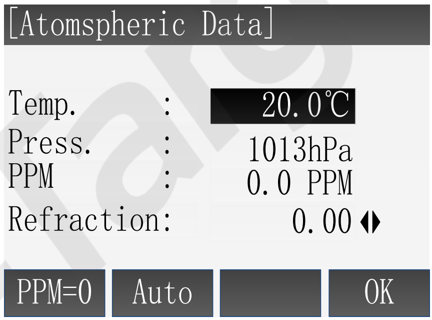
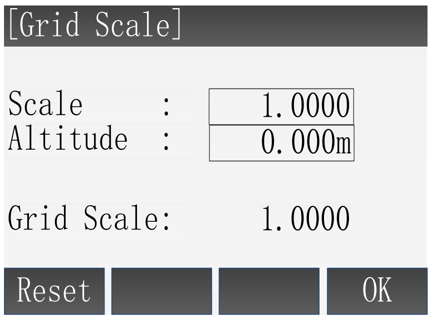
2. Ground distance

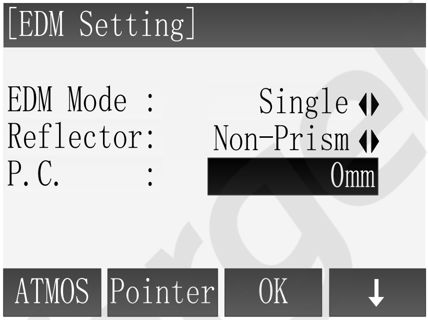
HD=HDg/(Grid factor)

Note:

1. The enter range of the scale factor: 0.99~1.01,the default value is 1.0.

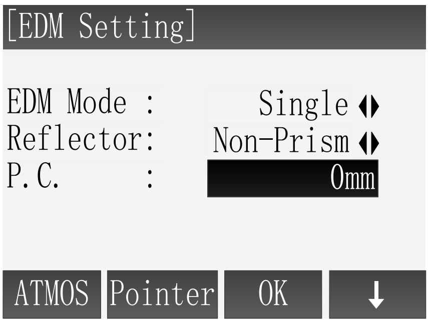
2. The enter range of the average height above sea level: -9999.9999~9999.9999. The average altitude retained after the decimal point one, the default value is 0.

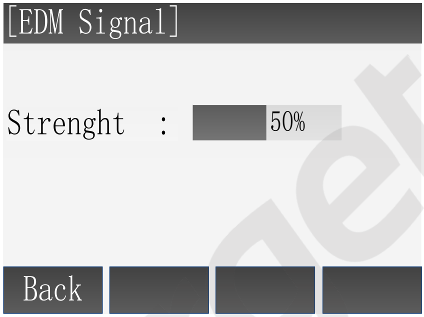
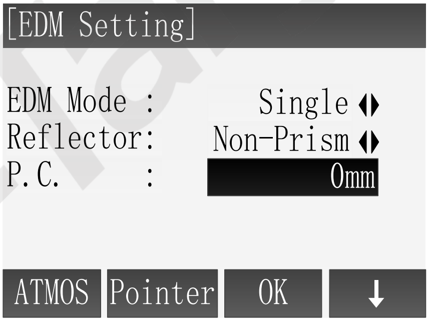
Steps	Key	Display
① After entering to the interface of EDM Setting, press the key of [F4] to enter the second page of soft key, then press the key of [F1](Grid) to set the Grid Scale.	[F4] [F1]	
② Interface displays the current setting. Enter the values of Scale and Altitude then press the key of [ENT].Program calculates the Grid Scale and displays it in the interface. If you want to set all enter area to 0,you	[ENT]	

can set the key of [F1] (Reset).		
③ After finished setting, press [F4](OK) to save settings and back to previous menu. Then press the key of [F3](OK) to save the setting of EDM and back to the function of measurement.	[F4]	

3.2.4 EDM signal

The function of signal is to display the intensity of signal received by total station. If the target is hard to be found or can’t see, using the function can achieve the best sighting accuracy.

Steps	Key	Display
① After entering to the interface of EDM Setting, press the key of [F4] to enter the second page of soft key, then press the key of [F2](Signal) to enter the	[F4] + [F2]	

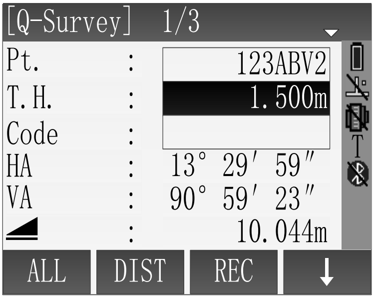
function of Signal intensity.		
② Using the bar chart and value of number to show the intensity of signal received by total station in the screen. As shown in the picture on the right.		
③ Press [F1] or [ESC] to back to the menu of EDM setting.	[F1] or [ESC]	

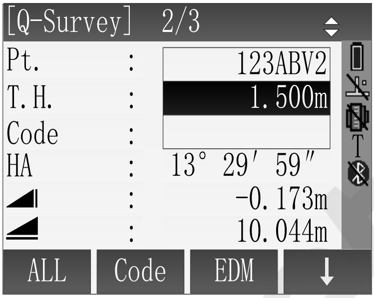
3.3 Start measurement

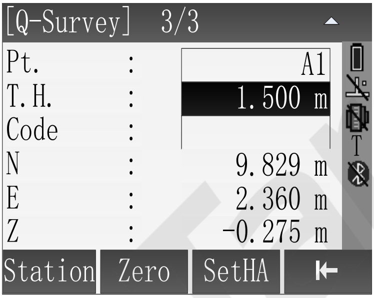
Q-Survey has 3 pages menu, including all measuring functions commonly used, such as angle measurement, distance measurement and coordinate measurement.

As shown below:

Hi-Target



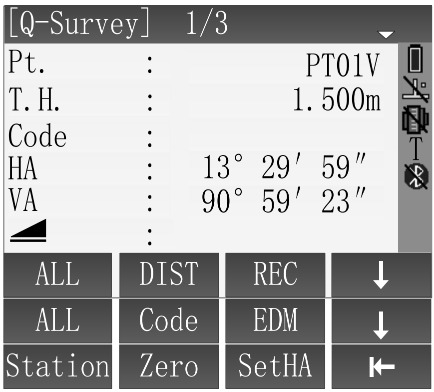


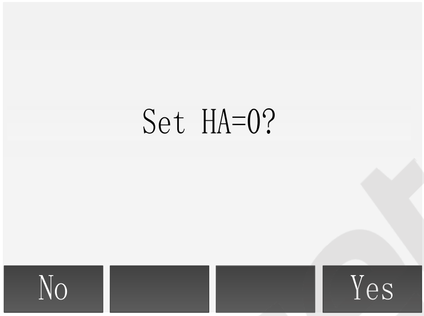
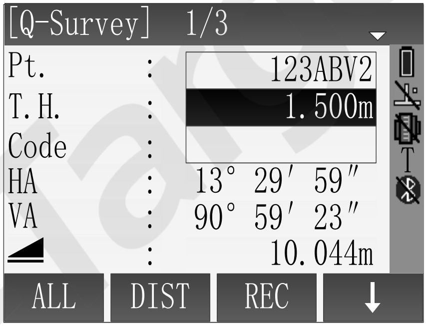


3.3.1 Set HA

You can set the horizontal angle as 0 or set it as wanted angle.

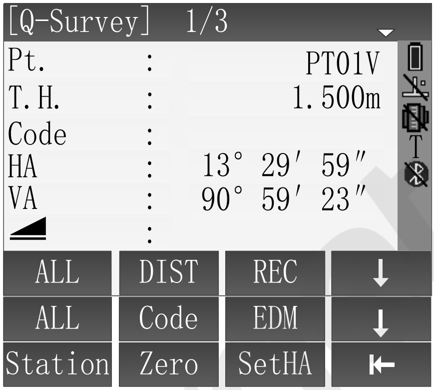
Set horizontal angle to 0.

Steps	Key	Display
① Aim at the target which used to orient. Press [F4] twice to enter third pages soft key.	[F4] + [F4]	

② Press [F2](Zero), the screen give a prompt to set HA as 0 or not.	[F2]	
③ Press [F4](Yes), the screen backs to Q-Survey and HA is set as 0. If you want to cancel the operation, please press [F1](No).	[F4] or [F1]	

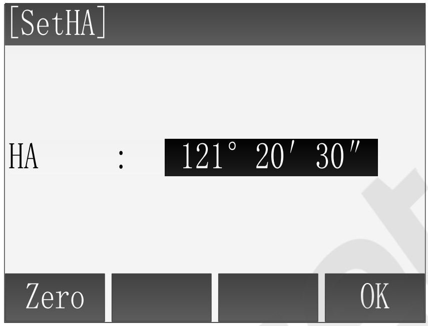
Set HA.

Steps	Key	Display

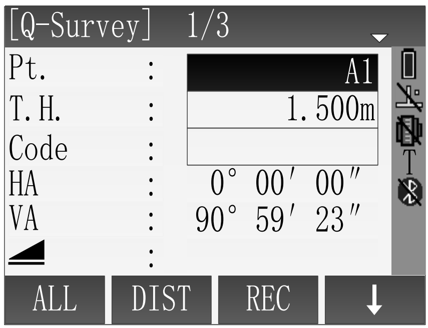
① Aim at the target which used to orient. Press [F4] twice to enter third pages soft key.	[F4] + [F4]	
② Press [F3](SetHA) to enter the interface of SetHA. Screen displays the current value of HA. A: If want the current value of HA as the orientation angle, press [F4](OK) or press [ESC] to go back. B If want other value of angle as the orientation angle, you	[F3] [F4]	 A: [OK]  B: Input angle

<table>
<tr>
<td>need to enter the wanted value of angle and press [ENT], then press [F4](OK).
Example: enter 121.2030 (121° 20′ 30″).

C:
If want to set HA to 0,press
[F1](Zero) and the value in the edit text of HA becomes 0 ° 00′ 00″ .Then press the key of [F4] (OK).</td>
<td>[F4]

[F1]
+
[F4]</td>
<td>

C: [Zero]

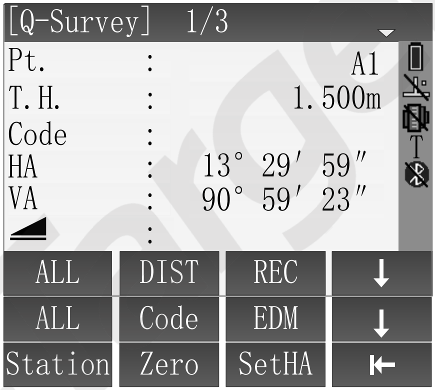
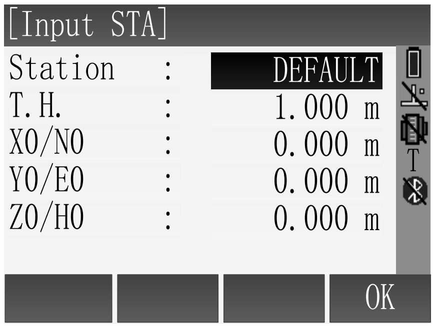
</td>
</tr>
<tr>
<td>③Back to the function of Q-Survey, the value of HA just set displays in the interface. Here take an example of setting HA to zero.</td>
<td>[F4]
[F1]</td>
<td>
</td>
</tr>
</table>

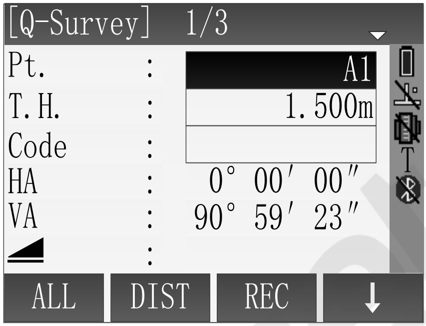
Hi-Target

3.3.2 Set Station and instrument height

After set the coordinate of station (the site of instrument) relatives to the origin, the instrument can calculate the coordinate of the location to your position (the site of prism).

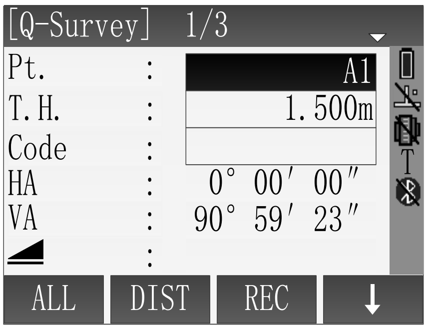
You can set station and the instrument height conveniently in the Q-Survey.

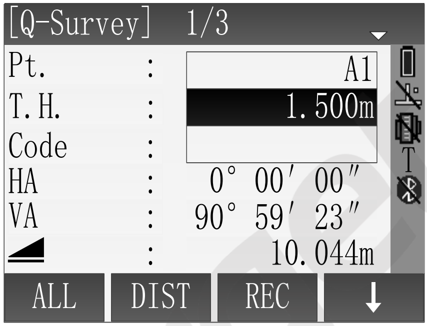
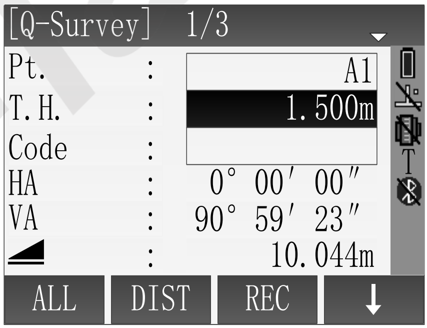
Steps	Key	Display
① Aim at the target which used to orient. Press [F4] twice to enter third pages soft key.	[F4] + [F4] + [F2]	
② Press [F1] (Station) to enter the interface of Enter STA. Enter the name of station, the instrument height and coordinates. After entering each item, move the cursor to the next edit text.	[F1]	

③ After finished entering, press [F4] (OK) to save the data of station and back to the function of Q-Survey.	[F4]	

3.3.3 Measurement

After all settings have been finished, you can start to measure. There are 3 pages to display the result of measurement, including all measurement data and you can press [PAGE] to view.

Steps	Key	Display
① Input the name of point and instrument height. Move the cursor to the next edit text after entering each item. You can enter Code when necessary.	[ENT] + [ENT]	

② Aim at the center of prism, press [F1](ALL) or [F2](DIST)+[F3](REC) to start to measure and record the measurement data. The measurement data including angle data, distance data and coordinate data. You can press [PAGE] to view.	[F1] or [F2] + [F3]	
③ After finishing measuring a point, program makes the number of point add 1 automatically, aim at the center of prism and repeat the above steps to start next point measurement.		

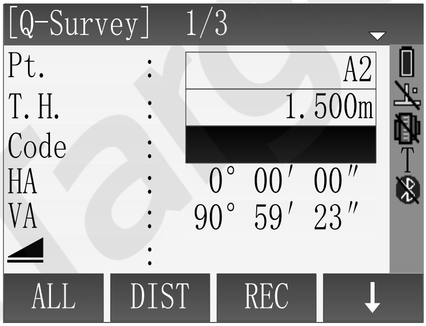
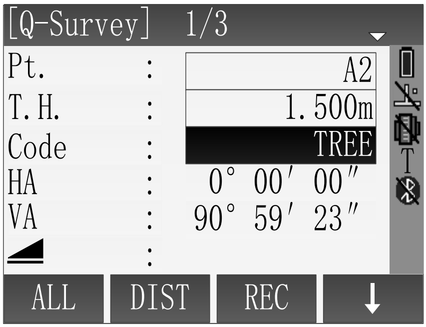
3.3.4 Code

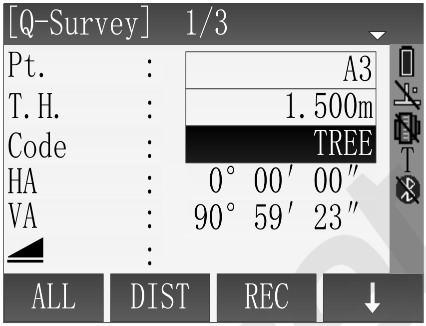
The code contains the information about the recording points, in the process of post-processing, with the help of encoding function , you can process conveniently according to the specific group. The function of "File Manager" also contains the information of code.

Simple Operation of Code

Hi-Target

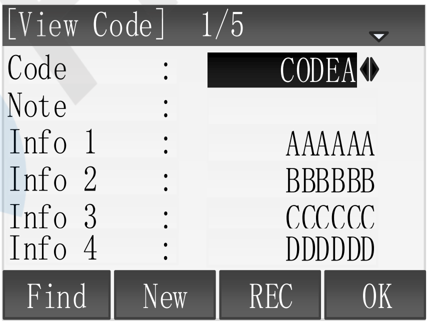
1. Move the cursor to the line of Code.
2. Enter the name of Code.
3. Press the key of [ALL] to start the distance measurement and record the data of code and measurement at the same time. If the name of code already exists in the code library, it will extract the information of code in the code library to record at the same time.

Steps	Key	Display
① Move the cursor to the line of Code.	↓	
② Enter code and press [ENT] to make sure. The entered code here will not be added to the code library.	Input code + [ENT]	

③ Press [F1] to start to measure, record the code and the date of measurement to job at the same time. ※[1]		
※[1] :The order to save code and measurement data is set in the "Setting" function. The set items of code record are Before REC and After REC. Before REC: Record code data before recording the actual measurement data. After REC: Record code data following after the actual measurement data.		

Soft key of Code

After starting the function of soft key (Code), Screen displays the following:



GSI-the introduction of code properties:

Code: The name of code

Note: The additional note

Hi-Target

Info1: The editable information of other contents

Info8: Other information

The introduction of soft key:

[Find]: Use the name of code or wildcard to find the needed code.

[New]: New a piece of editable information of code and use it.

[REC]: Record the current code data to the job and the code data not with any measurement point binding at this time.

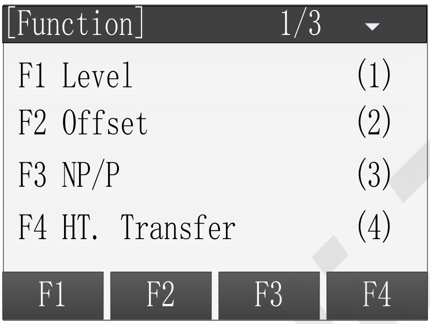
[OK]: Select the current code and use it.

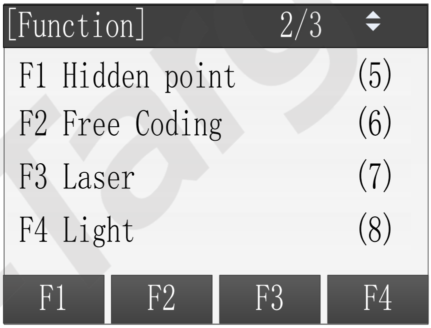
Using the soft key of [Code] can select the code in the code library directly, it will back to the interface of Q-survey after selecting, the code in the edit text of Code is the selected code.

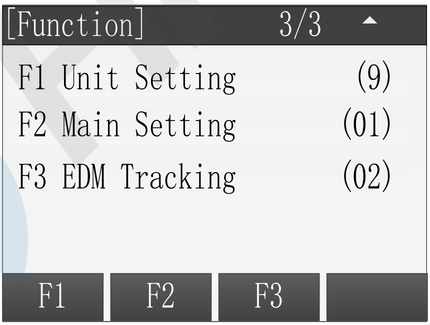
4 Functions

Bring the total station's common functions and settings together, they can be used in the process of measurement conveniently. In the function of Q-Survey which in the Main menu or other interface of measurement in the program, you can press [FNC] to enter the menu of Function

The menu of Function has 4 pages, you can press 【PAGE】 to view. The specific introduction as follows:



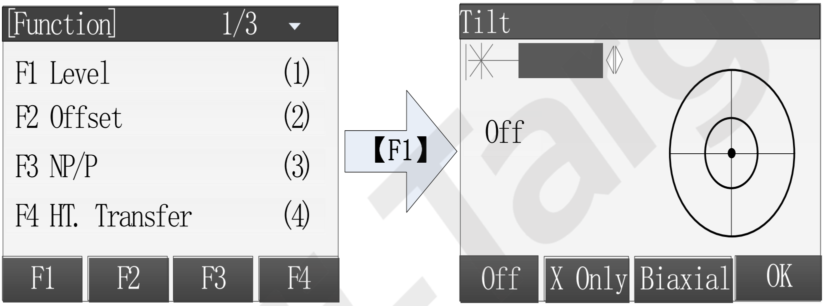




You can open Function menu to select the function you want to use, you can also define the function which on the Function menu to the key of [USER1] or [USER2], then press the key of [USER1] or [USER2] to use these functions.

4.1 Level

When the compensator is on, Compensator can compensate to the tilt caused by the instrument is not level. Manually level the instrument with the tribrach screws to make the compensation value of compensator tend to 0, by doing these can make the instrument tend to level. When the instrument is level, the laser plummet is in the direction vertical, the place of laser points is the place of instrument station.



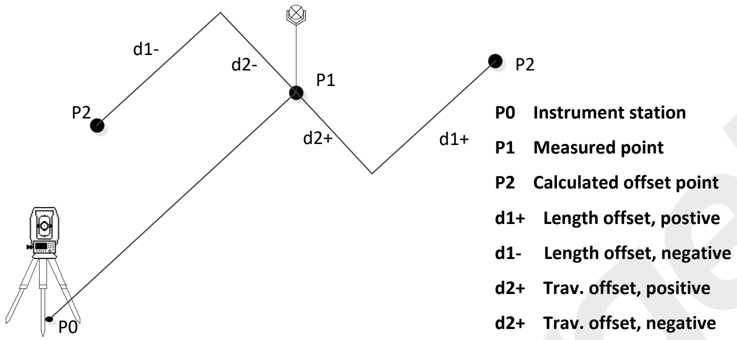
- ◆ Press [On] to open the compensator and press [Off] to close the compensator.
- ◆ Press [X Only] to open the compensator of X direction.
- ◆ Press [▲][▼] to adjust the laser plummet brightness.
- ◆ Press [OK] to close the laser plummet and exit.

4.2 Offset

The Offset is used to measure the points which are not intervisible, or intervisibility but can not set up prism in the Station.

Offset contains Dist. Offset and two subprograms, the two subprograms are Cylinder Offset and Angle Offset.

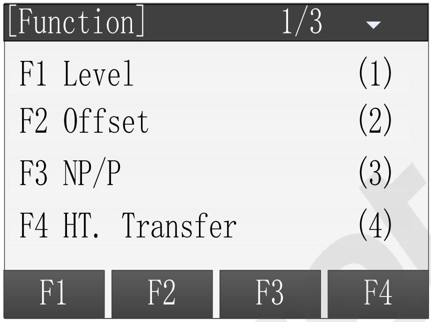
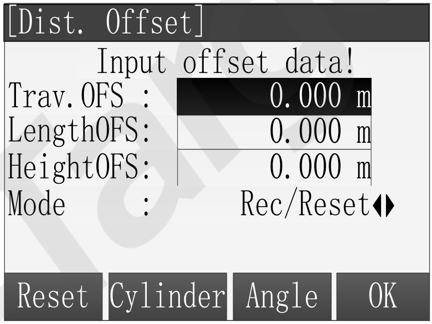
4.2.1 Distance Offset



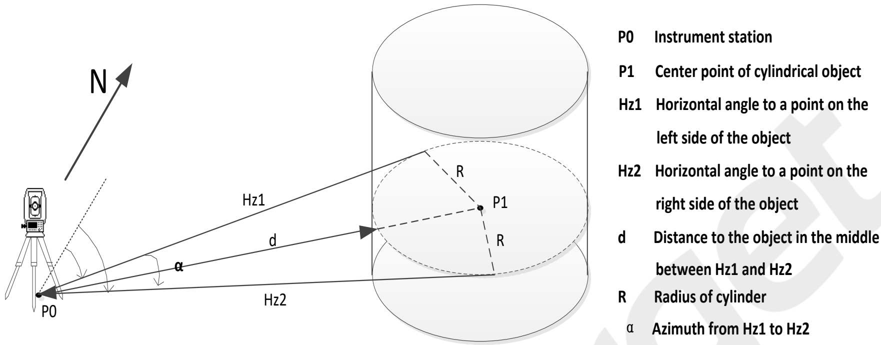
Using the external tools to measure the Offset values of the target point p2 and measurement point p1 along the line of station point and measurement point, the Offset values are Trav.OFS, LengthOFS and HeighOFS. Combining the information of measuring point (p1) can calculate the distance of station point (p0) to target point (p2), can also calculate the angel and coordinate.

When the measurement point is set on the left of target point or the right of target point, you should make the angle that between line of measurement point and target point and the line of measurement and station point about equals 90° . When the offset point is set on the front of target point or on the back of target point, you should make it on the line of station point and target point.

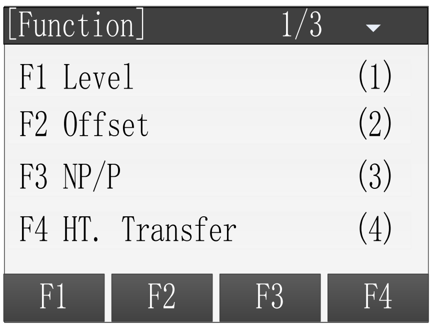
Steps	Key	Display

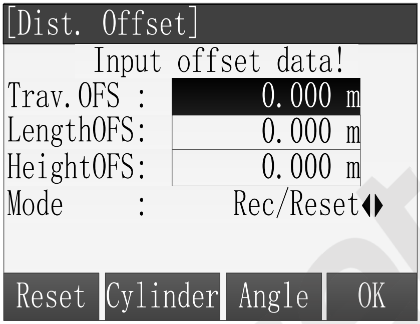
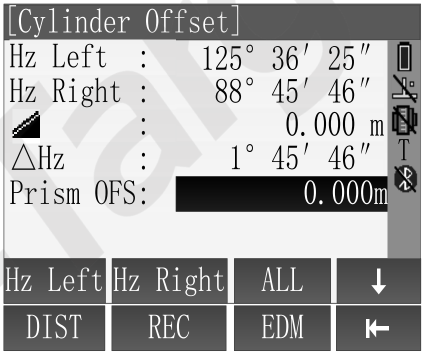
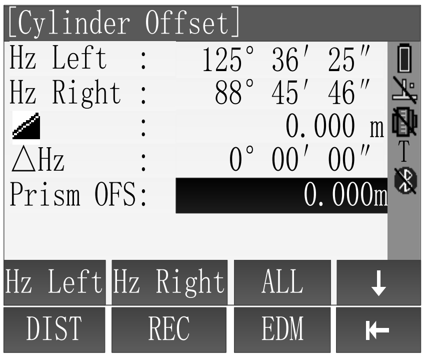
① In the program of Q-Survey, press [FNC] to open the menu of Function, next pressing [F2] to enter the program of Offset.	[F2]	
② Input the values of Trav.OFS, LengthOFS and HeightOFS, then select the mode of offset and press [F4] to save. ※[1]	[F4]	
※[1]: Rec/Reset: Make sure the inputed values of Offset and reset all the values of Offset to 0 after once measurement. Permanent: The values of Offset are always working in the calculation of measurement point.		

4.2.2 Cylinder Offset

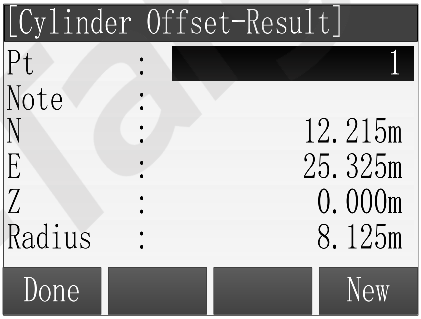


As for the not intervisible cylinders, you can measure the angles of station point with cylinder in Hz Left and Hz Right and the shortest distance of station point to cylinder firstly. Then calculate the coordinate of cylinder center and radius of cylinder through the geometric relationships. The shortest distance between station point and cylinder is in the bisector of angle of station point with cylinder in Hz Left and Hz Right. Turning the instrument to make the collimation axis in the bisector of angle that station point with cylinder in Hz Left and Hz Right, thus can measure the distance between cylinder and station.

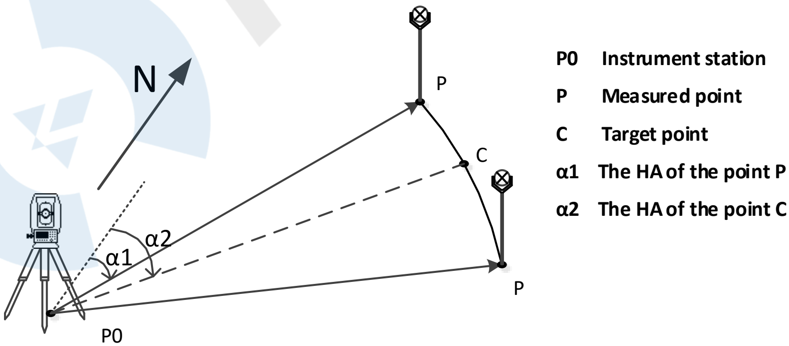
Steps	Key	Display
① In the program of Q-Survey, press [FNC] to enter the menu of Function, then pressing [F2] to enter the program of Offset.	[F2]	

② Press [F2] to enter the subprogram of Cylinder Offset.	[F2]	
③ Aim at the left edge of cylinder, press [F1] to make sure the angel of Hz Left, turn the instrument to aim at the right edge of cylinder and press [F2] to make sure the angle of Hz Right.	[F1]+[F2]	
④ Turn the instrument to make △ Hz=0, if use the prism,please input the thickness of prism in the edit text of PrismOFS, if don’t use the prism, the	[F3] or [F4] + [F1]+[F2]	

Hi-Target

<table>
<tr><td>default value is 0 in the edit of PrismOFS, then press [F3] to measure the shortest distance of the instrument to cylinder and enter the interface of Cylinder Offset-Result.</td><td></td><td></td></tr>
<tr><td>⑤Display the result of cylinder offset.</td><td></td><td>
</td></tr>
</table>

4.2.3 Angel Offset

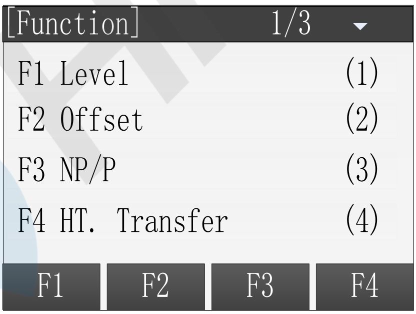


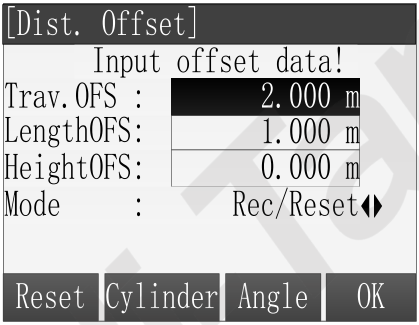
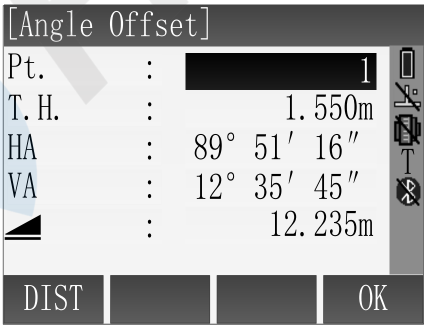
Angle Offset is used to measure the points which are intervisible but have

Hi-Target

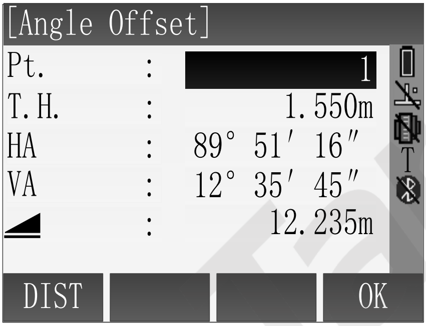
no reflector and can’t set up the prism. The basic principle is making the target point and measurement point in the concentric circles whose center is station point, then measurement the position information of station point and measurement point and the angle offset of station to target point, thus can calculate the coordinate of target point.

Set the measurement point P in the place where is as far as possible to close the left or right of target point C, and make the distance between measurement point P and station point A and the distance between station point A and target point C are approximately equal.

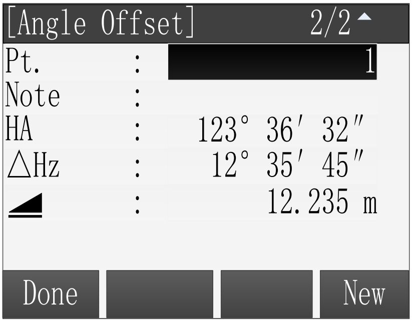
Steps	Key	Display
① In the program of Q-Survey, press [FNC] to enter the menu of Function, then pressing [F2] to enter the	[F2]	

program of Offset.		
② Press [F3] to enter the subprogram of Angel Offset.	[F3]	
③ Aim at the measurement point and press [F1] to measure distance.	[F1]	

Hi-Target

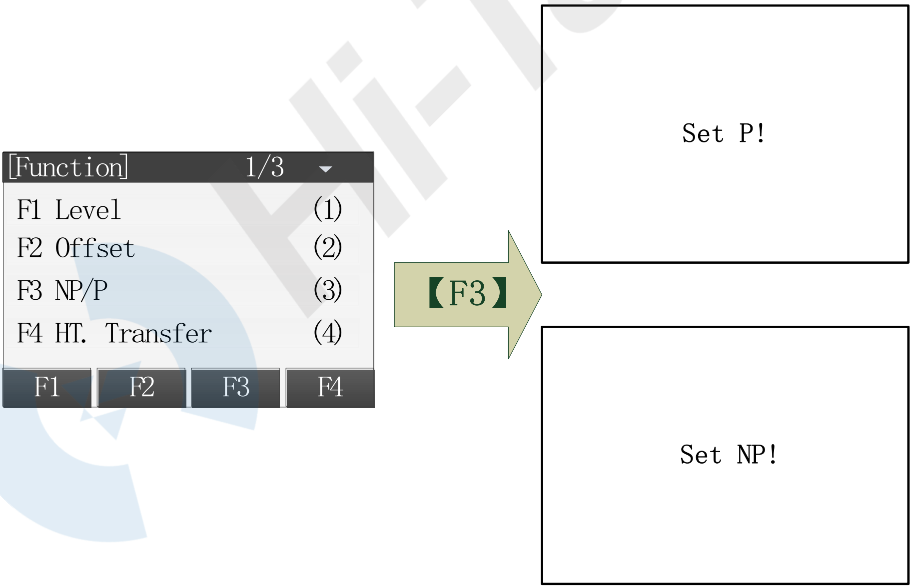
<table>
<tr><td>④ Aim at the target point and press [F4] to make sure the direction of target point, next enter the program that displaying the result of angle measurement.</td><td>[F4]</td><td>
</td></tr>
<tr><td>⑤ Display the result of angle Offset.</td><td></td><td>
</td></tr>
</table>

Hi-Target

4.3 NP/P Toggle

Switch the mode of reflector quickly. (P is the mode of Prism and NP is the mode of Non-Prism)

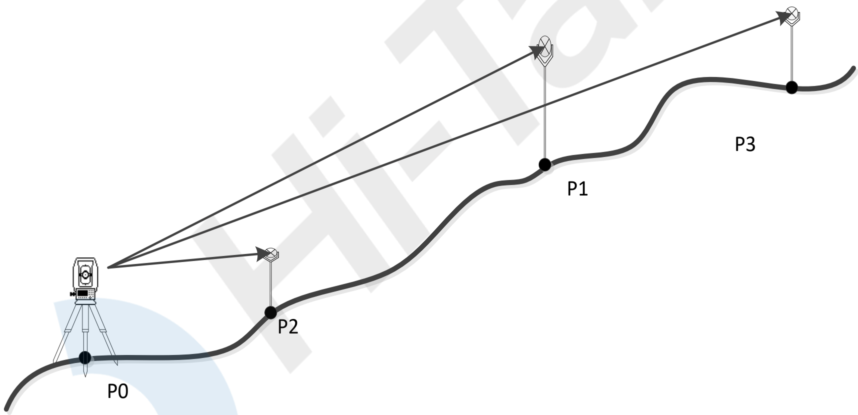


Open the first page of Function Menu and press [F3] to switch the mode of reflector.

4.4 Height Transfer

The functions of HT. Transfer as follows: Using the measurement data of target point, the fixpoints, fix measurement points and so on to calculate the height of current station point and set the height of station again. You can receive the coordinate of target point by calling the points in the file or through the keyboard to input, you can observe 5 fixpoints' height at most and to calculate.

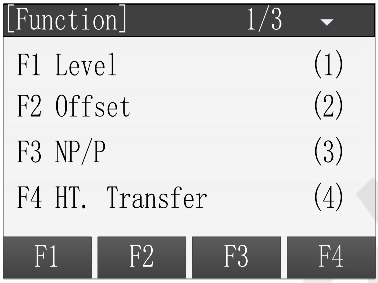
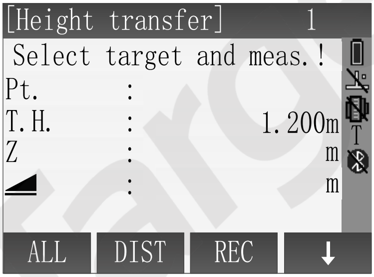
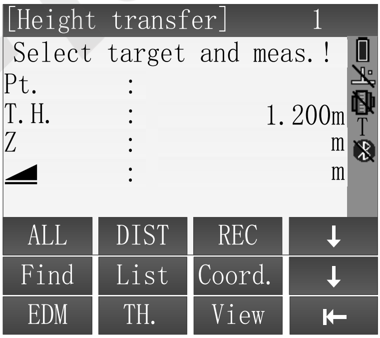
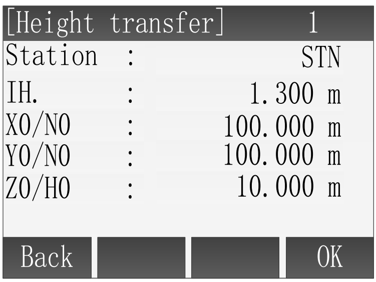
The principle of Height Transfer:



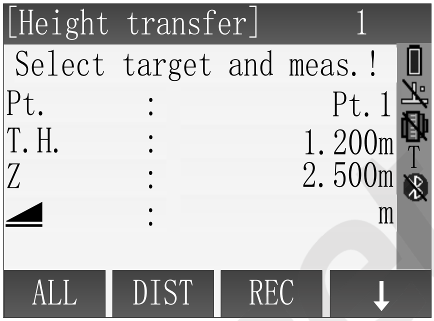
P0 Station point

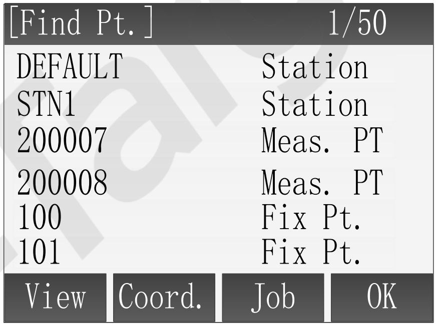
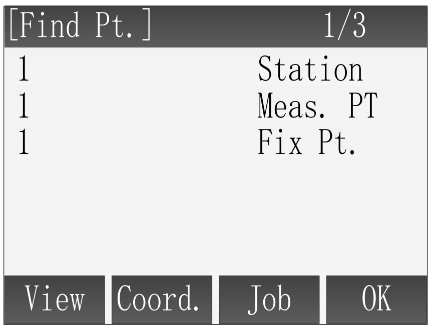
P1~P3 Target fixpoints height

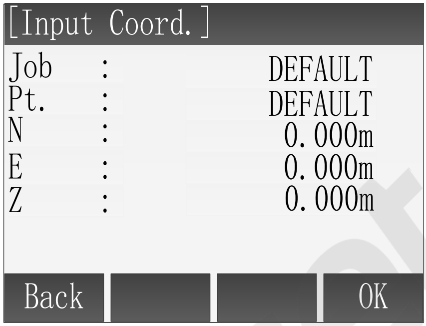
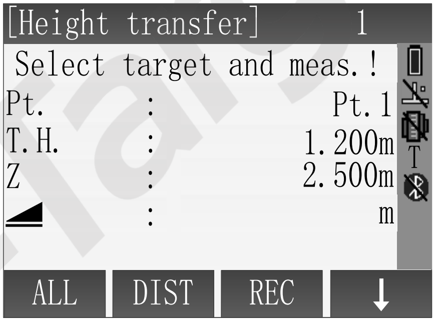
Steps	Key	Display

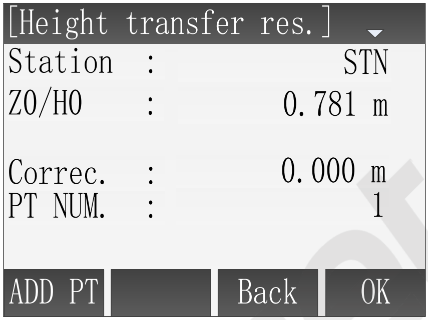
① Press [F4] or [4] in the first page of [Function] to enter the function of Height Transfer measurement.	[F4] or [4]	 
② Press [F4] twice and display the third page of soft keys, press [F2](IH)to enter the function of setting instrument height, inputting the current instrument height and press [F4] to back to the function of Height Transfer interface.	[F4] + [F4] + [F2] + [F4]	 

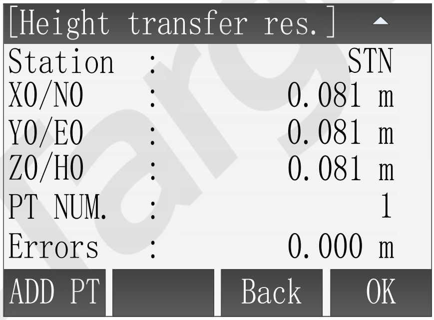
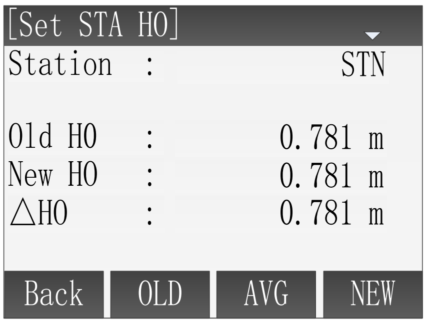
Hi-Target

<table>
<tr>
<td>③ Select the fixpoint and input the height of Prism. The numbers of measured fixpoints are displayed in the top right corner.
There are 3 methods to selecting fixpoint.
A: Press [F4] to enter the second page of soft key and press [F2](List) .In the dialog of [Find Pt.], by pressing [▲] or [▼] to select the fixpoints to call.</td>
<td>[F4]
+
[F2]
+
[F4]</td>
<td>

A: [List]

</td>
</tr>
<tr>
<td>B: Input the name of point and press [F1] (View) to view the point whether exists in the file or not. If exists, you can call it, otherwise, you need to input or measure the coordinate of the point.</td>
<td>[F1]
(View)
+
[F4]
(OK)</td>
<td>B: Search point

</td>
</tr>
<tr>
<td>C: Press [F2] (Coord.)</td>
<td>[F3]</td>
<td>C: Input point</td>
</tr>
</table>

and input a point name which not exists in the file.	(Coord) + [F4]	
④ After finishing setting up the fixpoint, the height of fixpoint is displayed in the screen and press [F1](ALL)or [F2](DIST)+[F3](REC) to start to measure and calculate, the height of station is calculated.	[F1] or [F2] + [F3]	

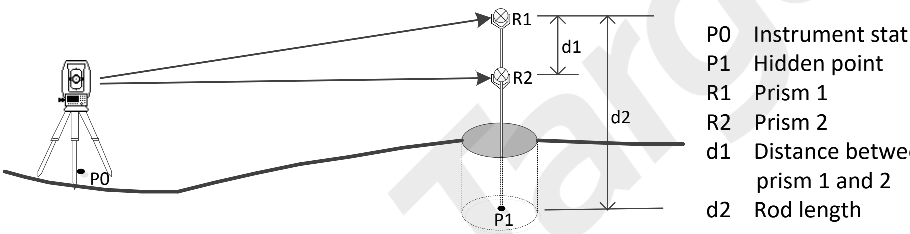
<table>
<tr>
<td>⑤ In the interface of [Height Transfer Result], pressing [PAGE] to switch the display of result information.
Press [F1](Add PT) to add a new point and to start a new measurement.
Press [F3](Back) to back to measure the current point again.
Press [F4](OK)to enter the interface of [Set STA HO].</td>
<td>[PAGE]</td>
<td>


</td>
</tr>
<tr>
<td>⑥ Pressing [F1] to back to the interface of [Height Transfer Result].
Press [F2] to set the height of station to the old value
Press [F4] to set the height of station to the new value which calculated after Height Transfer.</td>
<td></td>
<td>
</td>
</tr>
</table>

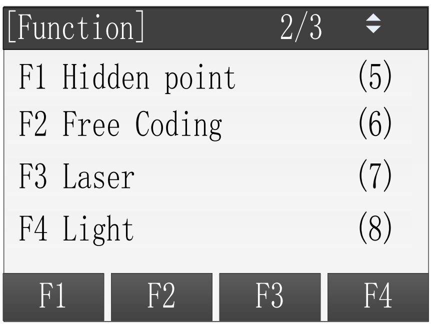
Press [F3] to set the height of station to the average of the old value and new value		

4.5 Hidden Point

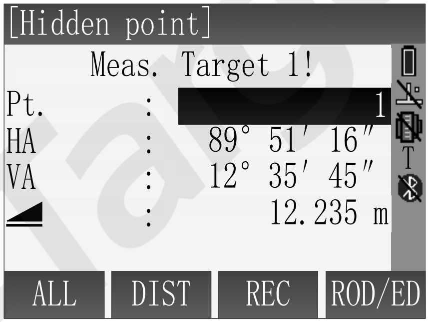
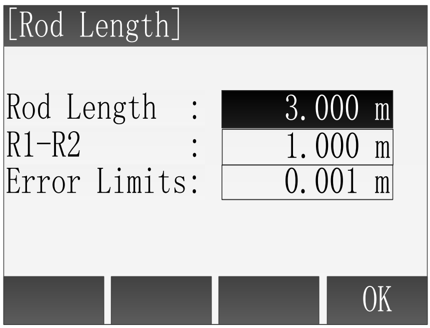
The function of Hidden Point is using a special hidden point measuring rod to measure the points which are not intervisible.



