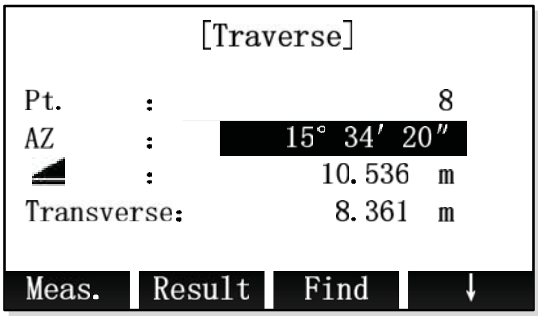
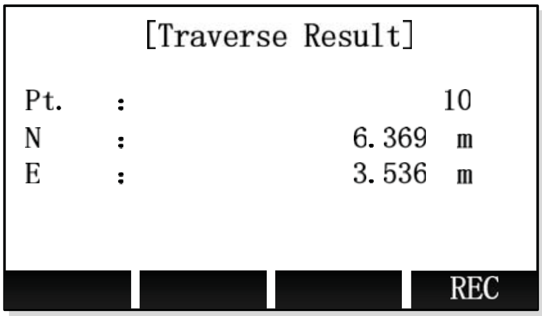
⑤ After setting known point, press [▼]\[▲] key to move focus to the "AZ", " " and "Transverse" field, input the content, then press [F2](Result) to calculate and show the traverse result.	[▲]\[▼] + Input content + [F2]	
⑥ Input the name of result point in the [Traverse Result] and press [F4](REC) to 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.

11.2 Inverse

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

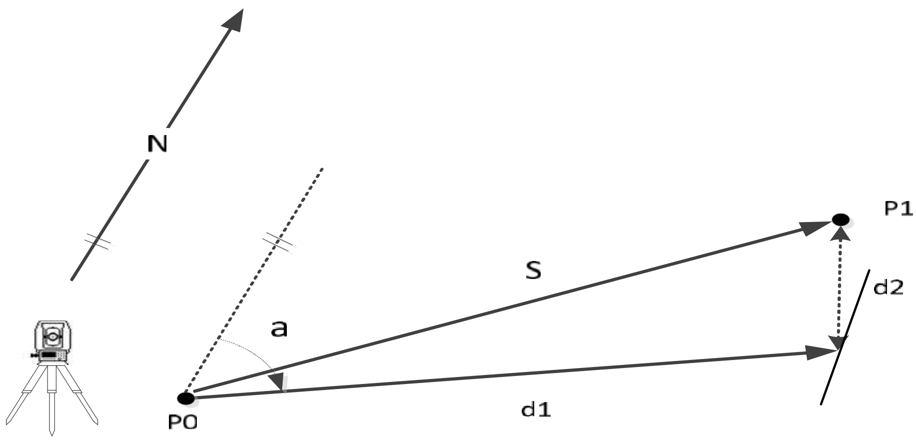


Figure 11.2 Inverse Diagram

Known

P0 First known point
P1 Second known point

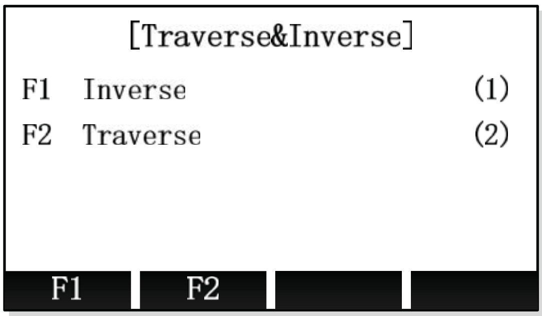
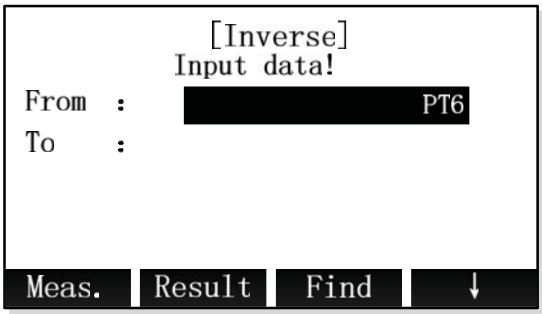
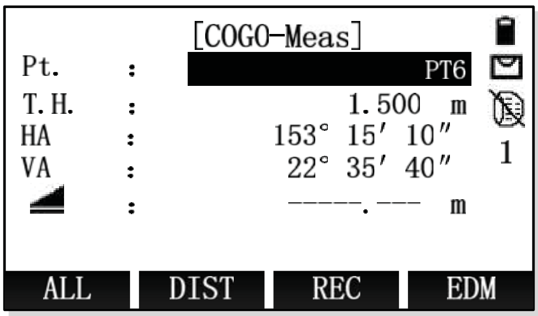
Unknown

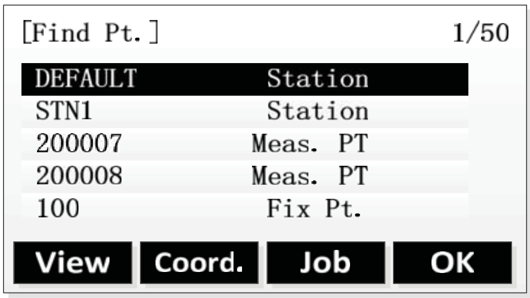
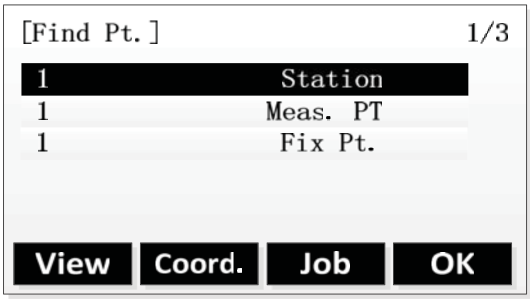
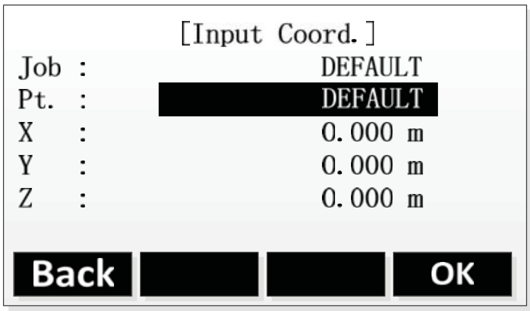
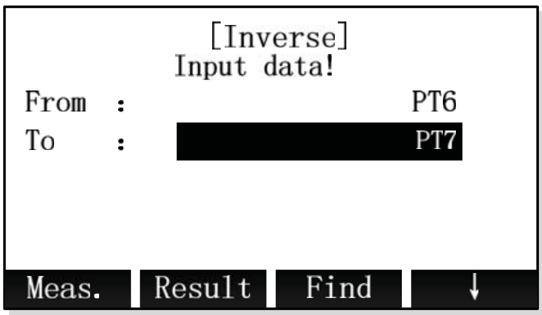
a Direction from P0 to P1

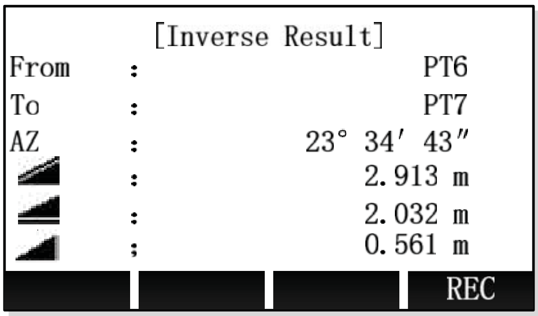
S Slope distance between P0 and P1

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 subapplication.	[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 [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.	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	[F1](List)	B: Select the point by list in the

[Traverse] screen, use the key [▲]\[▼] to select a Known point in the point list for inverse calculation, then press [F4](OK) to be done.	+ [F4](OK)	instrument. 
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. 
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 calculate the inverse	[▲]\[▼] + [F2]	

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 previousmenu.

※ The result point is plane data.

11.3 Bearing-Bearing Intersection

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

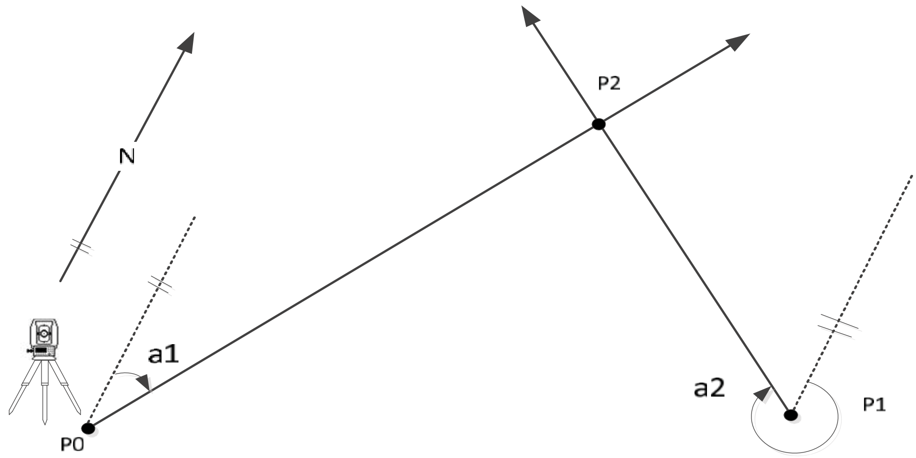


Figure 11.3 BRG-BRG Diagram

Known

P0 First known point

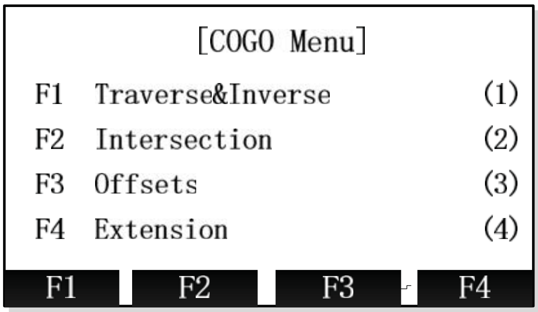
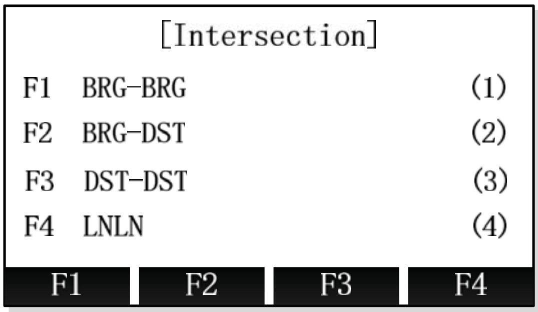
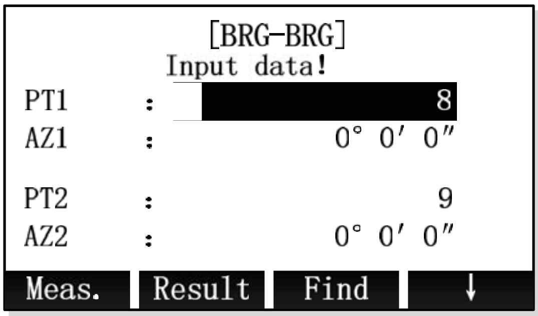
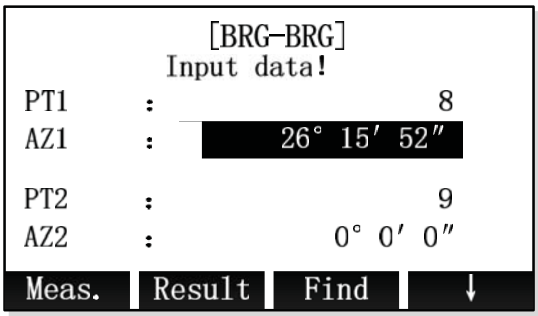
P1 Second known point

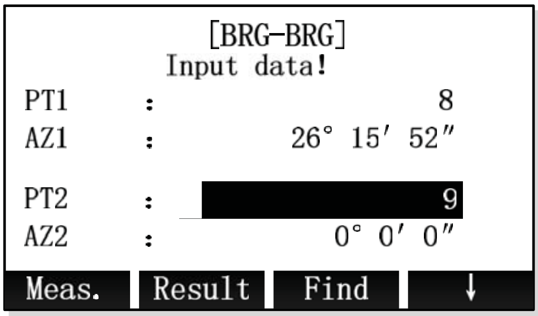
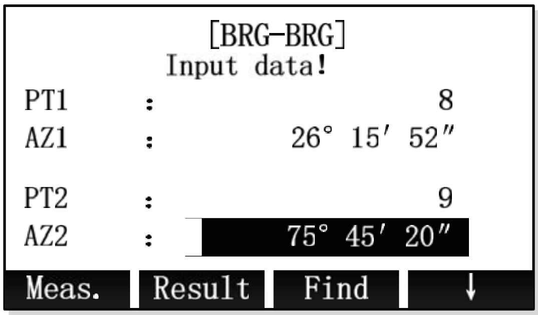
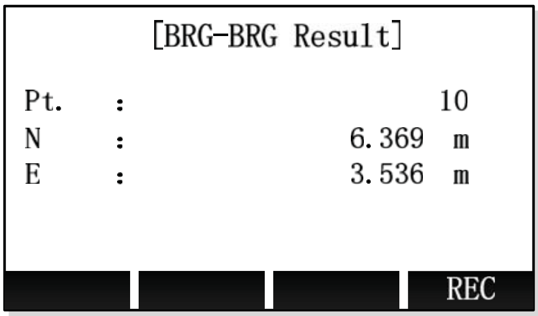
a1 Direction from P0 to P2

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 subapplication.	[F2] or [2] [F1] or [1]	 
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".	Input name of first point	
③ Move the focus to "AZ1" by using [▼] and input the first bearing after set first point.	[▼] + Input first bearing	

④ Move the focus to "PT2" by using [▼] to setting second point.	[▼] + Set second point	
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 previousmenu.