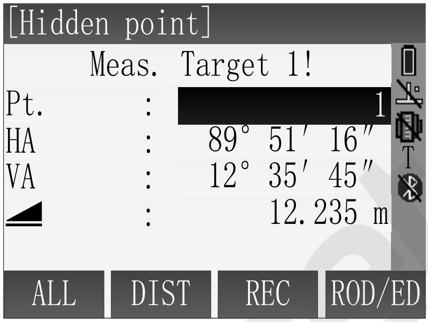
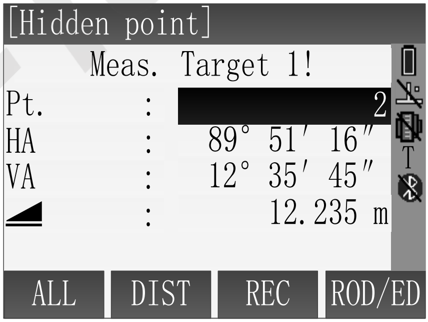
The length of measuring rod is known, by measuring the position information of prism 1 and prism 2 in the measuring rod and using mathematical methods to calculate the coordinate of hidden point on the other side of the measuring rod.

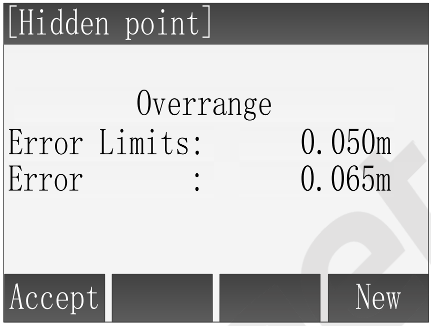
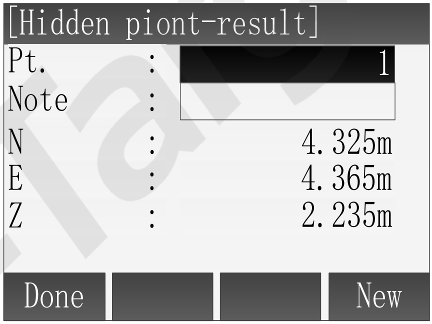
Steps	Key	Display
① In the program of Q-Survey, press [FNC] to enter the menu of Function, then pressing [PAGE] to open the second page of Function and then pressing [F1] to	[F1]	

Hi-Target

<table>
<tr><td>enter the function of hidden point measurement.</td><td></td><td></td></tr>
<tr><td>② In the interface of measuring the first prism point, pressing [F4] to enter the interface of Rod Length.</td><td>[F4]</td><td>
</td></tr>
<tr><td>③ Inputting the correct value of Rod length and pressing [F4] to back to measure the first prism point.</td><td>[F4]</td><td>
</td></tr>
</table>

Hi-Target

④ The instrument aims at the prism on the top and pressing [F1] to finish measuring the first prism and enter the interface of measuring the second prism.	[F1] or [F2] + [F3]	
⑤ Aim at the second prism and press [F1] to finish the second prism's measurement. Start to calculate the information of hidden point now. If the error is beyond the set value, enter the step ⑥ of giving a prompt of error, otherwise, enter step ⑦ to display the result of hidden point measurement.	[F1] or [F2] + [F3]	

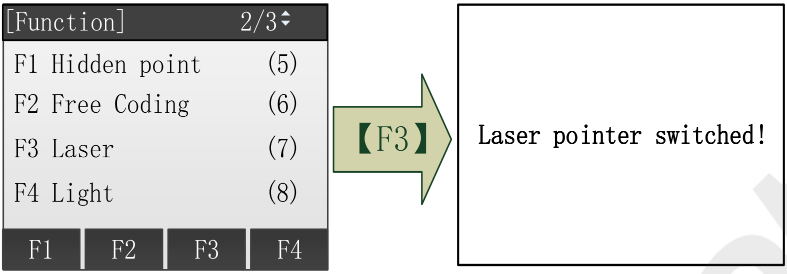
⑥ A prompt of error. Press [F1] to enter the step ⑦ to display the result of hidden point measurement, press [F4] to back to the step ②。	[F1] or [F4]	
⑦ Display the result of hidden point measurement.		

4.6 Free Coding

Please refer to “3. Q-Survey” → “3. Start Measurement” → “3.4 Code”

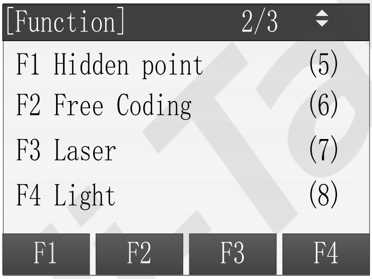
4.7 Laser Pointer

Open or close the laser fastly.



4.8 Light

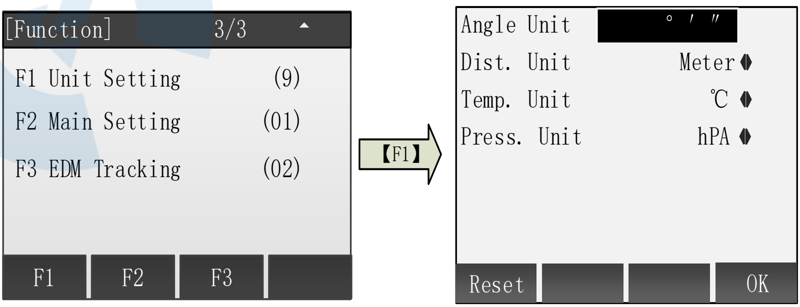
Turn on or off the light of instrument screen fastly.



Open the second page of Function Menu and press [F4] to turn on or off the Light.

4.9 Unit Setting

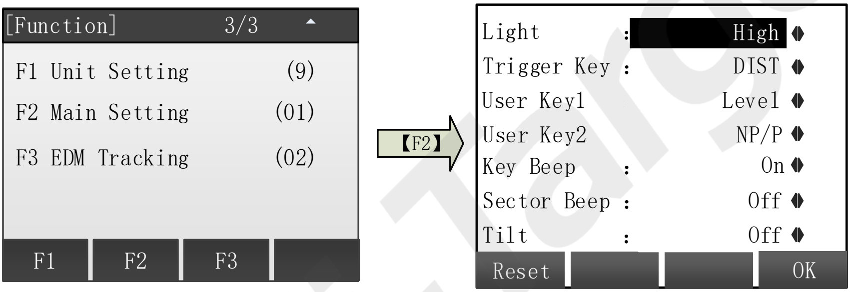
Set the common Unit fastly.



Open the third page of Function Menu and press [F1] to enter the interface of unit setting. After finishing setting the units in the interface of Unit Setting, press [F4](OK) to save the settings, press [F1](Reset)to restore all units to factory default.

4.10 Main Setting

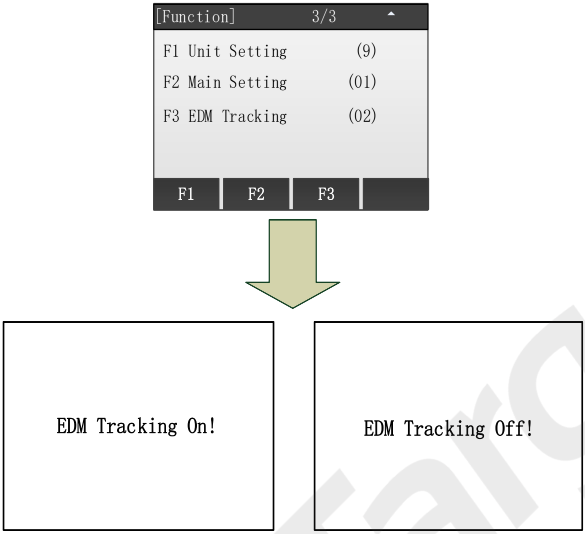
Open the settings about instrument’s hardware, the spe cific items as follows:



As for the setting of specific items , please refer to “General Setting”.

4.11 EDM Tracking

Open or close the mode of EDM Tracking fastly.

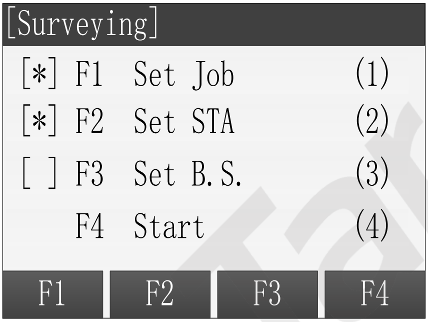


Open the third page of Function Menu, press [F3] to open or close the mode of EDM tracking.

5 Applications

Prepare setting before measuring:

Before starting the application, there are some preparations needed to set up. The Pre-Settings screen will be shown after the user selects an application. User can select and set the content of the Pre-Settings menu successively.



[*]: Setting has been done.

[ ]: Setting has not been done.

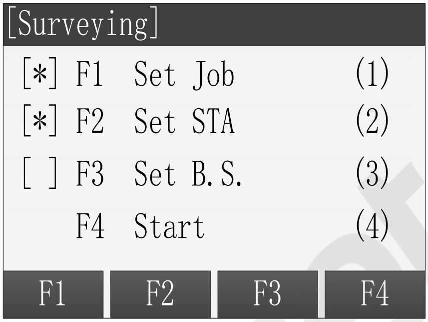
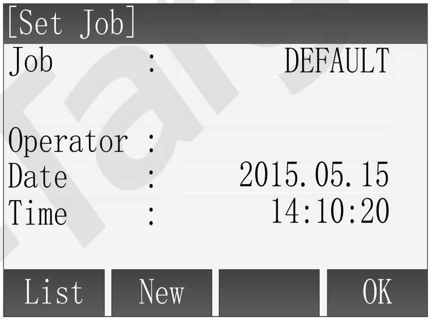
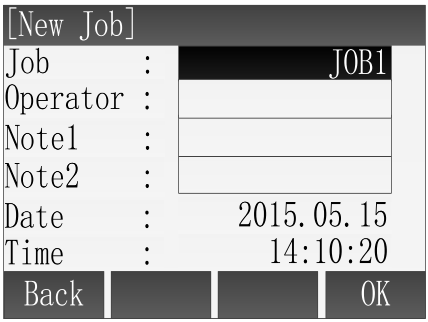
The details of every setting are as follows.

5.1 Setting the Job

The measured data and fix data are saved in the jobs which are shown as child directories. The job contains different types of data, such as fix points, measured points, station points, codes, etc. The data in the job can be read, edited and deleted.

5.1.1 Create a new Job

Steps	Key	Display

<table>
<tr>
<td>① Press [F1] in the Pre-Settings screen. Then enter the Set Job function.</td>
<td>[F1]</td>
<td>
</td>
</tr>
<tr>
<td>② Press [F2](New) and then enter the Create a New Job screen.
Press [F4](OK), the displayed job will be set as current job and then back to Pre-Settings screen.</td>
<td>[F1]</td>
<td>
</td>
</tr>
<tr>
<td>③ Continue to show New Job screen. Input the new job's name, operator, etc. Press [ENT] to finish one input item and the cursor moves to the next input item automatically at the same time. ※1</td>
<td>Input job's data + [ENT]</td>
<td>
</td>
</tr>
</table>

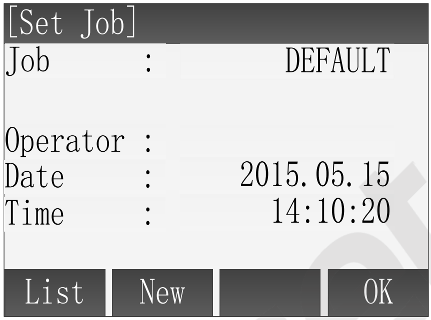
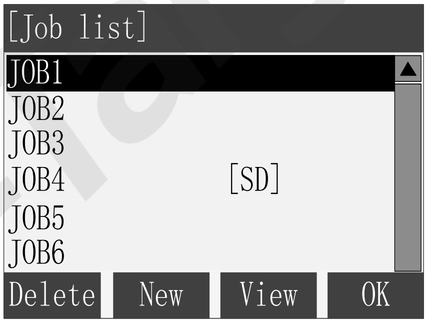
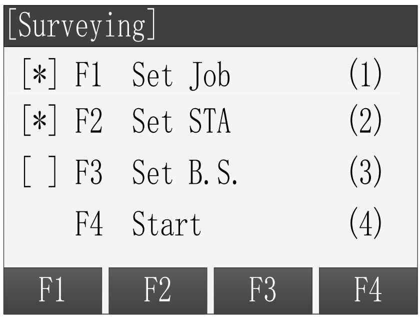
Hi-Target

④ Press [F4](OK) to complete setting a new job after finishing all the inputs. This job will be set as the current job. Then back to the Pre-Settings screen. The completed setting item is marked with [*].	[F4]	Job Set! [Surveying] [*] F1 Set Job (1) [*] F2 Set STA (2) [ ] F3 Set B.S. (3) F4 Start (4) F1 F2 F3 F4

5.1.2 Select an Existing Job from Memory

If there is any job existing in the memory, user can select this job and set it as the current job.

Steps	Key	Display
① Press [F1] in the Pre-Settings screen. Then enter the Set Job function.	[F1]	[Surveying] [*] F1 Set Job (1) [*] F2 Set STA (2) [ ] F3 Set B.S. (3) F4 Start (4) F1 F2 F3 F4

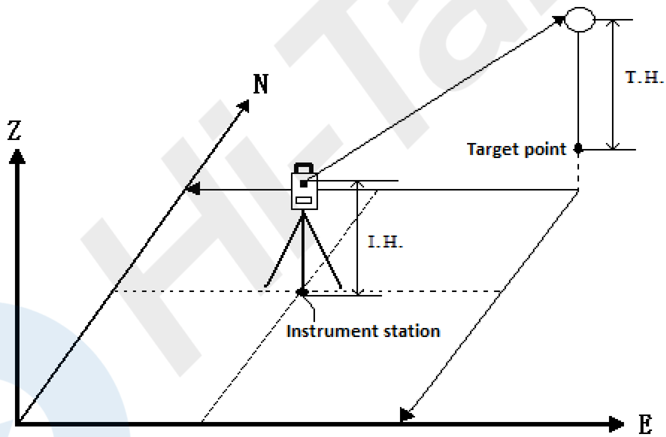
② Press [F1] (List) to enter Job list screen.	[F1]	
③ All the existing jobs, including that stored on SD Card and will be shown as a list. The current job is marked with a *. Select the target job through Up and Down key and then press [F4](OK) to confirm the selection. The selected job is set as current job.		
⑤ Back to Pre-Setting screen. The completed setting item is marked with *.	[F4]	

Note: Don't pull out the SD Card when it is in operating state, otherwise it will cause the SD Card's data loss or damage.

- All measured data are stored in the current job.
- If start the application without setting the job, press ALL key or press REC key in the Q-Surveying screen, the instrument system will create a job which named DEFAULT automatically.

5.2 Setting the Station

Every target coordinate's calculation is related to the position of the station. The station coordinate can be input manually or selected from the instrument memory.



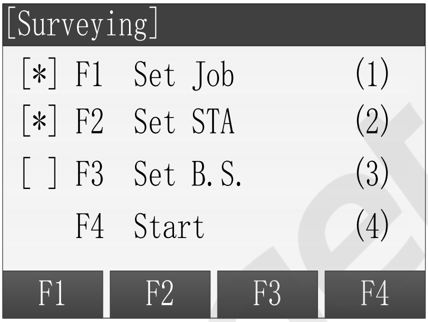
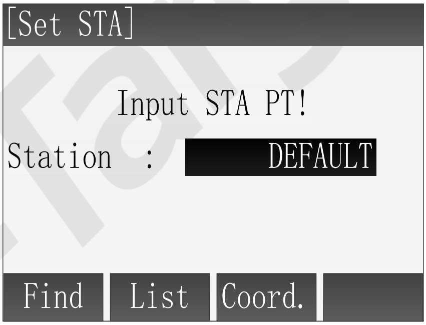
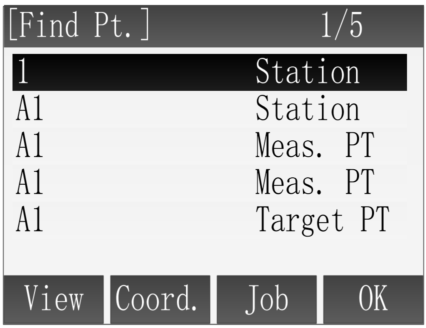
5.2.1 Select the coordinate from memory [Find]

Steps:

1、 Select the coordinate from memory.

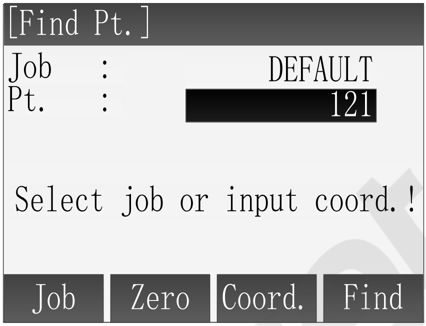
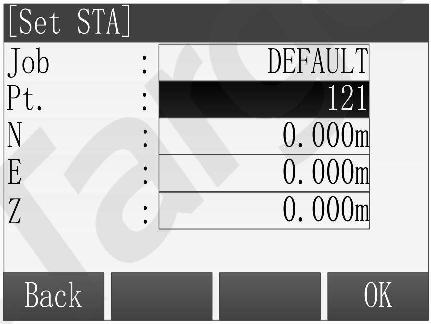
2、 Input instrument height.

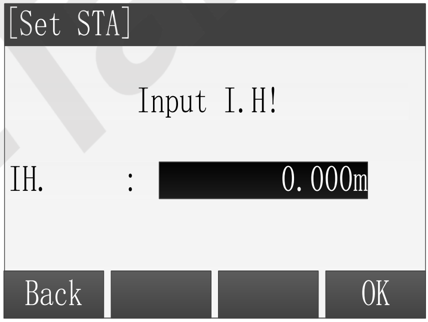
3、 [OK] Set station.

<table>
<tr><th>Steps</th><th>Key</th><th>Display</th></tr>
<tr><td>① Press [F2] in the Pre-Settings screen. Then enter the Set STA function.</td><td>[F2]</td><td>
</td></tr>
<tr><td>② Input the name of the station point which exists in the job and then press [ENT]. ※1</td><td>Input point name
+
[ENT]</td><td>
</td></tr>
<tr><td>③ Press [F1](Find):
A: If the input name exists in the current job, there will show the screens shown on the right figure. The multiple points with the same name will be sorted by type.</td><td></td><td>A:


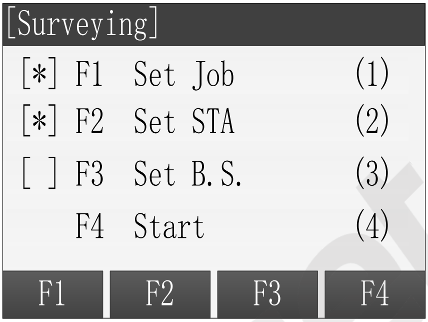
B:</td></tr>
</table>

Hi-Target

B: If the input name doesn't exist in the current job, the program prompts the message "Pt. not found". Then enter the [Find Pt.] screen. There can also select point from other jobs and set it as the station point. Input the point name and press [F4](Find). If the point is found, press [OK] in the [Find Pt.] list screen to set it as station. Program enter input instrument height screen. If the point doesn't exist, press [F3](Coord.) to input the coordinates of N, E and Z. Set this point as station. **[Zero]:** Set this point's all coordinates		 

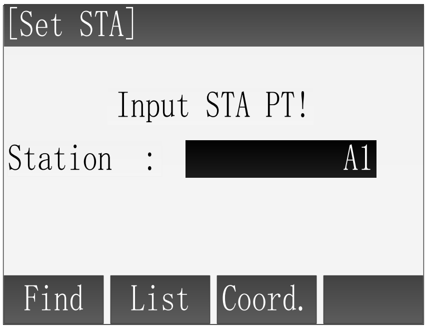
as 0 and set the point as station. **[Coord.]:** Enter [Input Coord.] screen. Input the coordinates and save them to the current job.		
④ Enter input instrument height screen. Input the instrument height and press [ENT] to confirm. Then press [F4](OK) to save and set the station information. Press [ESC] then back to previous screen. Continue to set the coordinates of station.	Input instrument height + [ENT] + [F4]	

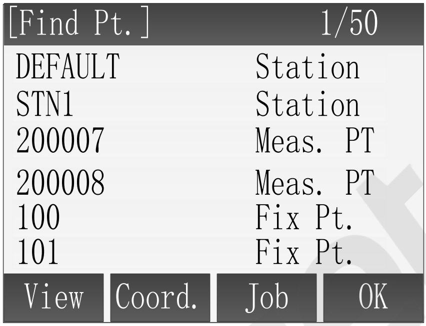
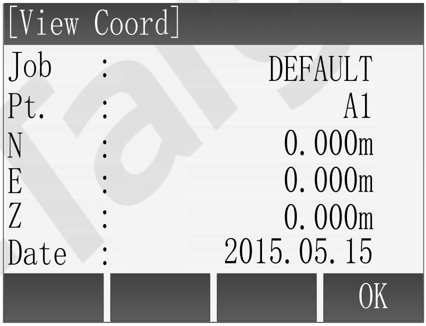
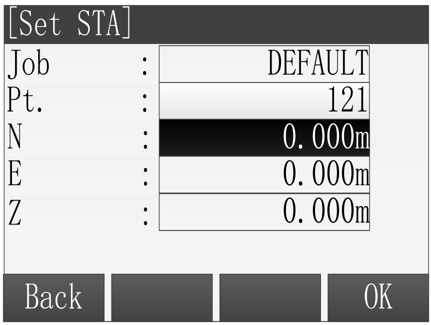
Hi-Target

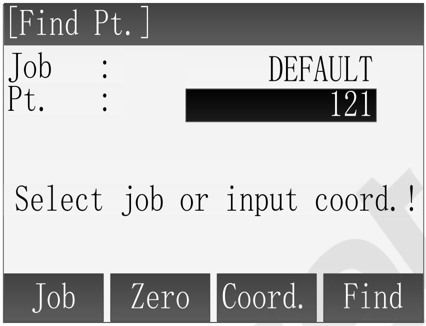
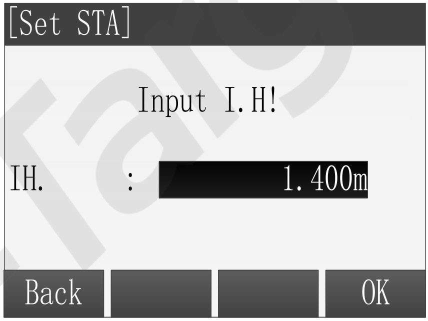
⑤ Back to Pre-Settings screen. The setting items that have been made are marked with *.		
※[1]: The details of [Find Pt.] can be found in the chapter "Find Point". You can also input the wildcard "*" to search all the points.		

5.2.2 Select the Fix Point in the Memory [List]

User can select the fix point in the memory's jobs to set station without inputting the point name.

Steps	Key	Display
② Press [F2](List) in the [Set STA] screen.	[F2]	

③ Show the point list all the fix points and measured points of the current job.		
④ Select the needed point through Up and Down key. [View]: Show the information of this point. [Coord.]: Input the coordinate data manually. [Job]: Select data from another job.	↑ ↓	[View]:  [Coord.]:  [Job]:

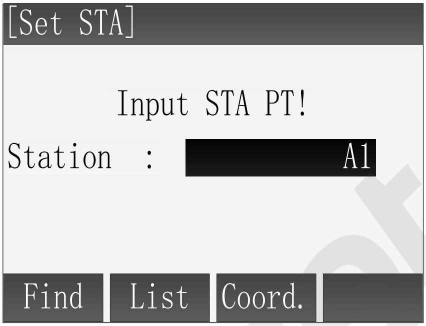
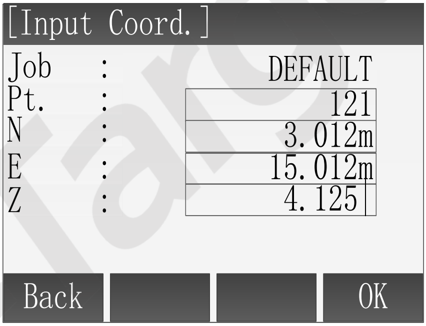
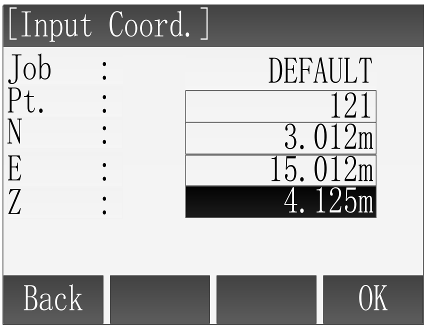
		
⑤ After selecting needed point, press [F4](OK) and enter input instrument height screen. Complete all settings and then back to Pre-Settings screen.	[F4] input instrument height + [ENT] [F4]	

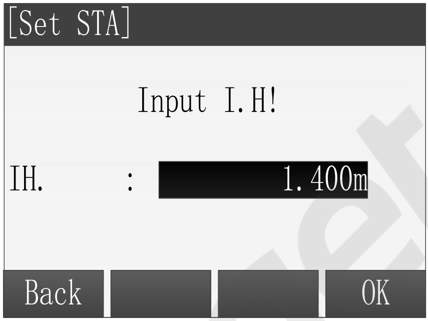
5.2.3 Input the coordinates manually.

Steps:

1. Press [Coord.], enter input coordinate screen.
2. Input the point name and coordinates.
3. [OK] Save the station coordinates. And then input the instrument height.

Steps	Key	Display

② Press [F3](Coord.) in the [Set STA] screen.	[F3]	
③ Input the point name and the point's coordinates. After inputting one item, the curser will move to next input item.	Input point name and coordinate + [ENT]	
④ Press [F4](OK) to save the coordinates of this point.	[F4]	

⑤ Program prompts "Saved!" Then enter input instrument height screen. Input the instrument height and press [ENT] to confirm. Then press [F4](OK) to finish the setting.	Input instrument height + [ENT] [F4]	
⑥ Back to Pre-Settings screen. The setting items that have been made are marked with *.		

5.3 Setting the Orientation

The orientation can be input manually or determined from points that are either measured or selected from the memory.

5.3.1 Manual input orientation

Steps 1. Press [F1] and enter manual input screen.

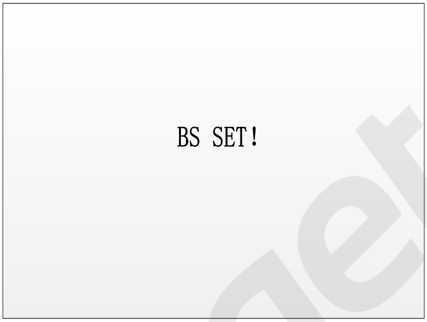
2. Input the azimuth, prism height and point name.

3.Press [F1](ALL) to start measuring and set the orientation.

4.Press [REC] to record the angle and orientation.

Steps	Key	Display
① Press [F3] in the Pre-Settings screen. Then enter the Set STA function.	[F3]	[Surveying] [*] F1 Set Job (1) [*] F2 Set STA (2) [ ] F3 Set B.S. (3) F4 Start (4) F1 F2 F3 F4
② Press [F1] and select the [Angle Setting] to input orientation manually.	[F1]	[Set B.S.] F1 Angle Setting (1) F2 Coordinates (2) F1 F2
③ Aim B.S. point and then input the azimuth, prism height and backsight point name. Press [ENT] after finishing every input.	Input horizontal angle + [ENT]	[Angle setting] Azimuth : 50° 00′ 00″ T.H. : 1.500 m BS PT : DEFAULT1 Aim BS. Then ALL/REC ALL REC Zero EDM

Hi-Target

<table>
<tr>
<td>④ Press [F1](ALL) to start measuring and set the orientation.
[REC]: Press this key to finish setting orientation without measurement.
[Zero]: Set the azimuth as 0.</td>
<td>[F1]</td>
<td>
</td>
</tr>
<tr>
<td>⑤ Back to Pre-Settings screen. The setting items that have been made are marked with *.</td>
<td></td>
<td>
</td>
</tr>
</table>

5.3.2 Set orientation with coordinates

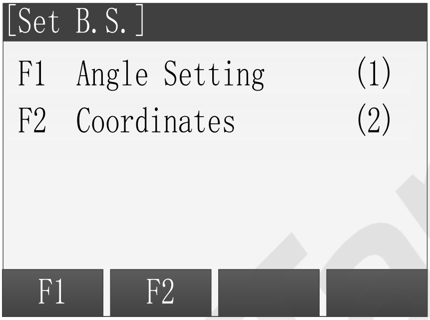
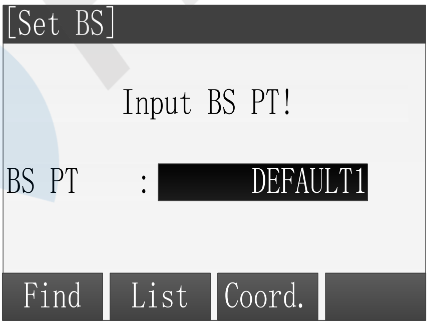
The determination of the direction value can also be carried out using a point with a known coordinate.

Steps:

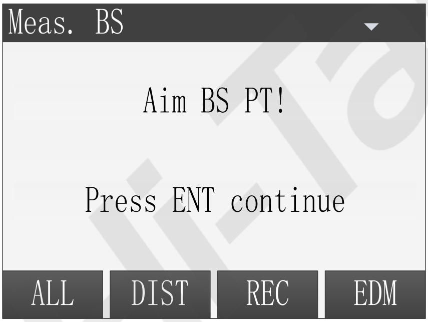
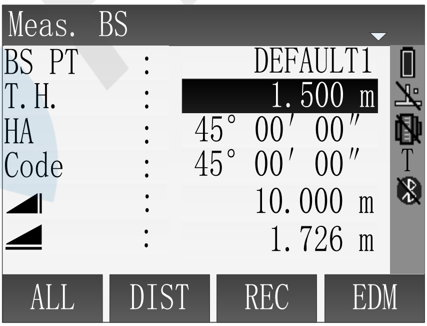
1. Press [F2] to go to set orientation with coordinates
2. Input the name of orientation point and find the point.
3. Input the prism height and determine it.
4. Use this point to set orientation.

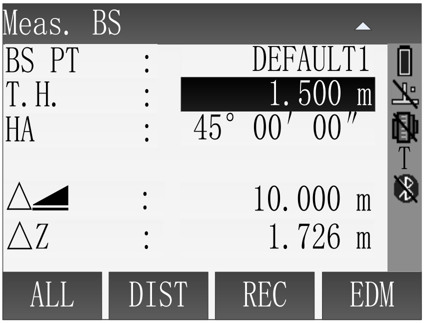
Hi-Target

➢ The orientation point can be select from memory or inputted manually.

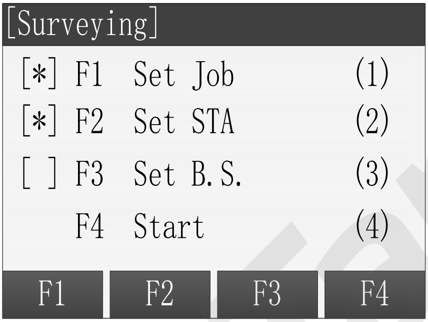
Steps	Key	Display
① Press [F2] to select Coordinate to Set orientation with coordinates.	[F2]	
② Find, select or input the backsight point coordi	Find, select or input the back sight point	

Hi-Target

nates and then go to the Meas. BS screen.		
③ Aim backsight point and then press [ENT]. Press [F1](ALL) or press [F2](DIST) and [F3](R	[ENT] [F1] or [F2]、[F3]	 

EC) to start measuring and finish setting orientation. User can also press [F3](REC) to finish setting orientation without measurement. Press		

the [PAGE] key to switch the display of measured values screen and backsight inspection values screen. [EDM]: Go to set EDM settings.		

<table>
<tr>
<td>④
Back to Pre-Settings screen. The setting items that have been made are marked with *.</td>
<td></td>
<td>
</td>
</tr>
</table>

5.4 Starting the Applications

The preset applications covers a wide range of measurement tasks. That makes the daily field measurement easier and faster. The all applications can be selected to use are as follows:

- Surveying
- Stakeout
- Free Station

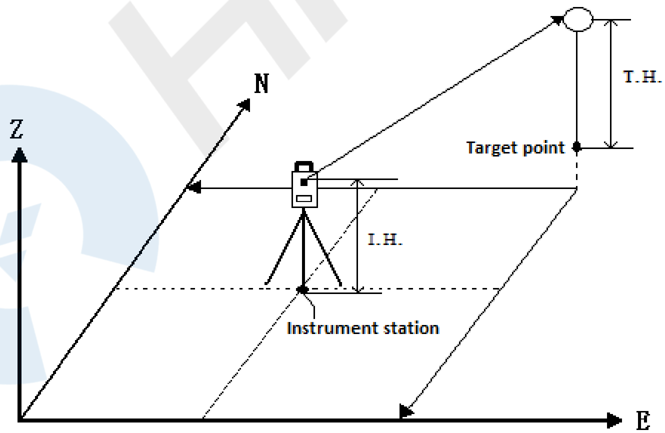
- Tie Distance
- Area
- Remote Height
- COGO
- Road

Steps:

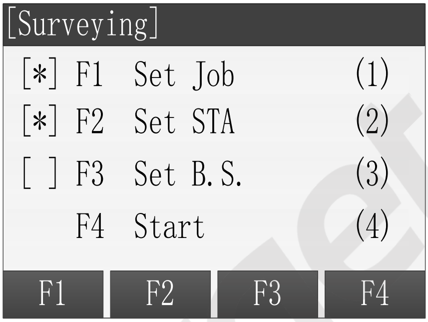
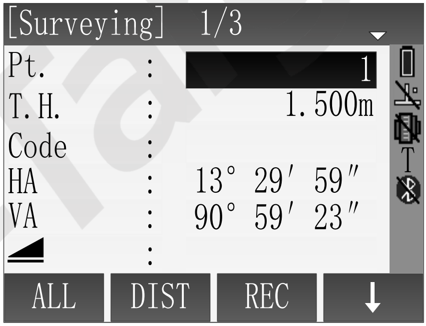
1. Go to the MAIN MENU.
2. Move the focus to [Program] or press the Numeric key 2 to select and go to the PROGRAM MENU.
3. Press [PAGE] to browse the application menu. Press [F1]-[F4] to select and start an application.

5.5 Surveying

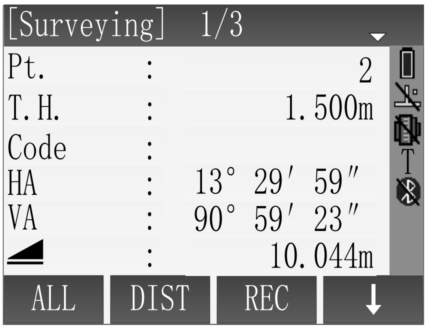
Compared with the Q-Surveying, Surveying has different guides in setting station and set orientation.



Operation: Must first finish setting the station and orientation.

Steps	Key	Display
① After finishing setting the job, setting the station and setting the orientation, press [F4] to start the application in the Pre-Setting menu.	[F4]	
② Input the point name, and then press [ENT] to move to next input item to input prism height.	Input point name + [ENT]	
③ Input the prism height and then press [ENT] to move the cursor to next input item. If needed, input the code.	Input prism height + [ENT]	

Hi-Target

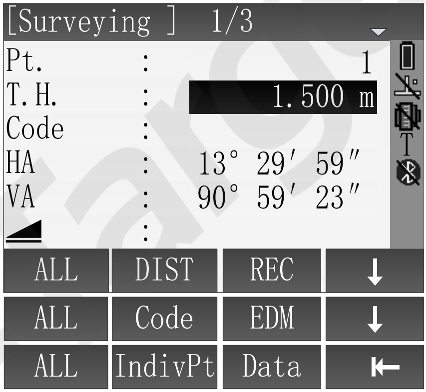
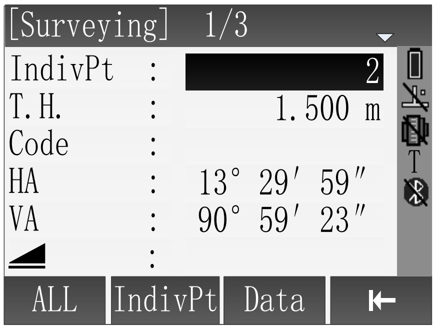
④ Press [F1](ALL) or press [F2](DIST) and [F3](REC) to start measuring and record the measured data. This data contains angle, distance and coordinates. Press [PAGE] to switch the display mode of the data.	[F1] or [F2]+[F3]	
⑤ After finishing measuring one point, the point name automatic plus one. Press [F1](ALL) or press [F2](DIST) and [F3](REC) to continue measuring next point. At this time, the screen remains the last measured data which can be looked over by pressing [PAGE].		

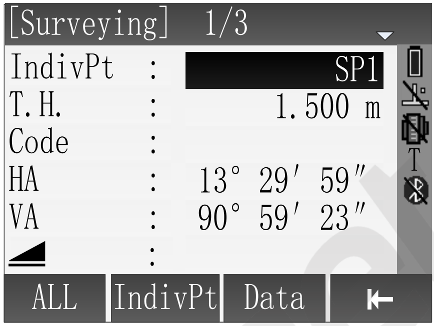
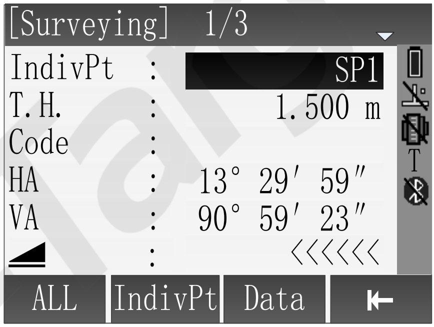
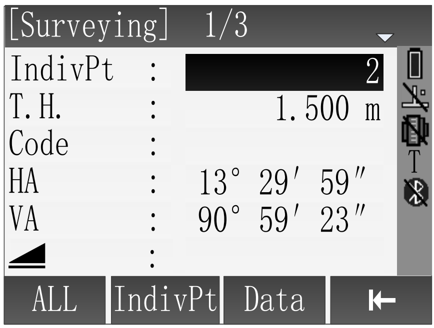
Hi-Target

5.5.1 Individual Point

[IndivPt]:

In the data acquisition, point can be recorded individually. Press this key to switch the screens of Individual Point Measurement and Consecutive Point Measurement.

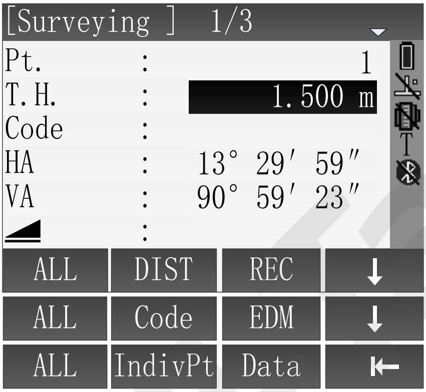
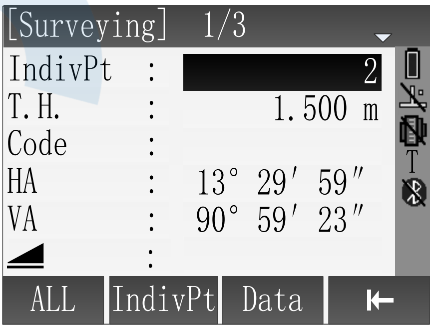
Steps	Key	Display
① Press [F4](↓) twice to display the last page of soft keys.	[F4]	
② Press [F2](IndivPt) to start measuring individual point function.	[F2]	

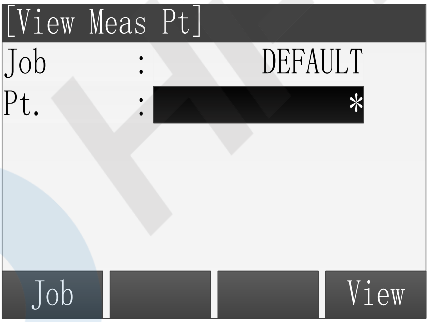
<table>
<tr>
<td>③ Input the individual point's name and prism height and press [ENT] to move the cursor to next input item.. If needed, input the code.</td>
<td>Input point name, prism height and code + [ENT]</td>
<td>
</td>
</tr>
<tr>
<td>④ Press [F1](ALL) or press [F2](DIST) and [F3](REC) to start measuring and record the measured data.</td>
<td>[F1] or [F2]+[F3]</td>
<td>
</td>
</tr>
<tr>
<td>⑤ Finish measuring, application turn off the function of measuring individual point and then continue to display the consecutive point name.</td>
<td></td>
<td>
</td>
</tr>
</table>

5.5.2 Data

[Data]:

Look over the measured data which are saved in current job.

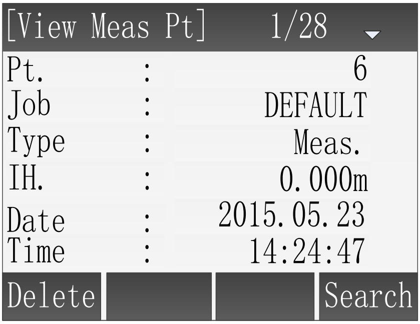
Steps	Key	Display
① Press [F4] (↓) twice to display the last page of soft keys.	[F4]	
② Press [F3] (Data) to	[F3]	

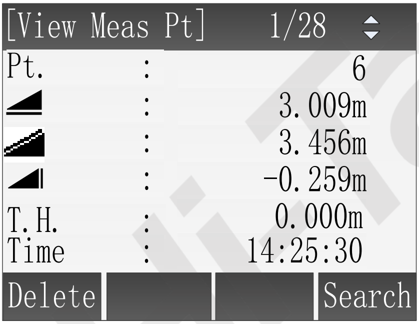
start view measured point function.		
③ After inputting the target point's name or wildcard (*), pres	Input point name/wildcard + [ENT] + [F4]	

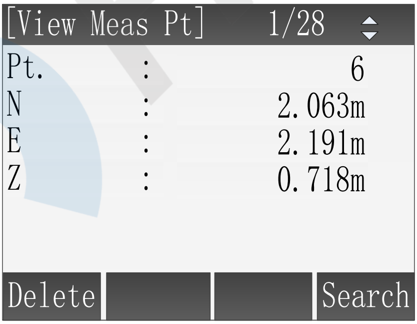
Hi-Target

s [ENT] and then press [F4] (View) to look over the data. If there is no match point, the program		

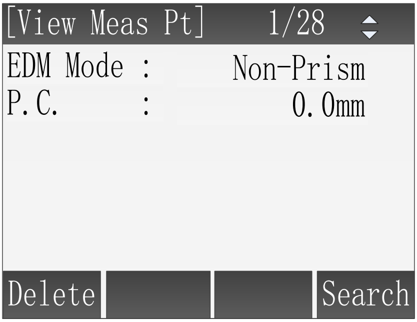
prompts “**Pt. not found!**” [Job]: Select the job where the measured data is to be viewed.		