※ The result point is plane data.

11.4 Bearing-Distance Intersection

Use the bearing-distance (BRG-DST) subapplication 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.

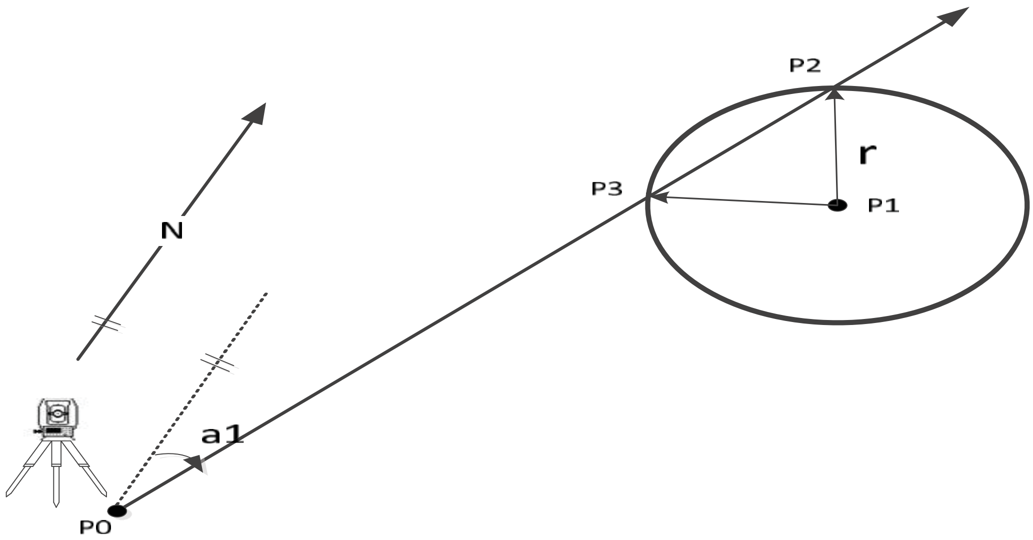


Figure 11.4 BRG-DST Diagram

Known

P0 First known point

P1 Second known point

a1 Direction from P0 to P2 or P3

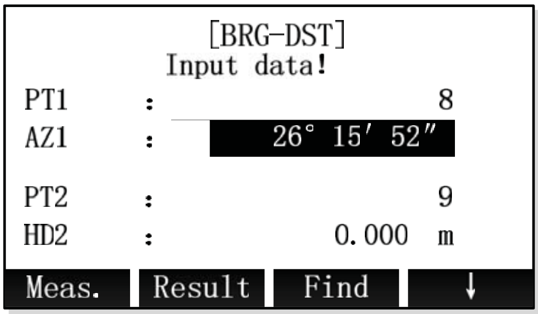
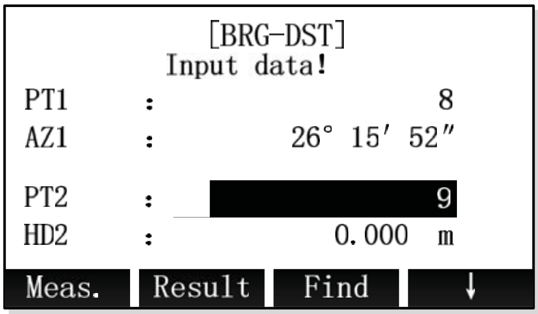
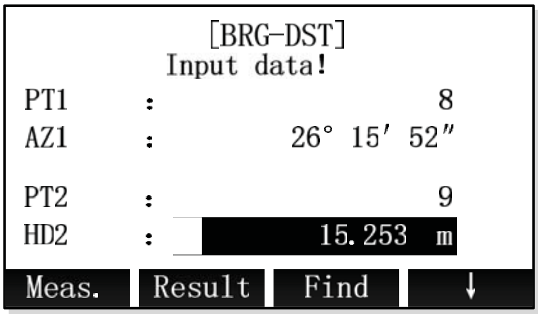
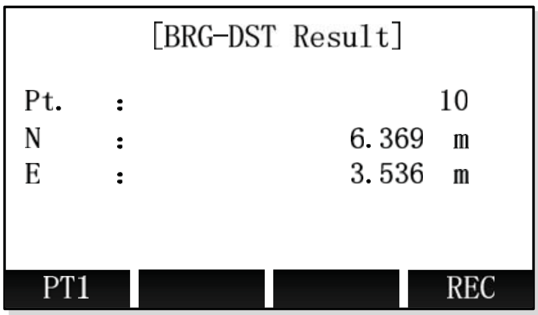
r Radius, as the distance from P1 to P2 or P3

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]	[Intersection] F1 BRG-BRG (1) F2 BRG-DST (2) F3 DST-DST (3) F4 LNLN (4) F1 F2 F3 F4
② Input the name of first point in "PT1" field. ※ There are four ways to get the known point for BRG-DST	Input name of first point	[BRG-DST] Input data! PT1 : 8 AZ1 : 0° 0′ 0″ PT2 : 9 HD2 : 0.000 m Meas. Result Find ↓

calculation. Please refer to the step ② in the "COGO Traverse".		
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	[F2]	 

Result] and press [F4](REC) to save the point. Press [F1] to switch to view results.		

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

※ The result point is plane data.

11.5 Distance-Distance Intersection

Use the distance-distance (DST-DST) subapplication 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.

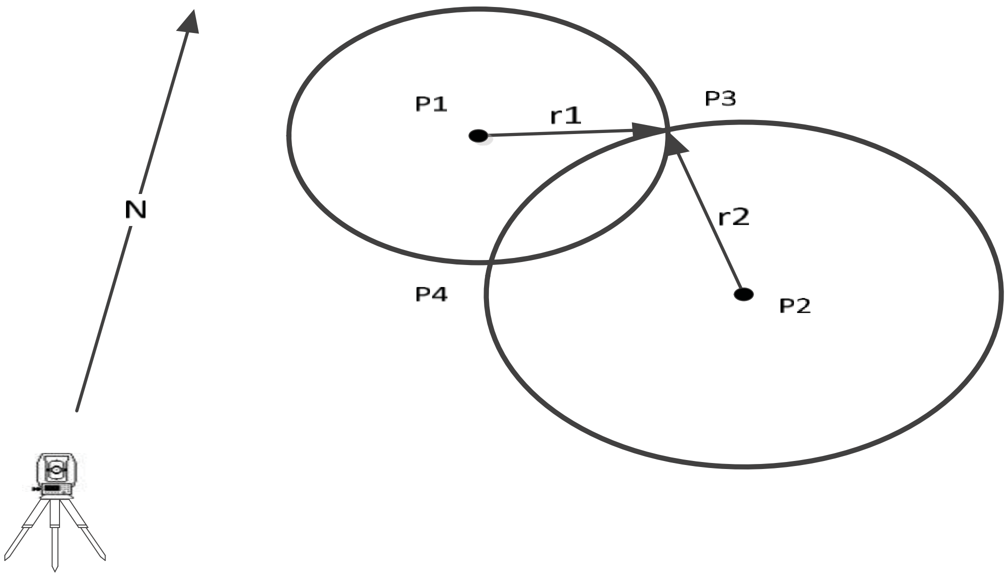


Figure 11.5 DST-DST Diagram

Known

P1 First known point

P2 Second known point

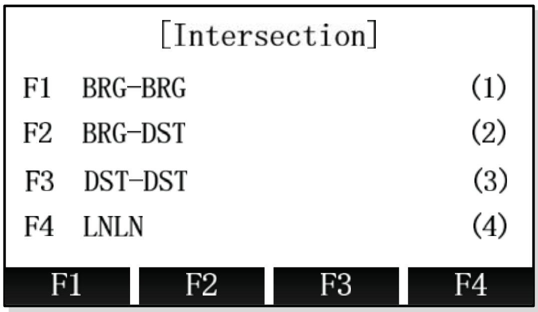
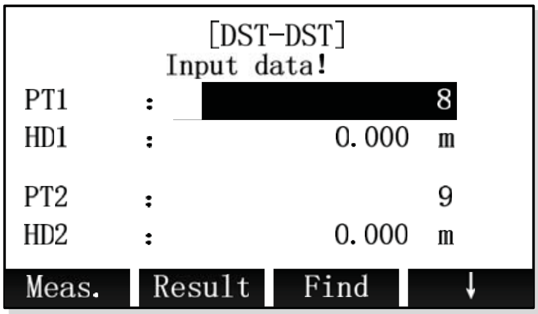
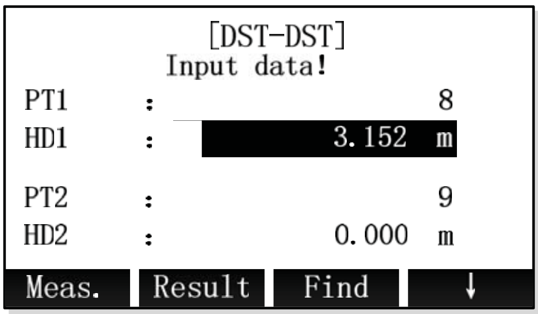
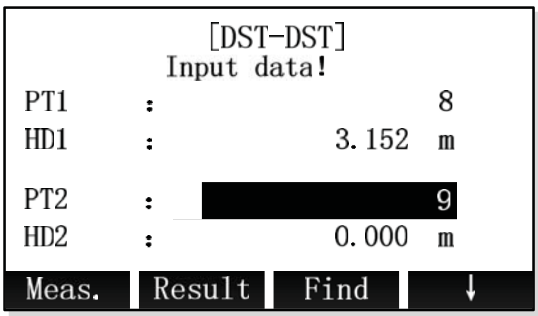
r1 Radius, as the distance from P1 to P3 or P4

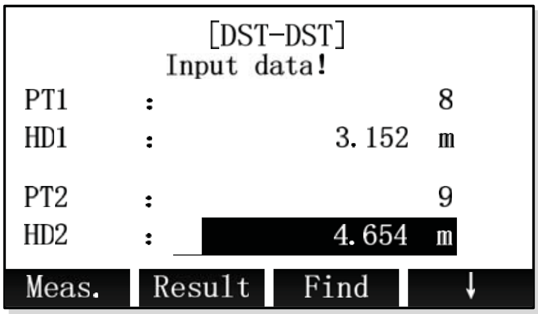
r2 Radius, as the distance from P2 to P3 or P4

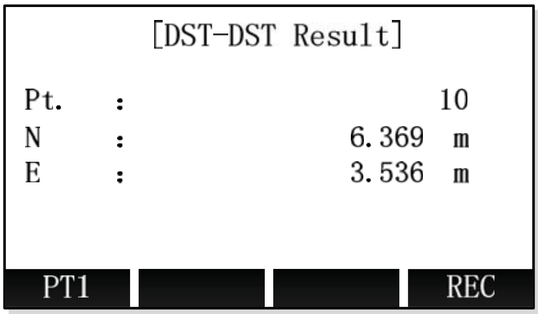
Unknown

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 subapplication.	[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 ② in the "COGO Traverse".	Set first point	
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	

<table>
<tr>
<td>⑤ Move the focus to “HD2” by using [▼] and input the second radius after set second point.</td>
<td>[▼]
+
Input second radius</td>
<td>
</td>
</tr>
<tr>
<td>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.</td>
<td>[F2]</td>
<td>


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

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

※ The result point is plane data.

11.6 Line-Line Intersection

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

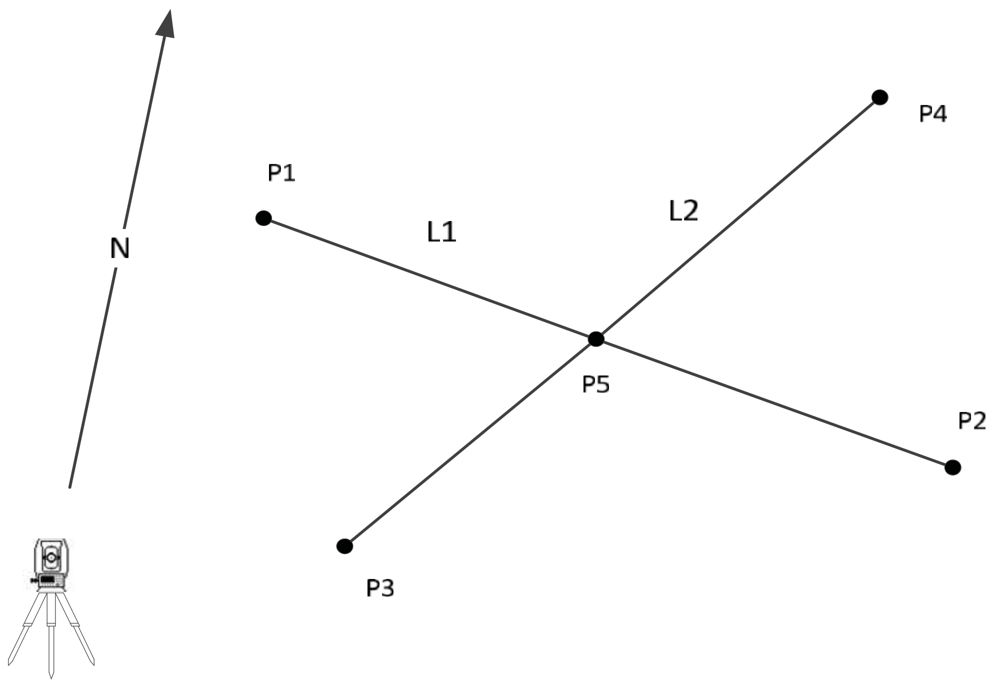


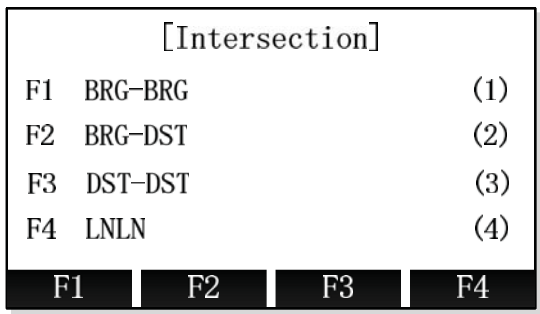
Figure 11.6 LNLN Diagram

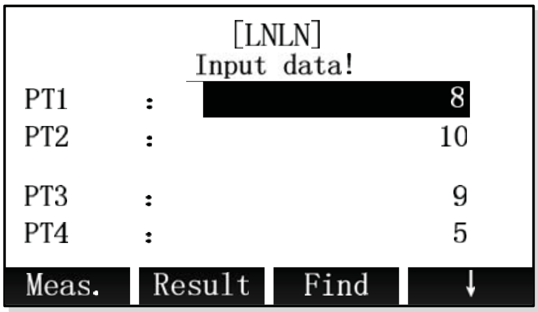
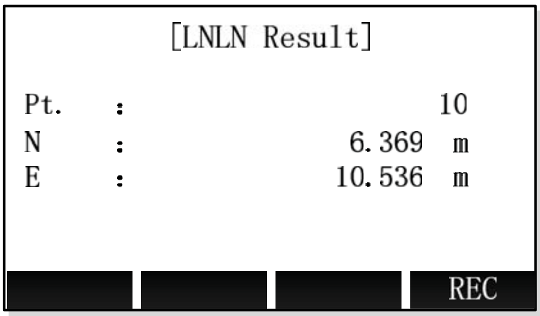
Known

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 subapplication.	[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 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 [LNLN Result] and press [F4](REC) to save the point.	[F2]	

※ In all of the above operation, press [ESC] to return to the previousmenu.
※ The result point is plane data.

11.7 Distance-Offset

Use the distance-offset (DistOff) subapplication 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.

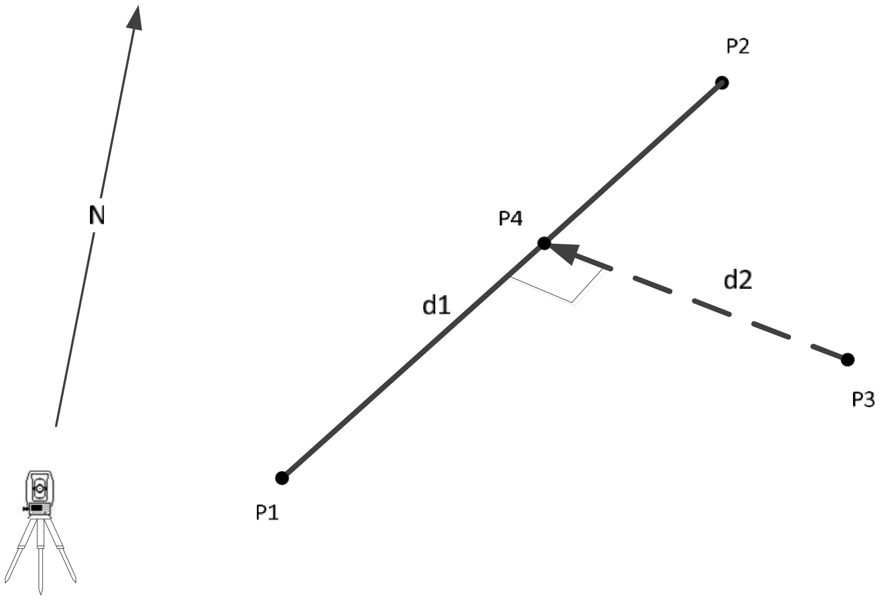


Figure 11.7 DistOff Diagram

Known

P1 Start point

P2 End point

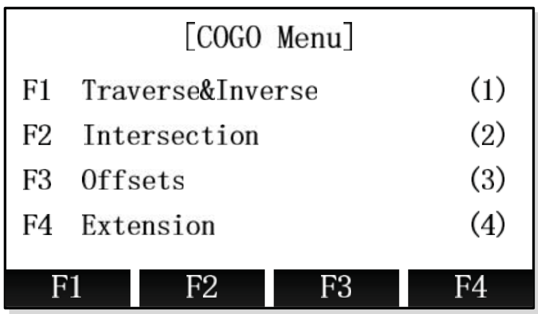
P3 Offset point

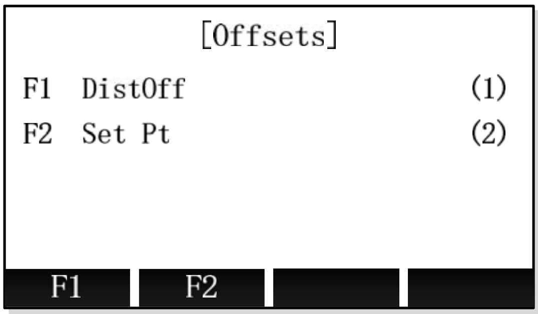
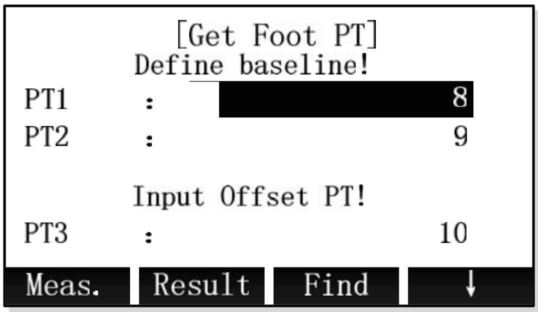
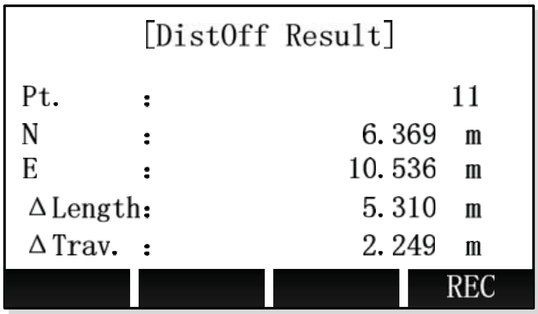
Unknown

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 DistOffsubapplication.	[F3] or [3]	

	[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 previousmenu.

※ The result point is plane data.

11.8 Set Point

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

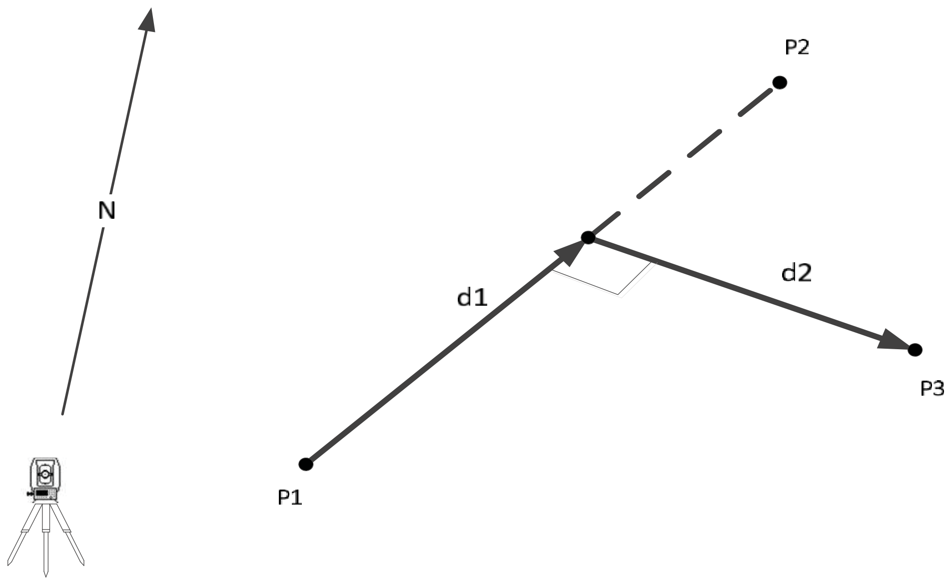


Figure 11.8 Set Point Diagram

Known

P1 Start Point

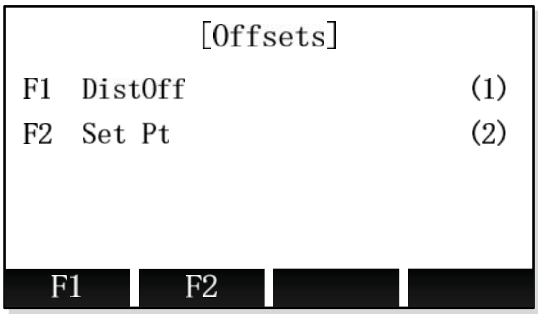
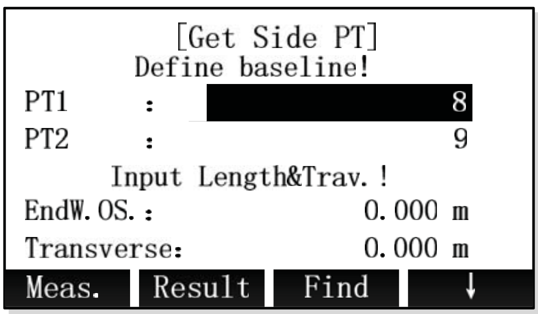
P2 End Point

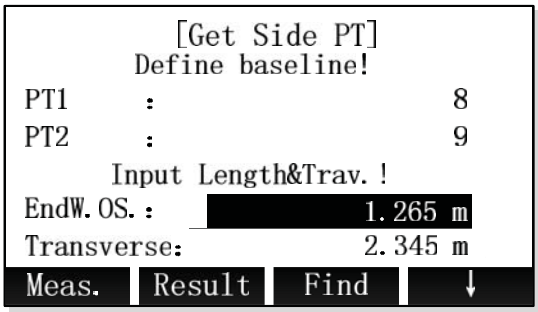
d1 △Line

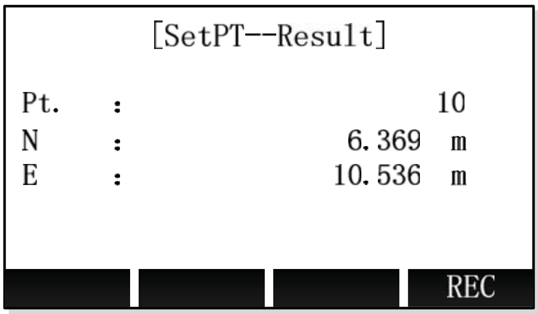
d2 △Offset

Unknown

P3 COGO point

Steps	key	Display
① In the [Offsets] screen, press [F2] or [2] to enter the Set Point subapplication.	[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	Set known points	

<table>
<tr>
<td>refer to the step ② in the “COGO Traverse”.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>③ Then baseline is defined, press [▼] key to move the focus down and input the longitudinal and offset distance.</td>
<td>[▼]
+
Input distance</td>
<td>
</td>
</tr>
<tr>
<td>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.</td>
<td>[F2]</td>
<td>
</td>
</tr>
</table>

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

※ The result point is plane data.