<table>
<tr>
<td>④
Go to View Measured Point screen. Press [PAGE] to turn the page and look over all data</td>
<td>[PAGE]
←
→</td>
<td>






</td>
</tr>
</table>

field of this point. Press direction key ← and → to browse the last or next measured point.		

[Delete]: Delete this point data. [Search]: Back to the Find Point screen.		

5.6 Stakeout

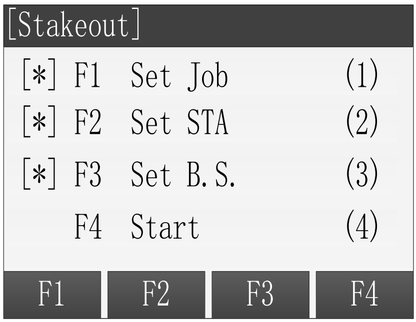
The Stakeout Application can calculate lofting elements base on lofting point's coordinate or manually input angle or horizontal distance. The application can continuously display differences, between current position and desired stake out position.

Steps of Stakeout :

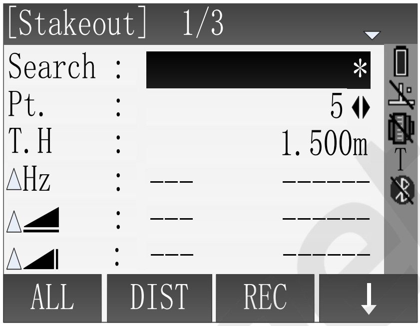
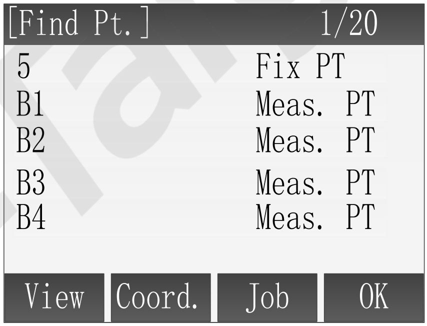
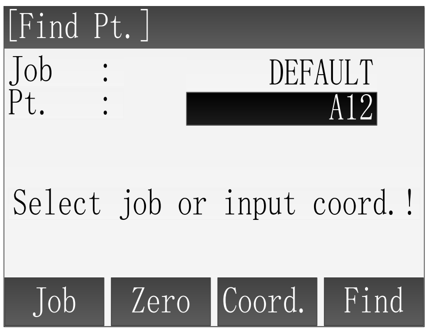
1. Set the job.
2. Set the station
3. Set the orientation
4. Extract coordinates from memory. The coordinates may be a measured point or a manually entered fix point.
5. Start staking out. There are three ways to choose: Polar Stakeout mode, Orthogonal to Station Stakeout mode, Cartesian Stakeout mode.

5.6.1 Set Stakeout Point

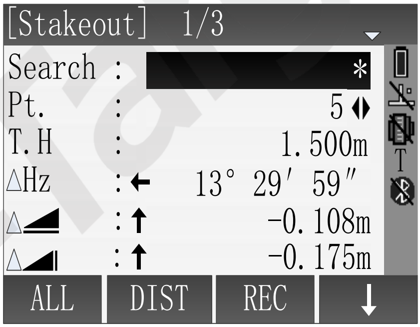
- **Extract coordinates from job**

Steps	Key	Display
① After finishing setting the job, setting the station and setting the orientation, press [F4] to start staking out in the Pre-Setting menu. ※1	[F4]	

Hi-Target

② Input the name of stakeout point in the Search item. Press [ENT] to start Find Point function. (Or input wildcard "*"to start the wildcard search.)	Input stakeout point's name + [ENT]	
③ A: The program search the point name in the job and show the result dialog. The match points will be listed, press [F4](OK) to identify selected point and back to Stakeout screen. (If the input is wildcard "*", the program will show all the points of the current job.)※2 B: If there is no match		 

Hi-Target

point in the job, the program prompts “**Pt. not found!**”.And then go in **Find Point In Job** screen. User can input a point or select a point from another job and then back to Stakeout screen.		
④ After finishing setting stakeout point, start staking out.		

※[1]: The settings of job, station and orientation have been elaborated in detail in the previous chapters, here is no longer repeat. Refer to chapters “Setting The Job、Setting The Station、Setting The Orientation”.

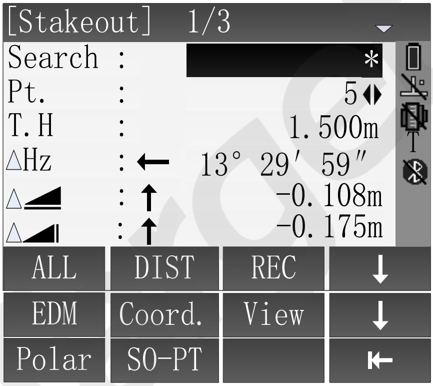
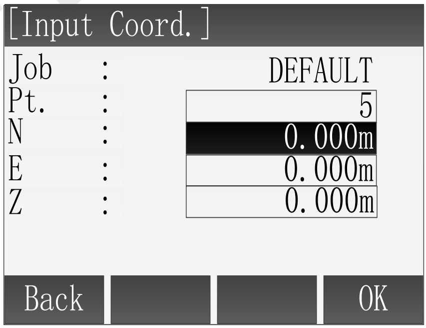
※[2]: Unlike the other place's points list, the stakeout points are ordered by time. In the stakeout points list, the newest point is at the back and the fix point is in the front of measured point. But in the other points list, the newest point is at the back and the measured point is in the front of fix point.

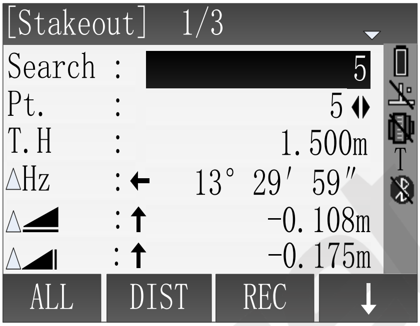
- **Manual input stakeout point**

  Press key [Coord.] or [SO-PT] to manual input stakeout point coordinates and then continue staking out.

[Coord.]:

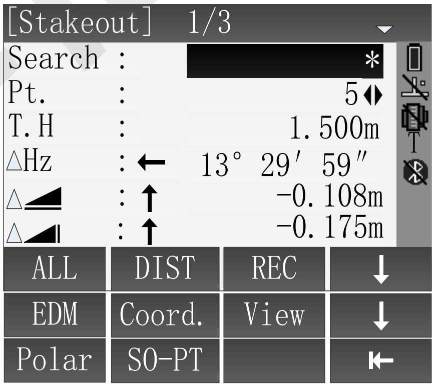
Press [Coord.] and then input a target point's coordinates. Saved this point into job and continue staking out.

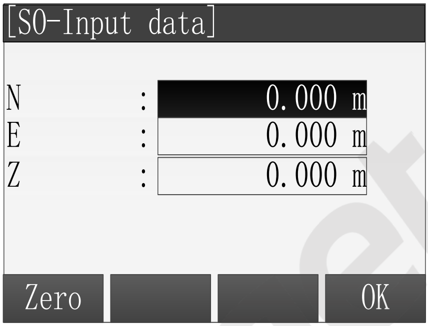
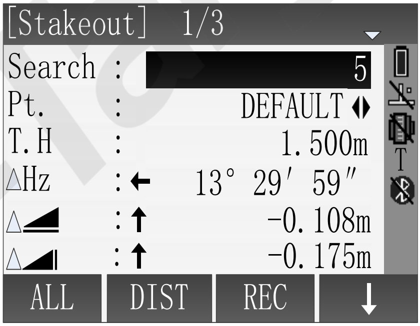
<table>
<tr><th>Steps</th><th>Key</th><th>Display</th></tr>
<tr><td>① Press [F4] (↓) to view the second page of soft keys.</td><td>[F4]</td><td>
</td></tr>
<tr><td>② Press [F2](Coord.) to go to Input Coord. Screen. Input point name and coordinate of the stakeout point. After input one item, the curser will move to next input item.</td><td>[F2]
+
Input point name and coordinates
+
[ENT]</td><td>
</td></tr>
</table>

③ After finishing inputs, press [F4](OK) to save the data. And then back to Stakeout screen. Start to stakeout the input point.		

[SO-PT]:

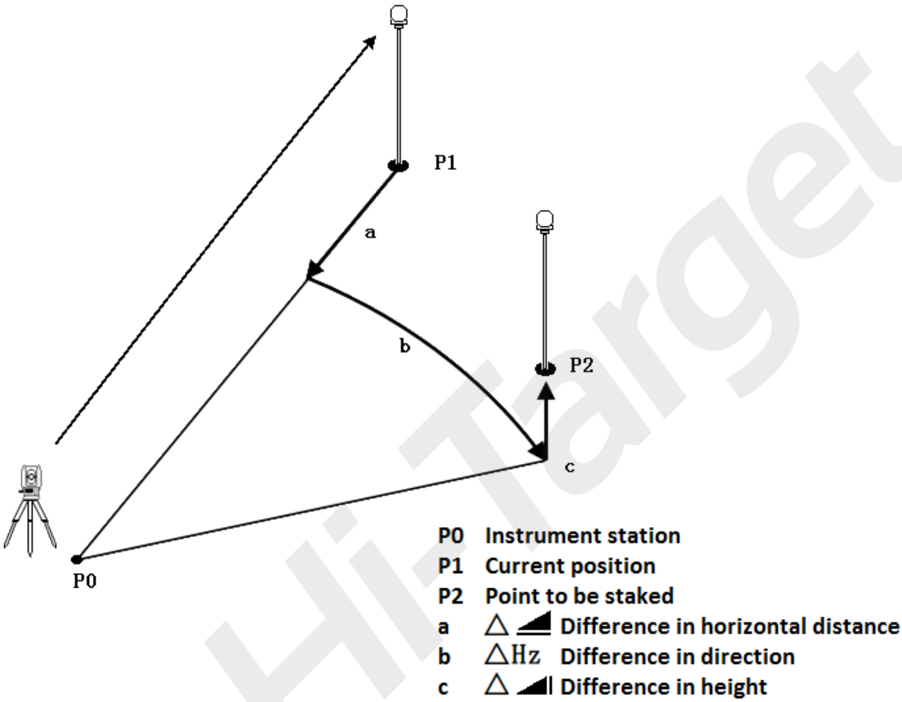
Press [SO-PT] to input a stakeout point without point name and being saved into job.

Steps	Key	Display
① Press [F4] (↓) to view the third page of soft keys.	[F4]	

② Press [F2](SO-PT) to go to SO-Input data screen. Input the coordinates of stakeout point. After input one item, the curser will move to next input item.	[F2] + Input point name and coordinates + [ENT]	
③ After finishing inputs, press [F4](OK) to save the data. And then back to Stakeout screen. Start to stakeout the input point. The program will name this point **DEFAULT** automatically. ※[1]		

※[1]: [SO-PT]: The input point won't be saved into job.

5.6.2 Polar Stakeout Mode

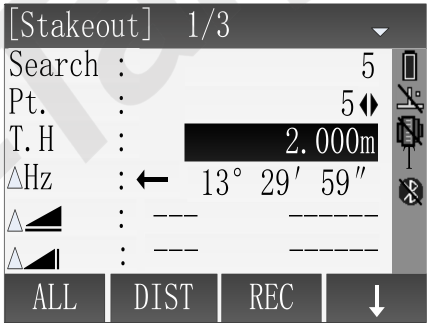
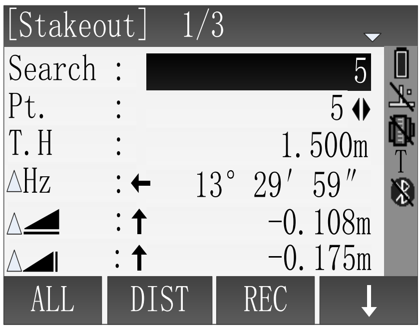


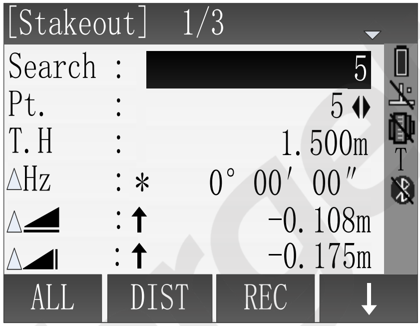
The meanings of the differences in the Polar Stakeout mode:

△Hz Difference in direction: If the measured point is located in the right side of stakeout point, the value is positive.

△ Difference in horizontal distance: If the measured point is farther than stakeout point, the value is positive.

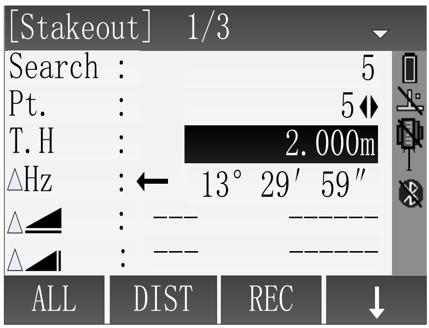
△ Difference in height: If the measured point is higher than stakeout point, the value is positive.

<table>
<tr><th>Steps</th><th>Key</th><th>Display</th></tr>
<tr><td>① Set all the points that are readied to stake out. Select one stakeout point through search the point name in the job.</td><td></td><td>
</td></tr>
<tr><td>② Press [PAGE] to go to page 1/3(Default page). Press direction key and move the cursor to input prism height item. Input the prism height and then press [ENT] to confirm.</td><td>[PAGE]
+
↓
+
Input prism height
+
[ENT]</td><td>
</td></tr>
<tr><td>③ Aim at the prism. Press [F2](DIST) to start measuring and calculate the differences between measured point and stakeout point.</td><td>[F2]</td><td>
</td></tr>
</table>

④ Turn the instrument telescope to make the △Hz equal 0° 00′ 00″ and command the staff to move the prism at the same time. Arrows Meaning: ←: Look forward from station and move the prism to the left. →: Look forward from station and move the prism to the right.		
⑤ While the △Hz equals 0° 00′ 00″, press [F2](DIST) to start measuring and calculate the differences between measured point and stakeout point. The arrow's direction is the direction of the prism need to move.	[F2]	

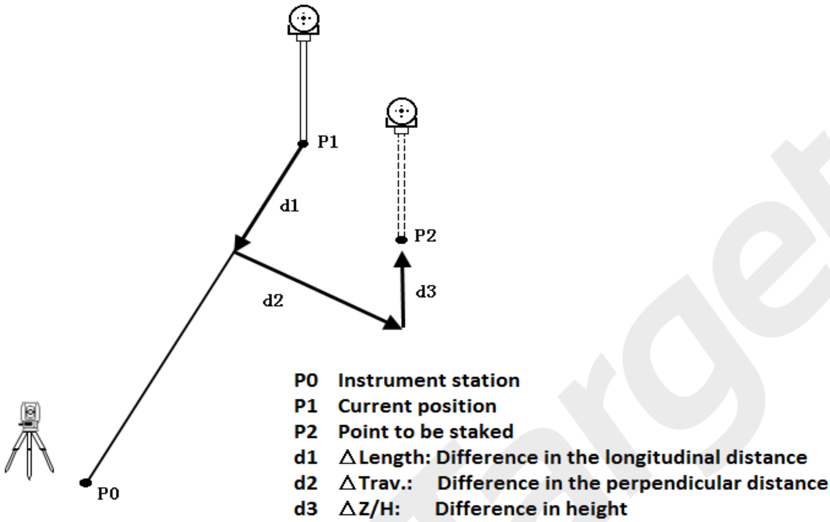
Hi-Target

⑥ Move the prism according to the direction of the arrow to make the value of △ equal 0m. Arrows Meaning: ↓ : Move the prism close to the station. ↑ : Move the prism far away the station. In the process of staking out, if using the Repeat Measurement or Tracking Measurement, the calculation of the differences between measured point and stakeout point can be displayed in real time and convenient.		

⑦ It means the current prism position is effective stakeout point while both the△Hz and △ are 0. △ Display as dig or fill data. ↓: The value expresses the depth of needed to dig. ↑: The value expresses the height of needed to fill.		
⑧ Now it finishes staking out a point. Repeat the previous steps to stake out next point.		

5.6.3 Orthogonal to Station Stakeout Mode

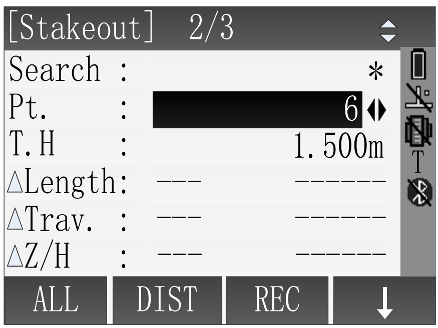
Use longitudinal difference and perpendicular difference to indicate the position differences of stakeout point and current prism position.



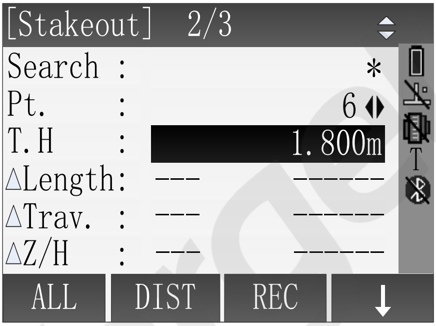
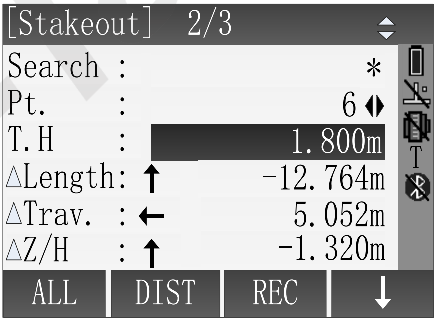
The meanings of the differences in the Orthogonal to Station Stakeout Mode:

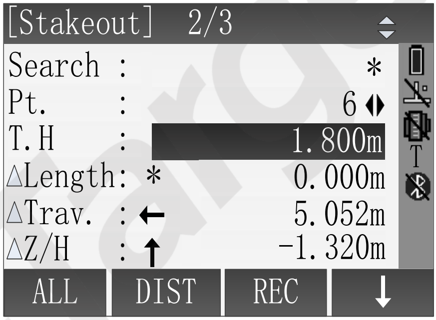
△Length Difference in longitudinal distance: If the measured point is farther than stakeout point, the value is positive.

△Trav. Difference in perpendicular distance: If the measured point is located in the right side of stakeout point, the value is positive.

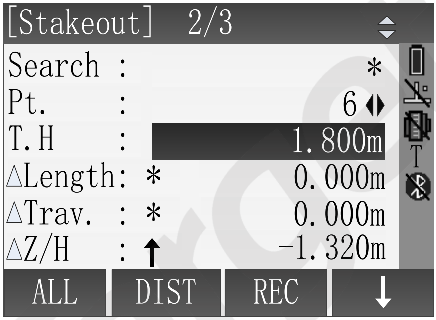
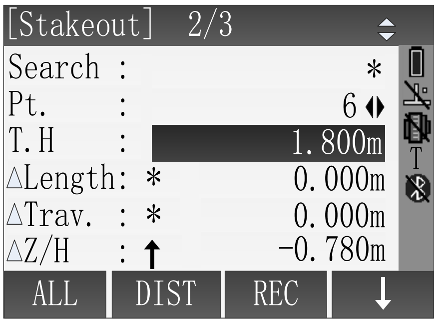
Steps	Key	Display
① Press [PAGE] to show Orthogonal to Station Stakeout Mode in page 2/3. Set the stakeout point. The stakeout point can be	[PAGE]	

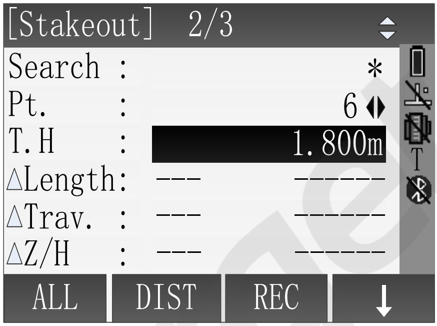
Hi-Target

found in the job through inputting point name in the search item.		
②Press direction key and move the cursor to input prism height item. Input the prism height and then press [ENT] to confirm.	↓ + Input prism height + [ENT]	
③Aim at the prism. Press [F2](DIST) to start measuring and calculate the differences between measured point and stakeout point. The arrow’s direction is the direction of the prism need to move.	[F2]	

④ Move the prism according to the direction of the arrow to make the value of △Length equal 0m. Arrows Meaning: ↓: Move the prism close to the station. ↑: Move the prism far away the station. In the process of staking out, if using the Repeat Measurement or Tracking Measurement, the calculation of the differences between measured point and stakeout point can be displayed in real time and convenient.		

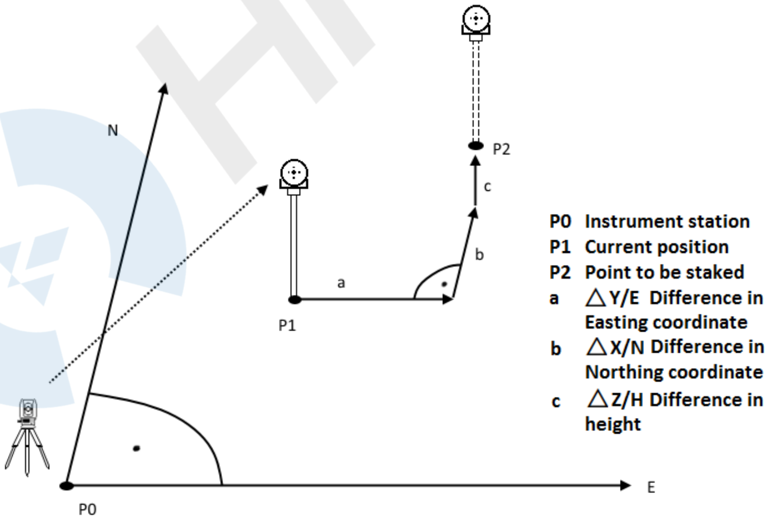
Hi-Target

⑤ Turn the instrument telescope to find the direction where makes the △Trav. equal 0m and command the staff to move the prism at the same time. Arrows Meaning: ←: Look forward from station and move the prism to the left. →: Look forward from station and move the prism to the right.		
⑥ It means the current prism position is effective stakeout point while both the△Length and △Trav. are 0. △Z/H: Display as dig or fill data. ↓ : The value expresses the depth of needed to dig. ↑ : The value expresses		

the height of needed to fill.		
⑧ Now it finishes staking out a point. Repeat the previous steps to stake out next point.		

5.6.4 Cartesian Stakeout Mode

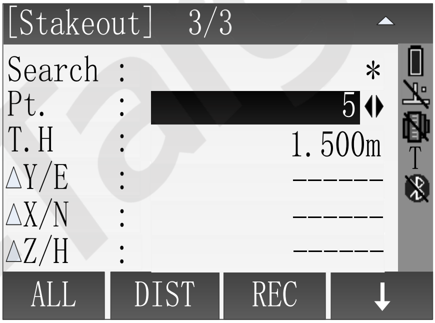
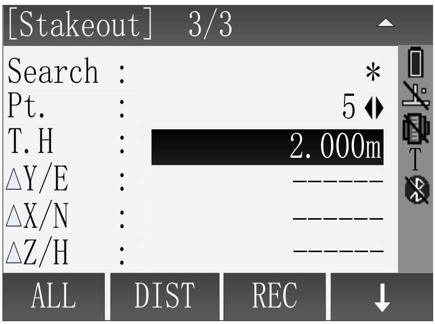
Stake out point based on the Cartesian coordinate system. The deviation values are the coordinate differences.



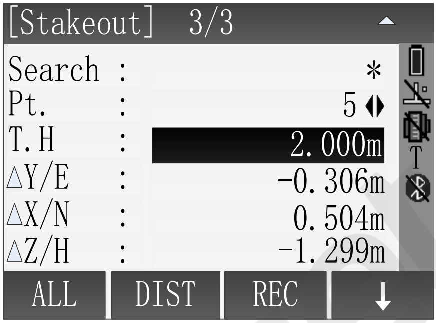
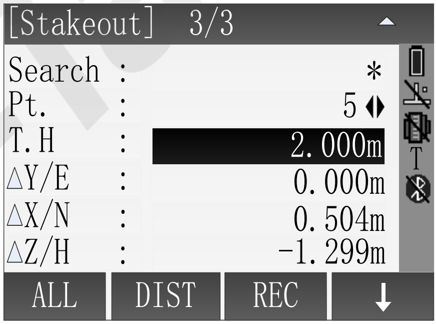
The meanings of the differences in the Cartesian Stakeout Mode:

△Y/E The difference in East coordinate between measured point and stakeout point.

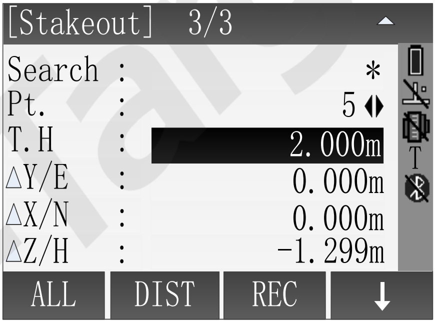
△X/N The difference in North coordinate between measured point and stakeout point.

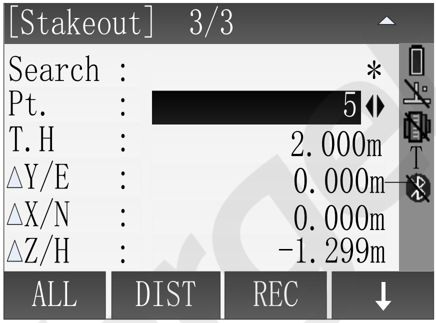
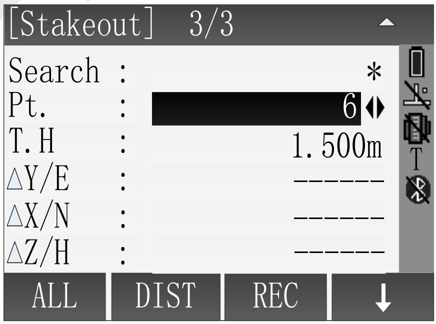
Steps	Key	Display
① Press [PAGE] to show Cartesian Stakeout Mode in page 3/3. Set the stakeout point. The stakeout point can be found in the job through inputting point name in the search item.	[PAGE]	
② Press direction key and move the cursor to input prism height item. Input the prism height and then press [ENT] to confirm.	↓ + Input prism height + [ENT]	

Hi-Target

<table>
<tr>
<td>③ Aim at the prism.
Press [F2](DIST) to start measuring and calculate the differences between measured point and stakeout point.</td>
<td>[F2]</td>
<td>
</td>
</tr>
<tr>
<td>④ Move the prism along the East direction to make the value of △Y/E equal 0m.
△Y/E is positive: The stakeout point is in the right side of measured point. Move the prism to right.
△Y/E is negative: The stakeout point is in the left side of measured point. Move the prism to left.</td>
<td></td>
<td>
</td>
</tr>
</table>

Hi-Target

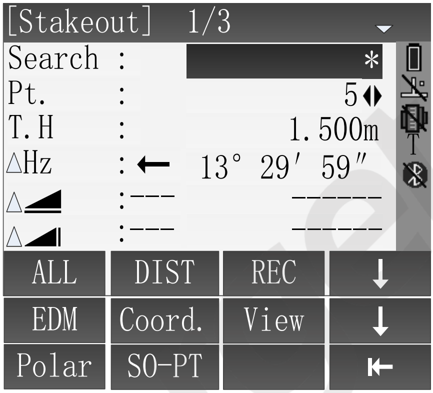
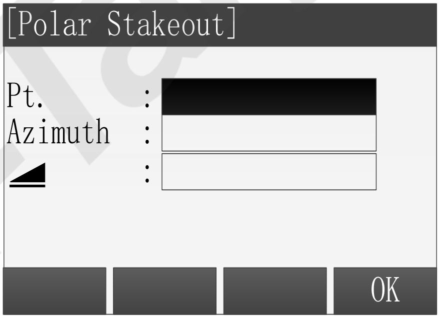
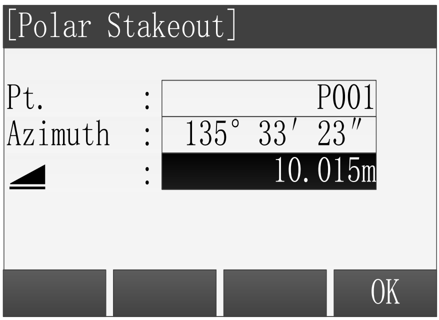
⑤ Move the prism along the North direction to make the value of △X/N equal 0m. △X/N is positive: The stakeout point is farther than the measured point. Move the prism far away the station. △X/N is negative: It needs to move the prism close to the station. In the process of staking out, if using the Repeat Measurement or Tracking Measurement, the calculation of the differences between measured point and stakeout point can be displayed in real time and convenient.		

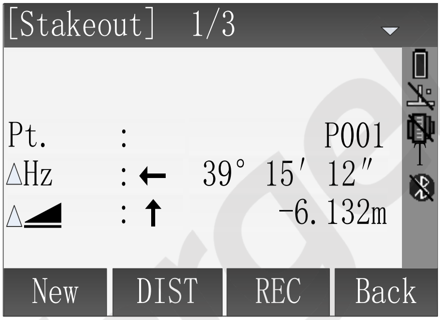
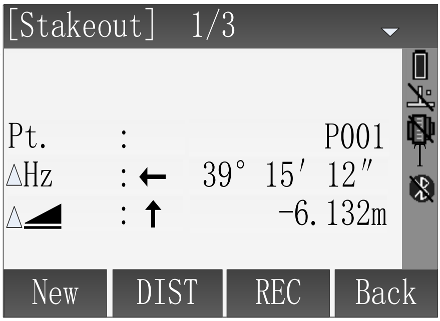
<table>
<tr>
<td>⑥ It means the current prism position is effective stakeout point while both the △ Y/E and △X/N are 0.
△Z/H: Display as dig or fill data.
△Z/H is positive: The value expresses the depth of needed to dig.
△Z/H is negative: The value expresses the height of needed to fill.</td>
<td></td>
<td>
</td>
</tr>
<tr>
<td>⑧ Now it finishes staking out a point. Repeat the previous steps to stake out next point.</td>
<td></td>
<td>
</td>
</tr>
</table>

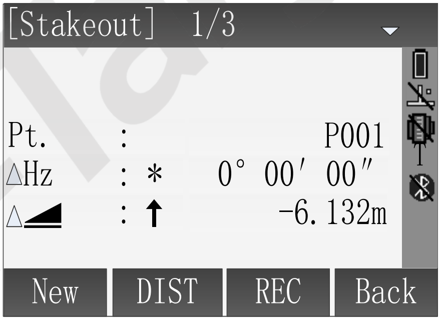
5.6.5 Polar

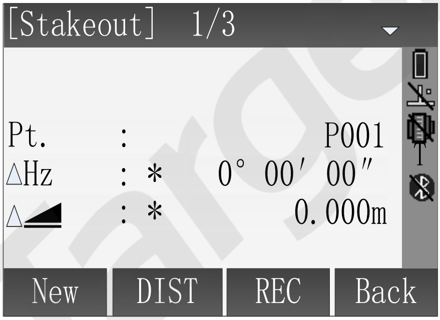
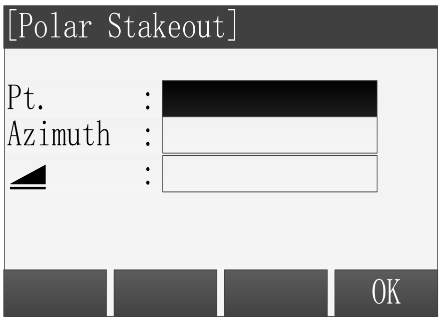
Press [Polar], then input the polar stakeout elements: Azimuth and Horizontal distance. Start to stake out after finishing inputs of Azimuth and Horizontal distance.

Hi-Target

Steps	Key	Display
① Press [F4](↓) twice to view the second page soft keys.	[F4]	
② Press [F1](Polar) to show the dialog as shown in figure.	[F1]	
③ Input the stakeout point's name, azimuth and horizontal distance. Press [ENT] to confirm every input and move the cursor to next input item. Press [F4](OK) to go to	Input point name, azimuth and horizontal distance + [ENT]	

Polar Stakeout screen after finishing all inputs. ※1	+ [F4]	
④ Aim at the prism. Press [F2](DIST) to start measuring and calculate the differences between measured point and stakeout point.	[F2]	
⑤ Turn the instrument telescope to make the △ Hz equal 0°00’00” and command the staff to move the prism at the same time. △Hz is positive: The stakeout point is in the left side of measured point. Move the prism to left. △Hz is negative: The stakeout point is in the		

right side of measured point. Move the prism to right.		
⑥ Set and aim at the prism in the direction of △Hz = 0°00’00”. Press [F2](DIST) to start measuring and calculate the differences between measured point and stakeout point. △ is positive: The stakeout point is closer to the station. Move the prism close to the station. △ is negative: The stakeout point is farther to the station. Move the prism far away the station.	[F2]	

⑦ Move the prism along the arrow direction to make the value of △◢ equal 0m. In the process of staking out, if using the Repeat Measurement or Tracking Measurement, the calculation of the differences between measurement point and stakeout point can be displayed in real time and convenient.		
⑧ Now it finishes staking out a point. Repeat the previous steps ② ～ ⑦ to stake out next point.		

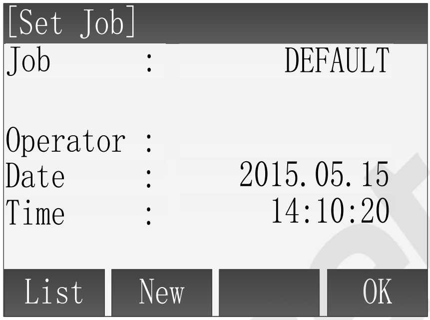
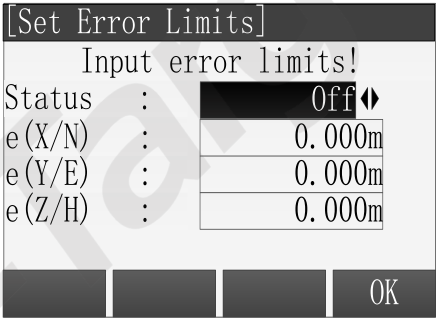
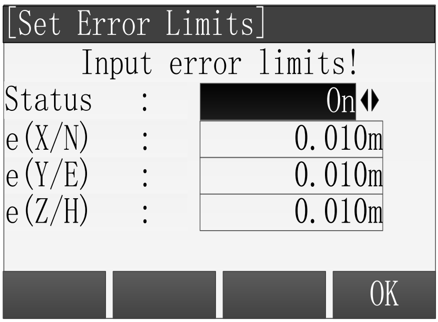
Hi-Target

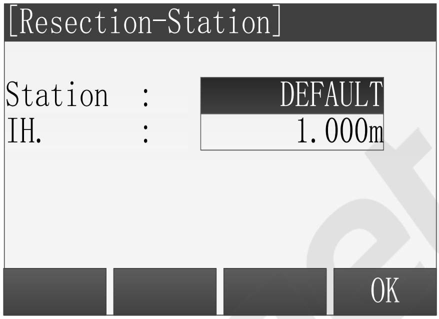
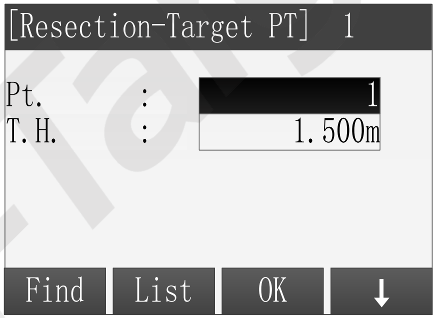
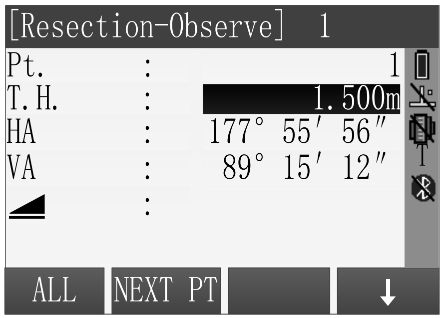
※[1]: The inputs of polar coordinate data won't be saved to job.

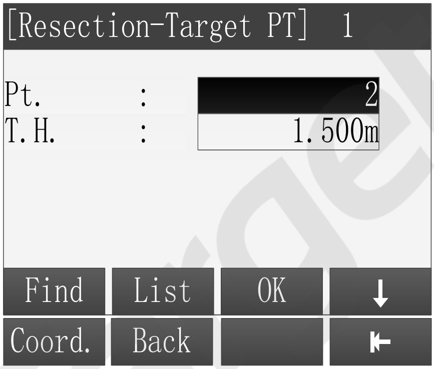
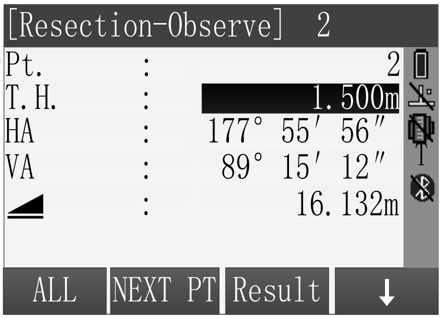
5.7 Resection

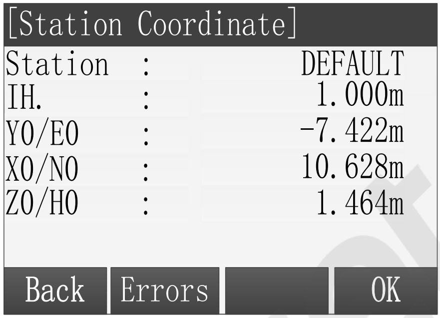
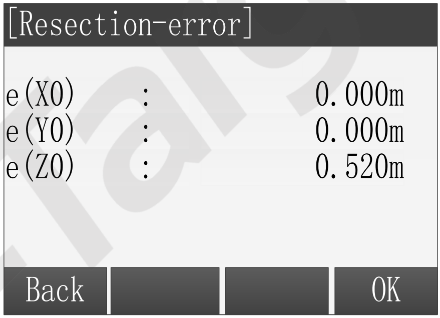
Resection measurement is an application used to determine the coordinate of the instrument station by measuring multiple known points. A minimum of 2 and a maximum of 5 known points can be used to determine the station. It should be used at least 2 known points by distance measurement or at least 3 known points by angle measurement.

Steps	Key	Display
① Select "Program" from the [Main Menu] window, press [F3] or number key [3] to enter the Resection application.	[F3]	[Program] 1/3 F1 Surveying (1) F2 Stakeout (2) F3 Resection (3) F4 Tie Distance (4) F1 F2 F3 F4
② Press [F1] in the [Resection] window to set the job.	[F1]	[Resection] [*] F1 Set Job [ ] F2 Set Error Limits F4 Start F1 F2 F4

③ In [Set Job] window, press [F1] (List) to select a job in memory or press [F2] (New) to new a job. Then press [F4] (OK) to next step.	[F4]	
④ The window back to the [Resection] window, and press [F2] to set error limits.	[F2]	
⑤ Press [◀] \ [▶] to turn on the error limits status and use the key [▲] \ [▼] to move the focus down to input the every error limit. Then press [F4] (OK) to set and back to the [Resection] window.	Input error limits + [F4]	

⑥ Press [F4] in [Resection] window to start resection measurement. It should be input the station name and the instrument high. Then press [F4] (OK) go to next step.	[F4] Input name and IH. + [ENT] [F4]	
⑦ Set the first known point and input prism high。 ※ [1]The title bar will display the number of known points in the current setting.		
⑧ Turn the instrument telescope aimed at first point and press [F1] to finish current measurement. Angle measurement: press [F2] (REC) to record an angle.	[F1]	

Distance measurement: [F1] (ALL) or [F1] + [F2] (DIST + REC).		
⑨ When finish a known point measurement, press [F2] (NEXT PT) to start next known point measurement. Repeat steps ⑦ and ⑧.	[F2]	
⑩ If the measured known points are enough, [Result] will display on the screen, then press [F3] (Result) to enter the [Station Coordinate] to view station result. Press [F1] (Back) back to a new known point measurement. Press [F2] (errors) to		 Press [F3] (Result) to enter the [Station Coordinate] to view result.

display standard deviation. Press [F4] (OK) to set the station coordinate and instrument height.		 Display standard deviation: 
※1: The known points can be called from the memory through the [Find], [List] or manually entered used [Coord.].		

5.8 Tie Distance

Tie Distance is an application used to compute slope distance, horizontal distance, height difference and azimuth of two target points which are either measured, selected from the memory, or input using the keypad.

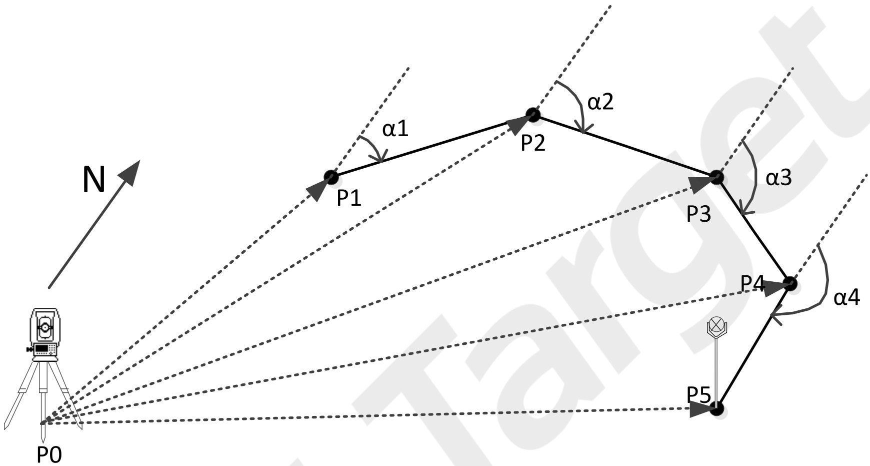
The user can choose between two different methods:

- Polygonal: P1-P2, P2-P3, P3-P4
- Radial: P1-P2, P1-P3, P1-P4

Hi-Target

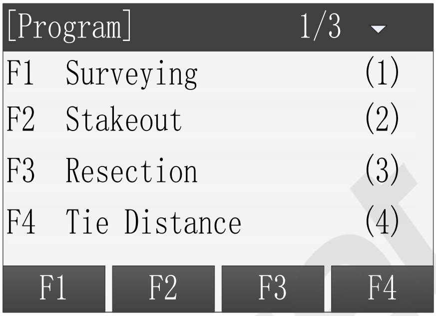
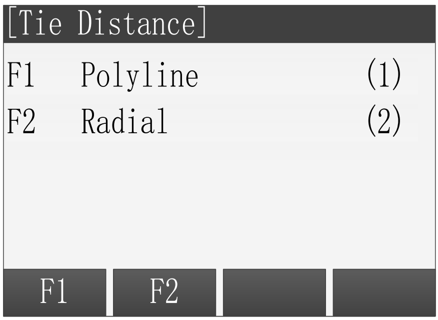
Start Tie Distance application through "Main Menu"→"Program"→"Tie Distance".

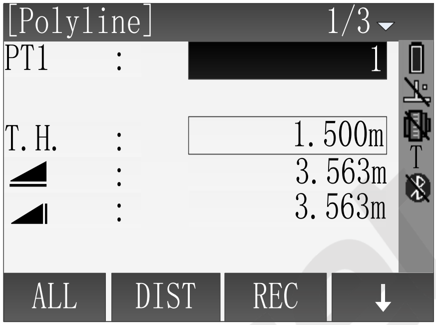
5.8.1 Polygonal

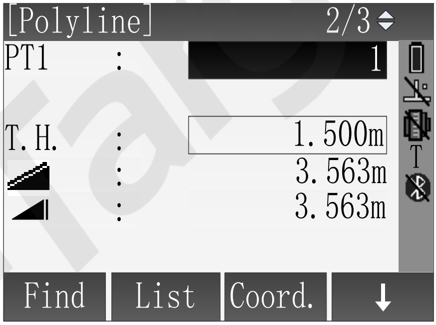


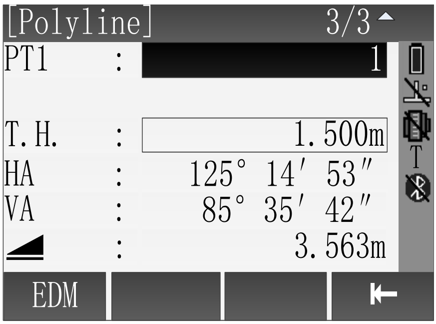
While Polygonal tie distance measuring continuous points, the new tie distance's first point will use the previous one tie distance's second point(P1-P2、P2-P3、P3-P4……).