11.9 Extension

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

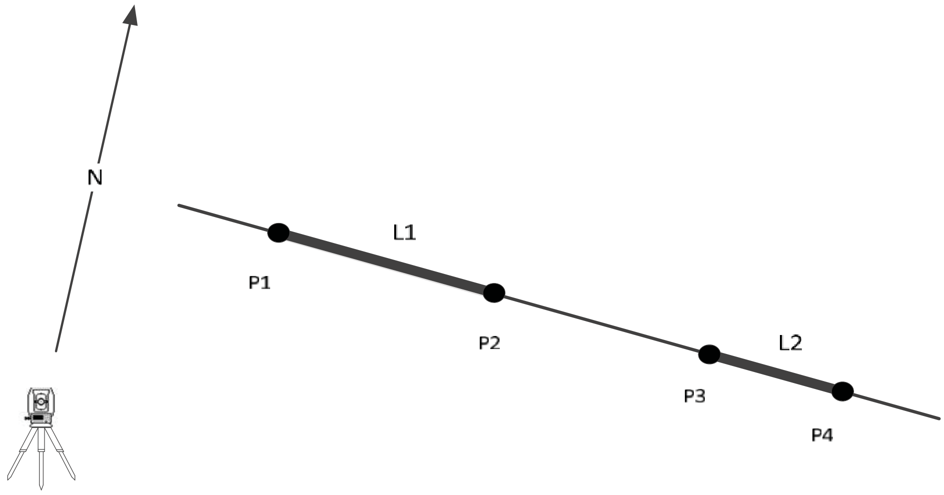


Figure 11.9 Extension Diagram

Known

P1 Baseline Start Point

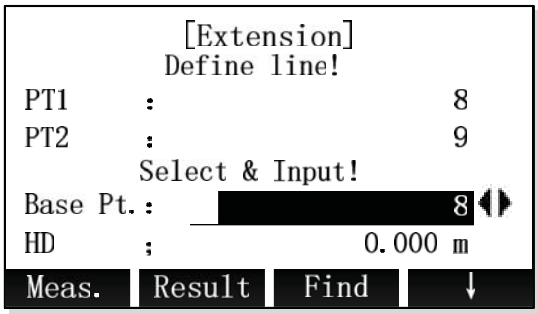
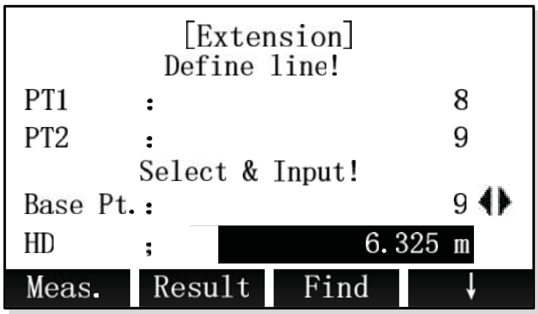
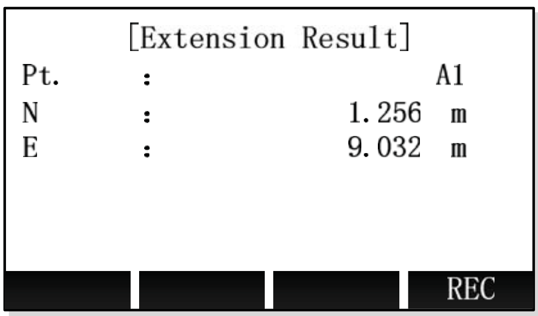
P2 Baseline End Point

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]	[COGO Menu] F1 Traverse&Inverse (1) F2 Intersection (2) F3 Offsets (3) F4 Extension (4) F1 F2 F3 F4
② Set the baseline start point and end point. ※ There are four ways to get the known point for Extension calculation. Please refer	Set known points	[Extension] Define line! PT1 : 8 PT2 : 9 Select & Input! Base Pt. : 8 HD : 0.000 m Meas. Result Find ↓

to the step ② in the "COGO Traverse".		
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	
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]	

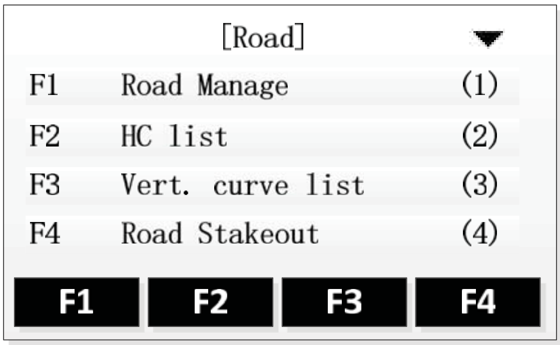
※ In all of the above operation, press [ESC] to return to the previousmenu.

※ The result point is plane data.

12. Road

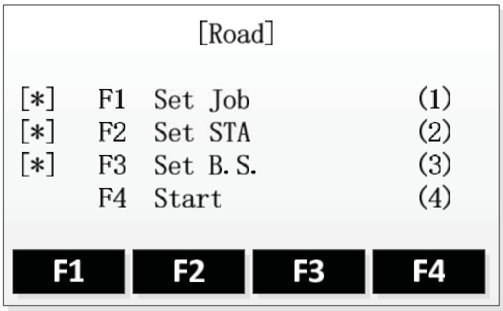
Using this program, user can simplely define a straight line, circular curve or transition curve as reference, to do surveying or staking out.

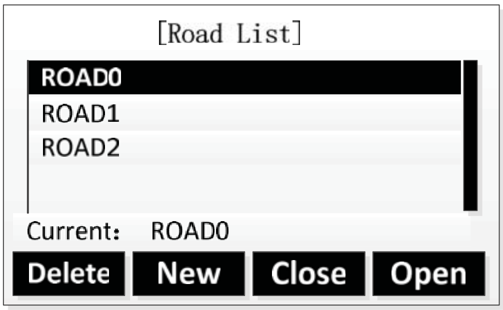
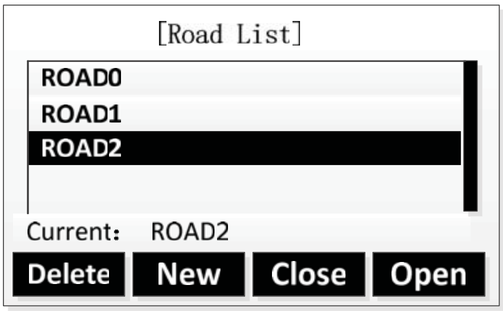
Setting job, setting station and setting backsight must be done before road define and staking out.



12.1 Road Manage

User can create some different roads. The data between different roads is individual.

Steps	Key	Display
① Pressing key [F4] enter road function menu. For job setting, station setting and BS setting can refer early content.	[F4]	
② Pressing key [F1] enter road manage.	[F1]	

<table>
<tr>
<td>③ Program shows roads list in memory, and current used road.
[Delete]: Delete selected road. ※[1]
[New]: Create new road。
[Close]: Close current used road.
[Open]: Open selected road to use.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>④ Use arrow key up and down to select the road, then press key [F4] to open it. Selected road is open as current road.</td>
<td>[F2]</td>
<td></td>
</tr>
<tr>
<td colspan="3">※[1]: Cuurent used road cannot be delete directly, it needs to be close first.</td>
</tr>
</table>

12.2 Horizontal curve definition

There are two ways to define the horizontal curve: one is ‘elements method’, another is ‘intersection method’.

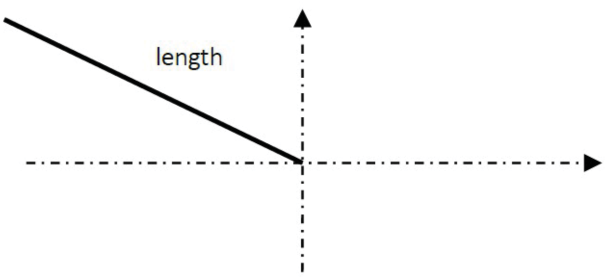
NOTE: Max amount of items of horizontal curve is 30.

- **Using elements method define horizontal curve.**

  Elements method constists of the following elements: start point, straight line, curcular curve and transition curve.

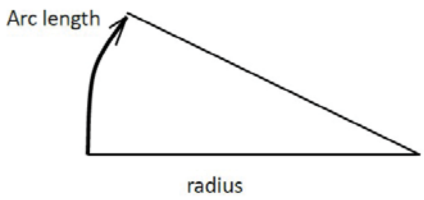
  ➢ Straight line

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



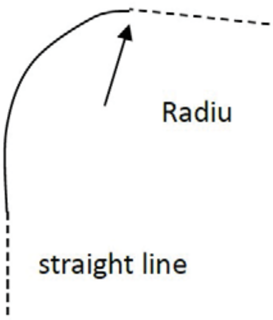
Straight line includes azimuth and distance, and the distance should nobe negative.

➢ Circular curve



Curcular curve includes radius and arc length. The rules of radius definition:。Along the arc direction, radius is positive if arc is clockwise; radius is negative if arc is anti-clockwise. Arc length should not be negative.

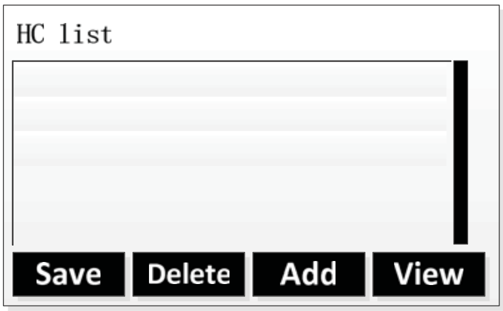
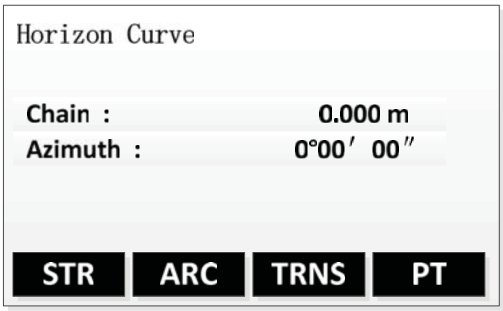
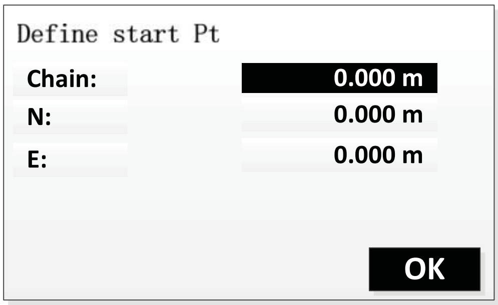
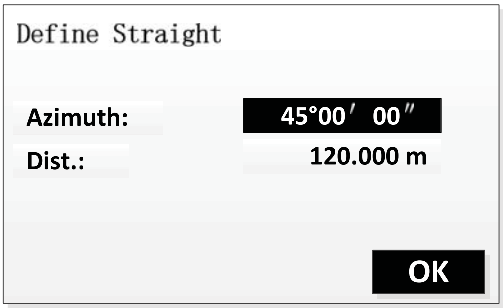
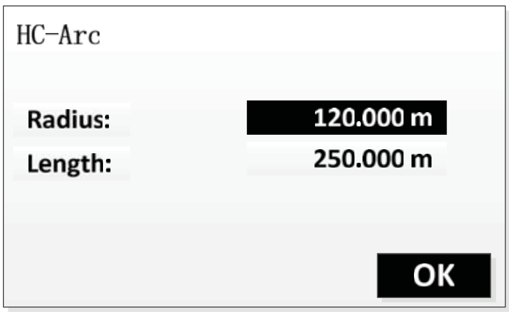
➢ Transition curve

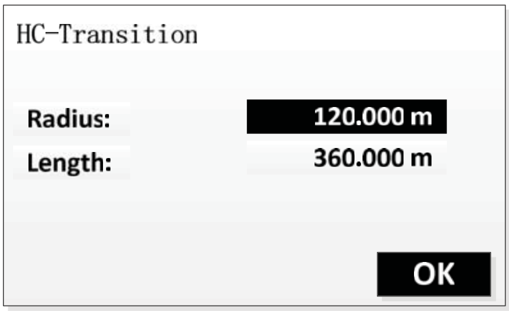
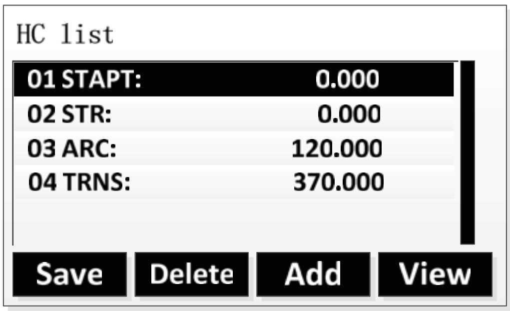
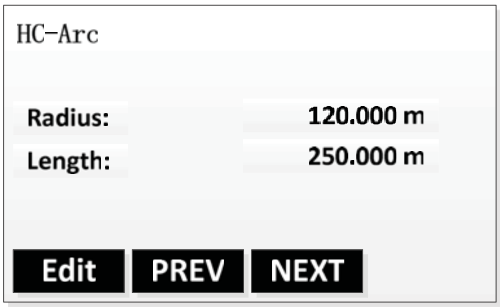
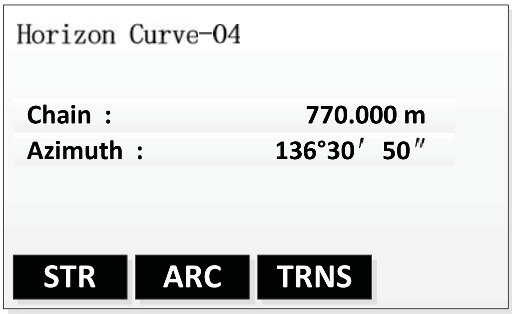
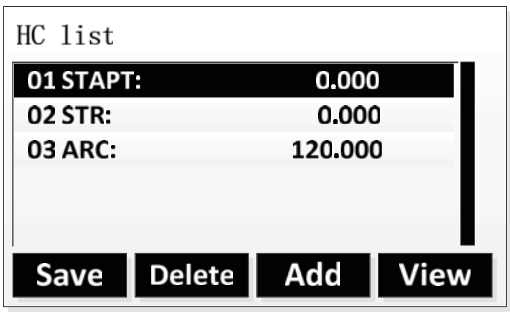


Transition curve includes the minimum radius and arc length. The rules of radius are same to curcular curve radius. Arc length should no be negative.

Steps:

Steps	Key	Display
① Pressing key [F4] enter Road functions menu.	[F4]	[Road] [*] F1 Set Job (1) [*] F2 Set STA (2) [*] F3 Set B.S. (3) F4 Start (4) F1 F2 F3 F4
② Pressing key [F2] enter horziontal curve list.	[F2]	[Road] F1 Road Manage (1) F2 HC list (2) F3 Vert. curve list (3) F4 Road Stakeout (4) F1 F2 F3 F4

③ Progam shows current road's hroziton curve data. Pressing key [F3](Add) enter editing.	[F3]	
④ If haven't input start poin, it will enter start point definition window, no matter what element you choosed.	[F1]~[F3]	
⑤ Input start point chain number and N, E data. Pressing key [F4] return previous window when input finished.	[ENT] [F4]	
⑥ Pressing key [F4] enter straight line definition window. Pressing key [F4] return previous window when input finished.	[F1] [ENT] [F4]	
⑦ Pressing F2 enter editing circular curve window. Pressing key [F4] return previous window when input finished.	[F2] [ENT] [F4]	

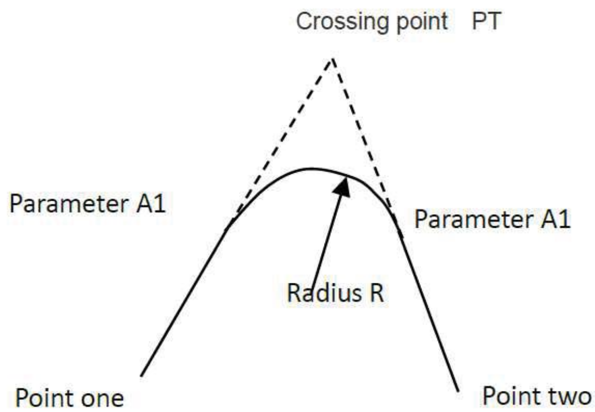
⑧ Pressing F3 enter editing transition curve window. Pressing key [F4] return previous window when input finished.	[F3] [ENT] [F4]	
⑨ When finished all elements input, pressing [ESC] return back to horizontal curve list window. In list, display type + start chain number for every element.	[ESC]	
⑩ Pressing [View] can see detail of selected element. Pressing [PREV], [NEXT] can see through elements data of current road. Pressing [Edit] can edit data of selected element.	[F4]	
⑪ Pressing [Add] can add more horizontal curve data in road.	[F3]	
⑫ Pressing [Delete] will delete selected element.※1	[F2]	

⑬ Pressing [Save] will save road data and return back to road menu.。 Pressing [ESC] will also save road data.	[F1]	Road Saved!
※[1]: Cannot delete start point.		

- **Using intersection method define horizontal curve.**

The intersection point includes coordinate, radius, parameter A1 and A2 of transition curve. The radius and A1, A2 should not be negative. If radius not being zero, it will insert an arc with input radius between current point and next point. If A1, A2 not being zero, it will insert and transition curve with sepecified length between straight line and the arc.

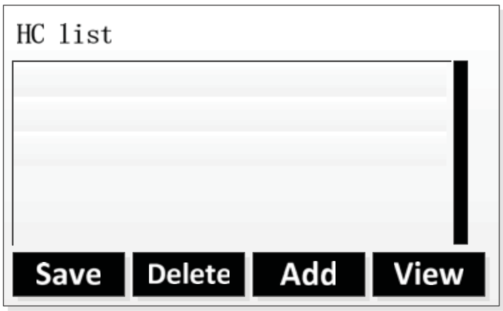
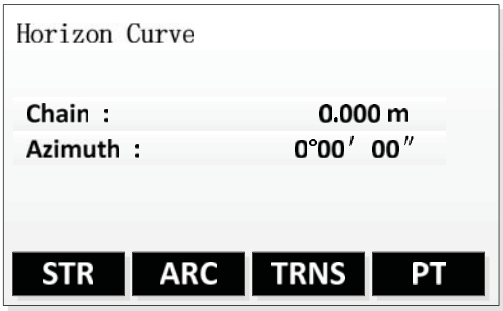
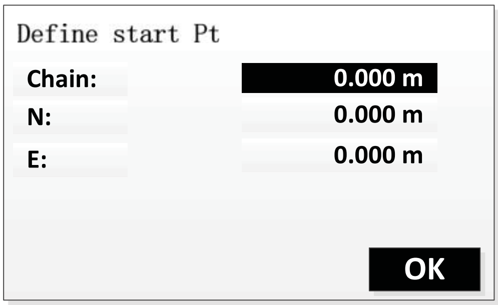
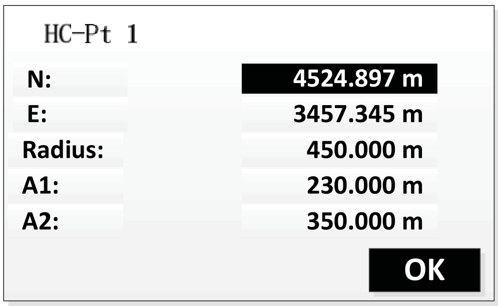
Don't mix the intersection point with straight line, circular curve or transition curve, otherwise the calculation will not be correct.

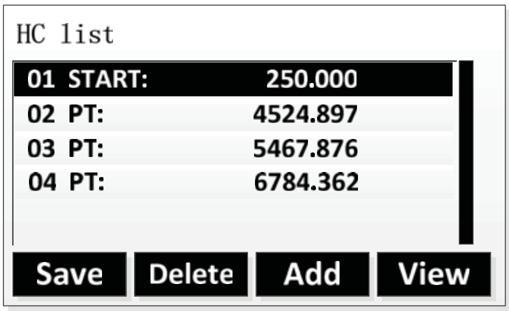
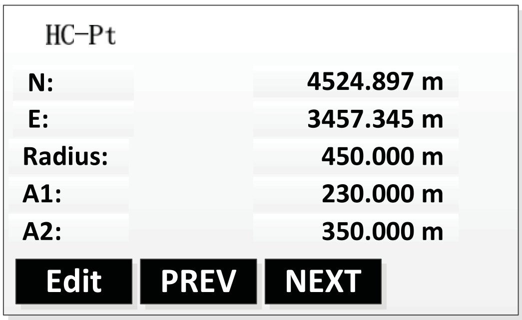
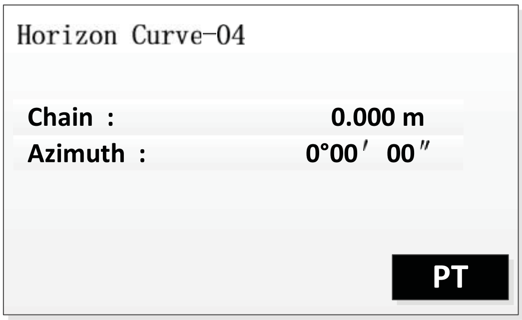
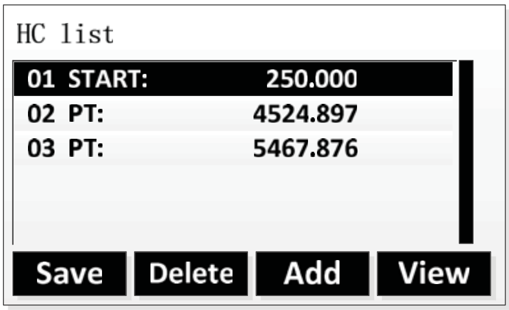


Follow is the intersection method for definition of horizontal curve steps.

Steps:

Steps	Key	Display
① Pressing key [F2] enter Horziontal curve editing.	[F4]	[Road] [*] F1 Set Job (1) [*] F2 Set STA (2) [*] F3 Set B.S. (3) F4 Start (4) F1 F2 F3 F4

② Pressing key [F2] enter horziontal curve list.	[F2]	
③ Progam shows current road's hroziton curve data. Pressing key [F3](Add) enter editing.	[F3]	
④ Press [F4] to entering intersection point.If haven't input start poin, it will enter start point definition window.	[F4]	
⑤ Input start point chain number and N, E data. Pressing key [F4] entering intersection point input window after input finished.	[ENT] [F4]	
⑥ Entering intersection point data, pressing [OK] go to next one input. ※1	[ENT] [F4]	

⑦ When finished all points input, pressing [ESC] return back to horizontal curve list window. In list, display type + N value for every point.	[ESC]	
⑧ Pressing [View] can see detail of selected point. Pressing [PREV], [NEXT] can see through points data of current road. Pressing [Edit] can edit data of selected point.	[F4]	
⑨ Pressing [Add] can add more horizontal curve data in road.	[F3]	
⑩ Pressing [Delete] will delete selected element.※2	[F2]	
⑪ Pressing [Save] will save road data and return back to road menu.。 Pressing [ESC] will also save road data.	[F1]	

※ [1]: When input A1, A2 according to curve length L1, L2, use follow formula to calculate A1, A2:

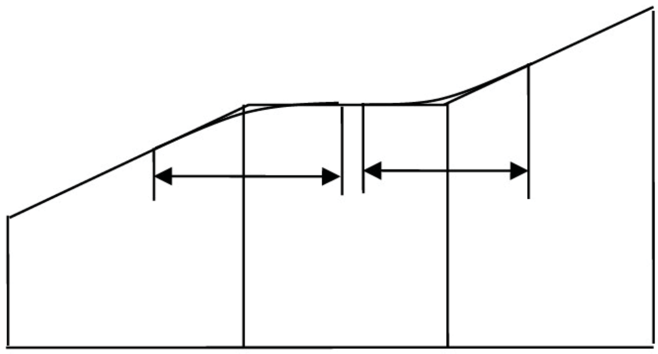
$$A_1 = \sqrt{L_1 \cdot R}$$

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

※ [2]: Cannot delete start point.

12.3 Vertical curve definition

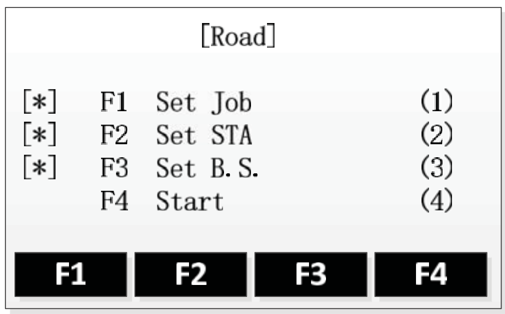
Vertical curve consist of a set of intersection points. Intersection point includes chain number, elevation and curve length. The curve length of start point and last point must be zero.

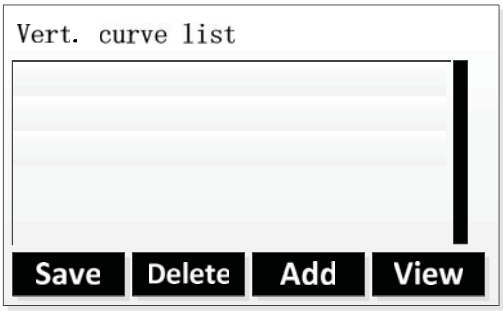


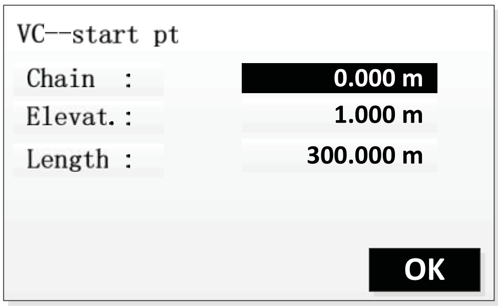
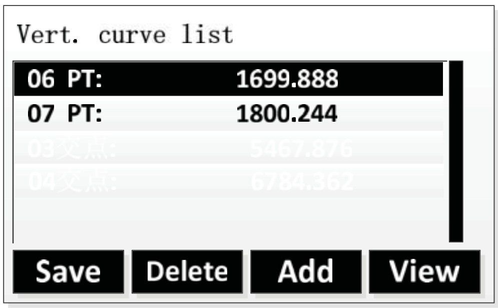
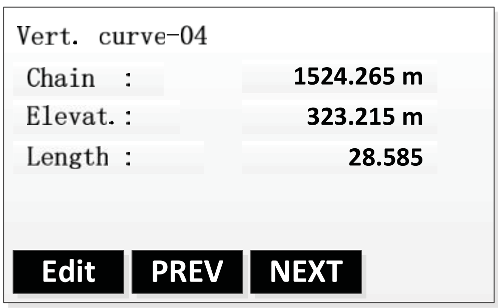
Piles number	1000	1300	1800	2300
Elevation	50	70	60	90
Distance	0	300	300	0

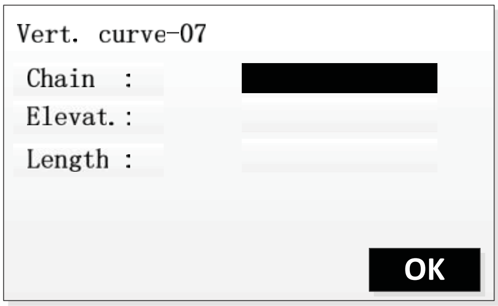
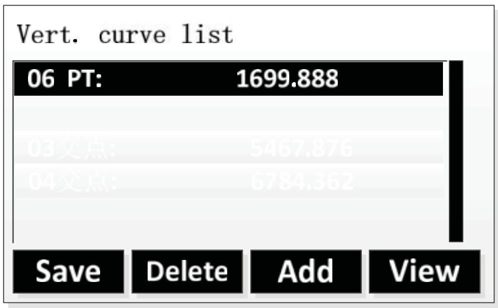
NOTE: Max amount of items of vertical curve is 30.