Steps	Key	Display

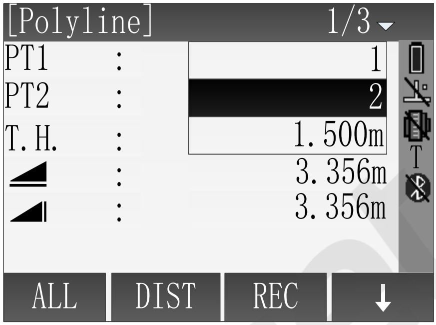
<table>
<tr><td>① Press [F4] in the Program Menu to go to Tie Distance application.</td><td>[F4]</td><td>
</td></tr>
<tr><td>② After finishing setting job, station and orientation, press [F4] in the Pre-Setting menu to go to Select Tie Distance Mode screen.</td><td>[F4]</td><td>
</td></tr>
<tr><td>③ Press [F1] to select the Polygonal tie distance.</td><td>[F1]</td><td>
</td></tr>
</table>

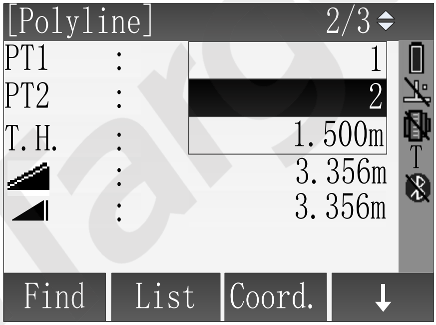
<table>
<tr>
<td>④ Start to measure the first target point. Aim at the first target point and press [F1](ALL) or [F2](DIST) + [F3](REC) to finishing measurement. ※1`</td>
<td>PAGE1
Press [F1]
or
[F2] +
[F3]</td>
<td>


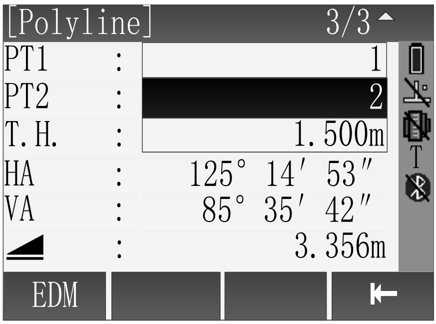




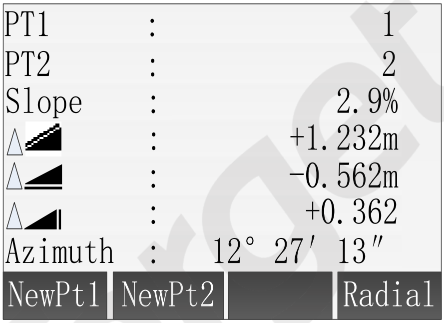
</td>
</tr>
</table>

<table>
<tr>
<td>⑤ Start to measure the second target point. Aim at the second target point and press [F1](ALL) or [F2](DIST) + [F3](REC) to finishing measurement. ※[1]</td>
<td>PAGE1
Press [F1]
or
[F2] +
[F3]</td>
<td>


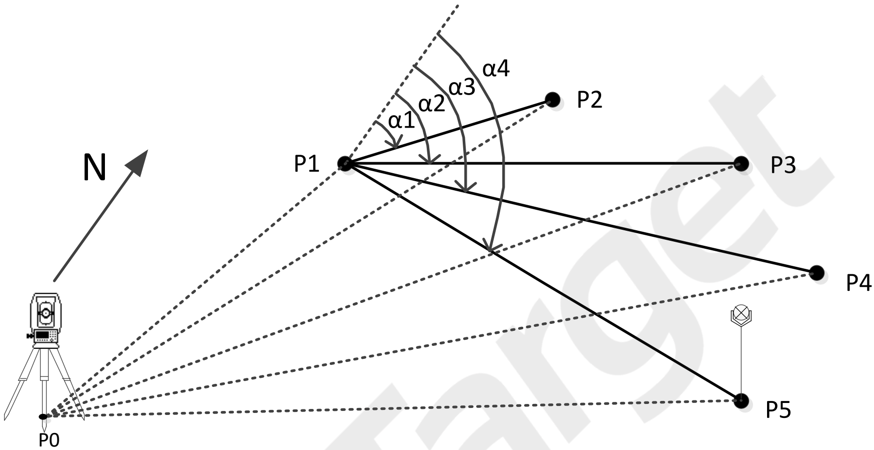




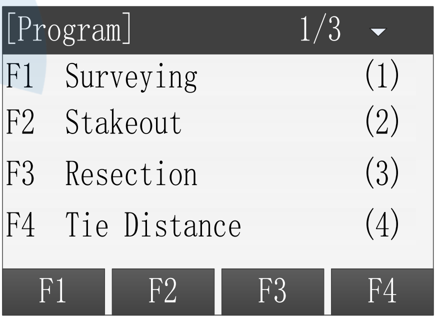
</td>
</tr>
</table>

⑥ Show the result of polygonal tie distance. [NewPt1]: Start a new polygonal tie distance. [NewPt2]: This polygonal tie distance's second point will be the new polygonal tie distance's first point and then go to ⑤ to measure the new second target point. [Radial]Radial: Go to Radial tie distance.		
※1: The target points can be measured, selected from the memory, or input using the keypad.		

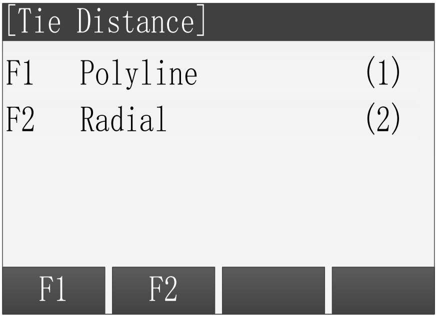
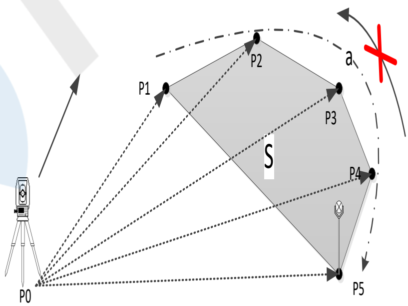
5.8.2 Radial

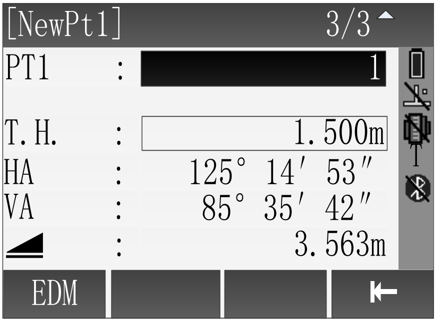


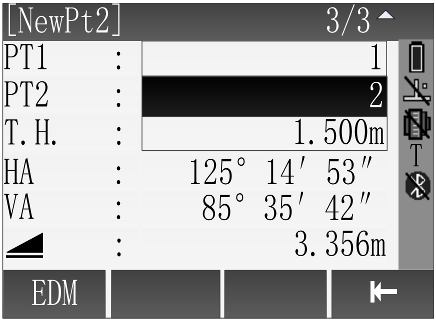
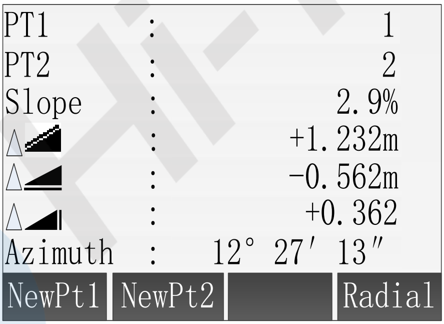
While Radial tie distance measuring continuous points, the new tie distance's first point continues using the previous tie distance's first point(P1-P2、P1-P3、P1-P4……).

Steps	Key	Display
① Press [F4] in the Program Menu to go to Tie	[F4]	

Distance application.		
② After finishing setting job, station and orientation, press [F4] in the Pre-Setting menu to go to Select Tie Distance Mode screen.	[F4]	

③ Press [F2] to select the Polygonal tie distance.	[F2]	
④ Start to measure the first target point. Aim at the first target point and press [F1](ALL) or [F2](DIST) + [F3](REC) to finishing	PAGE 1 Press [F1] or [F2] + [F3]	 

measurement. ※1		
⑤ Start to measure the first target point. Aim at the first target point and press [F1](ALL) or [F2](DIST) + [F3](REC) to finishing	PAGE 1 Press [F1] or [F2] + [F3]	

measure ment. ※1		
⑥ Show the result of Radial tie distance. [NewPt1]: Start a new Radial tie distance. [NewPt2]: This Radial tie distance's first point continues to be the		

new polygonal tie distance's first point and then go to ⑤ to measure the new second target point. [Polygonal]Radial: Go to Polygonal tie distance.		
※1: The target points can be measured, selected from the memory, or input using the keypad.		

5.9 Area

Area is an application used to calculate the polygon areas to a maximum of 20 points which connected by straights. The target points coordinate can be measured, selected from memory or entered via keypad in same direction. And the following three methods can be alternately performed. The calculate area is projected onto the horizontal plane (2D).

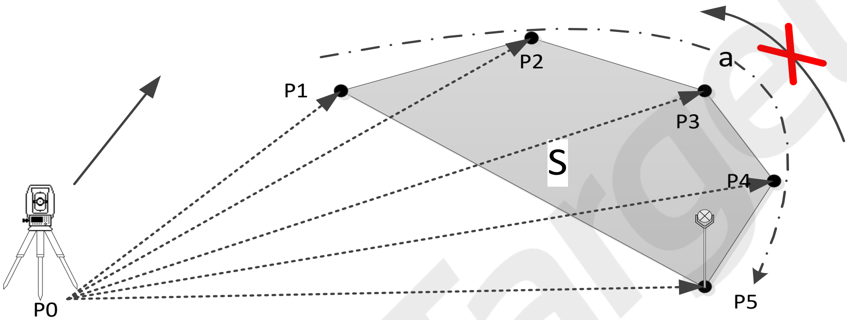


Figure 9.1 Area Diagram

P0　　　Instrument Point

P1　　　Start Target Point

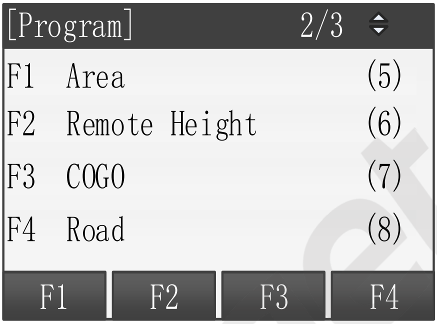
P1~P5　　Target Point

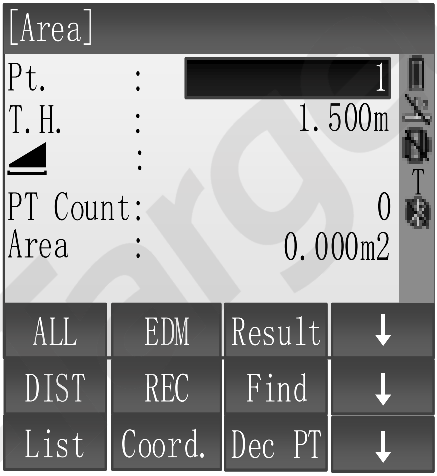
a　Perimeter, polygonal length from start point to the current measure point.

S　Calculated area always closed to the start point P1, projected onto the horizontal plane.

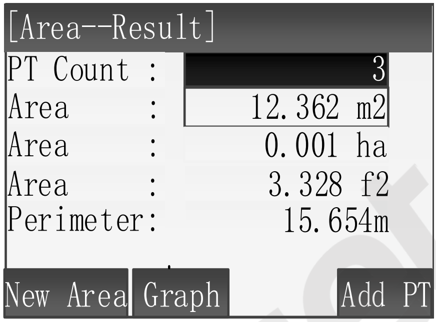
Select “Program” from the [Main Menu] window, then press [PAGE] switch to second program list and press [F1] or number key [5] to enter the Area application.

Steps	Key	Display

① Select "Program" from the [Main Menu] window, then press [PAGE] switch to second program list and press [F1] or number key [5] to enter the Area app.	[PAGE] + [F1] or [5]	
② After finishing the pre-settings (know more details at the beginning of chapter 5), press [F4] to start Area app.	[F4] or [4]	

③ To measure the points of the polygon, you will get the area result once the points are more than 3. [DIST]: To measure the range from object point to the station. [REC]: To record the horizontal info [Find]: To search the points in the point library. [List]: To show the points [Coord.]: To input the coordinates manually by keyboard. [Dec PT]: To delete the current point	F4+ F1 F4+ F2 F4+ F3	

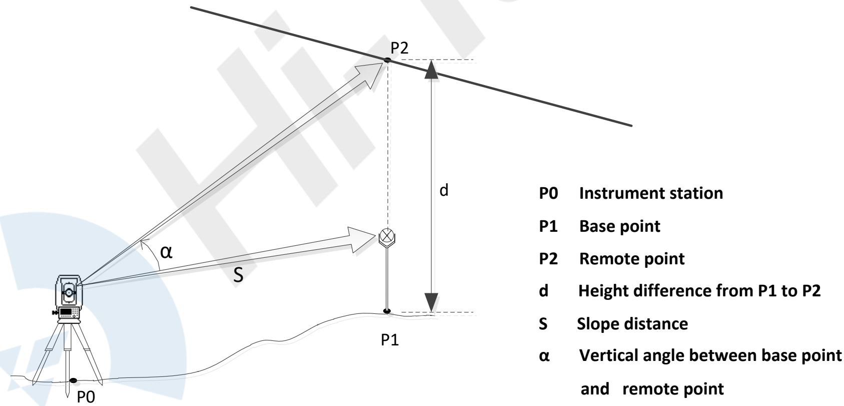
<table>
<tr>
<td>④ On Area interface

Press the key of F3 to select Result function. To display the 2D result(area, perimeter)</td>
<td>F3</td>
<td>
</td>
</tr>
</table>

※In all of the above operation, press [ESC] to return to the previous screen.

5.10 Remote Height

Remote Height is an application used to measure the height to the target (such as electric cable, bridge, etc.) where can't be set prism.



Prism High Known

If the high of prism is known, the calculation formula of the remote height is:

$$H = S * \cos\alpha_1 * \tan\alpha_2 - S * \sin\alpha_1 + V$$

H Height difference between the base point and the remote point

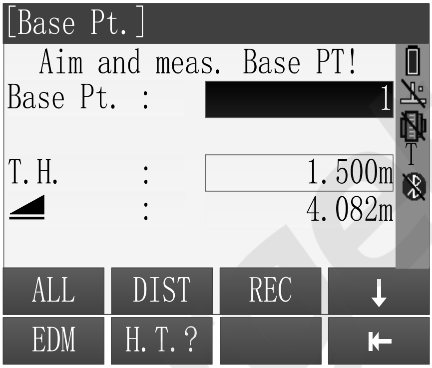
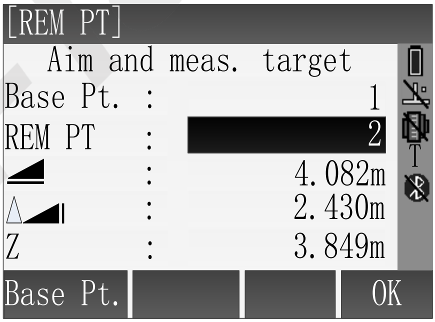
V Prism High

α_1 Vertical angle to prism

α_2 Vertical angle to target

Steps	Key	Display
① Select "Program" from the [Main Menu] window, then press [PAGE] switch to second program list and press [F2] or number key [6] to enter the Area application.	[PAGE] + [F2] or [6]	[Program] 2/3 F1 Area (5) F2 Remote Height (6) F3 COGO (7) F4 Road (8) F1 F2 F3 F4
② After finishing the pre-settings (know more details at the beginning of chapter 5), press [F4] to enter the [Base Pt.] window to start Remote Height app.	[F4]	[Remote Height] [*] F1 Set Job (1) [*] F2 Set STA (2) [*] F3 Set B.S. (3) F4 Start (4) F1 F2 F3 F4

Hi-Target

③ Move the prism just standing below the remote point, then aim at the prism after input the prism high and press [F1] (ALL) or [F2] + [F3] (DIST + REC) to finish the base point measuring. Then enter the [REM PT] window.	[F1] or [F2] + [F3]	
④ Turn the instrument telescope aimed at remote point and press [F4] to finish current remote point measuring. Press [F1] to re-set the base point.	[F4]	

5.10.1 Prism High Unknown

If the high of prism is unknown, the calculation formula of the remote height is:

$$H = S * \cos\alpha_1 * \tan\alpha_2 - S * \sin\alpha_1 * \tan\alpha_3$$

H Height difference between the base point and the remote point

V Prism High

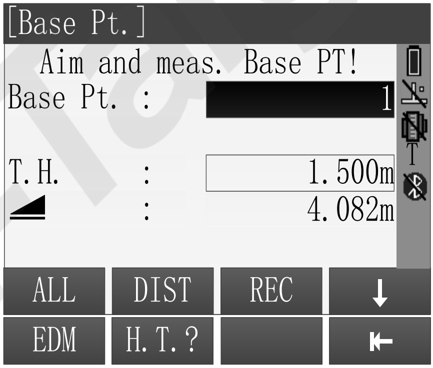
S Slope distance between instrument and prism

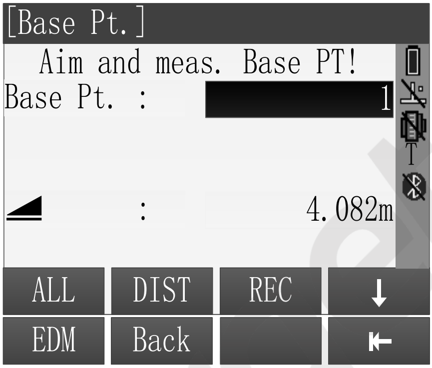
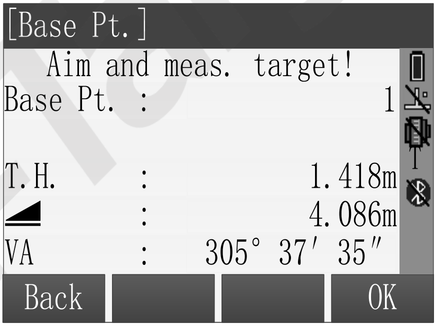
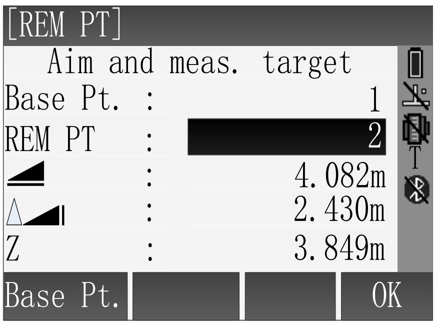
α_1 Vertical angle to prism

α_2 Vertical angle to target point (remote point)

α_3 Vertical angle to base point

Steps	Key	Display
① Select "Program" from the [Main Menu] window, then press [PAGE] switch to second program list and press [F2] or number key [6] to enter the Remote Height application.	[PAGE] + [F2] or [6]	

② After finishing the pre-settings (know more details at the beginning of chapter 5), press [F4] to enter the [Base Pt.] window to start Remote Height app.	[F4]	
③ In [Base Pt.] window, press [F4] to second page of function keys, then press [F2] (H.T.?) switch to the situation of prism high unknown to start measuring.	[F4] + [F2]	

<table>
<tr>
<td>④ Move the prism just standing below the remote point, then aim at the bottom of prism rod and press [F1] (ALL) or [F2] + [F3] (DIST + REC) to finish the base point measuring.</td>
<td>[F1] or [F2]+[F3]</td>
<td>
</td>
</tr>
<tr>
<td>⑤ Turn the instrument telescope aimed at prism and press [F4] to measure the prism high. Then enter the [REM PT] window.</td>
<td>[F4]</td>
<td>
</td>
</tr>
<tr>
<td>⑥ Turn the instrument telescope aimed at remote point and press [F4] to finish current remote point measuring. Press [F1] to re-set the base point.</td>
<td>[F4]</td>
<td>
</td>
</tr>
</table>

5.11 COGO

COGO(Coordinate Geometry)is an application used to perform coordinate geometry calculations by the preset conditions such as , coordinates of points, bearings between points and distance between points.

The COGO calculation methods include:

✧ Inverse and Traverse

✧ Intersections

✧ Offset

✧ Extension

5.11.1 Traverse

Use the traverse sub application to calculate the plane coordinate of a new point using the bearing and distance from a known point. Offset is optional.

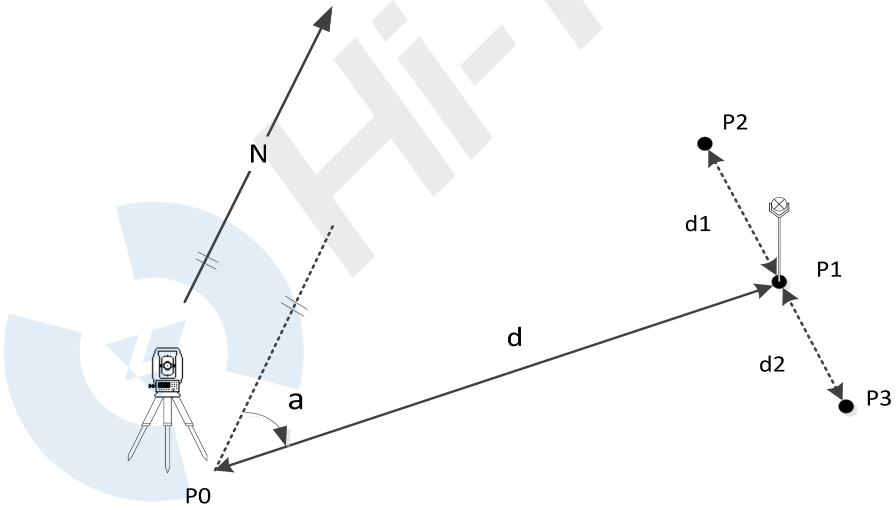


Figure 11.1 Traverse Diagram

Known

P0 known point

a Direction from P1 to P2

d Distance between P1 and P2

d1 Positive offset to the right

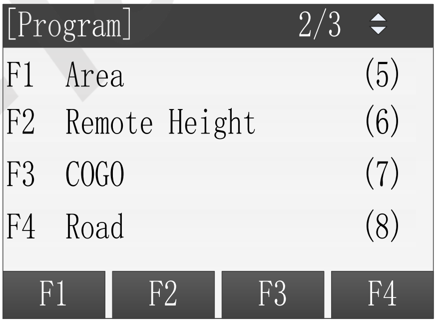
d2 Negative offset to the left

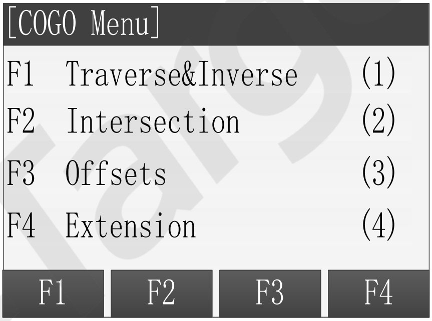
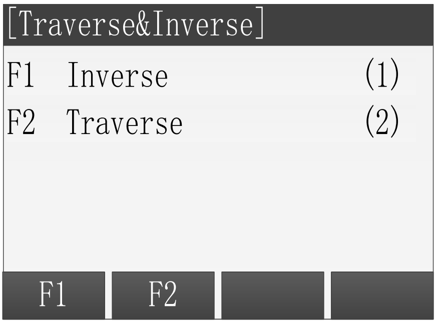
Unknown

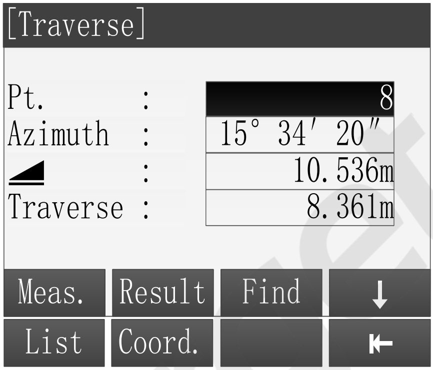
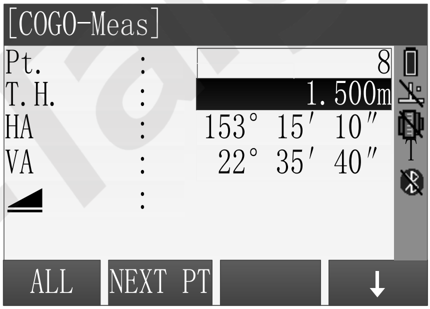
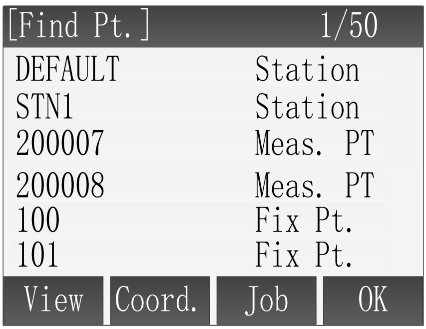
P1 COGO point without offset

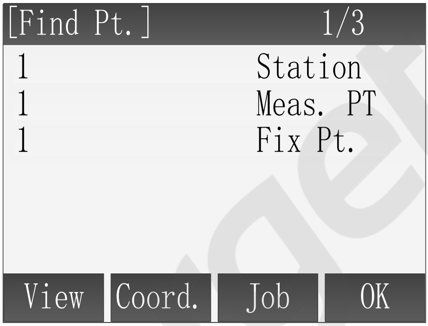
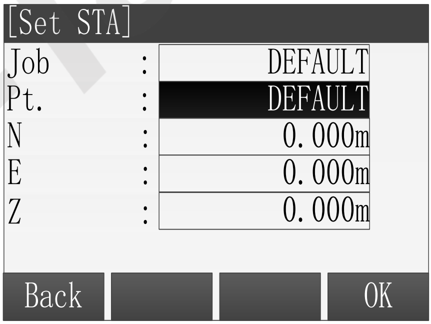
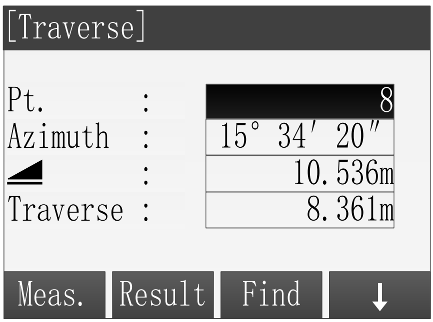
P2 COGO point with negative offset

P3 COGO point with positive offset

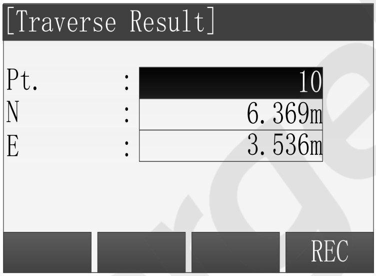
Steps	Key	Display
① Select "Program" from the [Main Menu] window, then press [PAGE] switch to second program list and press [F1] or number key [7] to enter the COGO application.	[PAGE] + [F2] or [7]	

② After finishing the pre-settings (know more details at the beginning of chapter 5), press [F4] to start COGO app.	[F4] or [4]	
③ In [COGO Menu] screen, press the [F1] or number key [1] enter the [Traverse & Inverse] screen, press [F2] or [2] enter the traverse sub application.	[F1] or [1] [F2] or [2]	 

④ There are four ways to get the known point for traverse calculation. A: Input the name of known point in "Pt." field in [Traverse] screen and press [F1](Meas.) entry the [COGO Meas] Input prism height in the "T.H." field in [COGO-Meas], then aim the prism and press [F1] (ALL) or [F2] (DIST) + [F3] (REC) to measuring and saving the point for traverse calculation.	Input point name + [F1](Meas.) [F1](ALL) or [F2](DIST) + [F3](REC)	A: Get the known point by COGO-Meas.  COGO-Meas. 
B: Press [F1](List) in [Traverse] screen, use the key [▲]\[▼] to select a Known point in the point list for traverse calculation, then press [F4](OK) to be selected.	[F1](List) + [F4](OK)	B: Select the point by list in the memory. 

C: Input the name of known point and press [F3](Find) to find whether the point is in memory, if exist, then press [F4](OK) to be selected for calculating; if not exist, then need to input or measure the point.	Input name + [F3](Find) + [F4](OK)	C: Input the name of the point and find whether it is in memory. 
D: Press [F2](Coord.) to input a known point that not exist in memory.	[F2](Coord.) + Input Coord. + [F4](OK)	D: Input the point through keyboard. 
⑤ After setting known point, press [▼]\[▲] key to move focus to the “AZ”, “ ◢ ” and “Transverse” field,	[▲]\[▼] + Input content + [F2]	

Hi-Target

input the content, then press [F2](Result) to calculate and show the traverse result.		
⑥ Input the name of result point in the [Traverse Result] and press [F4](REC) to save the point.	[F4](REC)	

※ In all of the above operation, press [ESC] to return to the previous screen.

※ The result point is plane data.

5.11.2 Inverse

Use the inverse sub application to calculate the distance, direction, height difference between two known points.

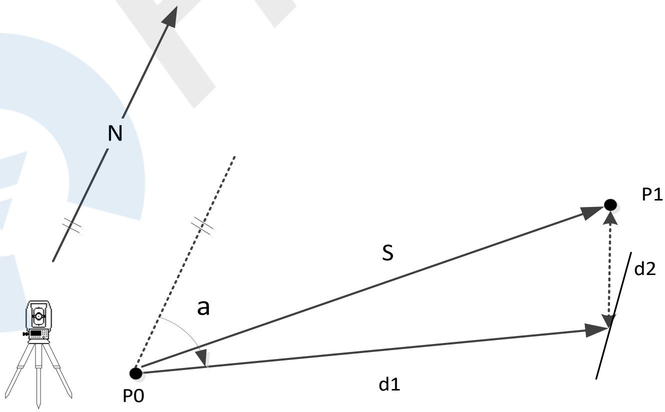


Figure 11.2 Inverse Diagram

Hi-Target

Known

P0 First known point

P1 Second known point

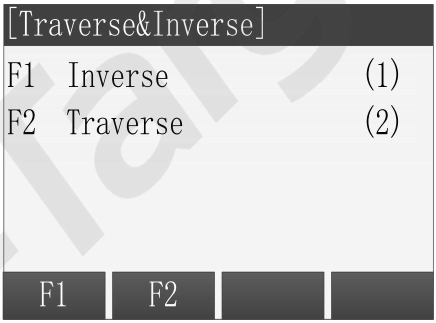
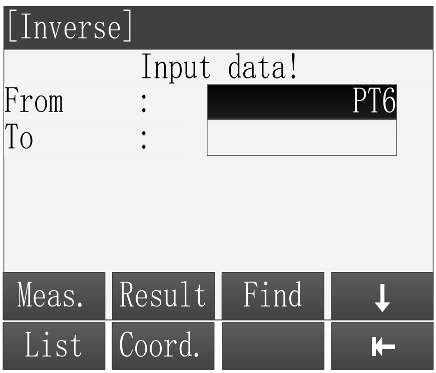
Unknown

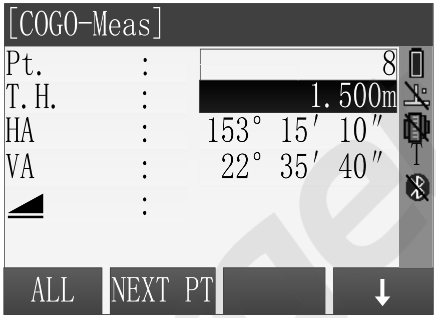
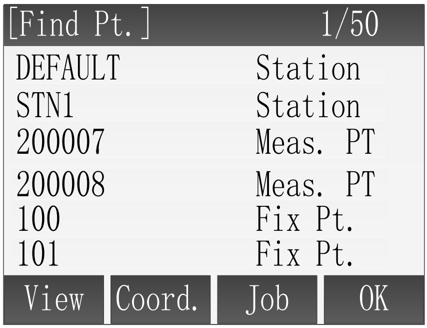
a Direction from P0 to P1

S Slope distance between P0 and P1

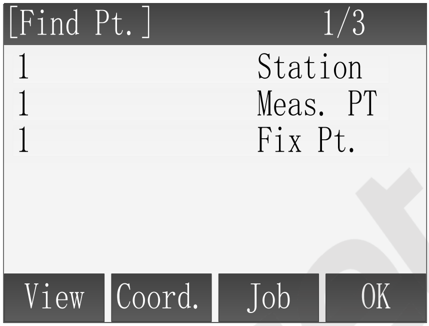
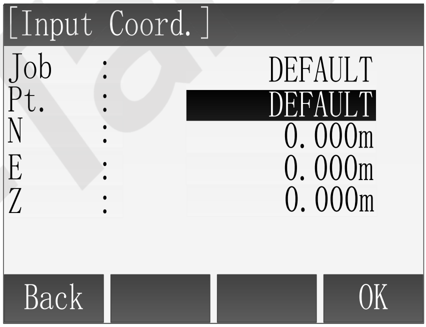
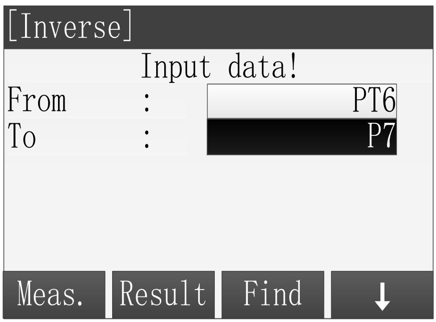
d1 Horizontal distance between P0 and P1

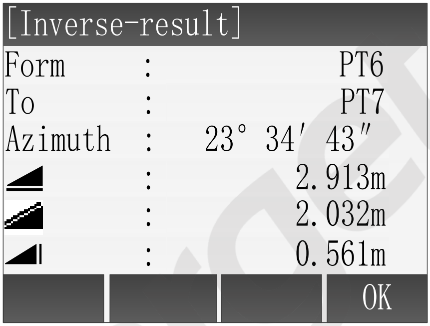
d2 Height difference between P0 and P1

Steps	key	Display
① In the [Traverse & Inverse] screen, press [F1] or [1] to enter the Inverse sub application.	[F1] or [1]	
② There are four ways to get the known point for inverse calculation. A: Input the name of known point in"Pt." field in [Traverse] screen and press	Input point name +[F1](Meas.) [F1](ALL) Or [F2](DIST) +	A: Get the known point by COGO-Meas 

[F1](Meas.) entry the [COGO Meas] Input prism height in the “T.H.” field on [COGO-Meas], then aim the prism and press [F1](ALL) or [F2](DIST) + [F3](REC) to measuring and saving the point for inverse calculation.	[F3](REC)	COGO-Meas. 
B: Press [F1](List) in [Traverse] screen, use the key [▲]\[▼] to select a Known point in the point list for inverse calculation, then press [F4](OK) to be done.	[F1](List) + [F4](OK)	B: Select the point by list in the instrument. 
C: Input the name of known point and press [F3](Find) to	Input name + [F3](Find)	C: Input the name of the point and find whether it is in memory.

Hi-Target

<table>
<tr>
<td>find whether the point is in memory, if exist, then press [F4](OK) to be selected for calculating; if not exist, then need to input or measure the point.</td>
<td>+
[F4](OK)</td>
<td>
</td>
</tr>
<tr>
<td>D: Press [F2](Coord.) to input a known point that not exist in memory.</td>
<td>[F2](Coord.)
+
Input Coord.
+
[F4](OK)</td>
<td>D: Input the point through keyboard.

</td>
</tr>
<tr>
<td>③ After setting the first known point then use [▼]\[▲] move the focus to “To” field to set the second known point, then press [F2](Result) to</td>
<td>[▼]\[▲]+
[F2]</td>
<td>
</td>
</tr>
</table>

calculate the inverse point and show the result.		
④ Input the name of result point in the [Traverse Result] and press [F4](REC) to save the point.	[F4](REC)	

※ In all of the above operation, press [ESC] to return to the previous menu.

※ The result point is plane data.

5.11.3 Bearing-Bearing Intersection

Use the bearing-bearing (BRG-BRG) sub application to calculate the intersection point of two lines. A line is defined by a point and a direction.

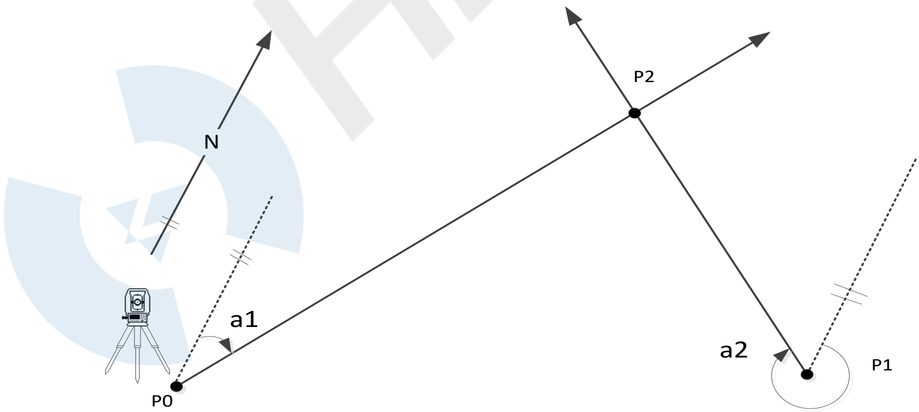


Figure 11.3 BRG-BRG Diagram

Known

P0 First known point

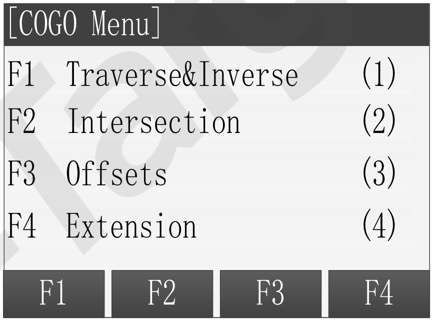
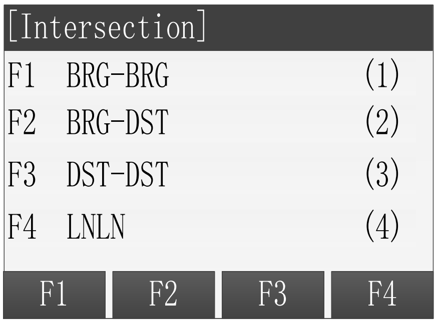
P1 Second known point

a1 Direction from P0 to P2

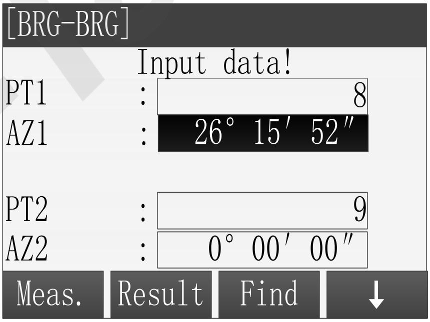
a2 Direction from P1 to P2

Unknown

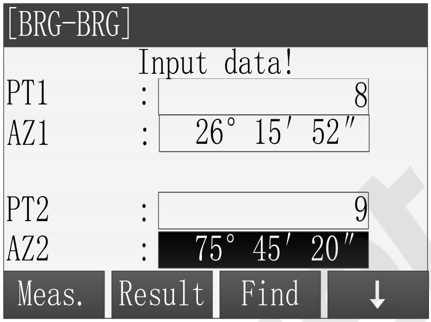
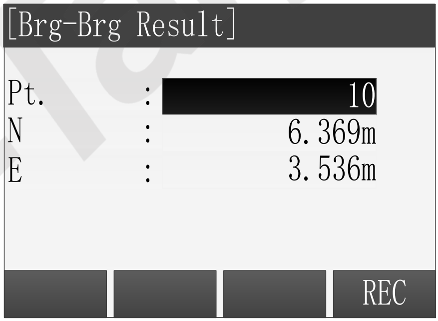
P3 COGO point

Steps	key	Display
① In [COGO Menu] screen, press the [F2] or number key [2] to enter the [Intersection] screen. Then press [F1] or [1] to enter the BRG-BRG sub application.	[F2] or [2] [F1] or [1]	 

<table>
<tr>
<td>② Input the name of first point in "PT1" field.

※ There are four ways to get the known point for BRG-BRG calculation. Please refer to the step ② in the "COGO Traverse".</td>
<td>Input name of first point</td>
<td>
</td>
</tr>
<tr>
<td>③ Move the focus to "AZ1" by using [▼] and input the first bearing after set first point.</td>
<td>[▼]
+
Input first bearing</td>
<td>
</td>
</tr>
<tr>
<td>④ Move the focus to "PT2" by using [▼] to setting second point.</td>
<td>[▼]
+
Set second point</td>
<td>
</td>
</tr>
</table>

Hi-Target

⑤ Move the focus to "AZ2" by using [▼] and input the second bearing after set second point.	[▼] + Input second bearing	
⑥ When all of the data are entered correctly, press [F2](Result) to calculate the intersection point and show the result. Input the name of result point in the [BRG-BRG Result] and press [F4](REC) to save the point.	[F2]	

※ In all of the above operation, press [ESC] to return to the previous menu.

※ The result point is plane data.

5.11.4 Bearing-Distance Intersection

Use the bearing-distance (BRG-DST) sub application to calculate the intersection point of a line and a circle. The line is defined by a point and a direction. The circle is defined by the center point and the radius. The result may be have 1 intersection point, may be have 2 points, or may be have no one.

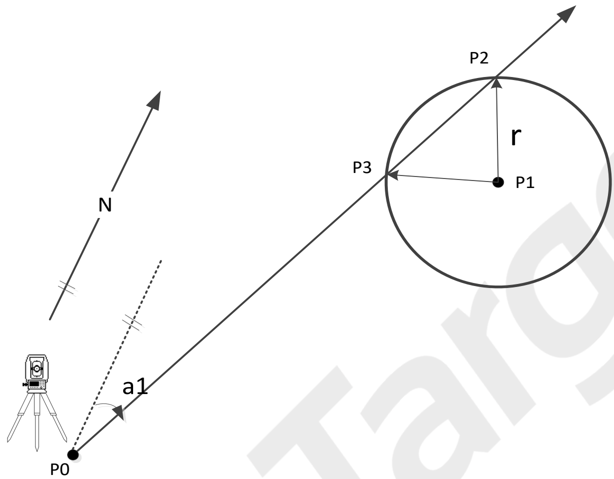


Figure 11.4 BRG-DST Diagram

Known

P0 First known point

P1 Second known point

a1 Direction from P0 to P2 or P3

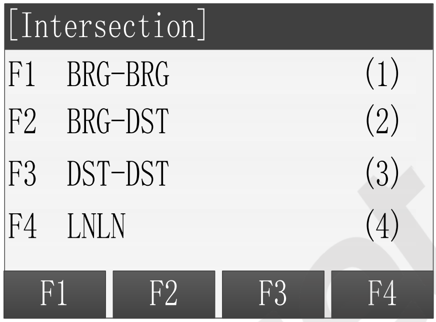
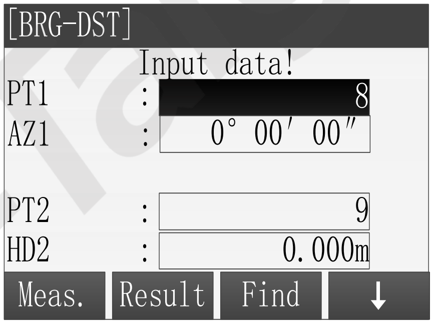
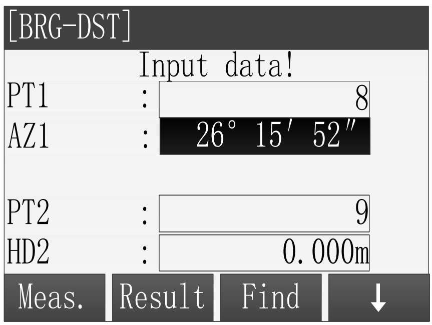
r Radius, as the distance from P1 to P2 or P3

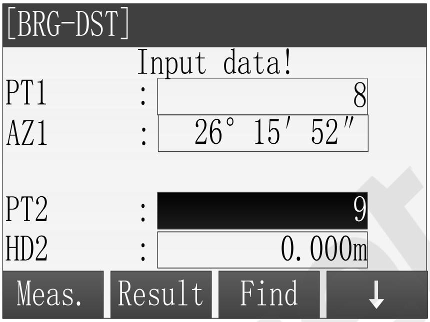
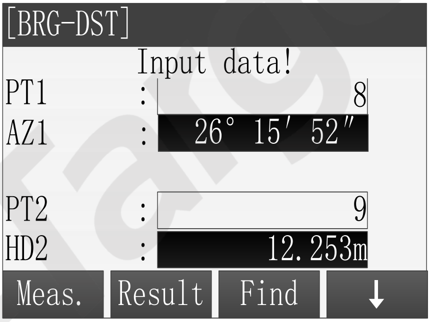
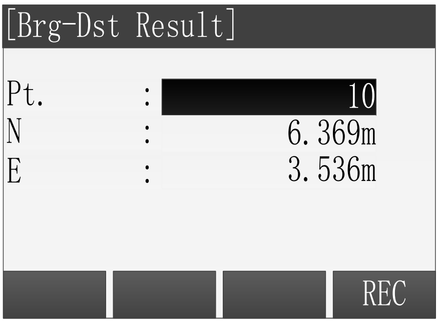
Unknown

P2 First COGO point

P3 Second COGO point

Steps	key	Display

① In the [Intersection] screen, press [F2] or [2] to enter the BRG-DST subapplication.	[F2] or [2]	
② Input the name of first point in “PT1” field. ※ There are four ways to get the known point for BRG-DST calculation. Please refer to the step ② in the “COGO Traverse”.	Input name of first point	
③ Move the focus to “AZ1” by using [▼] and input the bearing after set first point.	[▼] + Input bearing	

④ Move the focus to “PT2” by using [▼] to setting second point.	[▼] + Set second point	
⑤ Move the focus to “HD2” by using [▼] and input the radius after set second point.	[▼] + Input radius	
⑥ When all of the data are entered correctly, press [F2] (Result) to calculate the intersection point and show the results. Input the name of result point in the [BRG-DST Result] and press [F4](REC) to save the	[F2]	

point. Press [F1] to switch to view results.		