Steps:

Steps	Key	Display
① Pressing key [F4] enter Road functions menu.	[F4]	

<table>
<tr><td>② Pressing key [F3] enter vertical curve list.</td><td>[F3]</td><td></td></tr>
<tr><td>③ Progam shows current road’s vertical curve data. Pressing key [F3](Add) enter editing.</td><td>[F3]</td><td></td></tr>
<tr><td>④ If haven’t input start poin, it will enter start point definition window.
Input start point’s chain number, elevation and length.
Pressing [F4] go to next one input.</td><td>[ENT]

[F4]</td><td></td></tr>
<tr><td>⑤ Pressing [ESC] return back to vertical curve list after input. In list, display type + N value of each point.</td><td>[ESC]</td><td></td></tr>
<tr><td>⑥ Pressing [View] can see detail of selected point.
Pressing [PREV], [NEXT] can see through points data of current road.
Pressing [Edit] can edit data of selected point.</td><td>[F4]</td><td></td></tr>
</table>

⑦ Pressing [Add] can add more vertical curve data in road.	[F3]	
Pressing [Delete] will delete selected element. ※1	[F2]	
⑨ Pressing [Save] will save road data and return back to road menu.。 Pressing [ESC] will also save road data.	[F1]	
※1: Cannot delete start point.		

12.4 Road Stakeout

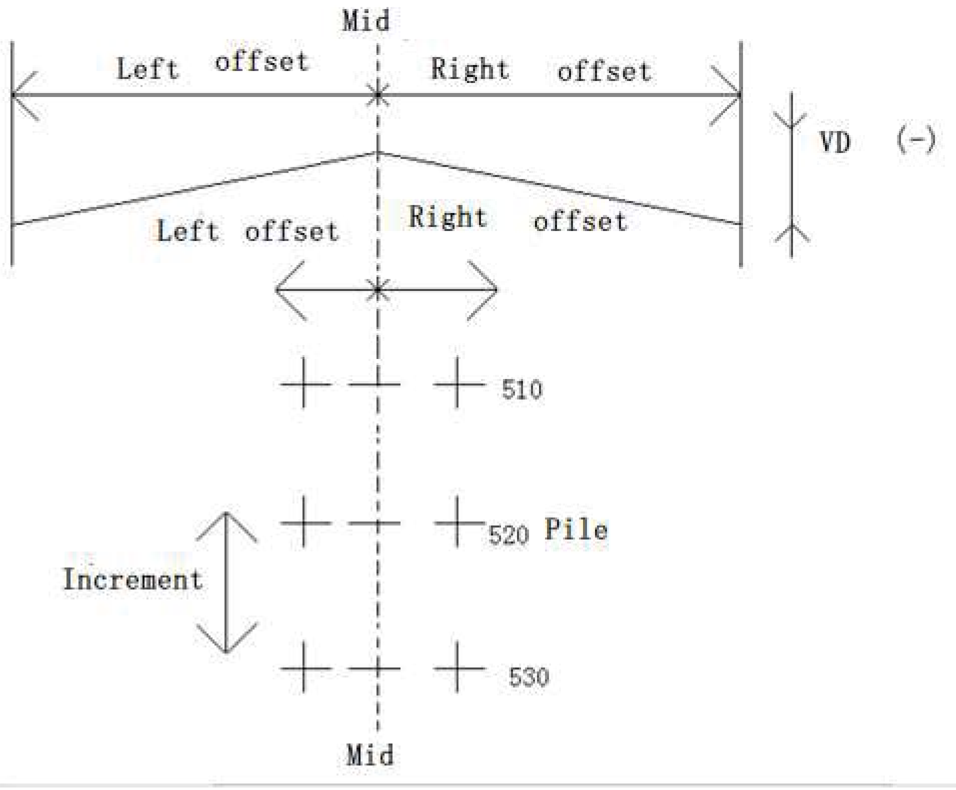
User can do road stakeout according to specific chain number and offset.

Before doing stakingout, user must define horizontal curve. If need calculating elevation, user must define vertical curve either.

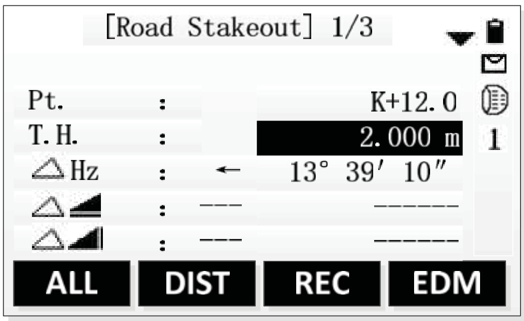
The rules of stakeout data are defined as shown below:

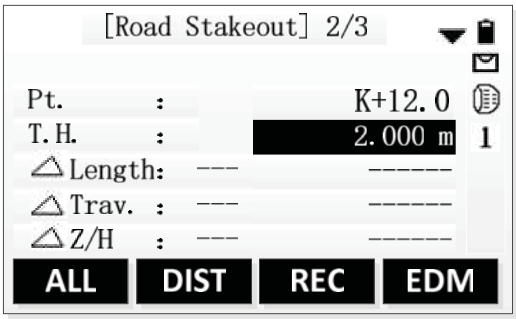
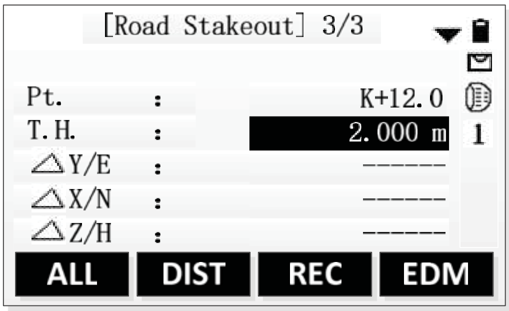
Offset left: the horizontal distance between left pile and center line; Right: the horizontal distance between right pile and center line.

Elevation left(right): the vertical distance between lefit(right) pile and center line.



In doing stakeout, center pile should be done first, then left and right pile.
Like point stakeout, there are three methods to do stakeout:

Method	Definition	Display
Polar staketou	△Hz Direction difference: Positve if measuring point being right side of target point. △ Horizontal distance difference: Positive if measuring point far away target point. △ Height difference: Positive if measuring point above of target	

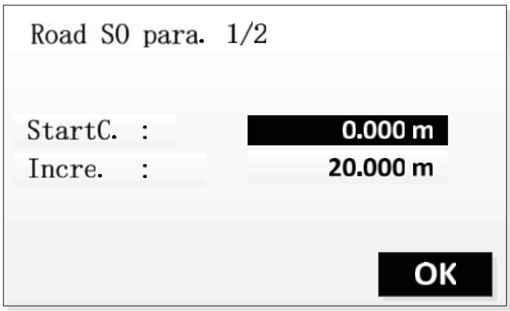
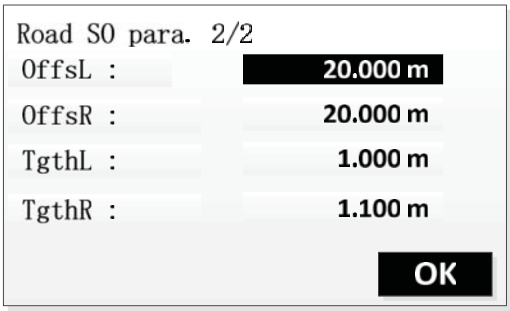
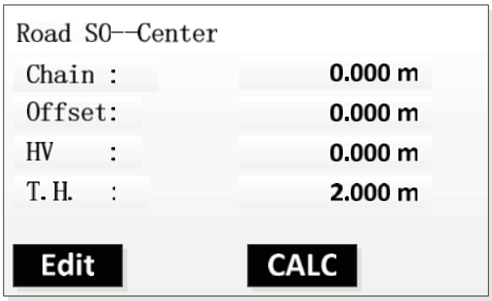
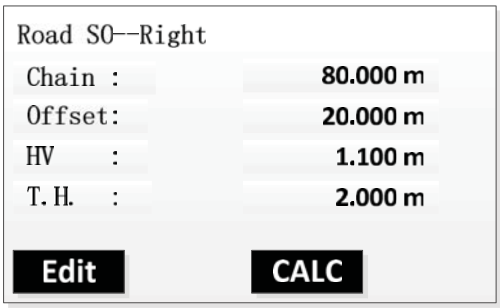
	point.	
Orthogonal to station stakeout	△Length Longitudinal distance: Positive if measuring point far away target point. △Trav Perpendicular distance: Positve if measuring point being right side of target point.	
Cartesian stakeout	△Y/E Difference of easting coordinates. △X/N Difference of northing coordinates.	

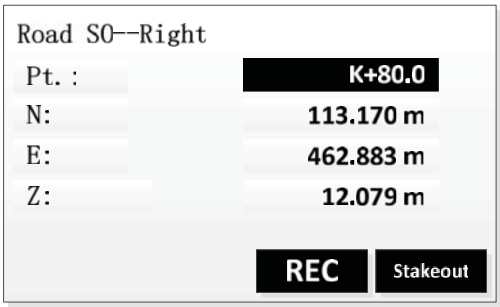
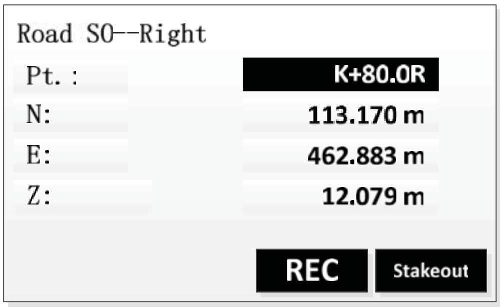
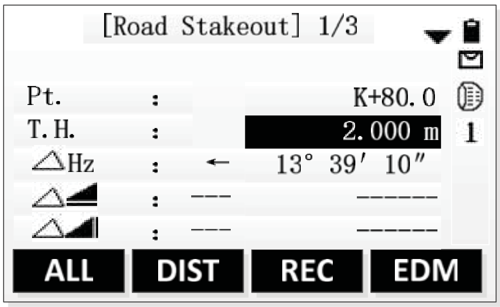
User can use [PAGE] key to switch method between these 3 methods.

Doing stakeout can refer to Point stakeout.

Steps

Steps	Key	Display
① Pressing key [F4] enter Road functions menu. Before doing stakeout, job seting, station seting, BS seting should be done.	[F4]	

② Pressing [F4] enter road stakeout.	[F4]	
③ Input road parameters and press [F4] entering chain parameters editing window.	[F4]	
④ Input chain parameters and press [F4] to next window.	[F4]	
⑤ Program shows chain's paramters that user has input. Press [←][→] to left or right pile. Press [↓][↑] to increase or decrease chain number. Press [Edit] to edit the parameters.	[F4]	 

⑥ Press [CALC] to see the result point coordinate.If need to calculate other chain point, press [ESC] to return.	[F3]	
⑦ Press [REC] to save the point coordinate data. User can edit the point's number.	[F3]	
⑧ Press [Stakeout] to do the point's stakeout.	[F4]	

Note: If has saved road data, next time user can directly go to the road program without inputting road data again.

13. Stakeout Reference Element

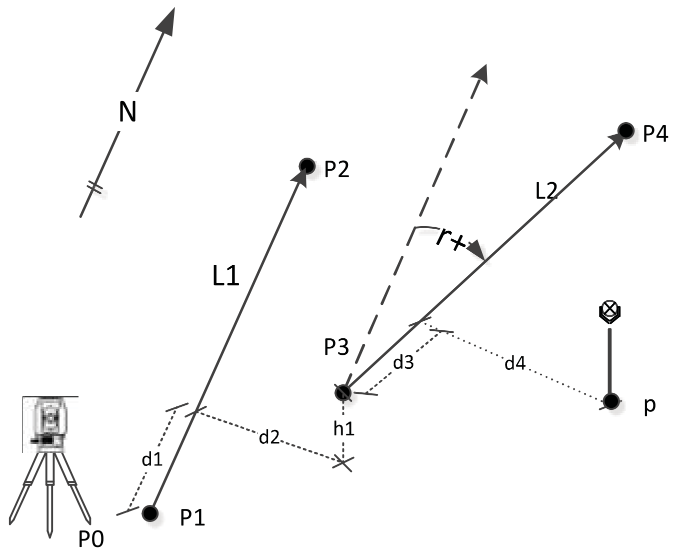
Stakeout Reference Element is used for making Reference Element stakeout and check easier, such as building, road cross section, or simple excavation. User can define a Reference Line/ARC, according to measuring result, to calculate out the deviated difference& elevation difference between measuring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

- ✧ RefLine
- ✧ RefArc

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 refered elevation point.

Refline schematic diagram:



Known

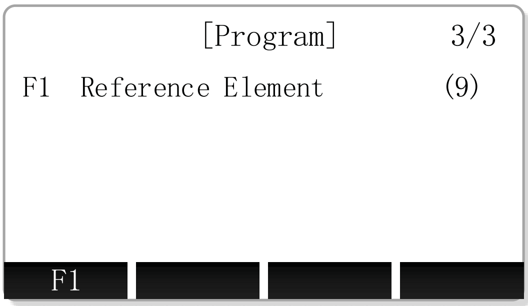
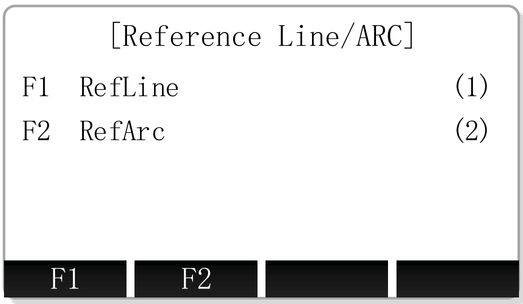
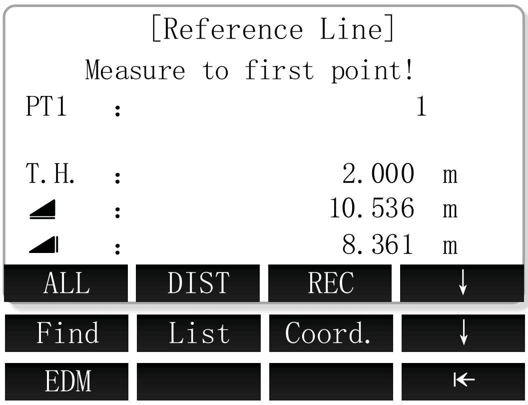
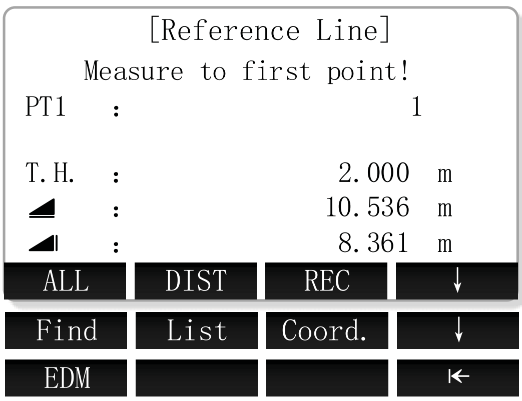
L1	Baseline	L2	Reference Line
P1	First point	P3	First reference point
P2	Second point	P4	Second reference point
d1	Offset	d2	Line
r+	Rotate	P0	STA

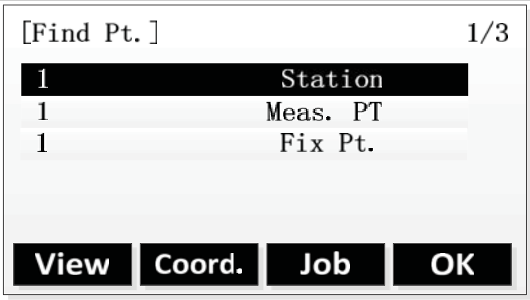
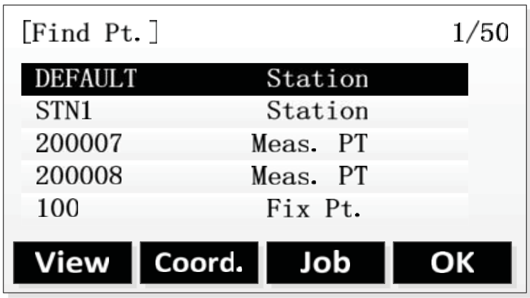
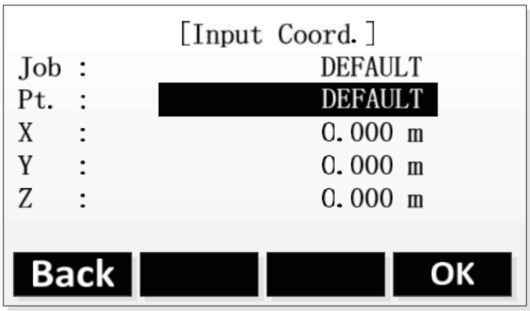
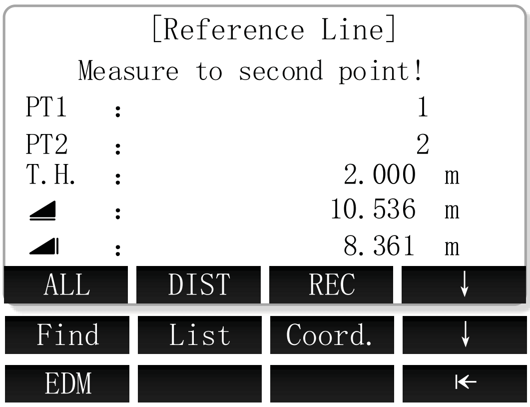
Unknown

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, press [F1] or numeric key [1] to enter RefLine function.	[F1] or [9] [F1] or [1]	 
② There're several methods to obtain the first point for baseline definition A: Enter point name, then press [F1](ALL) to define first point.	Input point name + [F1]	A: Get the target point by measure. 
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	Input point name + [F4]	C: Input the name of the point and find whether it is in memory.

check if this point exists, if not exist, then should firstly input or measure this point's coordinate.	+ [F1] + [F4]	
D: Press [F2](List) , in [Find Pt.] dialog, search the known points in job through [▲]\[▼] and press [F4](OK) to select.	[F2] + [F4]	D: Select the point by list in the instrument. 
E: Press [F3](Coord.), input point name, coordinate data and press [F4](OK), it will indicate cover if the point name is repeated.	[F3] + Input point name coordinate+ [F4]	E: Input the point through keyboard. 
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 [Reference Line-Main] page, press [◀]\[▶] to choose Ref.Hgt, after set up.※1	[▲]\[▼] + Input parameter [F4] + [◀]\[▶]	[Reference Line-Main] 1/2 Length : 360.555 m Enter values to shift line! Offset : 5.000 m Line : 2.000 m Height : 10.536 m Rotate : 1° 02′ 03″ Grid Meas. Stake ↓ NewBL Zero Segment ⇤ [Reference Line-Main] 2/2 PT1 : 1 PT2 : 2 Length : 360.555 m Select Height Reference! Ref.Hgt : PT1 ◀▶ Grid Meas. Stake ↓ NewBL Zero Segment ⇤
⑤ In the interface of [Reference Line-Main], if baseline needs to be redefined, press [F4](↓) to shift to subscript function and press [F1] (NewBL) to redefine new baseline.	[F4] + [F1]	[Reference Line-Main] 1/2 Length : 360.555 m Enter values to shift line! Offset : 5.000 m Line : 2.000 m Height : 10.536 m Rotate : 1° 02′ 03″ Grid Meas. Stake ↓ NewBL Zero Segment ⇤
⑥ In the interface of [Reference Line-Main] , input translation parameters, if you need to clear, press [F4] (↓) to shift subscript function, press [F2] (Zero) to recover input parameters to zero.	[F4] + [F2]	[Reference Line-Main] 2/2 PT1 : 1 PT2 : 2 Length : 360.555 m Select Height Reference! Ref.Hgt : PT1 ◀▶ Grid Meas. Stake ↓ NewBL Zero Segment ⇤

※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

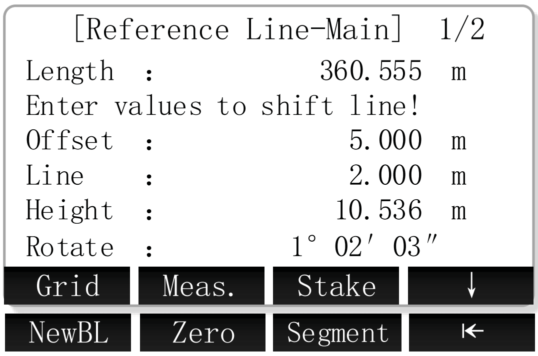
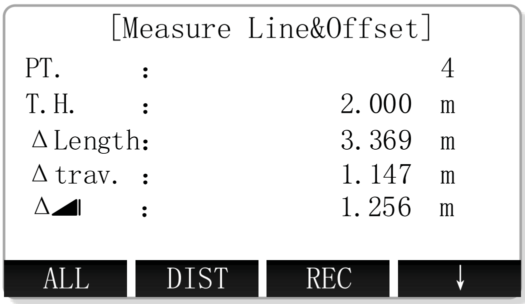
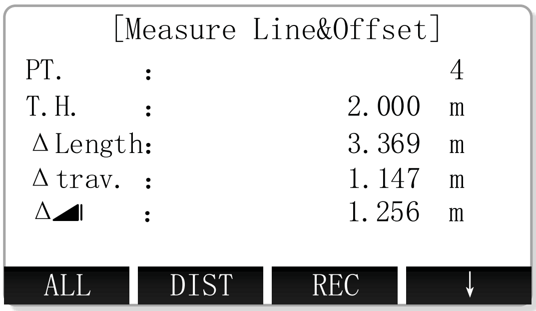
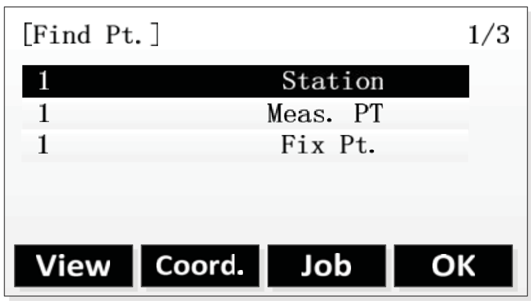
- **Stakeout Grid**

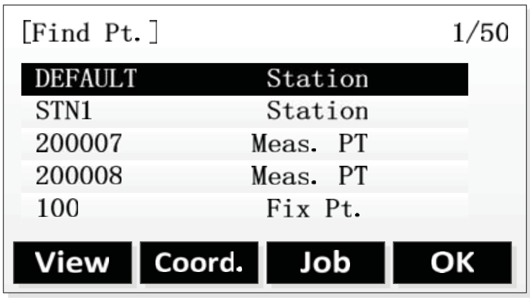
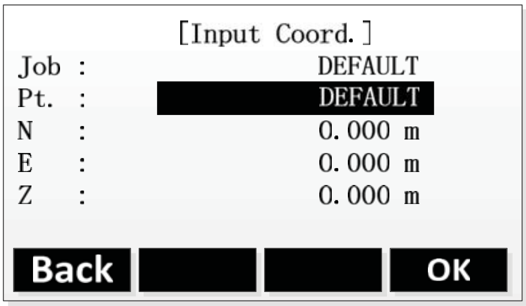
Steps	Key	Display
① In the interface of [Reference Line-Main], press [F1] (Gird) to enter the [Grid Definition] .	[F1]	[Reference Line-Main] 1/2 Length : 360.555 m Enter values to shift line! Offset : 5.000 m Line : 2.000 m Height : 10.536 m Rotate : 1° 02′ 03″ Grid | Meas. | Stake | ↓ NewBL | Zero | Segment | ⇤
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]	[Grid Definition] Enter start chainage of gird! Start Chain: 1.147 m Increment grid points Increment : 2.258 m Transverse: 3.369 m Back | | | OK
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]	[Stakeout Grid] 1/2 PT : 3 T.H. : 2.000 m Offset<-> : 3.369 chainage: 1.147 ΔHz : → 1° 02′ 03″ Δ : ↑ 1.256 m ALL | DIST | REC | EDM

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

- **Measure Line&Offset**

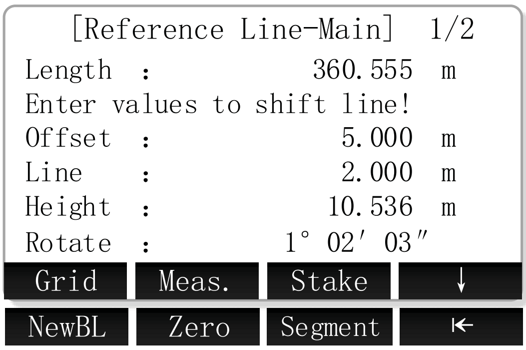
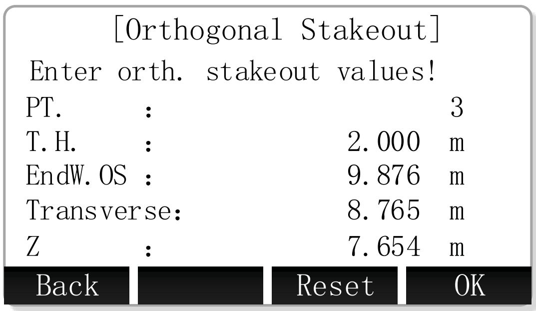
Steps	Key	Display

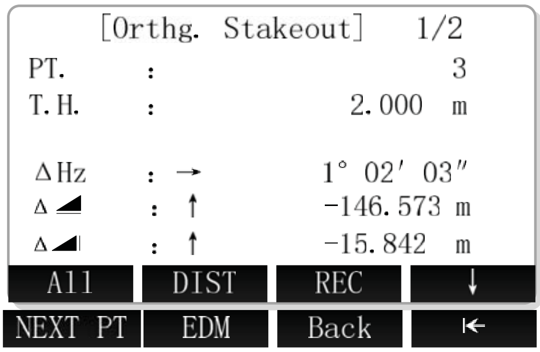
<table>
<tr><td>① In interface of [Reference Line-Main] , press [F2] (Meas.) to enter [Measure Line&Offset] interface.</td><td>[F2]</td><td>
</td></tr>
<tr><td>② There are many methods to obtain points for calculating Line&Offset
A: Input the name of point, press [F1](ALL) to measure current point, calculate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

</td></tr>
<tr><td>B: Input point name, press [F2] (DIST) to measure target point, calculate and display this point's offset to refline, then press [F3](REC) to save this point data.</td><td>[F2]
+
[F3]</td><td>B: Get the target point by DIST+REC.