※ In all of the above operation, press [ESC] to return to the previous menu.

※ The result point is plane data.

5.11.5 Distance-Distance Intersection

Use the distance-distance (DST-DST) sub application to calculate the intersection point of two circles. The circles are defined by the known point as the center point and the distance from the known point to the COGO point as the radius. The result may be have 1 intersection point, may be have 2 points, or may be have no one.

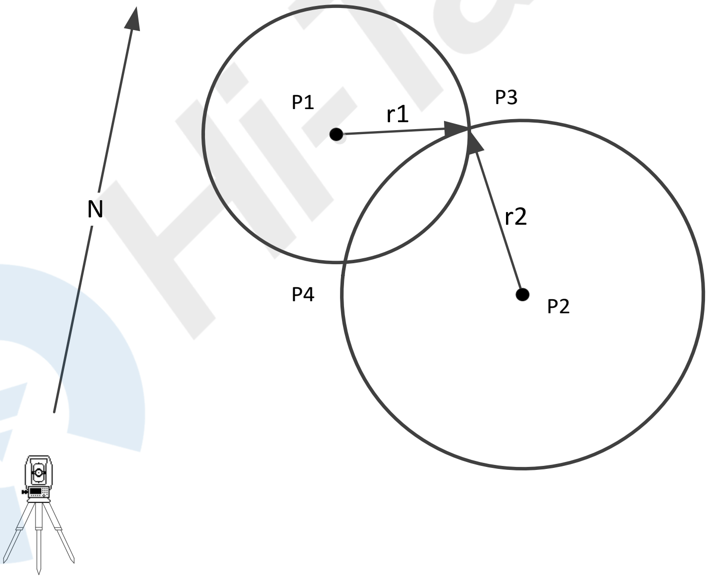


Figure 11.5 DST-DST Diagram

Known

P1 First known point

P2 Second known point

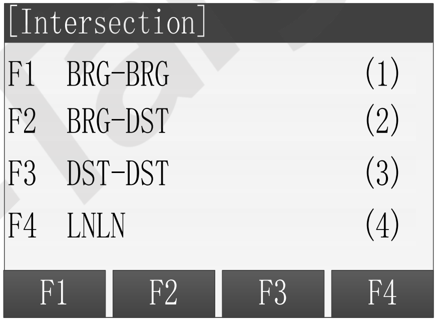
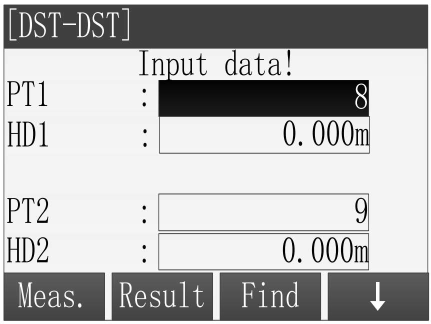
r1 Radius, as the distance from P1 to P3 or P4

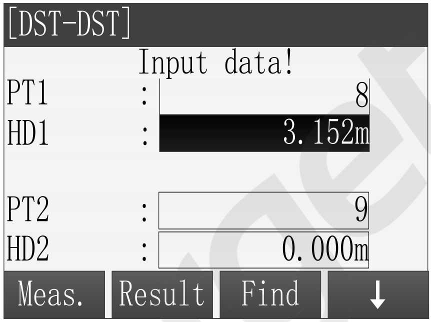
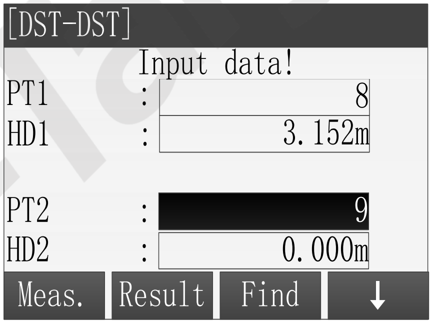
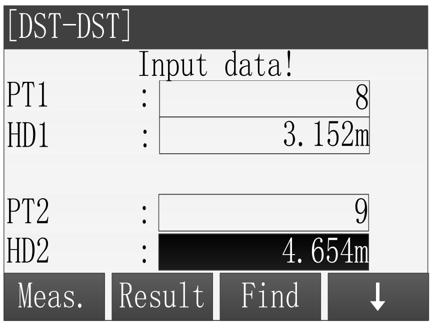
r2 Radius, as the distance from P2 to P3 or P4

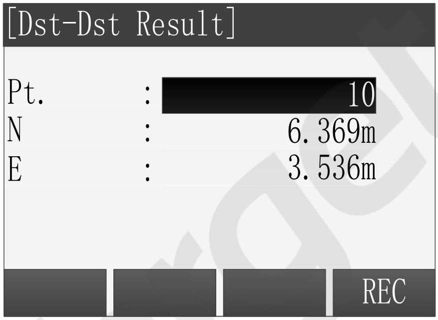
Unknown

P3 First COGO point

P4 Second COGO point

Steps	key	Display
① In the [Intersection] screen, press [F3] or [3] to enter the DST-DST sub application.	[F3] or [3]	
② Input the name of first point in "PT1" field. ※ There are four ways to get the known point for DST-DST calculation. Please refer to the step	Set first point	

② in the “COGO Traverse”.		
③ Move the focus to “HD1” by using [▼] key and input the first radius after set first point.	[▼] + Input first radius	
④ Move the focus to “PT2” by using [▼] to setting second point.	[▼] + Set second point	
⑤ Move the focus to “HD2” by using [▼] and input the second radius after set second point.	[▼] + Input second radius	

⑥ When all of the data are entered correctly, press [F2](Result) to calculate the intersection point and show the results. Input the name of result point in the [DST-DST Result] and press [F4](REC) to save the point. Press [F1] to switch to view results.	[F2]	

※ In all of the above operation, press [ESC] to return to the previous menu.

※ The result point is plane data.

5.11.6 Line-Line Intersection

Use the line-line (LNLN) sub application to calculate the intersection point of to lines. A line is defined by two points.

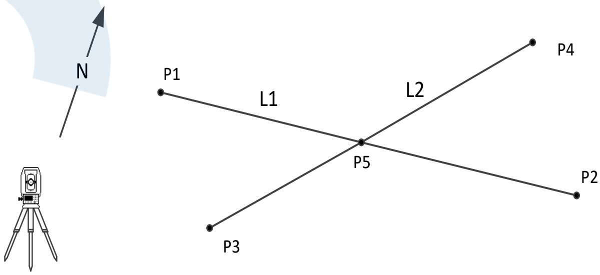


Figure 11.6 LNLN Diagram

Known

P1 First known point

P2 Second known point

P3 Third known point

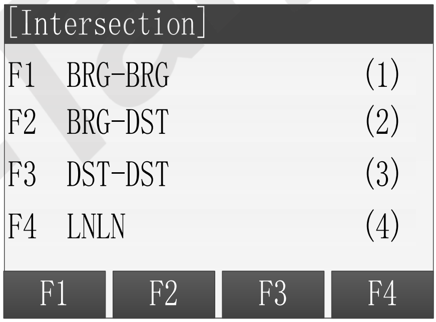
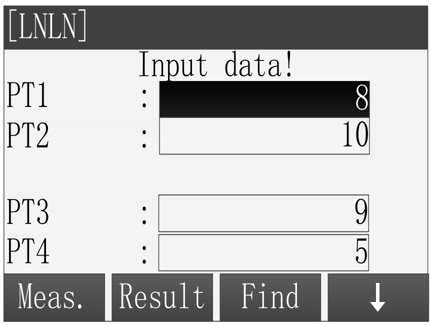
P4 Fourth known point

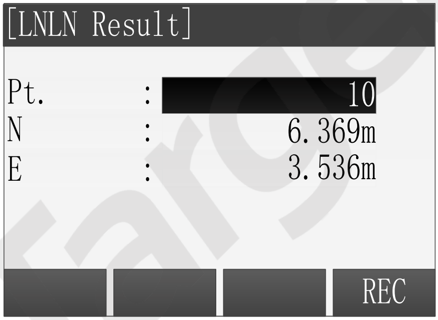
L1 Line from P1 to P2

L2 Line from P3 to P4

Unknown

P5 COGO point

Steps	key	Display
① In the [Intersection] screen, press [F4] or [4] to enter the LNLN sub application.	[F4] or [4]	
② Set the known point one by one. ※ There are four ways to get the known point for LNLN calculation. Please refer to the step ②	Set the known points	

in the “COGO Traverse”.		
③ When all of the points are set correctly, press [F2](Result) to calculate the intersection point and show the results. Input the name of result point in the [LNLN Result] and press [F4](REC) to save the point.	[F2]	

※ In all of the above operation, press [ESC] to return to the previous menu.

※ The result point is plane data.

5.11.7 Distance-Offset

Use the distance-offset (DistOff) sub application to calculate the foot point (COGO point) coordinates of offset point to baseline, the baseline is defined by two known points, and the longitudinal and offset distance of the offset point in relation to the line.

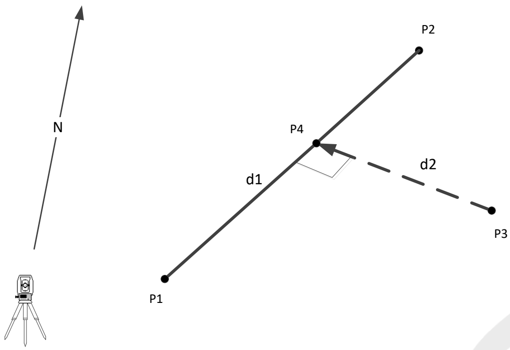


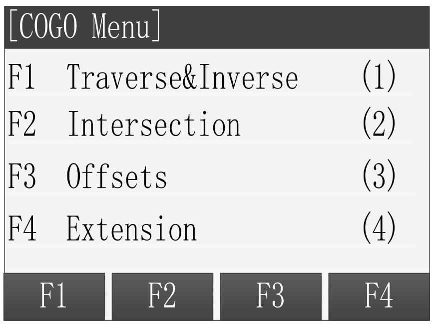
Figure 11.7 DistOff Diagram

Known

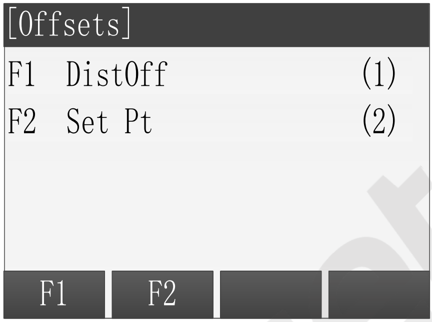
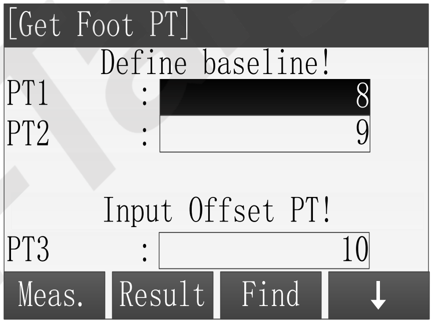
P1	Start point
P2	End point
P3	Offset point

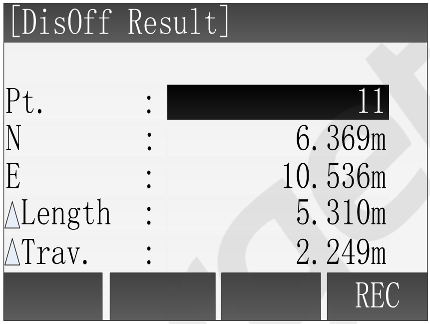
Unknown

d1	△Line
d2	△Offset
P4	COGO point (foot point)

Steps	key	Display
① In [COGO Menu] screen, press the [F3] or number key [3] enter the [Offsets] screen, then press [F1] or [1] enter the DistOff sub application.	[F3] or [3]	

Hi-Target

	[F1] or [1]	
② Set the start point, end point and offset point one by one. ※There are four ways to get the known point for DistOff calculation. Please refer to the step ② in the "COGO Traverse".	Set the known points	

③ When all of the points are set correctly, press [F2](Result) to calculate the intersection point and show the results. Input the name of result point in the [DistOff Result] and press [F4](REC) to save the point.	[F2] + [F4]	

※ In all of the above operation, press [ESC] to return to the previous menu.

※ The result point is plane data.

5.11.8 Set Point

Use the Set Point (Set Pt) sub application to calculate the coordinate of a new point in relation to a line from known longitudinal and offset distance.

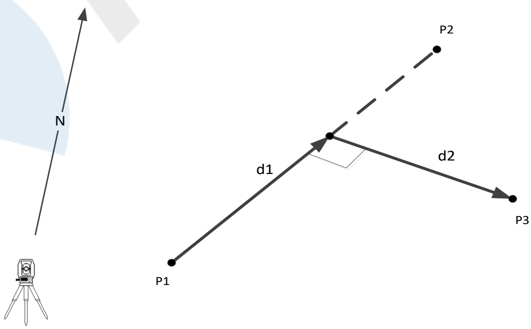


Figure 11.8 Set Point Diagram

Known

P1 Start Point

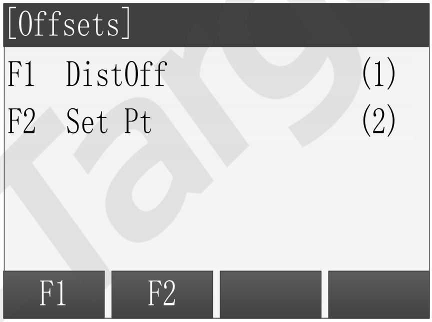
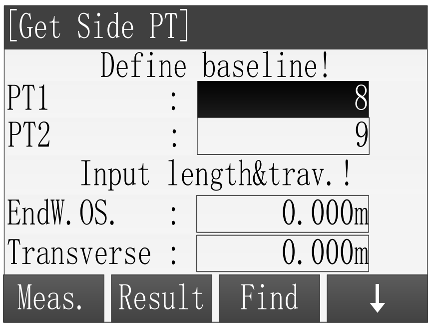
P2 End Point

d1 △Line

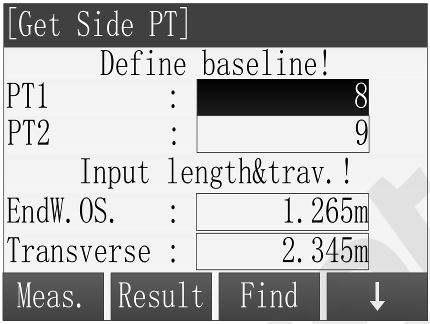
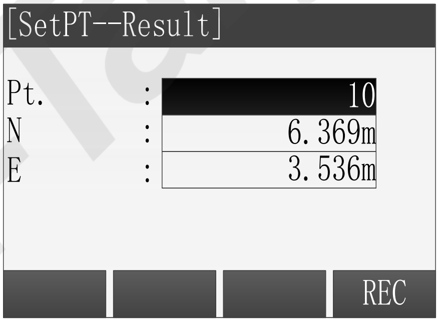
d2 △Offset

Unknown

P3 COGO point

Steps	key	Display
① In the [Offsets] screen, press [F2] or [2] to enter the Set Point sub application.	[F2] or [2]	
② Set the start point and end point. ※There are four ways to get the known point for Set Point calculation. Please refer to the step ② in the “COGO Traverse”.	Set known points	

Hi-Target

③ Then baseline is defined, press [▼] key to move the focus down and input the longitudinal and offset distance.	[▼] + Input distance	
④ When all of the data are set correctly, press [F2](Result) to calculate the intersection point and show the results. Input the name of result point in the [SetPT Result] and press [F4](REC) to save the point.	[F2]	

※ In all of the above operation, press [ESC] to return to the previous menu.

※ The result point is plane data.

5.11.9 Extension

Use the Extension sub application to calculate the coordinate of extended point from a known baseline.

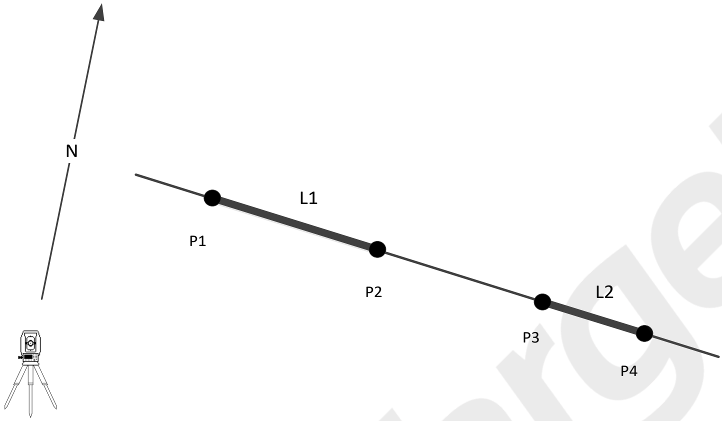


Figure 11.9 Extension Diagram

Known

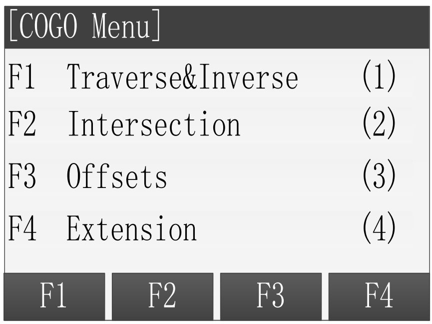
P1 Baseline Start Point

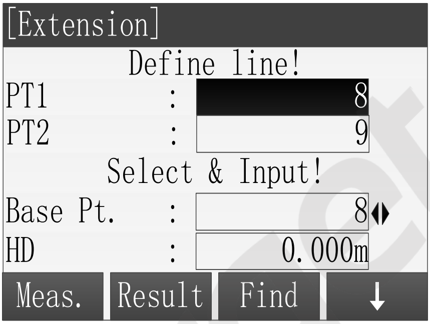
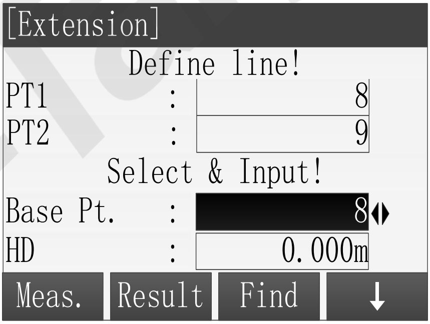
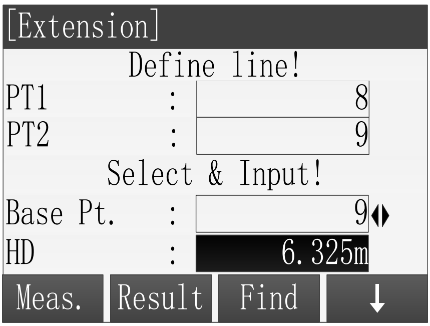
P2 Baseline End Point

L1, L2 Extension Distance

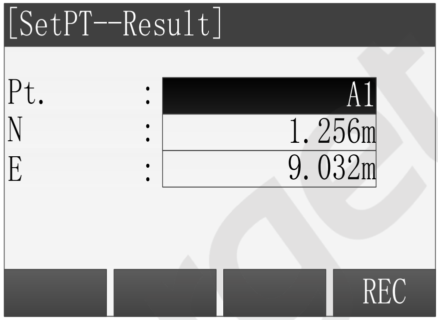
Unknown

P2, P4 Extended COGO Point

Steps	Key	Display
① In the [COGO Menu] screen, press the [F4] or number key [4] enter the [Extension] screen.	[F4] or [4]	

② Set the baseline start point and end point. ※ There are four ways to get the known point for Extension calculation. Please refer to the step ② in the "COGO Traverse".	Set known points	
③ Then baseline is defined, press [▼] key to move the focus down and use [◄]\[►] Key to select base point.	[▼] + [◄]\[►]	
④ Then press [▼] key to move the focus down and input the extension distance in the "HD" field.	[▼] + Input distance	

Hi-Target

⑤ When all of the data are set correctly, press [F2](Result) to calculate the intersection point and show the results. Input the name of result point in the [Extension Result] and press [F4](REC) to save the point.	[F2]	

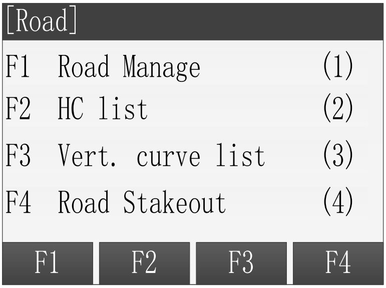
※ In all of the above operation, press [ESC] to return to the previous menu.

※ The result point is plane data.

5.12 Road

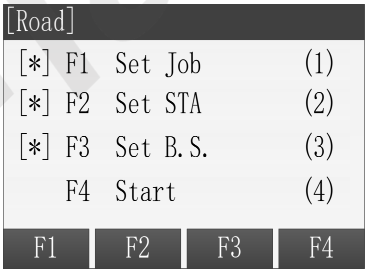
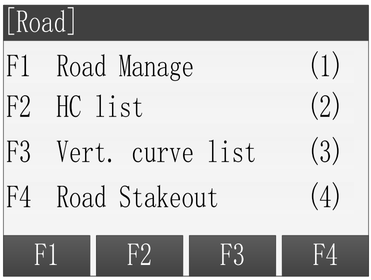
Road is an application used to measure or stake out points relative to a defined element. The element can be a line, curve or spiral. Chainage, incremental stake outs and offsets(left and right) are supported.

Setting job, setting station and setting backsight must be done before road define and staking out.

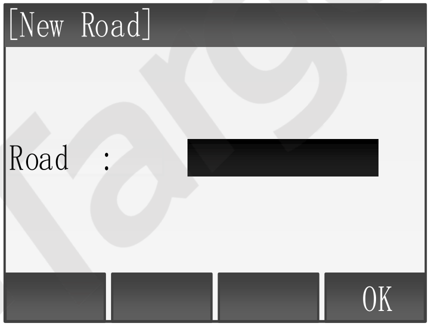


5.12.1 Road Manage

After setting up the job, station and back sight point, user can start to define the road path.

Steps	Key	Display
① Pressing key [F4] to start the road function after job setting, station setting and BS.	[F4]	
② Pressing key [F1] **Road Manage**.	[F1]	

Hi-Target

③ All road files are displayed here,which can be deleted, created, closed, and opened.	[F1]	
④ Press [F2] and choose [New] to enter a new interface, enter the road name to create a new road file.		
※[1]: The type combo must be Line-Spiral-Curve-Spiral-Line, Line-Spiral-Spiral-Line,Line-Curve-Line, Spiral-Curve-Spiral. ※[2]: Maximum 20 sets of data can be used in Intersection Method.		

5.12.2 HC list

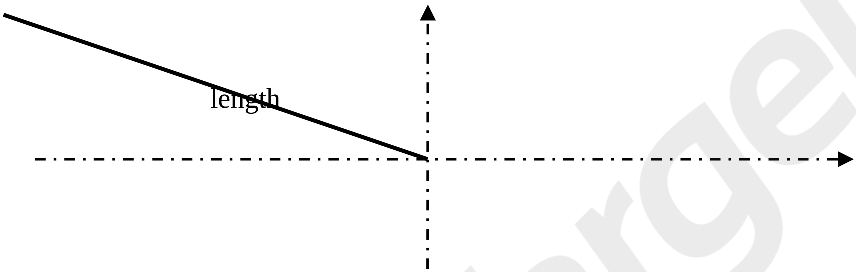
The horizontal curve data can be manually edited, and also be imported from the computer. There are two ways to define the horizontal alignment: one is "element ", another is "intersection".

(1) Define a horizontal alignment by “element method”

The element method consists of the following elements: the starting point, straight line, circle and easement curve.

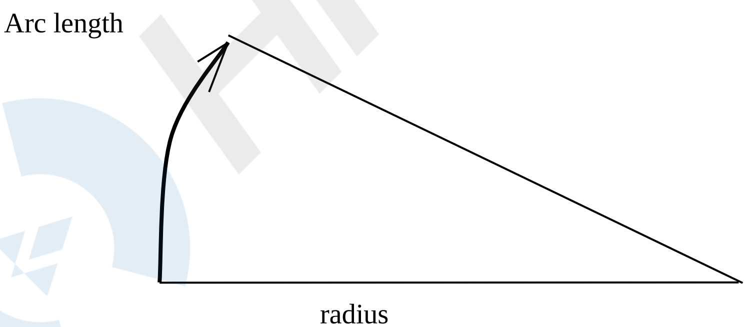
➢ Straight line

The straight line can be defined when start point and other type of line have been defined.



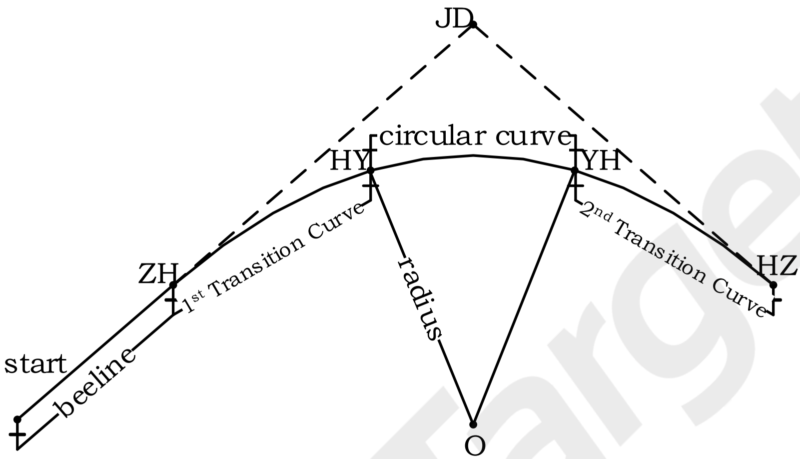
Straight line includes azimuth and distance, and the distance cannot be minus.

➢ Circle



Circular curve includes radius and arc length. The rules of radius: Along the curve direction, when turning to the right, the radius is positive, negative radius when turning to the left. Arc length cannot be negative.

➢ Easement curve



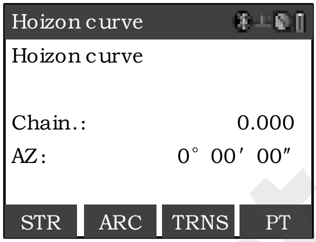
Easement curve data includes the minimum radius and arc length. The radius positive-negative regularity of easement curve is the same as the radius of circle. Also, the arc length cannot be negative

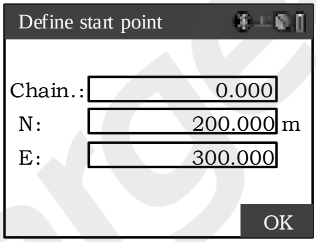
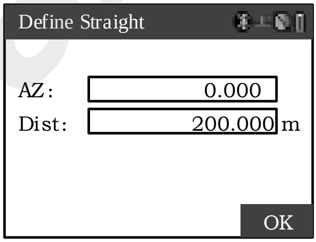
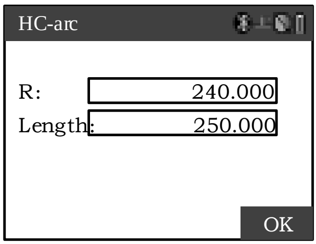
Follow is the input Steps of the horizontal alignment element method.

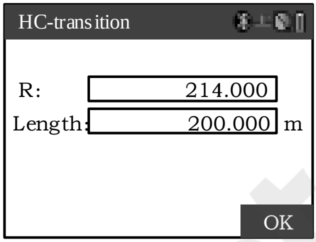
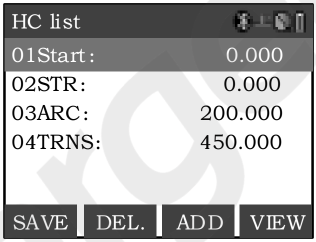
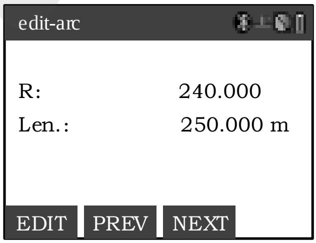
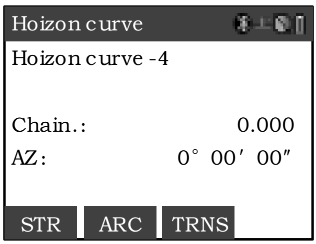
▸Steps

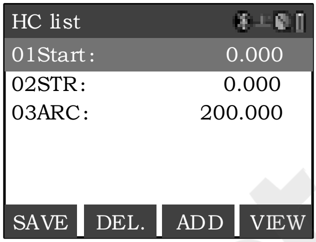
Operating procedure	Key	Display
（1）Choose "2.HC list" from the road menu.	"2. HC list"	

<table>
<tr>
<td>（2）Press 【ADD】 . If you haven’t input starting point, you will come in starting point interface whatever straight line, circular curve or easement curve you choose. Input the start point and press【OK】.</td>
<td>【ADD】

【OK】</td>
<td>


</td>
</tr>
<tr>
<td>（3)Press【STR】come in the straight line data input screen. When completed setting, press 【OK】.</td>
<td>【STR】</td>
<td>
</td>
</tr>
<tr>
<td>（4）Press 【ARC】 come in the circular curve data input interface. When completed setting ,press 【OK】 .</td>
<td>【ARC】</td>
<td>
</td>
</tr>
</table>

（5）Press 【TRNS】 come in the easement curve data input interface.	【TRNS】	
（6）Complete setting all line data, press【ESC】return to horizontal alignment list interface.	【ESC】	
（7）Press 【VIEW】to show the road data of the line you chosen. Here we choose the circular curve as an example. ·You can view the road date in the list according to【▼】【▲】. Press 【EDIT】 to edit the road data.	【VIEW】	
（8）Press【ADD】to add new road data.	【ADD】	

(9) Press 【DEL.】 to delete the chosen line date (start point is forbidden).	【DEL.】	
(10) Press 【SAVE】to get a prompt box , press 【ENT】to save the data in the current opened road file.	【SAVE】	

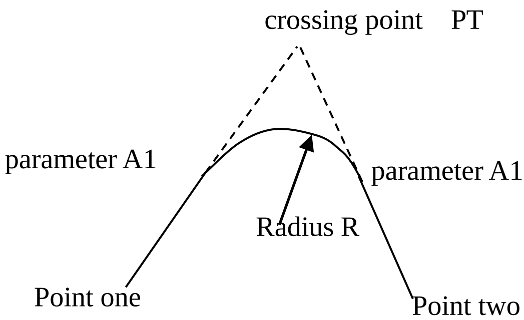
Note: If you don't save the data, there will be no data or the data existent earlier in the road file when you restart the total station.

(2) Define the horizontal alignment by "intersection method"

The intersection of point includes coordinate, radius and parameters A1,A2 of the easement curve. The radius and parameters A1, A2 can't be minus. If inputting radius there will be inserted an arc with a specified radius between the current point and the next point. If inputting easement curve and parameters A1, A2 there will be inserted an easement curve with a specified length between the straight line and the arc.

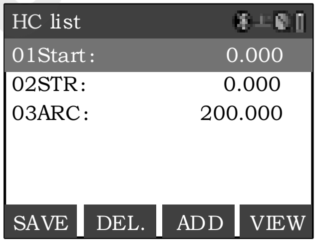
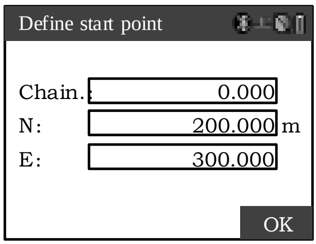
Don't mix the point of intersection with the straight line, arc and easement curve, or the calculation will be wrong.

Hi-Target

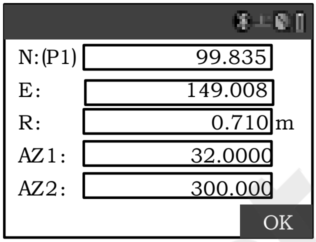
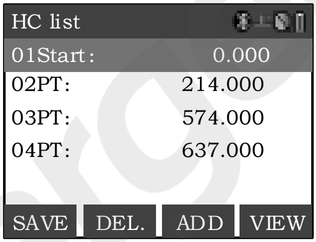
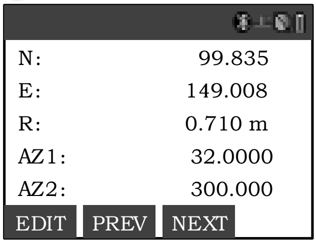
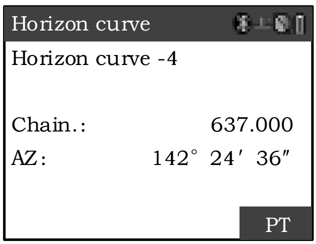


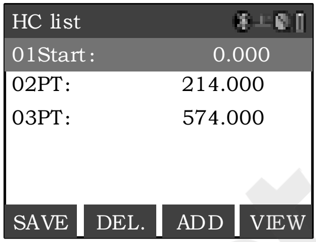
Follow is the Intersection method definition of horizontal alignment input Steps.

▶Steps

Operating procedure	Key	Display
（1）Choose “2. HC list” from the road menu.	“2. HC list”	
（2）Press 【ADD】 come in line choose interface . If you haven’t input starting point, you will come in starting point interface.	【ADD】 【OK】	

Hi-Target

（3）Input start point, then press 【OK】 come in the point of intersection input interface. Press 【OK】 to input the next point of intersection.	【OK】	
（4） After input all points of intersection press【ESC】return to horizontal alignment list interface. It is line + N coordinate of the intersection in the list.	【ESC】	
（5）Press 【VIEW】 to show the detail data of the current road you chosen. ·You can view the road date in the list according to【◄ 】or 【►】. ·Press 【EDIT】 to edit the road data, the operation is the same as the input.		
（6）Press【ADD】to continue to add new road data.	【ADD】	

<table>
<tr><td>（7）Press 【DEL.】 to delete the line date chosen(start point is forbidden).</td><td>【DEL.】</td><td>
</td></tr>
<tr><td>（8）Press 【SAVE】to get a prompt box ，press【ENT】to save the data in the current opened road file.</td><td>【SAVE】</td><td>
</td></tr>
</table>

Note： Use the following formula to compute when you input A1,A2 according to L1，L2。

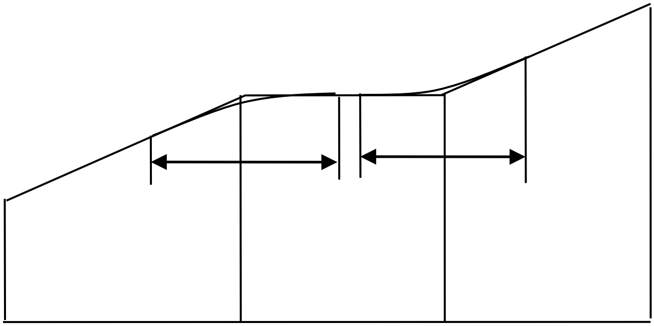
$$A_1 = \sqrt{L_1 \cdot radius}$$

$$A_2 = \sqrt{L_2 \cdot radius}$$

You can edit the alignment just according to the alignment menu.

5.12.3 Vert.curve list

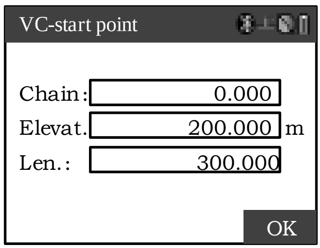
Vertical alignment consists of a set of intersection points. Intersection point including pile number, height and the curve length. The curve length of starting point and end point of vertical alignment must be zero.

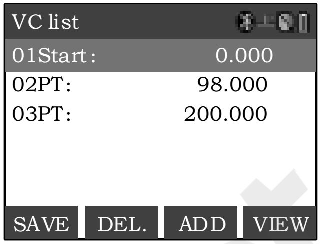
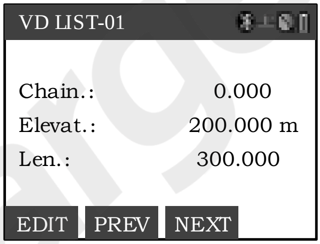
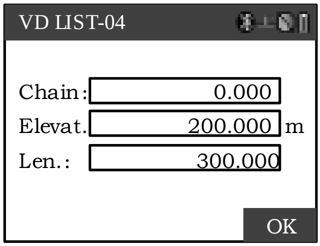
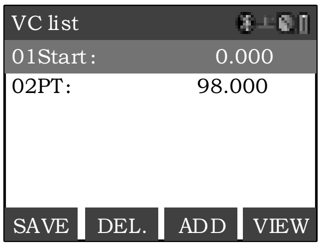


Chain	1000	1300	1800	2300
Elevation	50	70	60	90
Lenth	0	300	300	0

Following is the vertical alignment input Steps.

▶Steps

Operating procedure	Key	Display
（1）Choose “3. VC list” from the road menu.	“3. VC list”	
（2）Press 【ADD】 come in line choose interface. After input data, press 【OK】 to input the next point.	【ADD】	

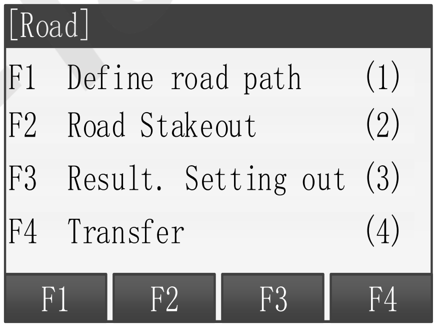
<table>
<tr>
<td>（3） After input line data, press 【ESC】return to vertical alignment list interface.</td>
<td>【OK】</td>
<td>
</td>
</tr>
<tr>
<td>（4）Press 【VIEW】 to show the detail data of the current road you chosen.
·You can view the road date in the list according to【▼】【▲】
·Press 【EDIT】 to edit the road data, the operation is the same as the input。</td>
<td>【VIEW】</td>
<td>
</td>
</tr>
<tr>
<td>（5）Press【ADD】to continue to add new road data.</td>
<td>【ADD】</td>
<td>
</td>
</tr>
<tr>
<td>（6）Press 【DEL.】 to delete the line date chosen(start point is forbidden).</td>
<td>【DEL.】</td>
<td>
</td>
</tr>
</table>

Hi-Target

（7）Press 【SAVE】to get a prompt box , press 【ENT】to save the data in the current opened road file.	【SAVE】	

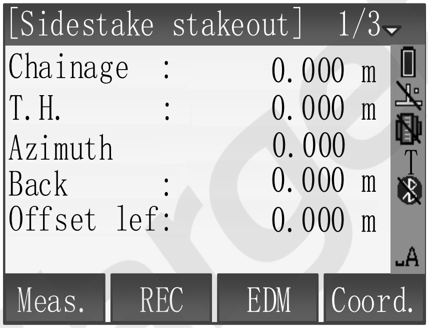
5.12.4 Road Stakeout

After the road had been designed and had been implemented into the program, user can start to do road stakeout.

Steps	Key	Display
① In Road program, click F2 **Road Stakeout** to enter the function.	[F2]	

Hi-Target

<table>
<tr>
<td>② Pressing F1 Sidestake Stakout to go for sidestake stakeout interface. Input the chainage and the coordinates of the points that should be stakeout will be loaded and you will start the staking job.
[T.H]:Target height
[Increment]: Interval between to stakes.
[Offset]： the offset to the center stake, left is negative while right is positive.</td>
<td>[F1]</td>
<td>



</td>
</tr>
</table>

5.13 Stakeout Reference Element

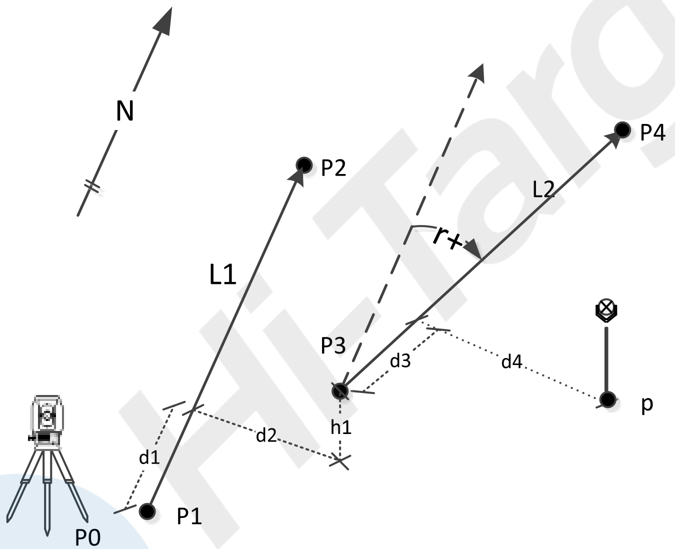
Stakeout Reference Element is used for making Reference Element stakeout and check easier, such as building, road cross section, or simple excavation. User can define a Reference Line/ARC, according to measuring result, to calculate out the deviated difference& elevation difference between measuring point and reference line/arc. Reference element function include:

- ✧ RefLine
- ✧ RefArc
- ✧ RefSurface

5.13.1 RefLine

User need to define a reference line through a known base line. The reference line can be shifted in longitudinal, horizontal, vertical direction, or rotate around the first base point as needed. The line after shift is as reference line, all observed data refer reference line. User can choose the first point, second point or mean point in refline direction as referred elevation point.

Refline schematic diagram:



Known

L1	Baseline	L2	Reference Line
P1	First point	P3	First reference point
P2	Second point	P4	Second reference point
d1	Offset	d2	Line
r+	Rotate	P0	STA

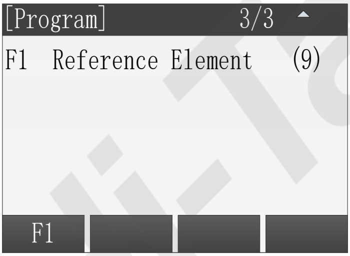
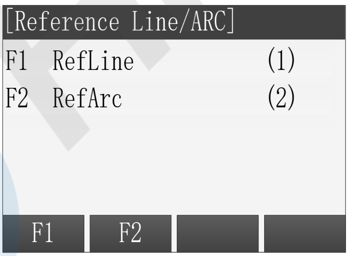
Unknown

p Measure point

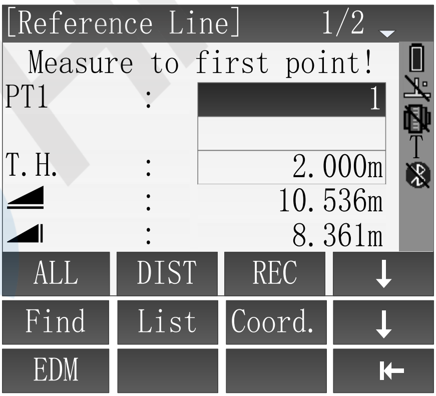
d3 Δ Length

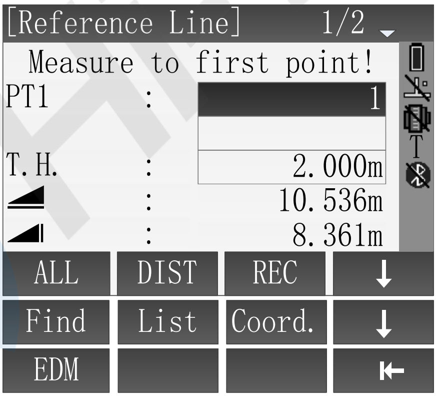
d4 Δ trav.

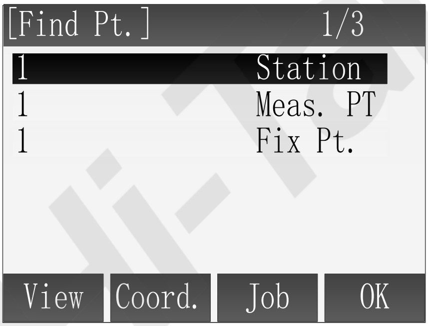
- **Reference Line**

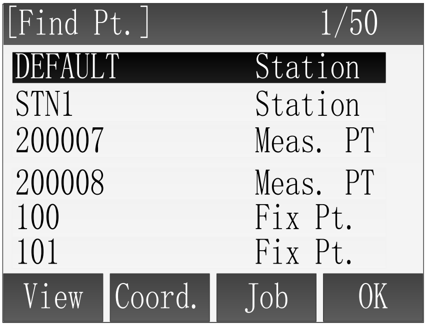
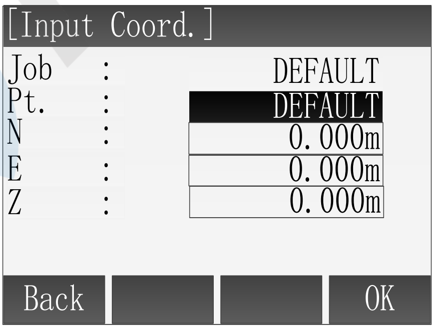
Steps	Key	Display
① Press [F1] or numeric key [9] in main menu, then set Job, B.S and enter [Reference Line/ARC] menu([F4]), press [F1] or numeric key [1] to	[F1] or [9] [F1] or [1]	 

<table>
<tr><td>enter RefLine function.</td><td></td><td></td></tr>
<tr><td>② There're several methods to obtain the first point for baseline definition

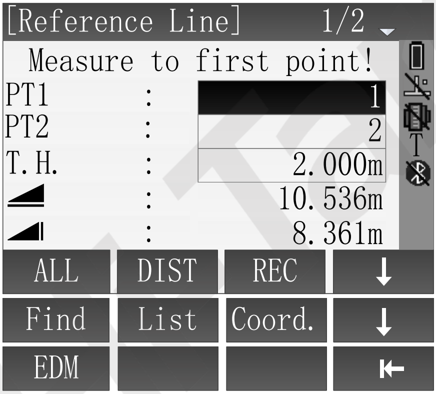
A: Enter point name, then press</td><td>Input point name + [F1]</td><td>A: Get the target point by measure.

</td></tr>
</table>

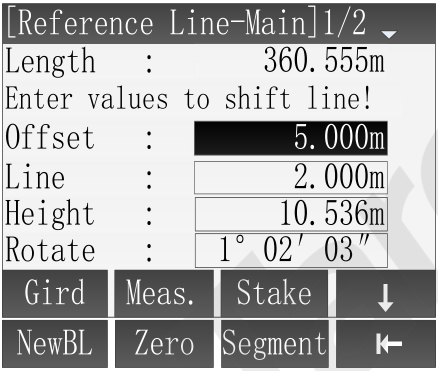
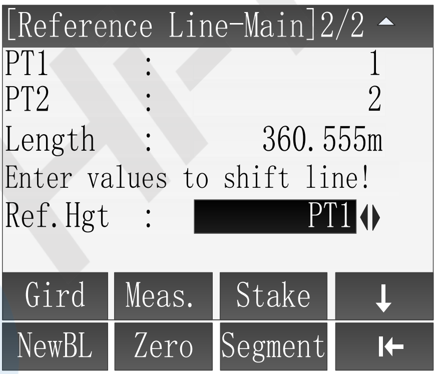
[F1](ALL) to define first point.		
B: Input point name, Press [F2](DIST) + [F3](REC) to save target point, the saved result will be directly put into calculation.	[F2] + [F3]	B: Get the target point by DIST+REC. 

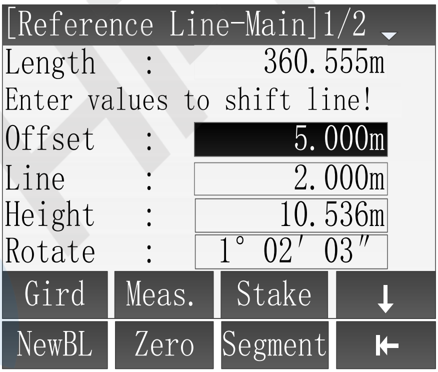
C: Input point name, press [F4](↓) to shift to subscript function, then press [F1](Find) to check if this point exists, if not exist, then should firstly input or measure this point's coordinate.	Input point name + [F4] + [F1] + [F4]	C: Input the name of the point and find whether it is in memory. 
D: Press	[F2]	D: Select the point by list in the instrument.

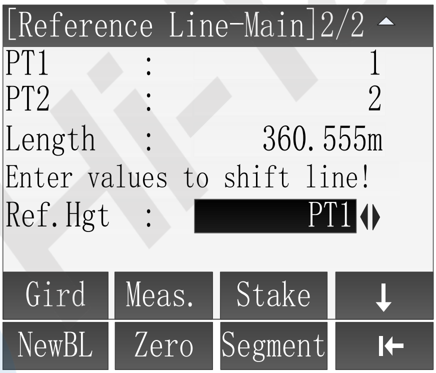
<table>
<tr>
<td>[F2](List), in [Find Pt.] dialog, search the known points in job through [▲]\[▼] and press [F4](OK) to select.</td>
<td>+
[F4]</td>
<td>
</td>
</tr>
<tr>
<td>E: Press [F3](Coord.), input point name, coordinate data and press [F4](OK), it will indicate</td>
<td>[F3]
+
Input point name coordinate+
[F4]</td>
<td>E: Input the point through keyboard.

</td>
</tr>
</table>

Hi-Target

cover if the point name is repeated.		
③ After defining first point of baseline, enter into interface of second point definition, the way is same as with first point.	[F1] or [F2]+[F3] or [F4]+[F1] or [F4]+[F2] or [F4]+[F3]	

④ After baseline definition, enter [Reference Line-Main] interface, select settings through [▲]\[▼], input translation and rotation parameters. Press [F4](↓) to enter [Referenc	[▲]\[▼] + Input parameter [F4] + [◀]\[▶]	 

e Line-Main] page, press [◄]\[►] to choose Ref.Hgt, after set up.※1		
⑤ In the interface of [Reference Line-Main], if baseline needs to be redefined, press [F4](↓) to shift to subscript function and press	[F4] + [F1]	

<table>
<tr><td>[F1] (NewBL) to redefine new baseline.</td><td></td><td></td></tr>
<tr><td>⑥ In the interface of [Reference Line-Main], input translation parameters, if you need to clear, press [F4] (↓) to shift subscript function, press [F2]</td><td>[F4] + [F2]</td><td>
</td></tr>
</table>

(Zero) to recover input parameters to zero.		

※1 Ref.Hgt options :

PT1 : The elevation value of defined first point

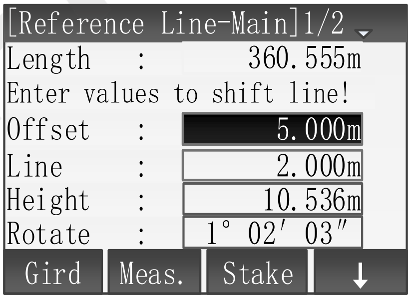
PT2 : The elevation value of defined second point

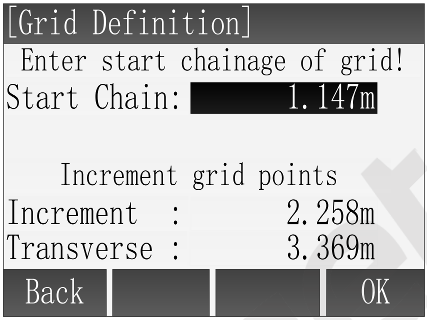
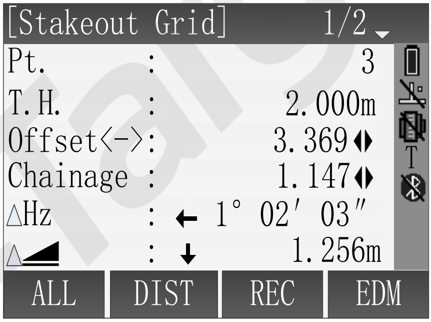
Equal : Average value of defined two endpoints' elevation

None : Not perform elevation difference calculation

※ In above operation, press [ESC] to return to previous menu

- **Stakeout Grid**

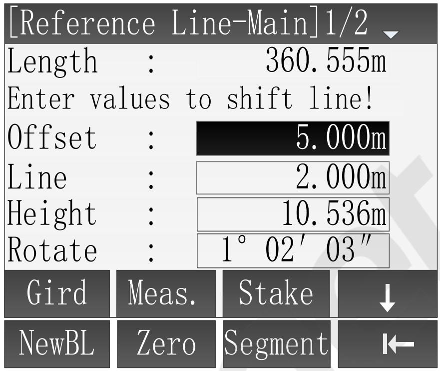
Steps	Key	Display
① In the interface of [Reference Line-Main], press [F1] (Gird) to enter the [Grid Definition] .	[F1]	

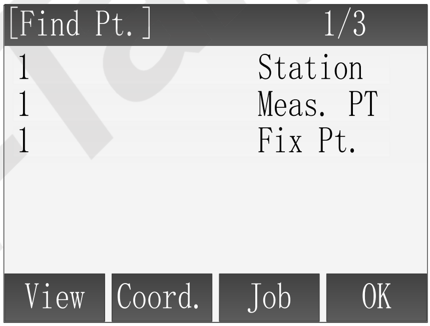
② In the [Grid Definition] interface, use [▲] \ [▼] to select input box, use keyboard to enter start chainage of gird and increment grid points, then press [F4](OK) to next step.	[▲]\[▼] + Input parameters + [F4]	
③ In [Stakeout Grid] interface, use [◀]\[▶] to select the offset, chainage, then press [F1](ALL) or [F2]+[F3] (DIST+REC) to save this measuring point data.	[◀]\[▶] + [F1] or [F2]+[F3]	

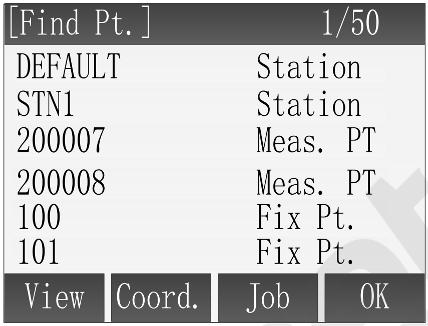
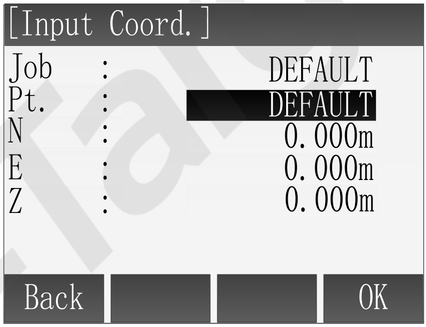
※ In above operations, press [ESC] to return to previous menu.

● **Measure Line&Offset**

Steps	Key	Display

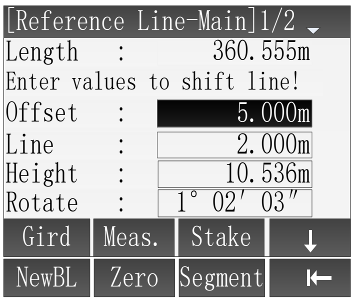
① In interface of [Reference Line-Main] , press [F2] (Meas.) to enter [Measure Line&Offset] interface.	[F2]	
② There are many methods to obtain points for calculating Line&Offset A: Input the name of point, press [F1](ALL) to measure current point, calculate and display the offset to refline , then save this point data.	Input point name + [F1]	A: Get the target point by measure. 
B: Input point name, press [F2] (DIST) to measure target point, calculate and display this point's offset to refline, then press	[F2] + [F3]	B: Get the target point by DIST+REC.

[F3](REC) to save this point data.		
C: Input the name of known point and press [F4](↓) to shift to subscript function, then press [F3](Find) to find whether the point is in memory, if exist, then press [F4](OK) to be selected for calculating; if not exist, then need to input or measure the point.	Input point name + [F4] + [F1] + [F4]	C: Input the name of the point and find whether it is in memory. 
D: Press [F2] (List) in [Find Pt.] screen, use the key [▲]\[▼] to select a known point in the point list for traverse calculation, then press [F4](OK) to	[F2] + [F4]	D: Select the point by list in the instrument.

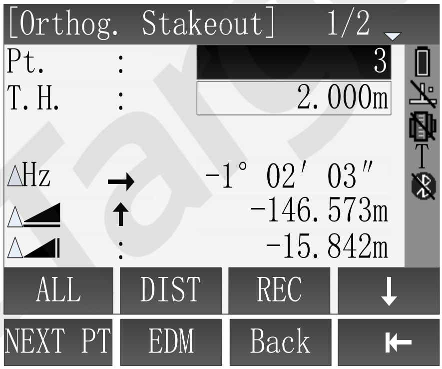
be selected.		
E: Press [F3](Coord.) to input a known point that not exist in memory.	[F3] + Input point name coordinate+ [F4]	E: Input the point through keyboard. 

※ In above operation, press [ESC] to return to previous menu.

- **Orthogonal stakeout**

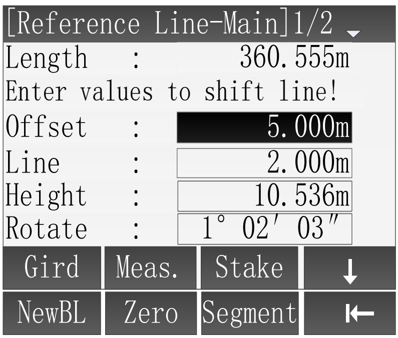
Steps	Key	Display
① In [Reference Line-Main] screen, press [F3](Stake) enter [Orthogonal stakeout] to input stakeout values.	[F1]	
② In interface of	[▲]\[▼]	

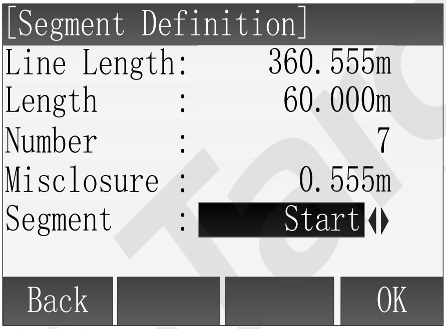
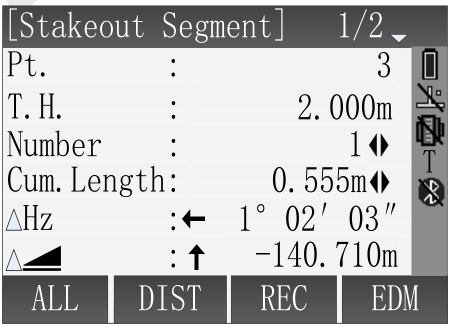
Hi-Target

[Orthogonal Stakeout] use [▲]\[▼] to select input box, use keyboard to set every offset parameters, then press [F4](OK) to enter orthogonal stakeout.	+ Input parameters + [F4]	
③ In [Orthg. Stakeout] interface, measure and save current measuring point through [F1](ALL) or [F2]+[F3](DIST+REC), and it will return to [Orthogonal Stakeout] screen.	[F1] or [F2]+[F3]	

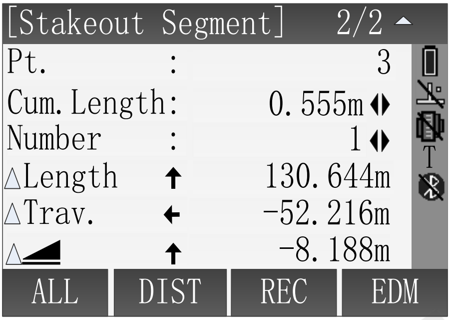
※ In above operation, press [ESC] to return to previous menu.

- **Segment stakeout**

Steps	Key	Display
① In [Reference Line-Main] screen, press [F4](↓) and Press [F3] to	[F4] + [F1]	

enter [Segment Definition] interface		
② In [Segment Definition] screen, select input box through [▲]\[▼], use keyboard to set the Segment Length, the Segment No. and others, then press [F4](OK) to enter segment stakeout.※1	[▲]\[▼] + Input parameters + [F4]	
③ In [Stakeout Segment] screen, use [◄]\[►] to select segment No., then save current point data through	[◄]\[►] + [F1] or [F2]+[F3]	

Hi-Target

[F1](ALL)or [F2]+[F3](DIST+REC)		

※1 Segment options:

Start : Misclosure at the start point

EndPt : Misclosure at the end point

Equal : Divide Reference Line equally into several pieces

※ In above operation, press [ESC] to return to previous menu.

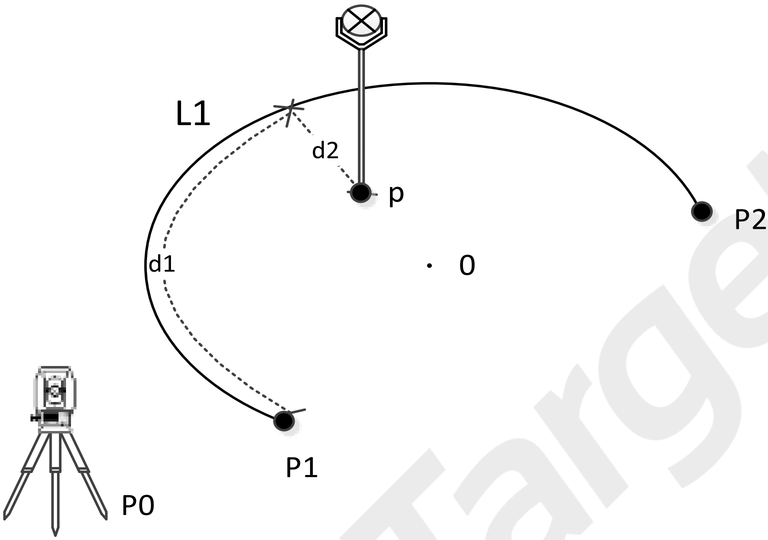
5.13.2 RefArc

RefArc can be defined through “Centre, Start Point” or “Start&End Pt, Angle”, and you can calculate Line&Offset of point to refarc. The application program allow user define a refarc and finish below task about refarc:

- Measure Line&Offset

RefArc schematic diagram:

Hi-Target



Known

L1	RefArc	P1	Start PT
O	Centre	P2	End PT
P0	STA		

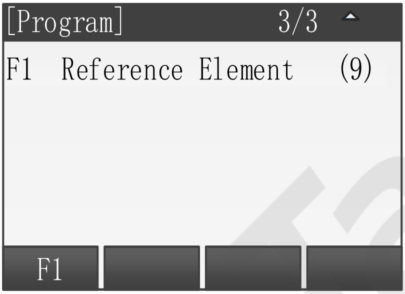
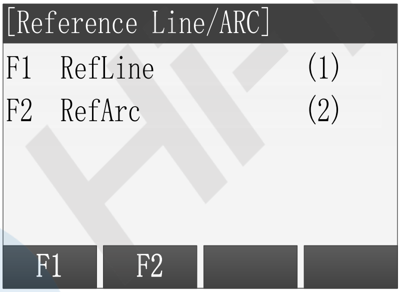
Unknown

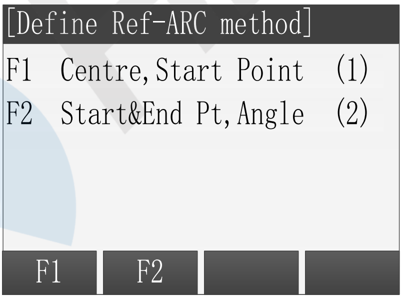
p	Measure point
d1	ΔLine
d2	ΔOffset

- **Centre, Start PT**

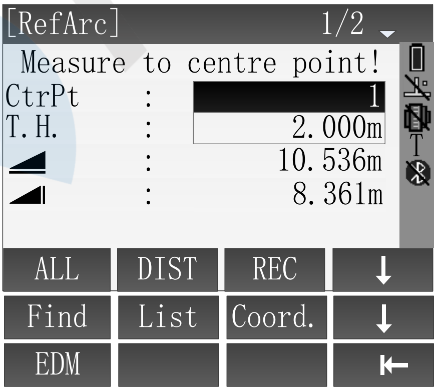
Steps	Key	Display

Hi-Target

① In [Program] main menu 3/3 page, press [F1] or numeric [9], set job, B.S. and enter [Reference Line/ARC] menu, then press [F2] or numeri	[F1] or [9] [F2] or [2]	 

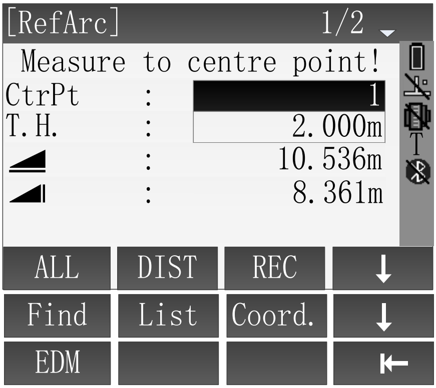
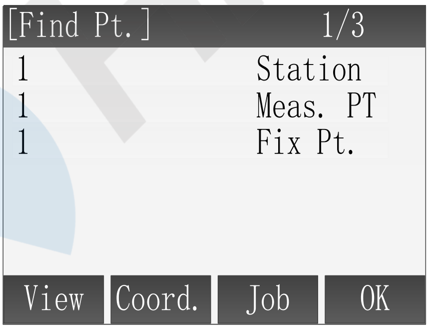
c [2] to enter RefArc function.		
② In [Define Ref-ARC method] screen, then press [F1] or	[F1] or [1]	

Hi-Target

<table>
<tr>
<td>numeric key [1], enter [Centre, Start Point] method, measure Centre point to define arc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>③ There are several methods to obtain CtrPt which is used</td>
<td>Input point name + [F1]</td>
<td>A: Get the target point by measure.

</td>
</tr>
</table>

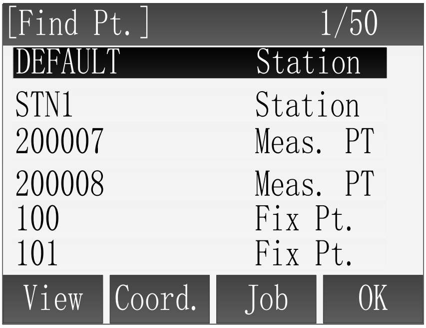
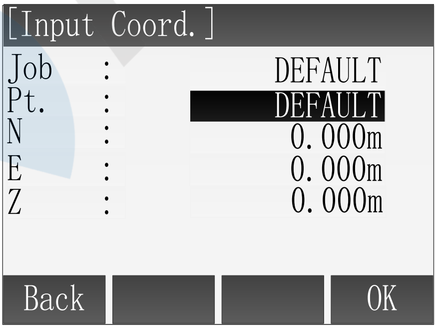
Hi-Target

for RefArc definition A: Enter point name, then press [F1](ALL) to define the CtrPt。		
B: Input point name, Press [F2](DIST) + [F3](REC) to	[F2] + [F3]	B: Get the target point by DIST+REC.

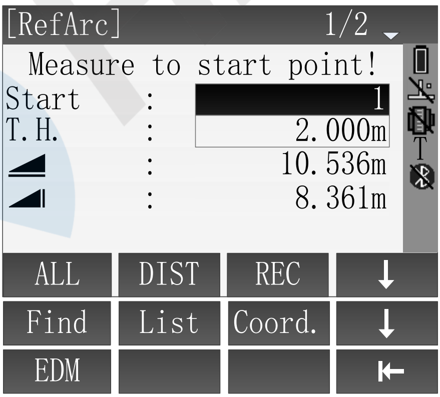
save the centre point, the saved result will be directly put into calculation.		
C: Input point name, press [F4](↓) to shift to subscript function,	Input point name + [F4] + [F1] + [F4]	C: Input the name of the point and find whether it is in memory. 

Hi-Target

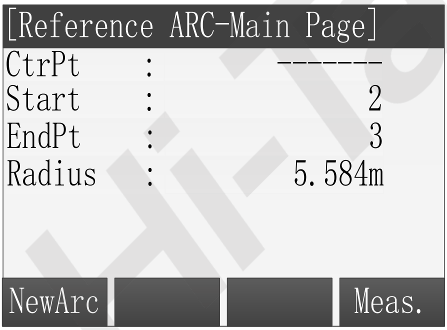
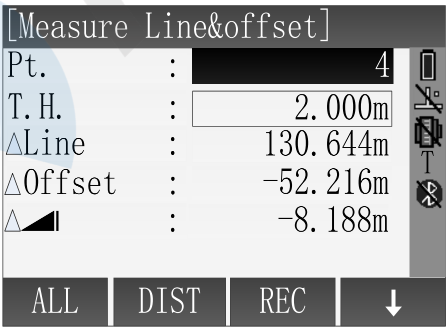
press [F1](Find) to check if this point exists, if not exist, then should firstly input or measuring this point's coordinate.		
D: Press [F2](List) , in [Find Pt.]	[F2] + [F4]	D: Select the point by list in the instrument.

dialog, search the known points in job through [▲]\[▼] and press [F4](OK) to select.		
E: Press [F3] (Coord.), input point name, coordinate's data, it	[F3] + Input point name coordinate + [F4]	E: Input the point through keyboard. 

Hi-Target

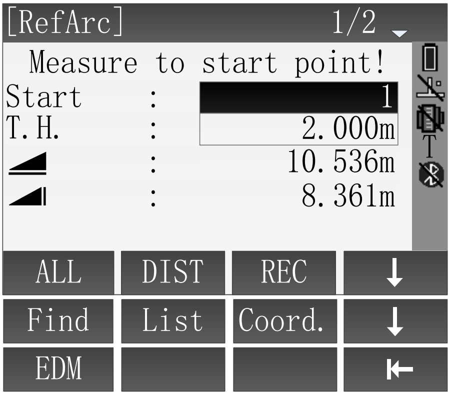
will indicate recover if point name is repeated, then press [F4](OK) to save the point.		
④ After measuring centre point, you can measure the start	[F1] or [F2]+[F3] or [F4]+[F1] or [F4]+[F2] or	

Hi-Target

point, the definiti on is same as centre point. ※1	[F4]+ [F3]	
⑤ After definiti on of RefArc , enter interfa ce of [Refere nce ARC-Main Page]; Press	[F4] [F1]	 

Hi-Target

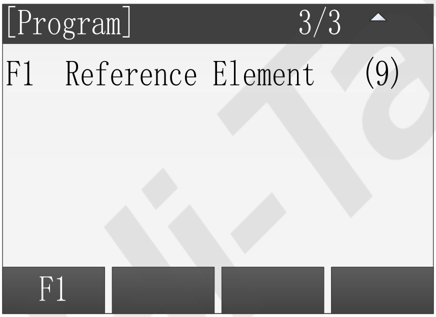
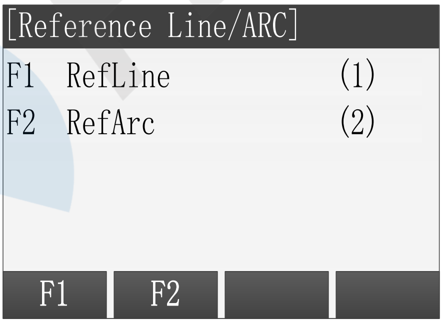
<table>
<tr>
<td>[F4](Meas.) to enter [Measure Line& Offset] interface;

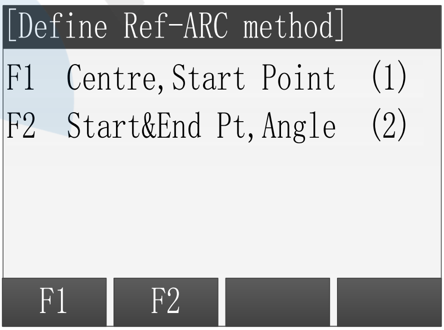
If it needs to define a new RefArc, press [F1](NewArc) to define.</td>
<td></td>
<td>
</td>
</tr>
</table>

※1 When the centre and start point coincide, the system error reporting "invalid target data, please input again, select "yes" or press [ESC], return to the measurement center interface, and restart the definition of arc.

※ In above operation, press [ESC] to return to previous menu.

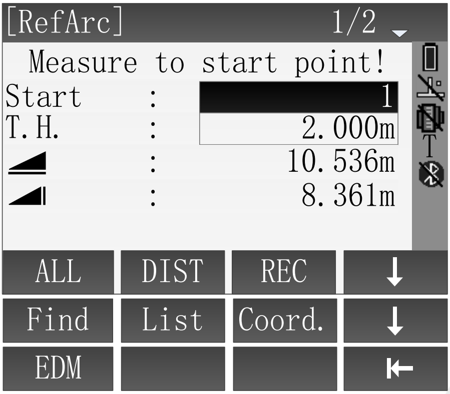
- **Start&End Pt, Angle**

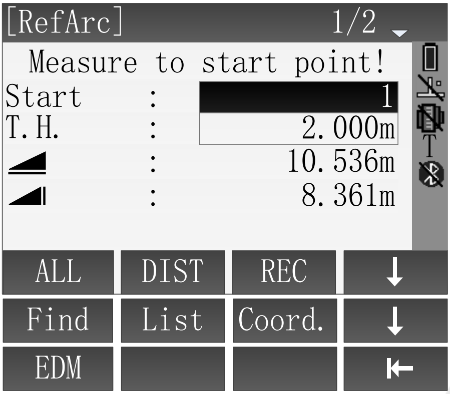
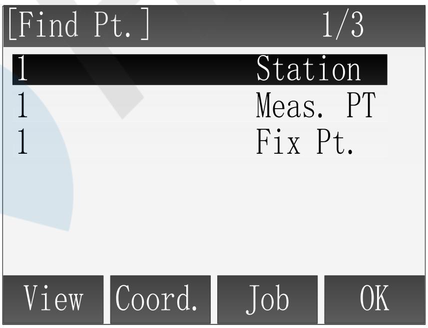
Steps	Key	Display
① Press the [F1] or the numeric key [9] in the 3/3 page of the main menu, set the job, B.S and enter [Refere	[F1] or [9] [F2] or [2]	 

nce Line/ARC] menu, then press the [F2] or the numeric key [2] to enter the definition of RefArc.		
② In [Define Ref-ARC method]	[F2] or [2]	

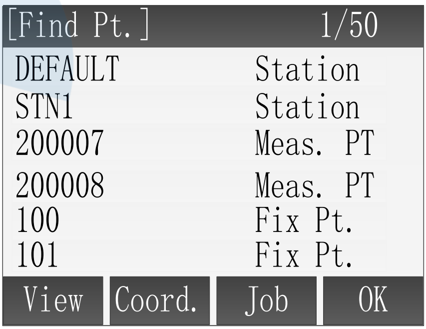
screen, press the [F2] or the numeric key [2] to choose the [Start& End Pt, Angle], and measure start point.		
③ There are several method to obtain the first point	Input point name + [F1]	A: Get the target point by measure.

Hi-Target

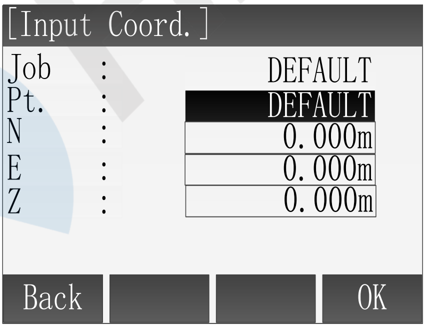
for baseline definition A: Enter point name, then press [F1](ALL) to define start point.		
B: Input point name, press [F2](DIST) + [F3](REC) to	[F2] + [F3]	B: Get the target point by DIST+REC.

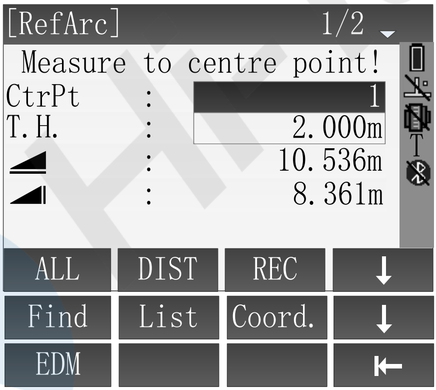
save target point , the saved result will be directly put into calculation.		
C: Input point name, press [F4](↓) to shift to subscript function, press	Input point name + [F4] + [F1] + [F4]	C: Input the name of the point and find whether it is in memory. 

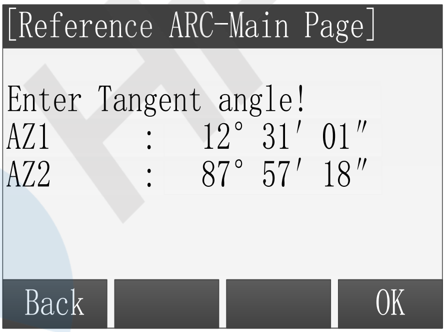
Hi-Target

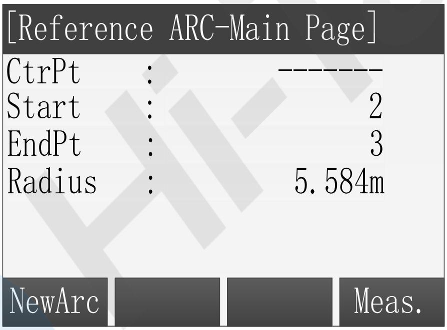
<table>
<tr><td>[F1](Find) to check if this point exists, if not exist, then should firstly input or measure this point's coordinate.</td><td></td><td></td></tr>
<tr><td>D: Press [F2](List) , in [Find Pt.] screen, search</td><td>[F2] + [F4]</td><td>D: Select the point by list in the instrument.

</td></tr>
</table>

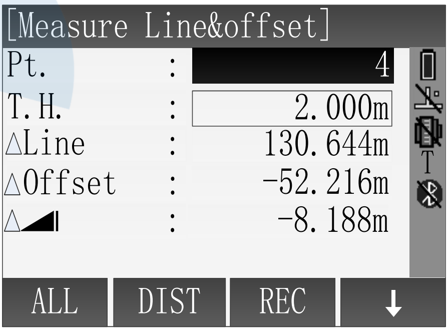
Hi-Target

the known points in job through [▲]\[▼] and press [F4](OK) to select.		
E: Press [F3](Coord.), input point name, coordinate and press [F4](OK), it	[F3] + Input point name coordinate+[F4]	E: Input the point through keyboard. 

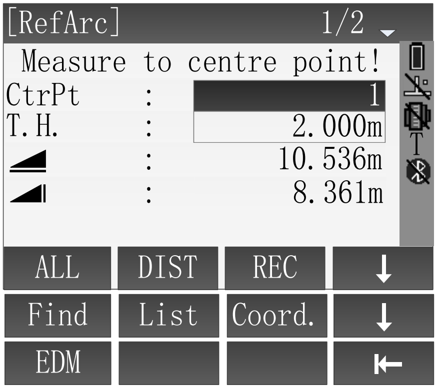
<table>
<tr><td>will be covered if the point name is repeated.</td><td></td><td></td></tr>
<tr><td>④ After definition of the start point, enter the interface of measure to end point, the definition of</td><td>[F1] or [F2]+[F3] or [F4]+[F1] or [F4]+[F2] or [F4]+[F3]</td><td>
</td></tr>
</table>

end point is same as start point.		
⑤ After completing the definition of the start&end point, input the AZ1(start point), AZ2(end	Enter angle + [F4]	

<table>
<tr><td>point) tangent angle respectively, then press [F4](OK) to next step. ※1</td><td></td><td></td></tr>
<tr><td>⑥ Reference arc was defined, enter the [Reference ARC-Main Page] interface;</td><td>[F4]</td><td>


</td></tr>
</table>

Hi-Target

Press [F4] (DIST) into the [Measure Line& Offset] function; If it needs to define a new RefArc ,	[F1]	

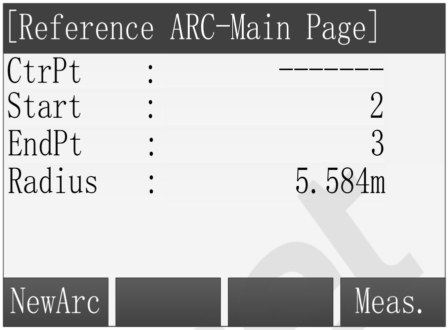
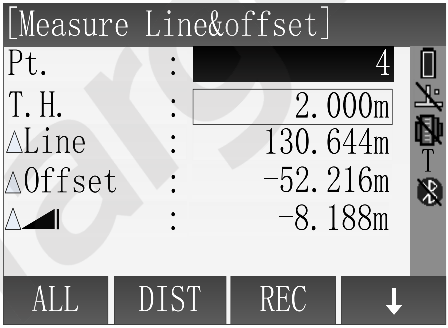
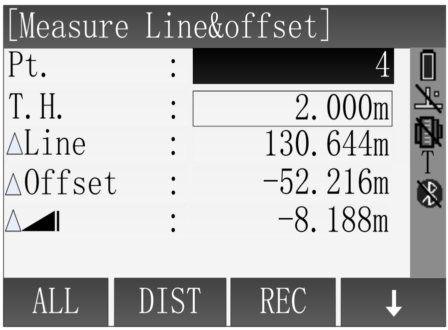
press [F1](NewArc) to define.		

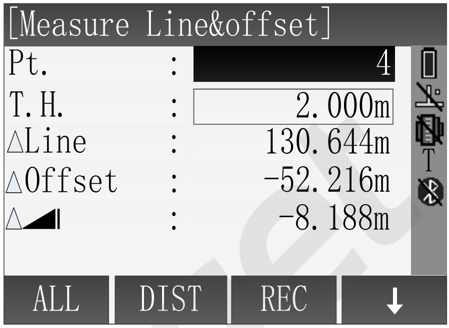
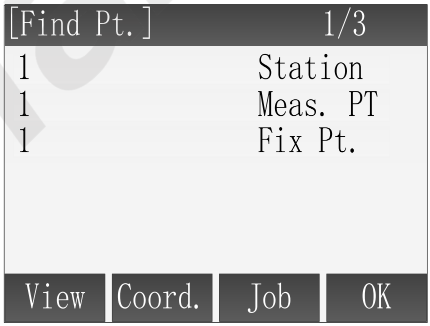
※[1] AZ1 and AZ2 are start point, end point tangent azimuth respectively . If the input data is not in conformity with the requirements, the instrument will report "invalid target data, please input again", you can select "yes" or press the [ESC] to return to the interface of starting point measurement, start to define arc.

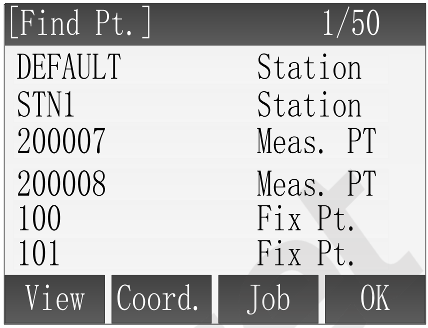
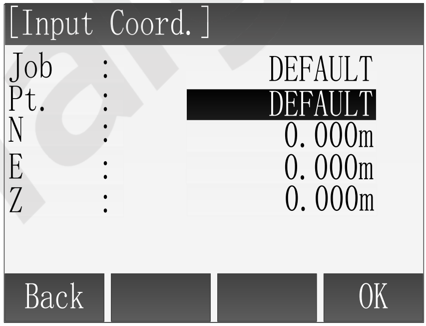
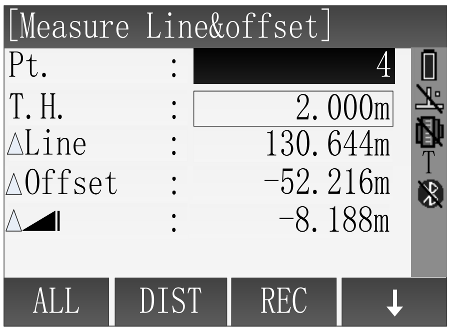
※ In above operation, press [ESC] to return to previous menu.

- **Measure Line&Offset**

Steps	Key	Display

① Using method of the "Centre, Start Point" or "Start&End Pt, Angle" defines the reference arc, entering the [Reference ARC-Main Page], and press [F4] (Meas.) to Measure Line&Offset	[F4]	 
② There are several methods to obtain the Pt which is used for Measure Line&Offset A: Enter point name, then press [F1](ALL) to define the Pt.	Input point name + [F1]	A: Get the target point by measure. 

<table>
<tr>
<td>B: Input point name, Press [F2](DIST) + [F3](REC) to save the Pt, the saved result will be directly put into calculation.</td>
<td>[F2]
+
[F3]</td>
<td>B: Get the target point by DIST+REC.

</td>
</tr>
<tr>
<td>C: Input point name, press [F4](↓) to shift to subscript function, press [F1](Find) to check whether this point was existed, if not exist, then should firstly input or measuring this point's coordinate.</td>
<td>Input point name
+
[F4]
+
[F1]
+
[F4]</td>
<td>C: Input the name of the point and find whether it is in memory.

</td>
</tr>
<tr>
<td>D: Press [F2](List) , in [Find Pt.] screen, search the known points in job through [▲]\[▼] and press [F4](OK) to select.</td>
<td>[F2]
+
[F4]</td>
<td>D: Select the point by list in the instrument.</td>
</tr>
</table>

<table>
<tr><td></td><td></td><td>
</td></tr>
<tr><td>E: Press [F3](Coord.), Input point name, coordinate's data, it will indicate recover if point name is repeated, then press [F4](OK) to save the point.</td><td>[F3]
+
Input point name coordinate
+
[F4]</td><td>E: Input the point through keyboard.

</td></tr>
<tr><td>③ After measuring points in different ways, we can see the result of the high deviation, ΔLine and ΔOffset.※1</td><td></td><td>
</td></tr>
</table>

Hi-Target

※[1] Result of Line&Offset:

ΔLine: Measuring point relative to the start point of arc , if it is beyond the reference arc ,ΔLine will be negative, and on the contrary is positive;

ΔOffset: the offset of the measuring point with respect to the arc in the direction of the radius. If the measuring point is in the circle, the ΔOffset will be positive, and on the contrary is negative.

Δ : the elevation difference between measuring point and starting point;If it is higher than start point, it will be positive, and on the contrary is negative.

※ In above operation, press [ESC] to return to previous menu.

5.13.3 RefSurface

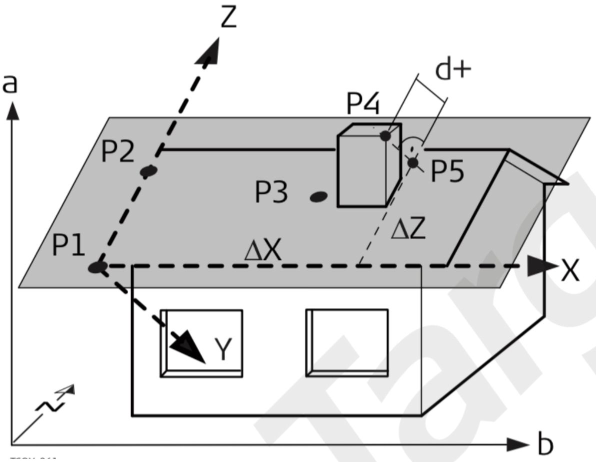
Reference Surface is also known as Reference Plane. It is a function that can be used to measure points relative to a reference plane. It can be used to:

- **Measuring a point to calculate and store the perpendicular offset to the plane**
- **Calculating the perpendicular distance form the intersection point to the local X and Z axis. The intersection point is the footprint point of the perpendicular vector from the measured point through the defined plane.**
- **Viewing, storing and staking out the coordinates of the intersection point.**

A reference plane is created by measuring three points on a plane. These three points define a local coordinate system:

Hi-Target

- **The first point is the origin of a local coordinate system.**
- **The second point defines the direction of the local Z-axis.**
- **The third point defines the plane.**



X-axis of local coordinate system.

Y-axis of local coordinate system.

Z-axis of local coordinate system.

P1 First point, origin of local coordinate system.

P2 Second point

P3 Third point

P4 Measured point. This point is prob- ably not located on the plane.

P5 Footprint point of the perpendicular vector from P4 to the defined plane. This point is definitely located on the defined plane.

Hi-Target

d+ Perpendicular distance from P4 to the plane.

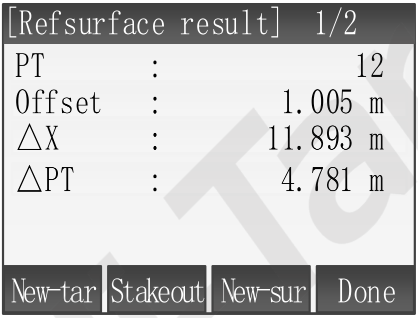
Functions that can be done by the software buttons:

[New-tar]: To record and save the intersection point and to proceed to measure a new target point.

[Stakeout]: To display stake out values for the intersection point.

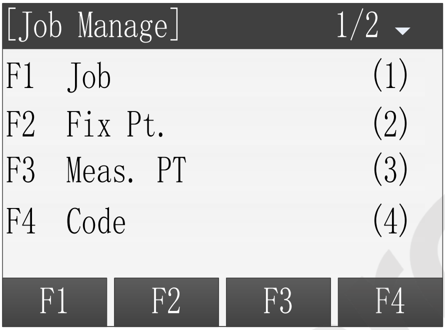
[New-sur]: To define a new reference plane.

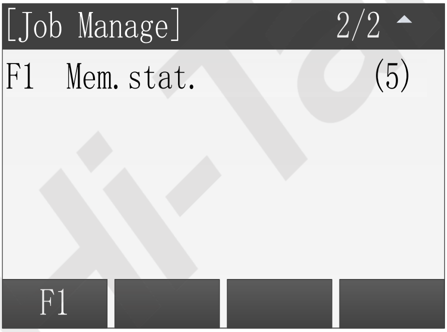
[Done]: to go back to the program menu.



6 File manage

File manager contains all functions of input data, edit data and view data.

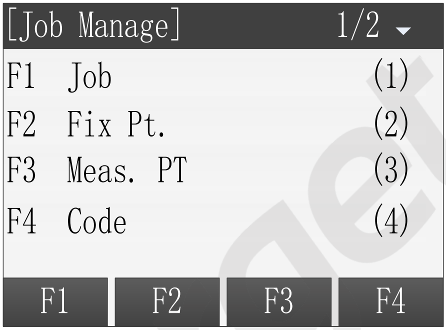
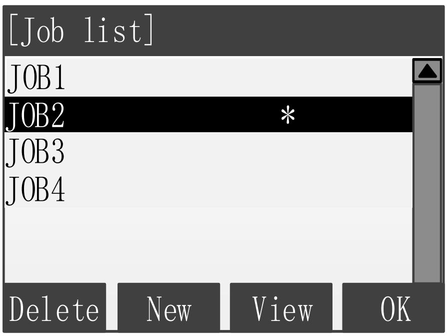




6.1 Job

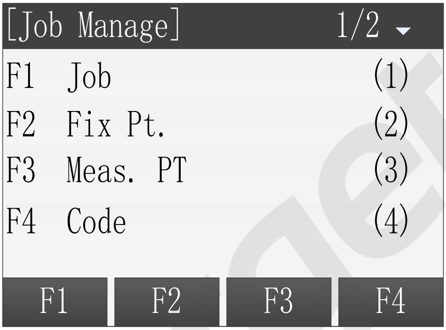
- All kinds of measurement data are saved in the selected job. Such as Fix Pt., Meas. PT and so on.
- The function can new a job, select a job and delete a job.
- The definition of the job contains the inputting of Job's name and Operator.

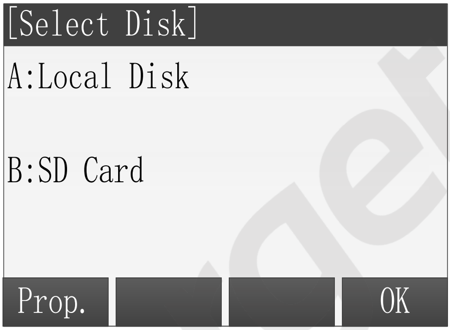
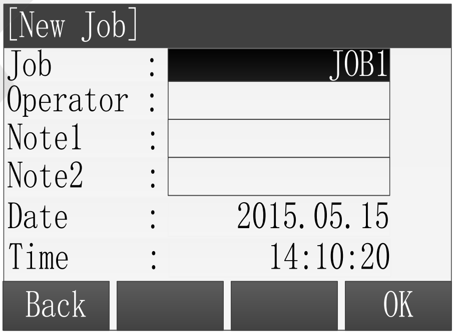
6.1.1 Select a Job

Steps	Key	Display
① Press [F1] in the menu of Job Manager to enter menu of job function.	[F1]	
② The interface displays the job list in the current storage.		
③ Using the direction keys to select a job, when the needed job is selected, press the key of [F4], the program gives a prompt of “Job Set” and open the job as the current job.	[↑]、[↓] + [F4]	

Hi-Target

6.1.2 New a Job

Steps	Key	Display
① In the menu of Job Manager, press [F1] to enter the menu of job function.	[F1]	
② The interface displays the job list in the current storage. The jobs in the SD card have the mark of "[SD]" and the current job have the mark of "*". Press [F2] (New) to enter the function of new a job.		

③ If the instrument has loaded the SD card, there is an interface of Select Disk. In the interface, selecting the disk which is used to new a job by pressing the key of up or down and press [F4] to make sure. A:Local Disk B:SD Card		
④ The screen displays the information of new job, including the name of the job, the operator and so on. After inputting one item, press [ENT] to move the cursor to the next input area.※1	[ENT]	

Hi-Target

⑤ After finishing inputting, press [F4] (OK) to save the job and set it as the current job.	[F4]	Job set!
※[1]: The system creates the data and time automatically.		

[Job]: The name of job inputted arbitrarily by the operator and saving data to the file after this.

[Operator]: The name of operator and it can have the default value.

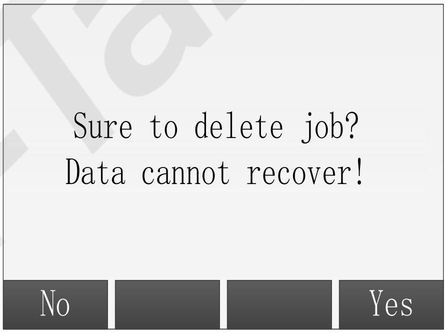
[Note1] and [Note2] describe the situation of the project and they can have the default values.

- If the job name you inputted exists, the program will give a prompt that Job exists, use another job name.

6.1.3 Delete a job

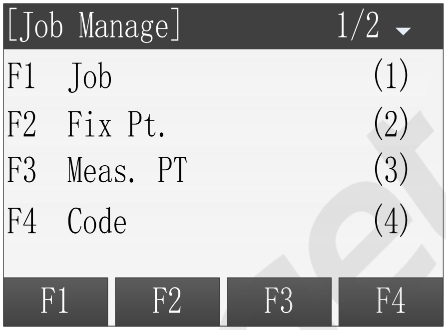
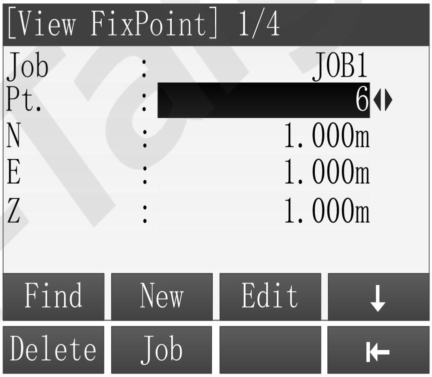
Steps	Key	Display
① In the menu of Job Manager, press [F1] to enter the menu of job function.	[F1]	[Job Manage] 1/2 F1 Job (1) F2 Fix Pt. (2) F3 Meas. PT (3) F4 Code (4) F1 F2 F3 F4

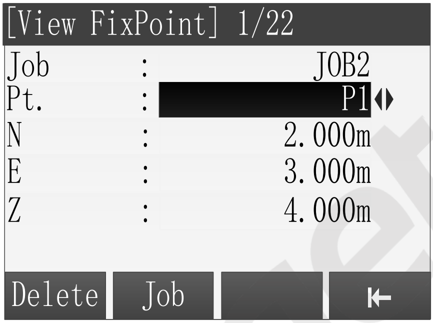
Hi-Target

② The interface displays the job list in the current storage.		
③ Using the direction key up or down to select the job that need to be deleted. Press [F1] (Delete) and a dialog appears as shown in the picture on the right. If you make sure to delete it, please press [F4] (Yes), otherwise, press [F1] (No) to back to the previous menu. ※1	[↑]、 [↓] + [F1] + [F4]	
※1: The current job can’t be deleted.		

6.2 Fix Pt.

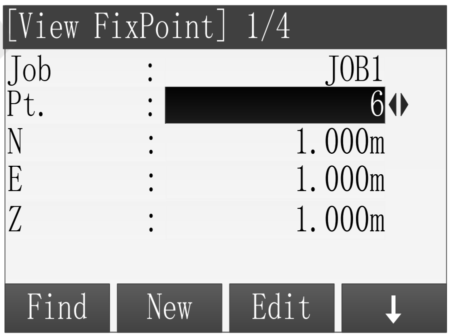
The function can view, edit and delete the fixpoints in all jobs.

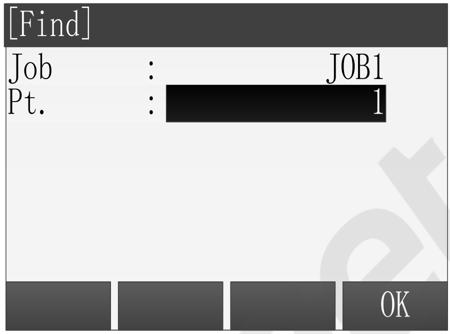
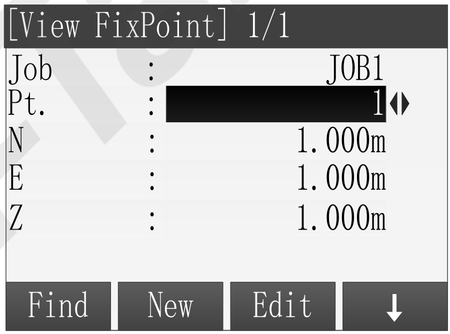
Steps	Key	Display
① In the menu of Job Manager, press [F2] to enter the interface of Fix Pt. function.	[F2]	
② The interface displays the fixpoints of the current job. Pressing the direction key of left or right can scan all fixpoints in the job. Press [F4] to switch to the second page' soft key.	[F4] + [F2]	
③ Press [F2](Job) to enter the list of job, press the direction key of up or down to select the job which the viewed fixpoints exist, then press [F4] to make	[F4]	

sure. ※[1]		
④ Program displays the data of fixpoints in the corresponding job. Press the direction key of left or right can view all fixpoints in the job.	[←] [→]	
※[1]: The selected job is only used to view fixpoints and it will not be set as current job.		

6.2.1 Search Fix Pt.

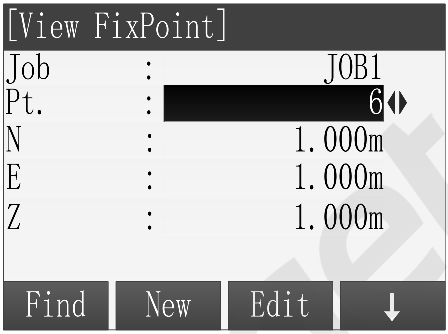
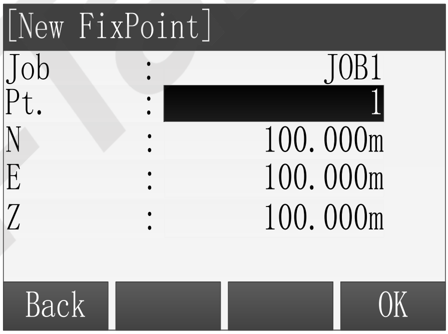
Input the name of point or "*" to view the fixpoints in the selected job.

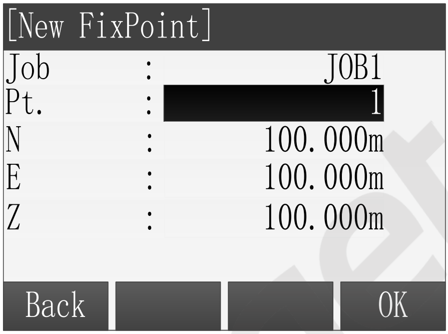
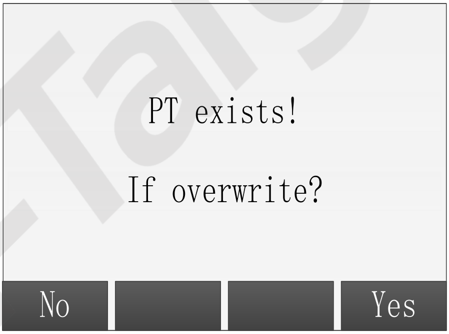
Steps	Key	Display
① In the interface of View FixPoints, pressing [F1] (Find) to enter the function of finding fixpoints.	[F1]	

② There appears a dialog as shown in the picture on the right. Input the name of point or the wildcard of “*”, press [ENT] to make sure and press [F4] (OK) to find.	[ENT] + [F4]	
③ Displaying the dialog of finding result. If the point exists in the job, the interface will display the coordinate information of the point. If input the wildcard of “*”, you can view all fixpoints by pressing the direction key of left or right.		

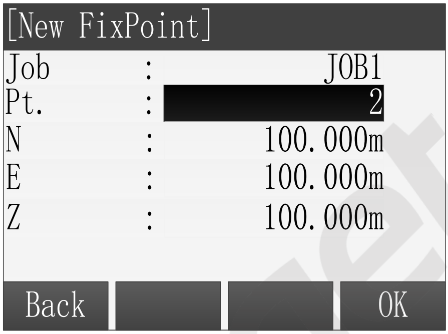
6.2.2 Add Fix Pt.

Steps	Key	Display

<table>
<tr>
<td>① In the interface of View FixPoint, pressing [F2] (New) to enter the function of new fixpoint. If you want to change the job which need to new points, you can press [Job] to select the target job.</td>
<td>[F2]</td>
<td>
</td>
</tr>
<tr>
<td>② There appears a dialog as shown in the picture on the right. If want to back to the previous menu, you can press [F1] (Back).</td>
<td></td>
<td>
</td>
</tr>
</table>

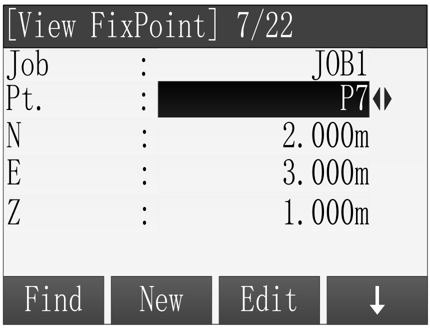
③ Input the new name and coordinate of fixpoint, press [Ent] to finish inputting and press [F4] (OK) to save the fixpoint. If the inputted point name exists in the memory, the program will give a prompt of whether to overwrite, press [F4](Yes) to overwrite or press [F1](No) to cancel the operation.	[F4]	 

Hi-Target

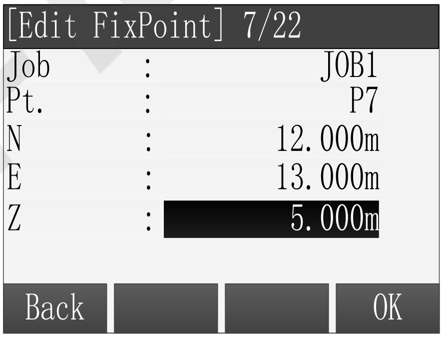
④ After finishing new a fixpoint, the program makes the point plus 1 automatically and you can continue to input other fix points, as shown in the picture on the right. Press [F1] (Back) or [ESC] to go back.		

6.2.3 Edit Fix Pt.

The function can edit the fixpoints in the memory.

Steps	Key	Display
① In the interface of View FixPoint, you can find the data of need to be edited by pressing the direction key of left or right or in the function of finding. If you want to change the job which the point needs to be edited, you can press [Job] to select the target job.		

Hi-Target

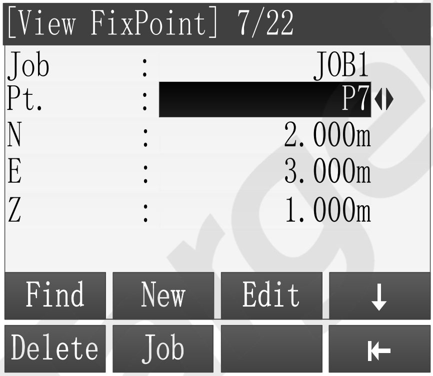
② Press [F3] (Edit) to enter the interface of Edit Fixpoint. The screen displays the point data. Input the new point's name and coordinate and press [ENT] to move the cursor to the next row. When the data doesn't need to be edited, you can press [ENT] directly.		
③ Press [F4] (OK) to save the edited data after finishing inputting. Program gives a prompt whether to overwrite or not and press [F4] (OK) to over right and save.	[F4]	

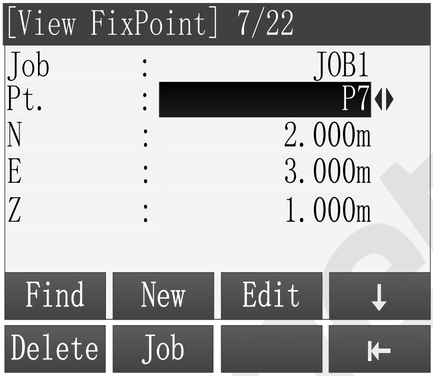
6.2.4 Delete Fix Pt.

Delete the selected fixpoint from the job.

Steps	Key	Display

Hi-Target

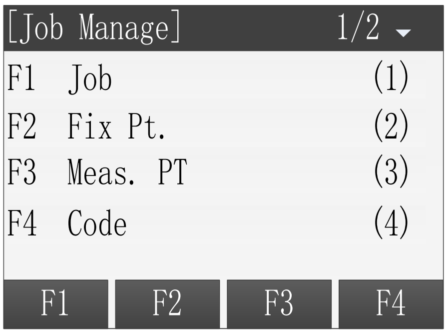
① In the interface of View FixPoint, you can find the data of need to be deleted by pressing the direction key of left or right or in the function of finding, then press [F4] to switch to the second page of soft key. If you want to change the job which the point needs to be deleted, you can press [Job] to select the target job.	[F4]	
② Press [F1] (Delete) to start the function of deleting data, the interface as shown the dialog on the right. Press [F4] (OK) to delete data and press [F1] (No) to cancel the operation.	[F2]	

③ The interface backs to the previous menu.		

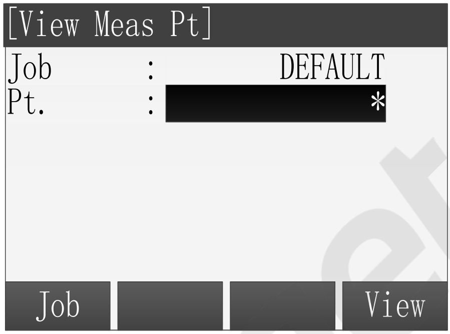
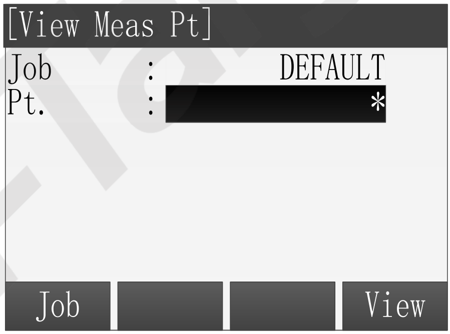
6.3 Meas. Pt.

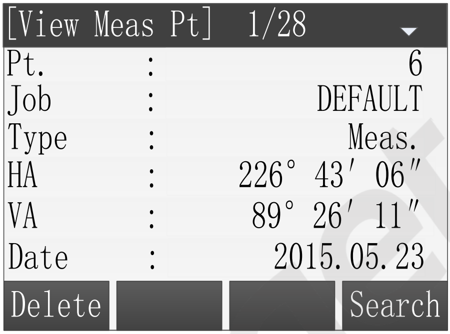
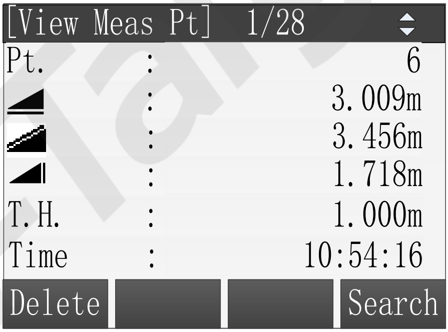
The measurement data in the job can be searched, displayed, and part of them can be deleted.

6.3.1 View the measurement data

Steps	Key	Display
① In the menu of Job Manager, press [F3] to enter the function of Meas.PT.	[F4]	

Hi-Target

② The default viewed job is the current job in the program, if you want to view the measurement data in other jobs, please press [F1] (Job) to enter the list of job to select.	[F2]	
③ The default viewed points are all points in the job and using the wildcard character to stand for. If want to view a certain point, you can input the name of the point and press [F4] to view.	[F4]	

④ The screen starts to display the information of measurement data from the first piece of data in the job. Press the direction key of left or right can view the measurement point data which match the view condition one by one. Pressing [PAGE] can view a piece of measurement point data' other pages. Press [Search] to back to the interface of View Meas PT.		 [PAGE] 

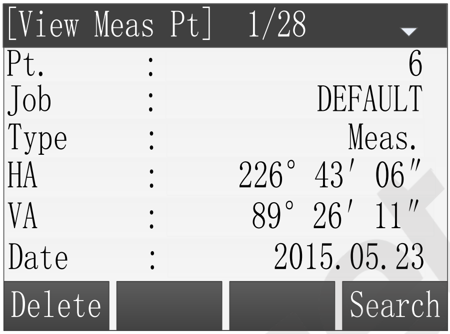
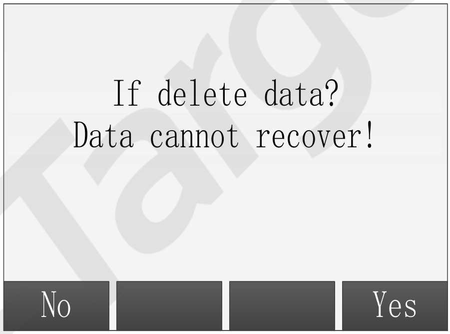
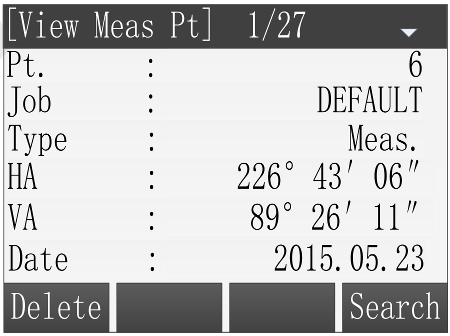
6.3.2 Delete measurement data

The not good and the repeating measurement data can be deleted.

The station data and the last piece of data in the data items can not be deleted.

Steps	Key	Display

HiTarget

① After finding the measurement point data which need to be deleted, press [F1] to delete.	[F1]	
② The window of program prompts whether to delete or not. Press [F4] to make sure to delete and press [F1] to cancel the operation.	[F4]	
③ After the data is deleted, the screen displays the next piece of data.	[F4]	

6.4 Code.

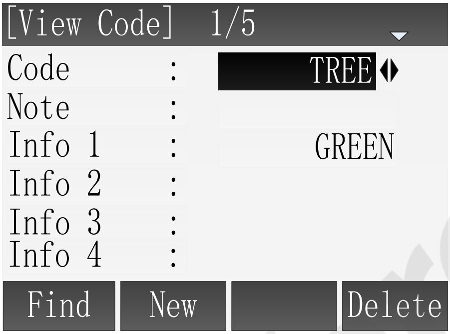
Here can make operations on the code library, such as new, finding and

Hi-Target

deleting.

6.4.1 Input Code

Every code has a note and up to 8 characters attributes.



GSI-The introduction of code' attributes:

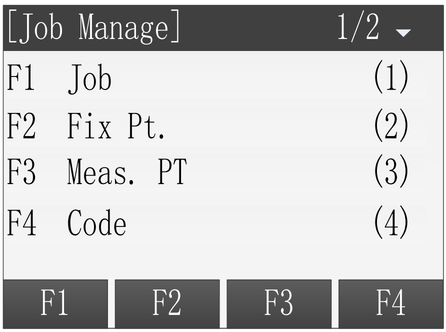
Code: Name of the code

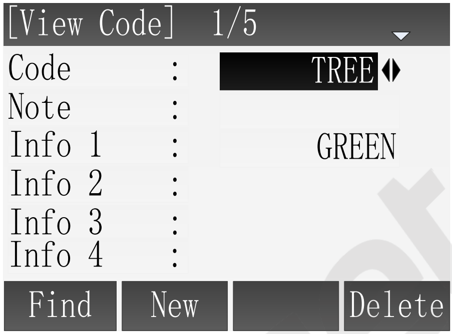
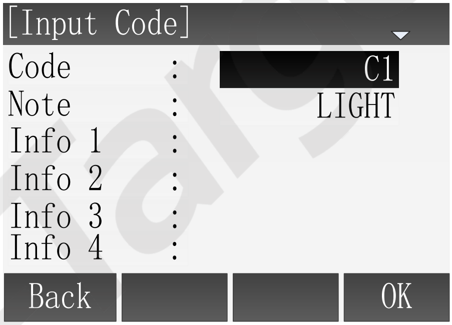
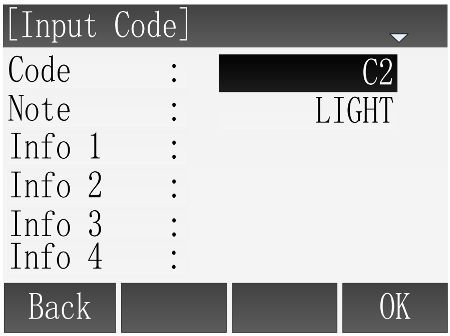
Note: Additional annotation

Info1: The other editable information

……

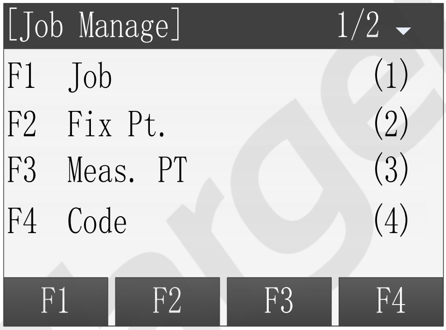
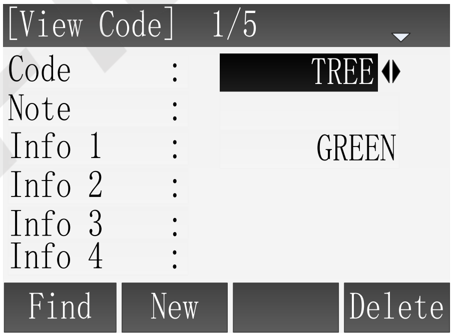
Info8: Other information

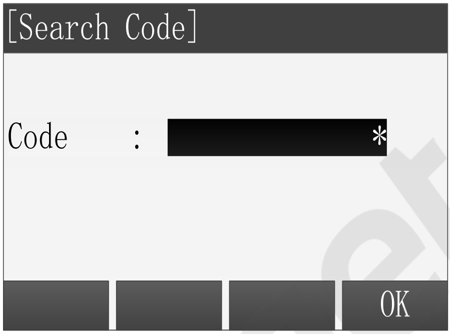
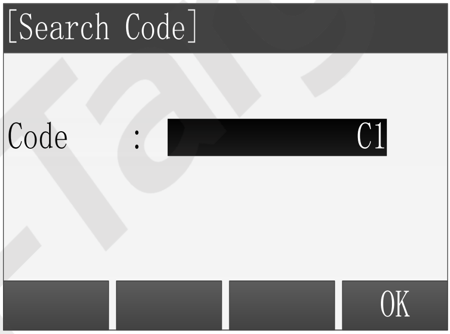
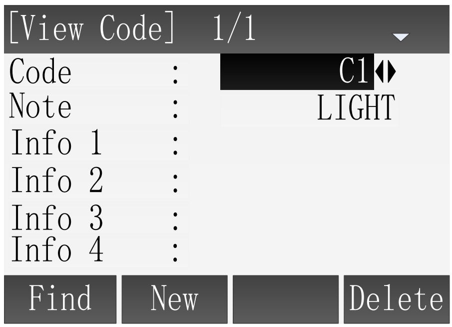
Steps	Key	Display
① In the menu of Job Manage, pressing [F4] to enter the function of Code.	[F4]	

② In the interface of View Code, pressing [F2] to enter the function of new code.	[F2]	
③ Input the name of code and the code information in the interface of Input code.		
④ After finishing inputting, press [F4] to save the code. Program makes the Code's name plus 1 automatically, and you can continue to input other code. If the inputted code name exists in the memory, the program will give a prompt of whether to	[F4]	

overwrite		

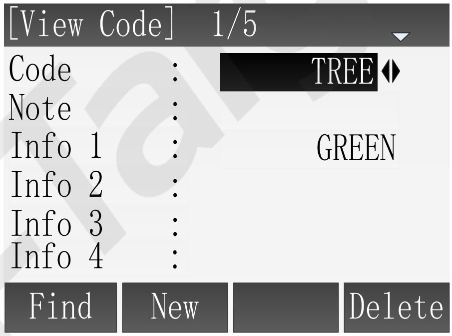
6.4.2 View Code

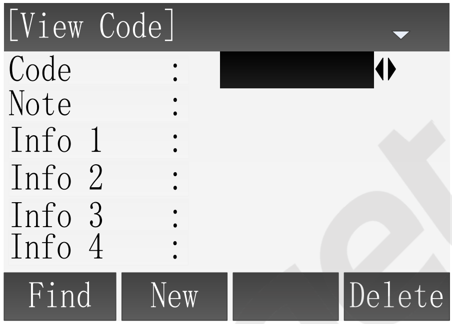
Steps	Key	Display
① In the menu of Job Manage, pressing [F4] to enter the function of Code.	[F4]	
② Press the direction key of left or right, you can view all codes one by one.		

<table>
<tr><td>③ Press [F1] to enter the interface of Search Code. The default value is wildcard character, it stands for all codes.</td><td></td><td>
</td></tr>
<tr><td>④ Input the certain code name and input [F4] to start to search.</td><td>[F4]</td><td>
</td></tr>
<tr><td>⑤ Program displays the searching result, if there are more than one codes matching the searching condition, you can view them one by one by pressing the direction key of left or right.</td><td></td><td>
</td></tr>
</table>

If there is no code matches the condition, the program will give a prompt.		

6.4.3 Delete Code

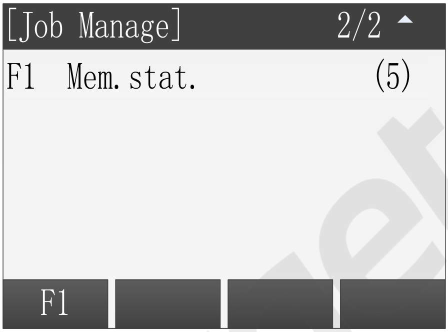
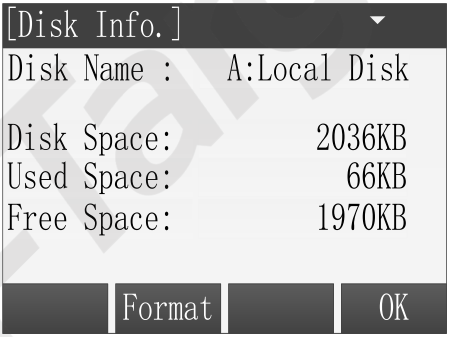
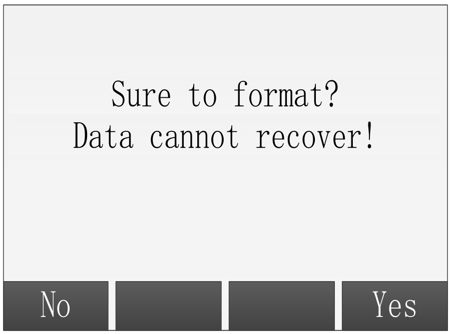
Steps	Key	Display
① After entering the dialog of code function, press the direction key of left or right to delete the code which need to be deleted. You can also press the key of [Find] to find the corresponding code.		
② After finding the code need to be deleted, press [F4] and program will give a prompt whether make sure to delete.	[F4]	A: 

A: If the deleted code is find by pressing the direction keys, after the code is deleted, the screen will display the next code. B: If the deleted code which find by press the key of [Find], after the code deleted, the interface displays an empty code, it means that all fields are empty. If there is more than one code matching the finding condition, it will display the next code.		B: 

6.5 Memory Statistics

Display the information of the memory usage and format the memory.

Format the memory can delete all data of job, code and road. The setting of application also can be reset, please operate carefully.

Steps	Key	Display
① In the menu of Job Manage, press [PAGE] and display the second page of the menu, press [F1] to enter the function of memory statistics.	[F1]	
② Press [F1] (Prop.) can view the properties of the disk, including free space.	[F1]	
③ Press [F2] (Format) can format the disk, program will give a prompt to make sure to format or not, press [F4] to make sure to format and press [F1 to cancel the operation.]	[F2]	

7 Data Transfer

This function is doing data transmission between instrument and computer, or between instrument and removable device. This function includes 2 parts, import and export.

The data transmission between instrument and removable device must have U Disk plugged in.

Note: The machine supports up to 8G U disk read and write, when running the program, don't insert or pull out the U disk. If you pull out the U disk when the instrument checking it, the subsequent operations may cause error!

7.1 Data Import

User can use this function to transfer fixed points data or code data to instrument from computer via RS232 cable. User can also transfer fixed points data to instrument via U Disk.

Import: Fixed Points, Code

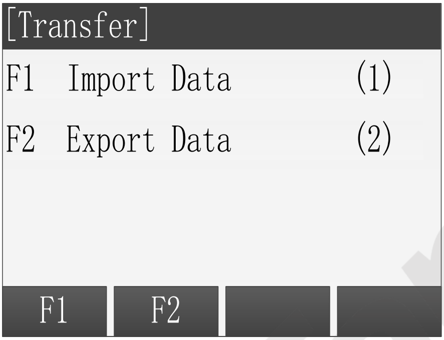
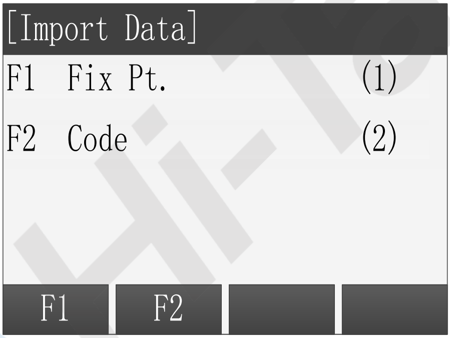
Method: RS232, U Disk

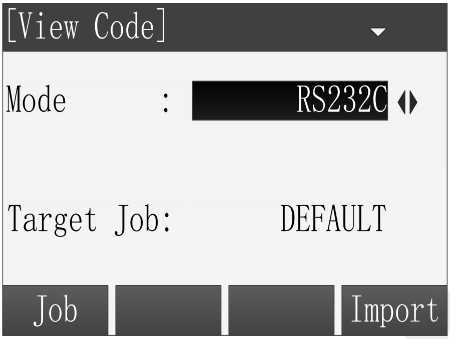
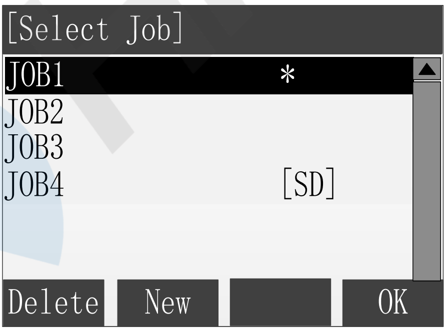
Format: CASS, GTS-7, CSV, GSI(For U Disk)

Source: Data file in U Disk (For U Disk)

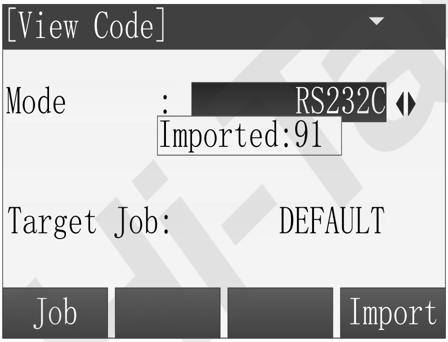
Job: Target job that data been transfer to.

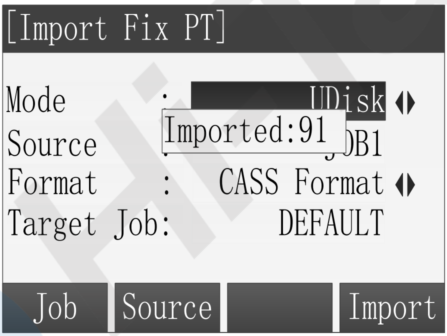
Steps	Key	Display

① In main menu, chooses "4 Transfer" to enter "Data Transfer" menu. Pressing [F1] or [1] enters "Import Data".	[4] [F1] or [1]	 

<table>
<tr>
<td>② In "Import Data" menu, press [F1] or [1] entering "Import Fix Pt" window.</td>
<td>[F1] or [1]</td>
<td>
</td>
</tr>
<tr>
<td>③ Press [F1](Job) to select the job you want transfer data into, then press [F4]</td>
<td>[F1]
[F4]</td>
<td>
</td>
</tr>
</table>

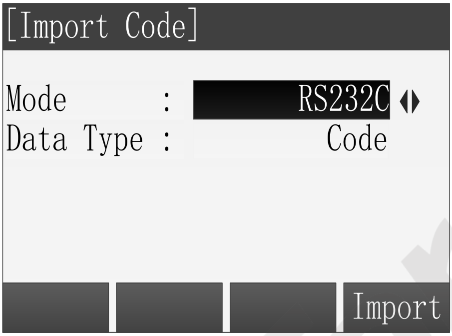
Hi-Target

(OK).		
④ If choosing RS232C method, using cable to connect instrument and computer first, on computer side, press button [Send] in transfer software, and then press	[F4]	

<table>
<tr><td>[F4] (Import) on the instrument.</td><td></td><td></td></tr>
<tr><td>⑤ If choosing U Disk method, plugging u disk in the instrument usb port first, then:
1. Press [◀], [▶] key to select “U Disk”;
2. Press</td><td></td><td>
</td></tr>
</table>

[F2] to explore files in u disk and select the data file. 3. Press [▼], [▲] moving to the format option, then press [◀], [▶] key to select the data file's format. 4. Press [F4] (Import) to start		

Hi-Target

import.		
⑥ Import code can only use RS232C method. This is same to Step ④.	[F4]	

7.2 Data Export

User can use this function to transfer internal data (fixed points, measurement data, and code) from instrument to computer or u disk.

Export: Fixed points, measure data, and code.

Method: RS232C, U Disk.

Format: CASS, GTS-7 (For fixed point, U Disk)

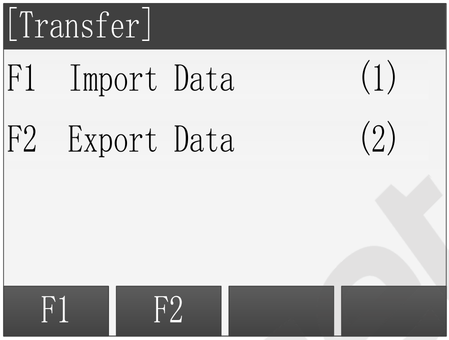
HTF format, GSI format, GTS-7, CSV, CASS(For measure data, U Disk)

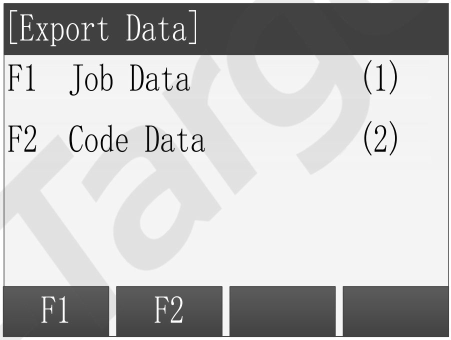
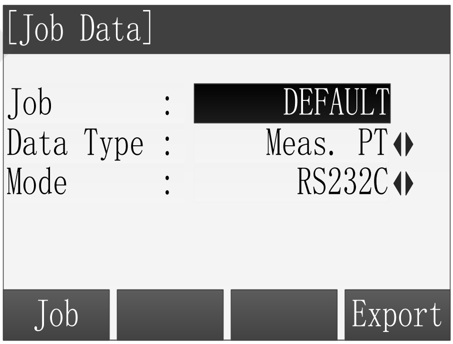
Job: Job needs to export.

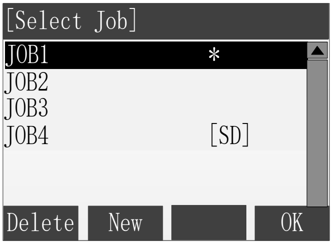
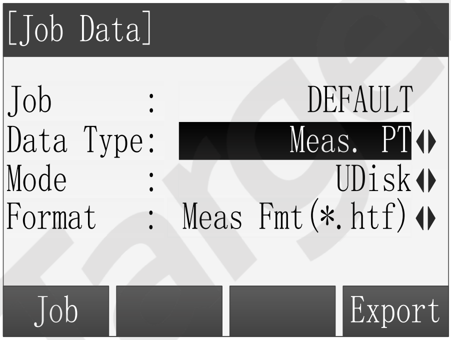
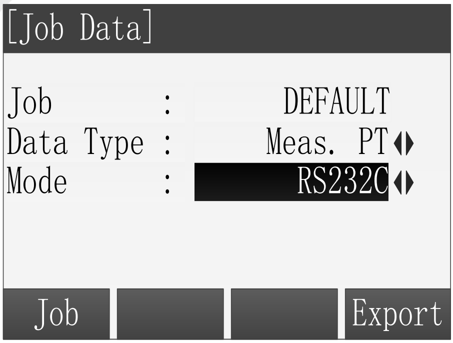
Steps	Key	Display

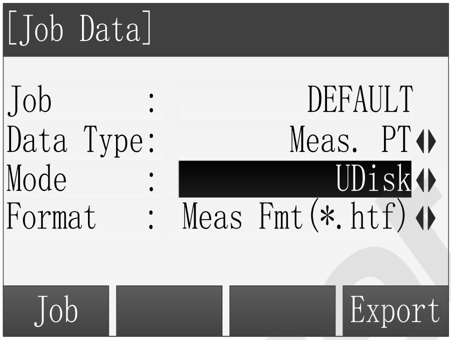
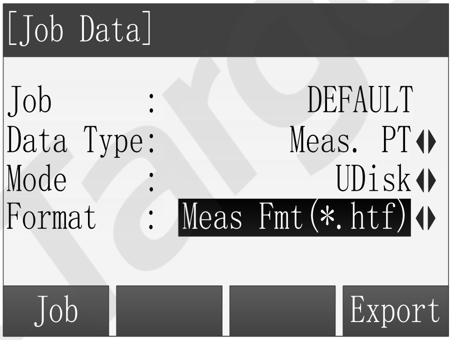
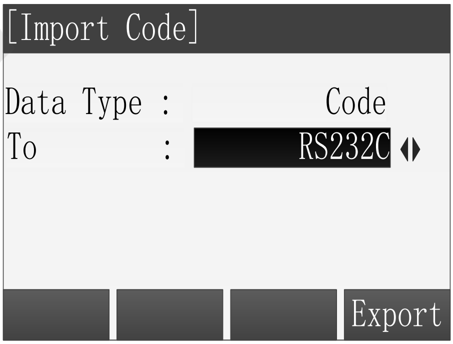
<table>
<tr>
<td>① In main menu, choose “4 Transfer” to enter “Data Transfer” menu.

Pressing [F2] or [2] enters “Export Data”.。</td>
<td>[4]

[F2] or [2]</td>
<td>


</td>
</tr>
<tr>
<td>② In “Export Data” menu, press [F1] or [1] entering “Export job data” function.</td>
<td>[F1] or [1]</td>
<td>
</td>
</tr>
</table>

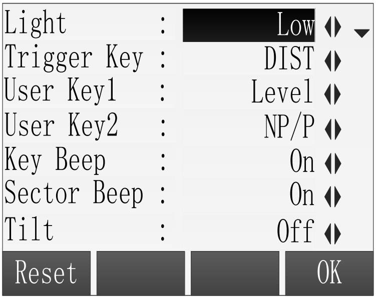
③ Press [F1] to select job that you need to export, then press [F4].	[F1] [F4]	
④ Press [◀], [▶] key to select data type that you want to export.	[◀] [▶]	
⑤ Two methods to use: RS232C, U Disk. Press [◀], [▶] key to select transfer method (mode). If choosing RS232C, software on the computer should be ready, and then press [F4] to start export.	[◀] [▶] [F4]	

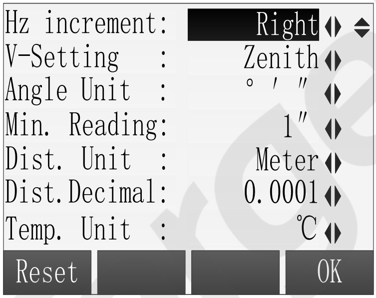
If choosing U Disk, the U Disk should have been plugged in, then press [F4] to start export. User can also use key [◄], [►] to select the format of export data. CASS, GTS-7 for fixed points data; HTF, GSI for measure data.		 
⑥ Export code can only use RS232C method. This is same to Step ⑤.	[F4]	

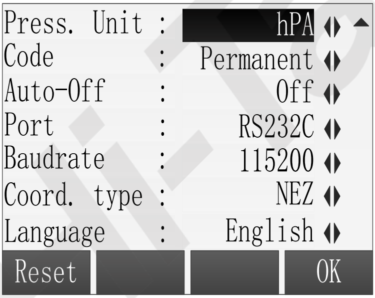
8 Instrument Setting

8.1 General Setting

In Setting Menu, choose “1 General” to enter “General Setting”.

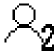


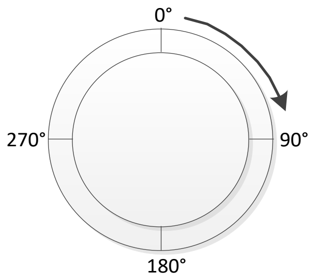
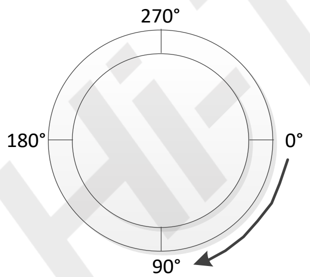


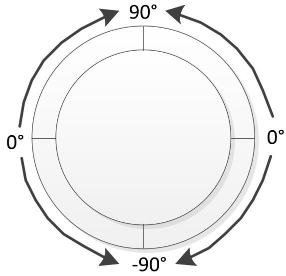
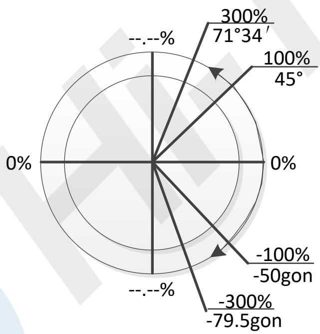


Fields of General Setting

Field	Description
Light	**High, Medium, Low, Off.** 4 Levels of background light.
Contrast	**1~9.** Set the display contrast.
Trigger Key	**Off:** Disable trigger key.

	ALL: Dist and record. **DIST:** Only dist.
User Key 1	Configures  with a function from the FNC menu.
User Key2	Configures  with a function from the FNC menu.
Key Beep	The beep is an acoustic signal after each key stroke. **On:** Enable beep**.** **Off:** Disable beep**.**
Sector Beep	**On:** Sector Beep sounds at right angles(0° , 90° , 180° , 270° or 0, 100, 200, 300 gon). **Off:** Sector Beep disabled.
Tilt	**On:** Biaxial compensation enable. **Off:** Tilting compensation disable. **X Only**: Single axis compensation enable.
Hz increment	**Right:** Set horizontal angle to clockwise direction measurement. **Left:** Set horizontal angle to counter-clockwise direction

	measurement.
V-Setting	**Zenith:** Zenith = 0° ; Horizon = 90° .  **Horiz.0:** Zenith = 270° ; Horizon = 0° 。  **Vert90:** Zenith = 90° ; Horizon = 0° ; Positive above horizon, negative below horizon.

	 **Slope:** Zenith 45° =100%; Horizon = 0%. Positive above horizon, negative below horizon. Exceed 300% shows "**--.--**%". 
Angle Unit	Sets The units shown for all angular fields. ° ′ ″ Degree sexagesimal, 0° to 359° 59'59". **GON** Gon, 0 gon to 399.999 gon.

	MIL Mil , 0 to 6399.99mil. The setting of the angle units can be changed at any time. The actual displayed values are converted according to the select unit.
Mini. Reading	Sets the number of decimal places shown for all angular fields. This is for data display and does not apply to data export or storage. **° ′ ″ :1" /5"/10"** **Gon:**0.0002/ 0.001 / 0.002 **Mil :**0.005 / 0.02 / 0.05
Dist. Unit	Sets the units shown for all distance and coordinate related fields. **Meter** Meters [m]. **US-ft** US feet [ft]. **INT-ft** International feet[fi]. **ft-in1/8** US feet-inch-1/8 inch [ft].
Dist. Decimal	Sets the number of decimal places shown for all distance fields. This is for data display and does not apply to data export or storage.

	3Display distance with three decimals. **4**Display distance with four decimals.
Temp. Unit	Sets the units shown for all temperature fields. ℃Degree Celsius. ℉Degree Fahrenheit.
Press. Unit	Sets the units shown for all pressure fields. **hPA** hecto-Pascal. **mmHg** Millimeter mercury. **inHg** Inch mercury.
Code	Sets if the code will be used for one, or many, measurements. **Rec/Reset** The code is cleared after ALL or REC. **Permanent** The code remains after measurements.
Auto-Off	**30min** Auto power off after 30min's no operation. **Off** Disable auto-off.

Port	**RS232C** Use serial port as communication interface. **Bluetooth** Use Bluetooth as communication interface. If instrument does not support Bluetooth, there will be no Bluetooth option here.
Baudrate	Sets the serial port baudrate. **9600/19200/115200**
Coord. type	Sets the type of coord. **NEZ/ENZ**
Language	Changes the software's interface language.

8.2 EDM Setting

See Chapter "3.2 EDM Setting".

9 Adjust and Tools

9.1 Adjust

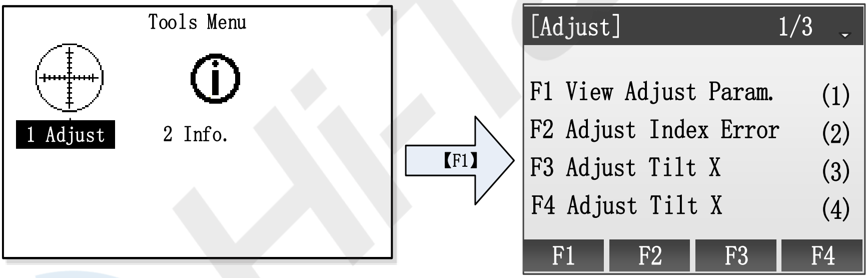
Warning:

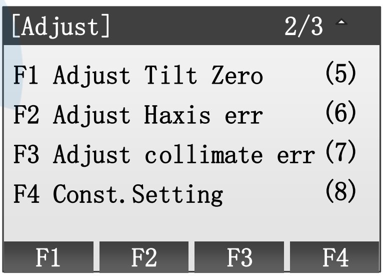
The following functions must be carried out under the guidance of professionals, if the operation is wrong, it may lead to the instrument can't work properly!

Through Main Menu →"6 Tools"→"1 Adjust", entering adjust menu,

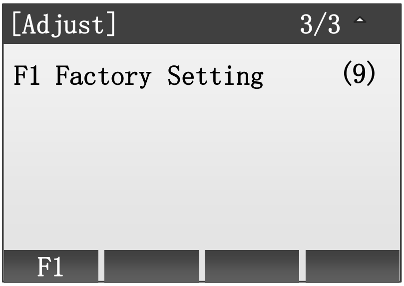
Like

below





Hi-Target

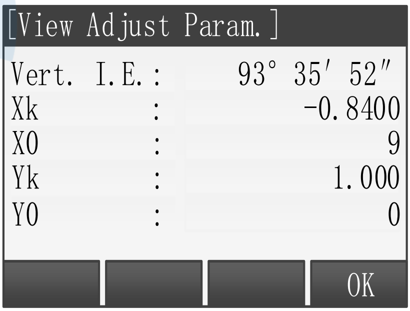


Input PIN code(82543), and then press key ENT, the instrument will be turned off.

9.1.1 View adjust parameters

In Tools Menu, choose "1 Adjust", and then press [F1] to enter "View adjust parameters".

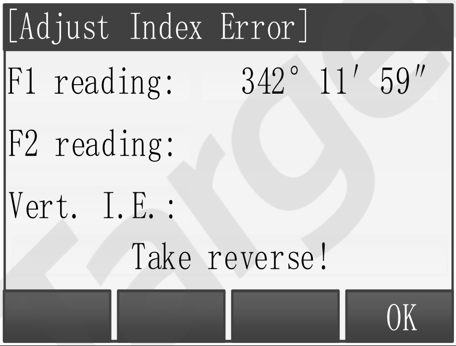
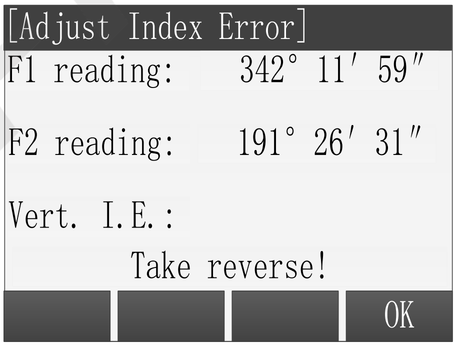
Parameters include Vert. I.E and tilt sensor parameters.

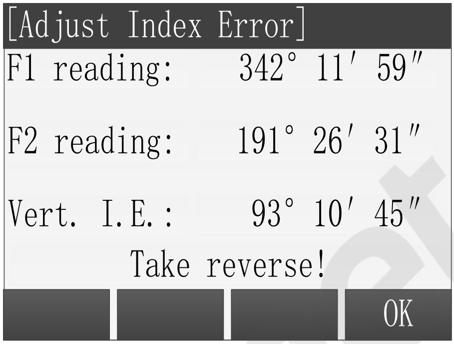


9.1.2 Adjust Index Error

In Tools Menu, choose "1 Adjust", then press [F2] to enter "Adjust Index Error".

Steps:

Steps	Key	Display
① After leveling the total station, aim at target with face left, then press [F4](OK).	[F4]	
② Aim at the same target with face right, and press [F4] (OK).	[F4]	

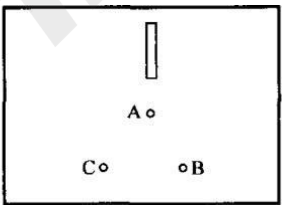
③ Program will show the result value, press [F4](OK) to save.	[F4]	

Note: If there is no special requirement, the compensator should be turned on before Index error correction.

9.1.3 Adjust Tilt X

Before compensating for the compensator, make sure that the indicator difference is recalibrated in accordance with 9.1.2 procedure in the closed compensator state.

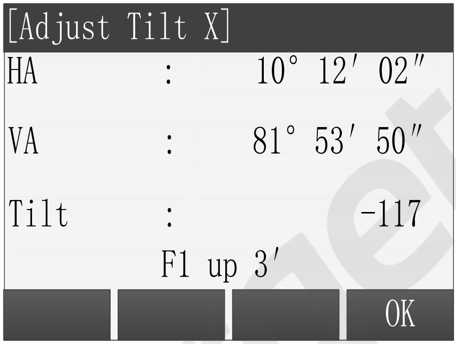
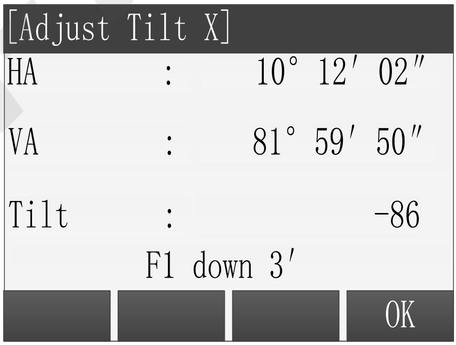
First, place the instrument as picture shown below with collimator facing up. This will help screw A to adjust the inclination of the instrument.

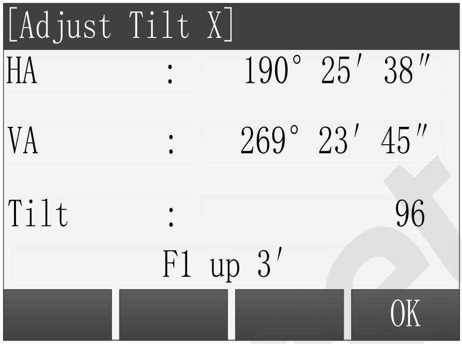
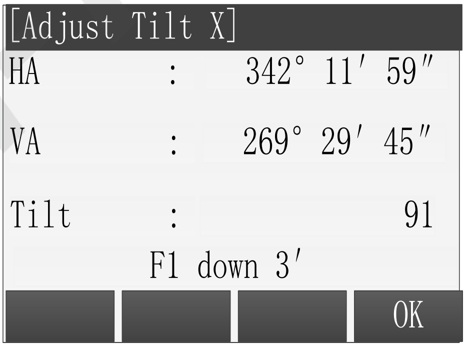


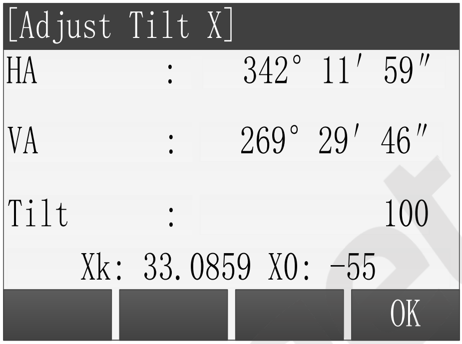
In Tools Menu, choose "1 Adjust", and then press [F3] to enter "Adjust Tilt X".

These are the calibration of x-direction of compensator's vertical axis.

Hi-Target

Steps	Key	Display
① Level instrument, focus on the reticle of collimator, record the vertical angle V0. Use fine tuning to set vertical angle to V0+3’,focus on the reticle center accurately, wait for stable value, press [F4](OK).	[F4]	
② Use fine tuning to set the vertical angle to V0-3’, focus on the reticle center accurately, wait for stable value, press [F4] (OK).	[F4]	
③ Use fine tuning to set the vertical angle as V0,focus on the reticle center accurately.		

4 Reverse the telescope, use face right to focus on the reticle of collimator, record the vertical angle V1.Use fine tuning to set the vertical angle as V1-3’,focus on the reticle center accurately, wait for stable value, pressF4(OK).	[F4]	
5 Use fine tuning to set the vertical angle as V1+3’, focus on the reticle center accurately, wait for stable value, press [F4](OK).	[F4]	

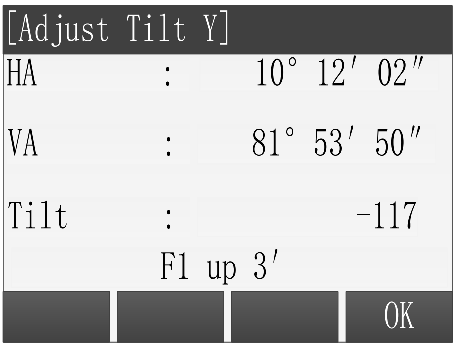
⑥ After finishing, it will display the results, press [F4](OK), save and back to menu.	[F4]	

Note: CoK (linear coefficient): If absolute value > 1.5, you need to re-calibrate; In the correction process by pressing the ESC key, will exit, holding compensator parameters unchanged.

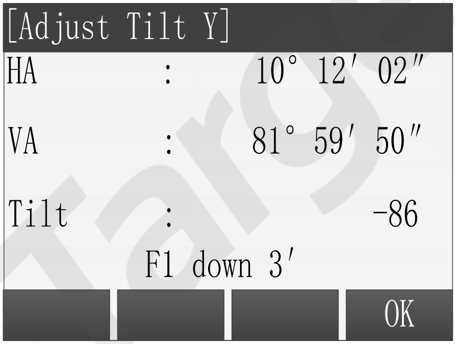
9.1.4 Adjust Tilt Y

In Tools Menu, choose “1 Adjust”, and then press [F4] to enter “Adjust Tilt Y”.

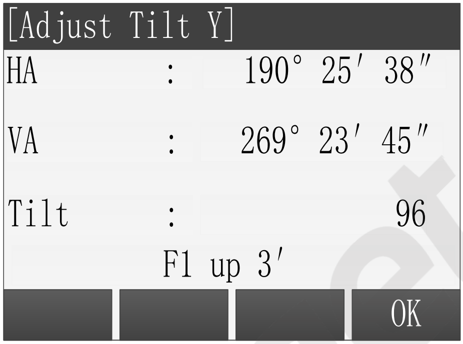
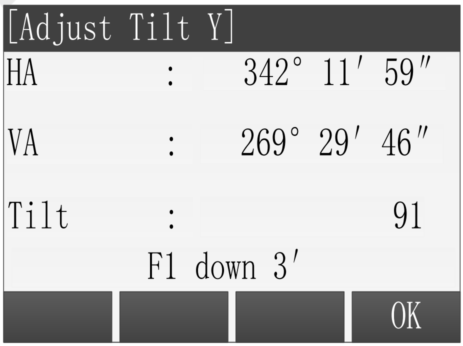
These are the calibration of y-direction of compensator’s vertical axis.

Steps	Key	Display
① Level instrument, focus on the reticle of collimator, record the vertical angle V0. Use fine tuning to set vertical angle to V0+3’,focus on the reticle center accurately,	[F4]	

Hi-Target

then turn the instrument counterclockwise 90 °, wait for stable value, press [F4](OK) ,and then turn 90 ° clockwise back to the original direction.		
② Use fine tuning to set the vertical angle to V0-3’, focus on the reticle center accurately, then turn the instrument counterclockwise 90 °, wait for stable value, press [F4] (OK) ,and then turn 90 ° clockwise back to the original direction.	[F4]	
③ Use fine tuning to set the vertical angle as V0,focus on the reticle center accurately.		

Hi-Target

④ Reverse the telescope, use face right to focus on the reticle of collimator, record the vertical angle V1.Use fine tuning to set the vertical angle as V1-3’,focus on the reticle center accurately, then turn the instrument counterclockwise 90 °, wait for stable value, pressF4(OK) ,and then turn 90 ° clockwise back to the original direction.	[F4]	
⑤ Use fine tuning to set the vertical angle as V1+3’, focus on the reticle center accurately, then turn the instrument counterclockwise 90 °, wait for stable value, press [F4](OK).	[F4]	

Hi-Target

⑥ After finishing, it will display the results, press [F4](OK), save and back to menu.	[F4]	[Adjust Tilt Y] HA : 342° 11′ 59″ VA : 269° 29′ 46″ Tilt : 100 Xk: 33.0859 X0: -55 OK

Note: CoK (linear coefficient): If absolute value > 1.5, you need to re-calibrate; In the correction process by pressing the ESC key, will exit, holding compensator parameters unchanged.

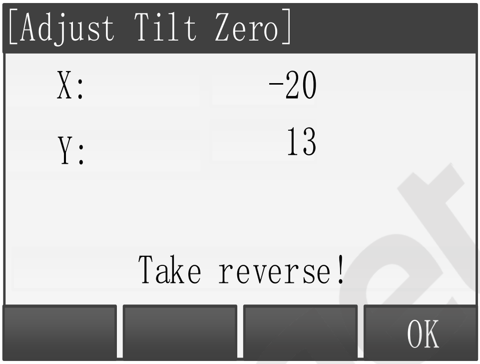
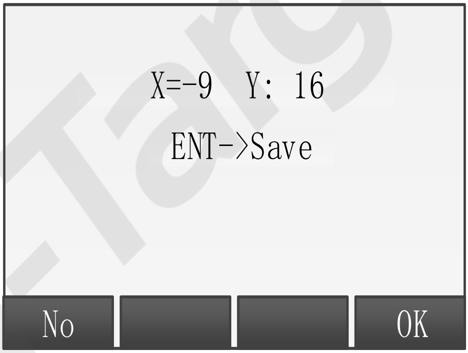
9.1.5 Adjust Tilt Zero

In Tools Menu, choose "1 Adjust", then press [F4] +[F1] to enter "Adjust Tilt Zero".

Steps:

Steps	Key	Display
① After leveling the total station, aim at target with face left, then press [F4](OK).	[F4]	[Adjust Tilt Zero] X: -15 Y: 19 Take positive! OK

Hi-Target

② Aim at the same target with face right, and press [F4] (OK).	[F4]	
③ Program will show the result value, press [F4](OK) to save.	[F4]	

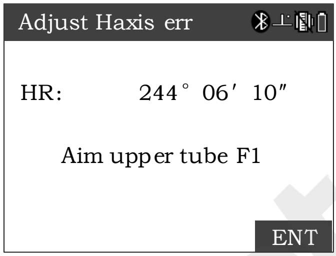
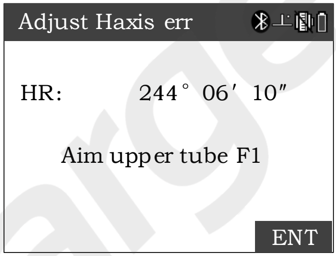
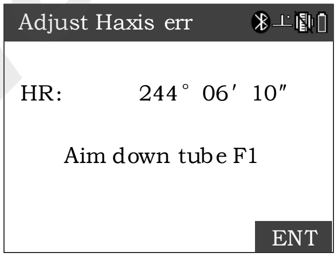
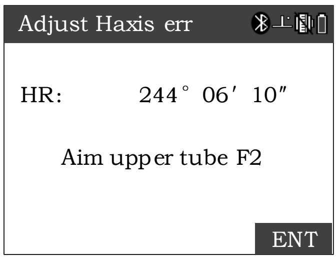
Note: If there is no special requirement, the compensator should be turned on before Index error correction.

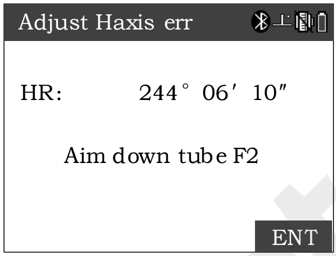
9.1.6 Adjust Haxis err

Follow the operation process below:

Operation process	Key	display
（1）Place the instrument on the test table and level the instrument.		

Hi-Target

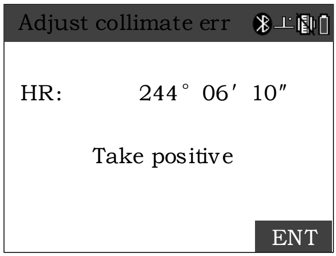
（2）In setting mode，“2. Instrument para.” then press 【ENT】，go to machine parameter setting menu. Then choose “8. Adjust H axis Err”.	“2. Instrument para.” + “8. Adjust H axis Err”	
（3）After entering, it will prompt “F1 up”, and let positive scope aim at the target, when the reading is stable, press 【ENT】 or 【F4】to confirm.	【ENT】. 【F4】	
（4）According to the prompt “F1 down”, and let positive scope aim at the target, when the reading is stable, press 【ENT】 or 【F4】to confirm.	【ENT】. 【F4】	
（5）Rotate the instrument counterclockwise by 180°. According to the prompt “F2 up”, let the reverse scope aim at the target. After the reading is stable, press【ENT】 or 【F4】 to confirm;	【ENT】. 【F4】	

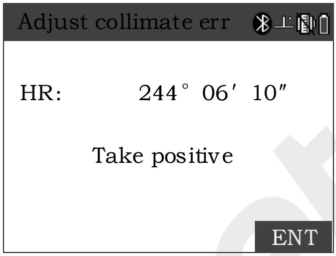
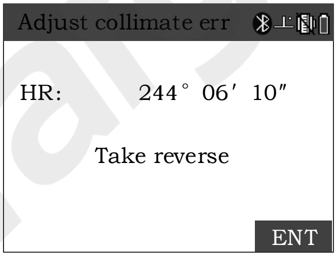
（6） According to the prompt “F2 down”, let the reverse scope aim at the target. After the reading is stable, press【ENT】 or 【F4】 to confirm;	【ENT】.【F4】	
（7） After finishing all steps, the instrument will save the parameter. During the calibration process, press the 【ESC】 key to exit the calibration.	【ESC】	

Note: If the calibration result is over 60″, the instrument needs to be calibrated again, otherwise it will cause the measurement results to be wrong.

9.1.7 Adjust collimate err

Follow the operation process below:

Operation process	Key	Display
（1）Place the instrument on the test table and level the instrument.		
（2）In setting mode，“2. Instrument para.” Then press【ENT】, go to machine parameter setting menu. Then choose “9. Ad. Collimate Err”.	“2. Instrument para.” + “9. Ad. Collimate	

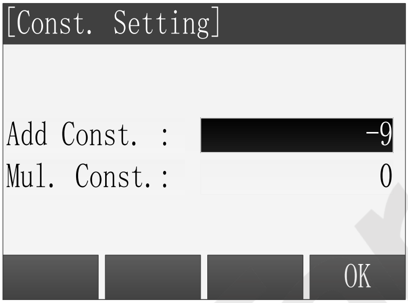
	Err”	
（3）Enter the collimation correction function, and the prompt displays "Take positive", then let the positive scope aim at the target. After the angle value is stable, press【ENT】 or 【F4】 to confirm;	【ENT】.【F4】	
（4）Rotate the instrument by 180°, and the prompt displays "Take reverse", then let the reverse scope aim at the target. After the angle value is stable, press 【ENT】 or 【F4】 to confirm; （5）When all process done, the instrument will save all parameters. During the calibration process, press the "ESC" key to exit the calibration.	【ENT】.【F4】	

Note: If the calibration result is over 60″, the instrument needs to be calibrated again, otherwise it will cause the measurement results to be wrong.

9.1.8 Instrument constant setting

In Tools Menu, choose “1 Adjust”, and then press [F4] to enter “Const. Setting”.

Press [F4](OK) to save after editing the constants.



9.1.9 Factory setting

In Tools Menu, choose “1 Adjust”, and then press [5] to enter “Factory Setting”.

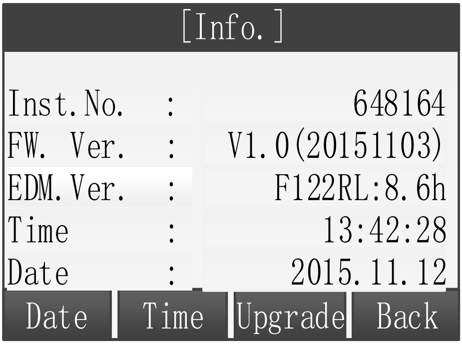
If you need to reset the instrument parameters to factory state, you can use this function, press key [F4] (Yes) and then the instrument will auto power off.

9.2 System information

9.2.1 View System Information

In Tools Menu, choose “2 Info.” to enter “Info”.

In this window, user can view detail information about the instrument, includes instrument type and SN, firmware version and date time.



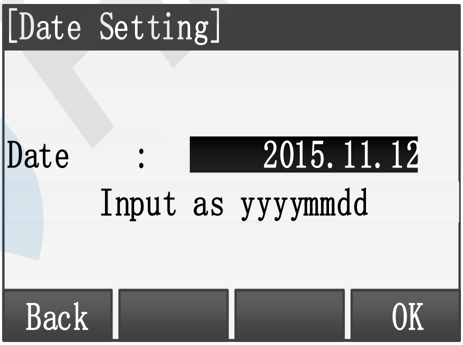
System Information

9.2.2 Set System Date

In system information window, press [F1] (Date) to enter "Date Setting" window.

To set the date, input the new date string that in the format of tips, then press [F4] (OK) to save the new date.

For example: To set date "2015-11-11", input string "20151111", then press [F4] (OK) to save.



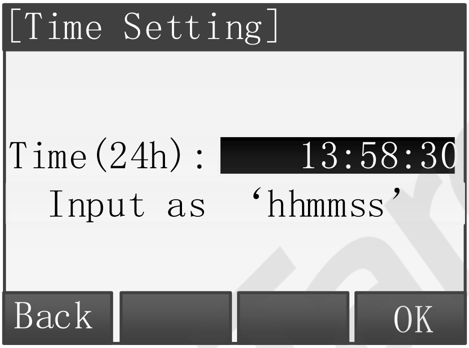
Date Setting

9.2.3 Set System Time

In system information window, press [F2] (Time) to enter "Time Setting" window.

To set the time, input the new time string that in the format of tips, then press [F4] (OK) to save the new time.

For example: To set time"13:58:30", input string "135830", then press [F4] (OK) to save.



Time Setting

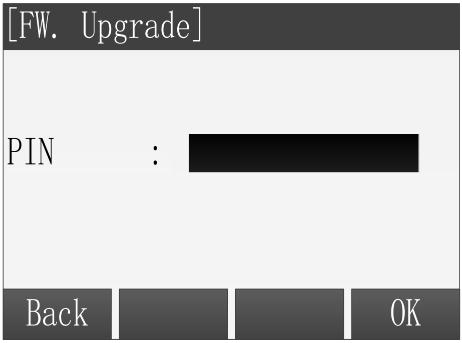
9.2.4 Firmware Upgrade

Warning:

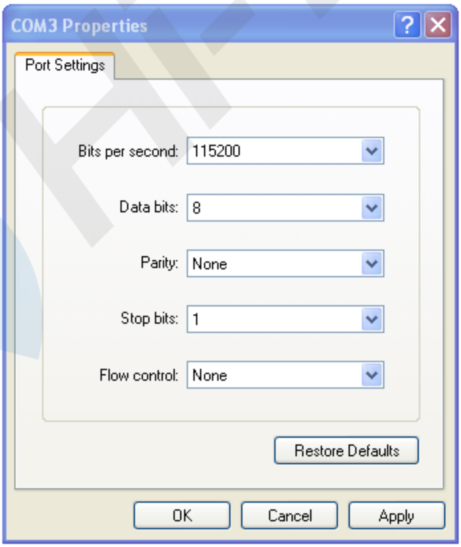
The following functions must be carried out under the guidance of professionals, if the operation is wrong, it may lead to the instrument can't work properly!

This function is prepared for the users to upgrade the instrument software.

1. Input PIN code(82543), and then press key ENT, the instrument will be turned off.



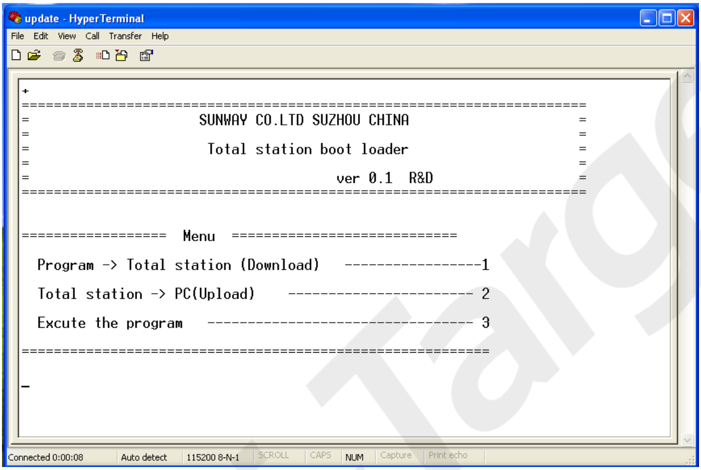
2. Connected to the computer through a serial cable, after installing the correct driver premise, open a HyperTerminal software, configure the correct serial port, it will "bits / sec" is set to 115200, "Data Flow Control" is set to "None" and press OK.



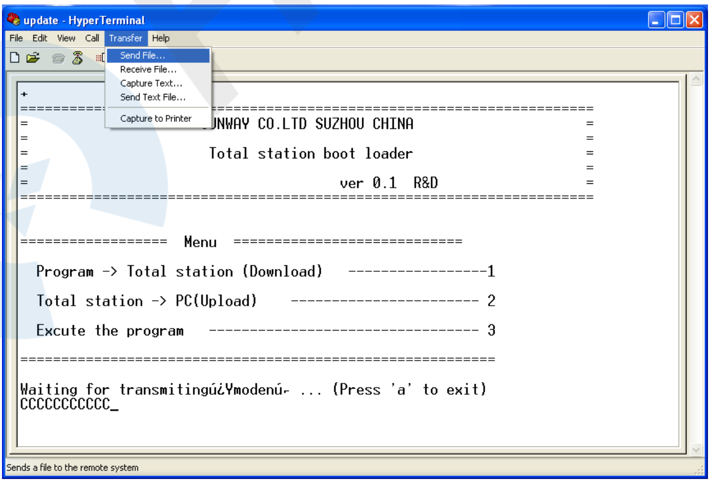
3. Press the power key of the instrument in Hyper Terminal , shown as

follows:

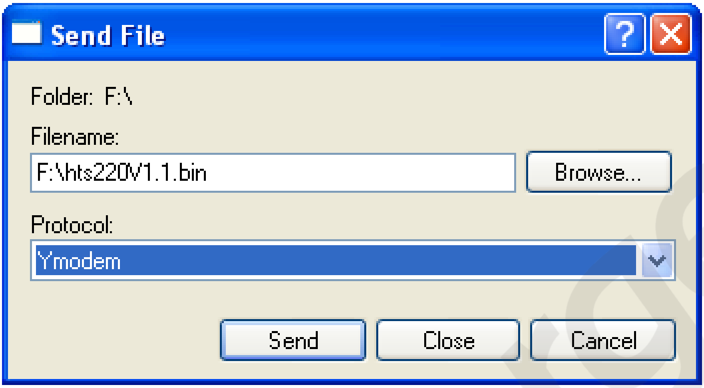
Note: Software upgrade operation must be careful once you select the instrument into the upgrade status; if press "3" in the picture below, you can also resume running the previous program.



4. Press 1 button on the keyboard into waiting to send program state, and then select "send file".



5. Select the new edition total station software, click on "send" button.

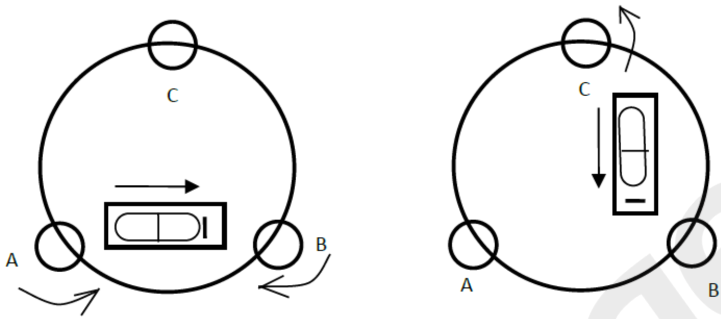


6. It will display the sending application process, and then close the super terminal, starting up after removing the instrument battery and then putting in again. The current software is the new version updated previously.

9.3 Checkout and calibration

The instrument at the factory has to undergo a rigorous inspection and correction, meeting the quality requirements. However, after long transport or environmental change, its internal structure will be some impact. Therefore, the new purchased instruments should be checked and calibrated before surveying to ensure the precision.

9.3.1 Tube level



- **Checkout**

Refer to the chapter "Leveling instrument accurately by tube level" of "Setting up the instrument”

- **Calibration**

1. In the calibration, if the leveling bulbs diverge 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 for 180 °, check that whether the bubble is in the center. If the bubble is not centered, repeat Step (1) until the bubble to the center.
3. Turn the instrument for 90°, use the third foot screw to adjust the bubble to the center.

- Repeat the Steps of checkout and calibration until the bubble in the center in every direction.

9.3.2 Circular level

- **Checkout**

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

- **Calibrtion**

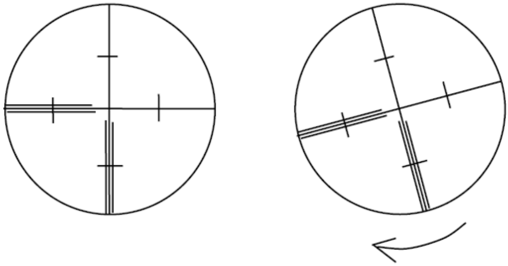
If the bubbles is not in the center, use the correction needle or six angle wrench to adjust the correction screw which under the bubble to make the buble to the center. For calibration, you shall first loosen the calibration screw (1 or 2) which opposite to the direction of the bubble offset, then tighten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

9.3.3 Telescope reticle

- **Checkout**

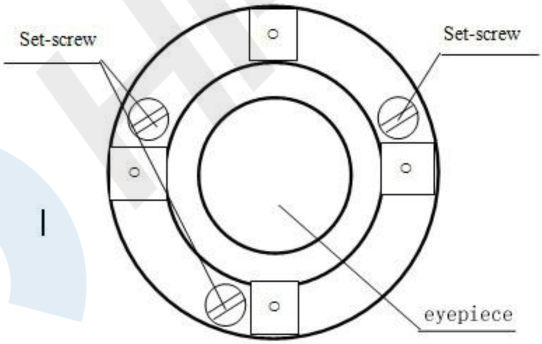
After leveling the instrument find a target A with the telescope, make the center of the crosshair focused on target A and fixed horizontal and vertical brake hand wheel.

1. Rotate telescope vertical micrometer hand wheel, move A point to the edge of the field of view (A 'points).
2. If A moves along the vertical line of the crosshair, but A point 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 pictured, the crosshair is slant, so need to calibrate the reticle.



◆ **Calibration**

1. First, take down the reticle cover between telescope eyepiece and focusing hand wheel, and you can see four fixed screw of the reticle bed (sees attached figure).
2. Unscrew the three fixed screw evenly with screwdriver, rotate the reticle around collimation axis, to make A point on the vertical line of the reticle.
3. Tighten the screw evenly, test the calibration results with the above methods.
4. Put the protective cover back.



9.3.4 The verticality of collimation axis and horizontal axis(2C)

◆ **Checkout**

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

target is within ± 3 °. Precisely level the instrument and switch on it.

2. Make the telescope focused on target A in face left, and read the horizontal angle.

   For example: horizontal Angle L = 10°13 '10".

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

   For example: level Angle R = 190°13 '40".

4. 2 C = L-(R ±180 °) = -30 "≥±20, need to calibrate.

- **Calibration**

1. Use the horizontal micrometer hand wheel to adjust the horizontal angle to the right reading which has eliminated the C.

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

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

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

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

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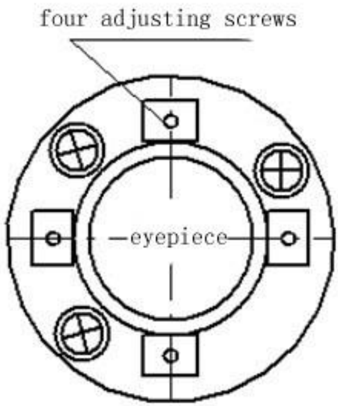


Notice: Check the photoelectric coaxiality after calibrating.

9.3.5 Vertical plate index zero automatic compensation

- **Checkout**

1. Set up and level the instrument, make the direction of the telescope consistent with the line between the center of the instrument and any of the foot screw.
2. The vertical plate index change to zero after switching on, tighten the vertical brake hand wheel, the instrument display the current telescope vertical angle.
3. 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 "compensation beyond!" 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, instruments 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 you find that instrument compensation is useless or abnormal, it should be sent to the factory for checking.

9.3.6 Vertical collimation error (I Angle) and vertical collimation zero value setting

- **Checkout**

1. Boot after settling and leveling the instrument, focus the telescope on a clear goal A, get the face left reading of vertical Angle L.
2. Turn the telescope to aim A and get the reading R for face right.
3. If the vertical zenith angle is 0 °, then i = (L + R-360 °) / 2, if the vertical Angle level is 0. Then i = (L + R-180 °) / 2 or (L + R-540 °) / 2.
4. If | i |≥10", may be you need reset the zero value of vertical index.
5. Operation refers to chapter "Adjust index error".

   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 it still can not accordant with the requirements after repeated operation, it should be sent to the factory for checking.

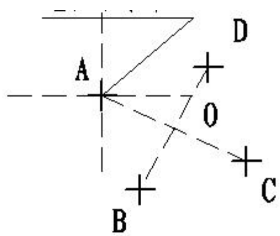
9.3.7 Plummet

- **Checkout**

1. Set up the instrument to the tripod, draw a cross on a white paper and put it on the ground below the instrument.
2. Adjust the focal length of the optical plummet (for the optical plummet) or switch on laser plummet, move the white paper to make the cross in the center in the field of view (or laser flare).
3. Turn the feet screw, make the center mark of the plummet coincide with the cross center.
4. Rotate alidade, every turn of 90 °, observe the contact ratio of the optical plummet and cross center.
5. When rotate the alidade, the center of the optical plummet always coincide with the cross center, there is no need to calibrate. Otherwise you should calibrate as the following methods.

◆ **Calibration**

1. Take down the screw cover between the optical plummet eyepiece and the focusing hand wheel.
2. Fix the white paper with a cross, and mark the points when the instrument rotates 90 °, as the figure shows A, B, C, D points.
3. Connect the diagonal points A、C and B、D with a straight line, the intersection name of the two line is 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.

9.3.8 Instrument additive 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 pressure data, accurately measure the horizontal distance of AB, AC.
3. Setting up and centering the instruments accurately, measure the horizontal distance of BC accurately.
4. You can get the instrument ranging constant:

$$K = AC-(AB + BC)$$

K should be close to 0, if | K | > 5 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

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after strict inspection, you need to calibrate it, 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 the ground to focus on.
- Whether the prism center of B coincide with the instrument centers is the guarantee of checking the accuracy, so, you had better use tripod and all-purpose tribrach, for example, if you change the three hand type prism connector with tribrach, keep the tripod and tribrach stable, just change the prism and the part above tribrach of instrument, and it can reduce the error of misalignment.

9.3.9 The parallelism of collimation axis and photoelectricity axis

- **Checkout**

1. Set up the reflecting prism 50 meters long from the instrument.
2. Focus on the reflecting prism center with telescope crosshair accurately.
3. Open EDM signal, observe maximum value of the signal, and find the center of the launch axis.
4. Check whether the telescope crosshair center coincide with the emission photoelectricity axis center, if they coincide on the whole we can say it qualified.

- **Calibration**

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

9.3.10 No 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. 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, and 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 indicate that the adjustment meet required accuracy. If the offset between the points position and the mark of crosshair is out of limitless, it need to send it to professional department for adjustment.

10 Technical parameters

Function		Unit	Configuration
			HTS-521^{L10}
Telescope			
Imaging		—	Erect
Magnification		×	30
Field of view		—	1 °30′
Min. target distance		m	1.5
Effective aperture		mm	40/50(EDM)
Angle measurement(Hz, V)			
Angle measurement accuracy		(″)	2.0
Angle measurement method		—	Absolute encoder
Minimum reading		(″)	1
Distance measurement（IR）			
Range	Single prism	km	5
	Triple prism	km	6
	No-prism[1]	m	1000
Time	Repeated	s	0.5
	Tracking	s	0.3
Minimum Display		mm	0.1
Accuracy	Prism	mm	$\pm(2+2\times10^{-6}D)$
	No-prism	mm	$\pm(3+2\times10^{-6}D)$

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Tilt compensator		
Compensation method	—	Biaxial type
Compensation range	（′）	±3
Communication port	—	RS232C
U disk interface	—	YES
Bluetooth	—	YES
Temperature and pressure sensors	—	YES
Display		
Screen	—	Both sides (320*240, Colorful)
Illumination	—	Support
Laser Plumb		
Laser (optional) Laser Plumb	—	Wavelength 635nm Maximum output power (adjustable): not less than 0.4 mW, not more than 1.0 mW
level		
Tubular Level	（″）/2 mm	30
Round level	（′）/2 mm	8
Built-in applications	—	Support
Battery supply		
Type	—	Rechargeable High-energy lithium battery
Voltage	V	7.4

Power		W	＜ 2.2
Battery capacity		mAh	3000
Working duration	Dist + Angle	h	8 （At + 20 ° C, dist once per 30s and keep measuring Angle）

1. It means good meteorological conditions (visibility not less than 30km), Target is KODAK CAT NO.E1527795 (90% reflective surface).

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11 Attachment A File transfer format description (local format)

These following examples to instruct exported file format

STA ST001,1.205,AD

XYZ 100.000,100.000,10.000

BS BS001,1.800

HVD 98.2354,90.2314,10.235

SC A1,1.800,CODE1

NEZ 104.662,99.567,10.214

SD A2,1.800,CODE1

HVD 78.3628,92.4612,4.751

SA A3,1.800,CODE1

HV 63.2349,89.2547

Each record consists of two rows:

The information in the first line of which is parsed as: record type, point name, elevation, code

Such as:

STA refers to station point

BS refers to back sight

SC refers to coordinate data

SD refers to distance measurement data

SA refers to Angle measurement data

The second line information: data types, data records

Such as:

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

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

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

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

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