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

point.		
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 be selected.	[F2] + [F4]	D: Select the point by list in the instrument. 
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.

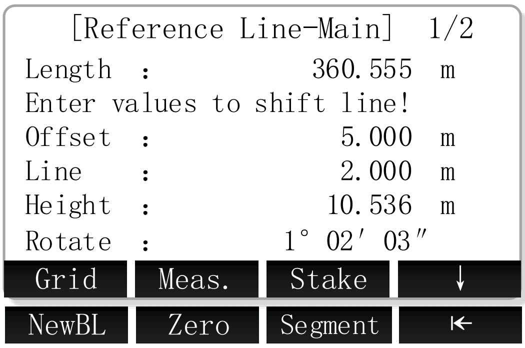
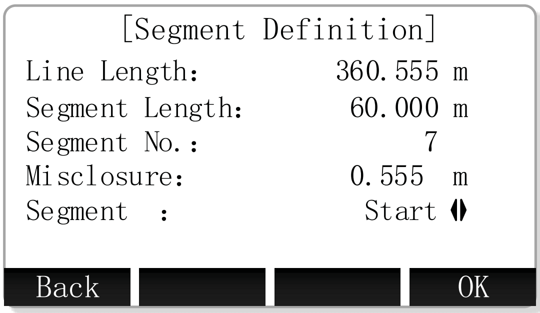
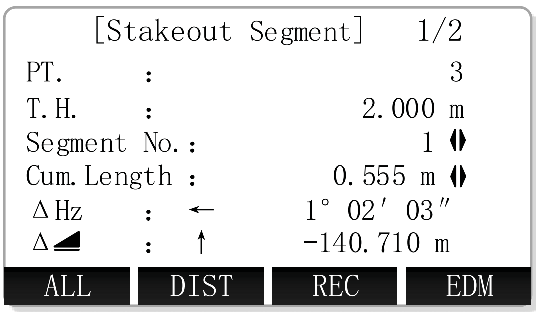
- **Orthogonal stakeout**

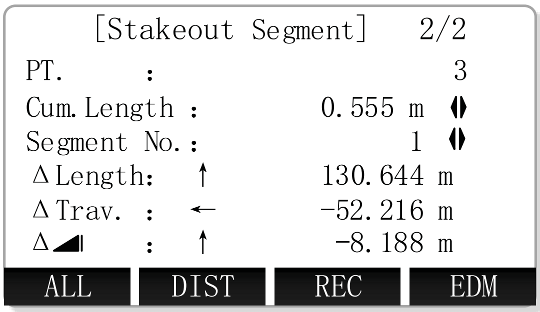
Steps	Key	Display
① In [Reference Line-Main] screen, press [F3](Stake) enter [Orthogonal stakeout] to input stakeout values.	[F1]	
② In interface of [Orthogonal Stakeout] use [▲]\[▼] to select input box, use keyboard to set every offset parameters, then press [F4](OK) to enter orthogonal stakeout.	[▲]\[▼] + Input parameters + [F4]	

<table>
<tr><td>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.</td><td>[F1]
or
[F2]+[F3]</td><td>
</td></tr>
</table>

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

- **Segment stakeout**

<table>
<tr><th>Steps</th><th>Key</th><th>Display</th></tr>
<tr><td>① In [Reference Line-Main] screen, press [F4](↓) and Press [F3] to enter [Segment Definition] interface</td><td>[F4]
+
[F1]</td><td>
</td></tr>
<tr><td>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</td><td>[▲]\[▼]
+
Input parameters
+
[F4]</td><td>
</td></tr>
<tr><td>③ In [Stakeout Segment] screen, use [◄]\[►] to select segment No., then save current point data through [F1](ALL)or [F2]+[F3](DIST+REC)</td><td>[◄]\[►]
+
[F1]
or
[F2]+[F3]</td><td>
</td></tr>
</table>

※[1] Segment options:

Start : Misclosure at the start point

EndPt : Misclosure at the end point

Equal : Divide Reference Line equally into several pieces

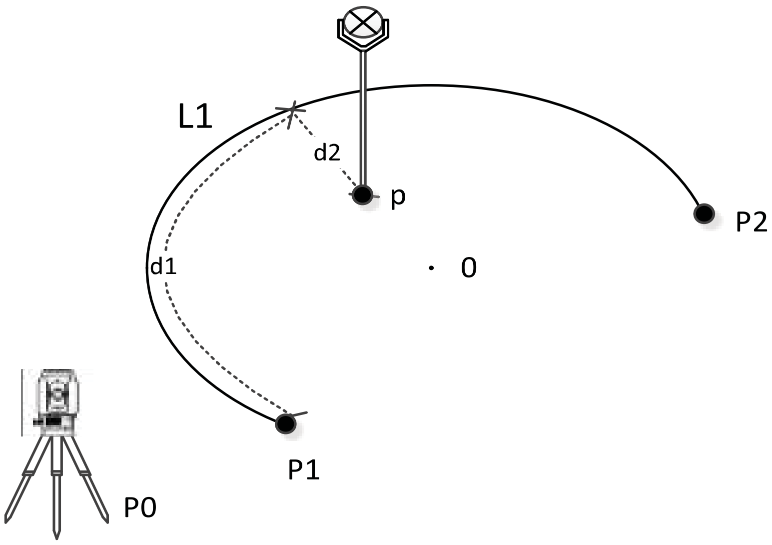
※ In above operation, press [ESC] to return to previous menu.

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:



Known

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

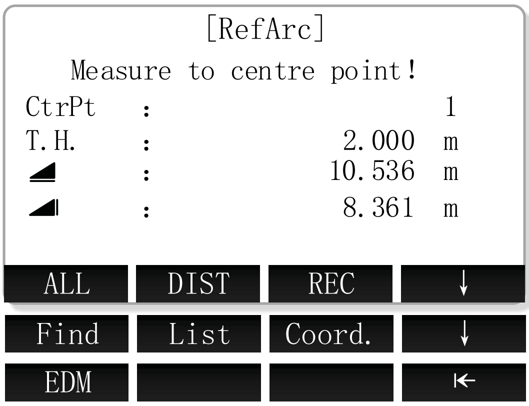
Unknown

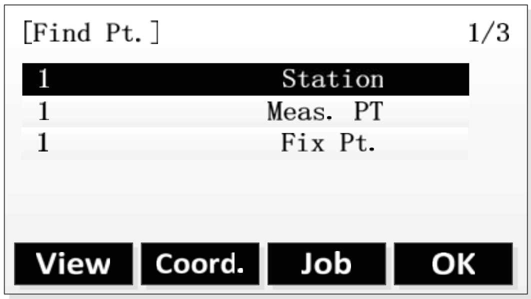
p	Measure point
d1	ΔLine

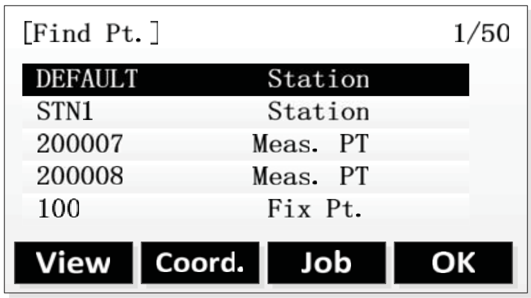
d2 ΔOffset

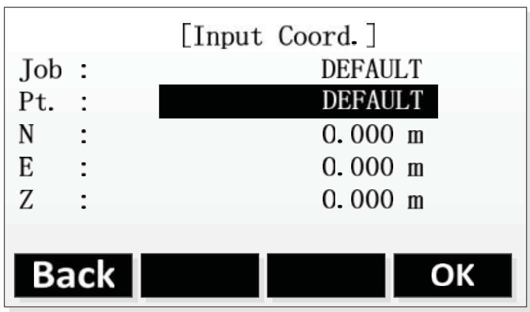
- **Centre, Start PT**

Steps	Key	Display
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 numeric [2] to enter RefArc function.	[F1] or [9] [F2] or [2]	[Program] 3/3 F1 Reference Element (9) F1 [Reference Line/ARC] F1 RefLine (1) F2 RefArc (2) F1 F2
② In [Define Ref-ARC method] screen, then press [F1] or numeric key [1] , enter [Centre, Start Point] method, measure Centre point to define arc.	[F1] or [1]	[Define Ref-ARC method] F1 Centre, Start Point (1) F2 Start&End Pt, Angle (2) F1 F2
③ There are several methods to obtain CtrPt which is used for RefArc definition A: Enter point name, then press [F1](ALL) to define the CtrPt。	Input point name + [F1]	A: Get the target point by measure. [RefArc] Measure to centre point! CtrPt : 1 T.H. : 2.000 m ◢ : 10.536 m ◢ : 8.361 m ALL DIST REC ↓ Find List Coord. ↓ EDM ⇤

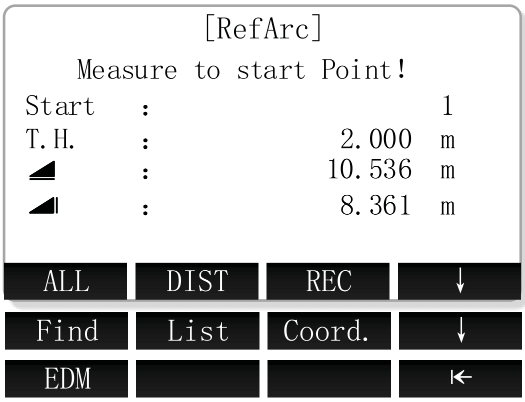
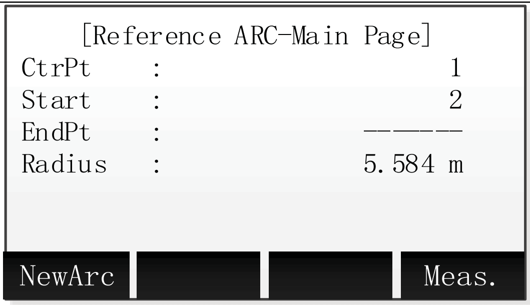
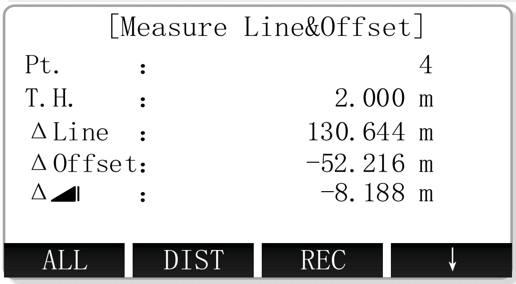
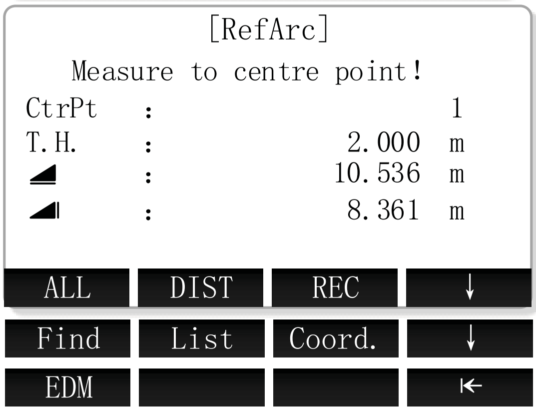
<table>
<tr>
<td>B: Input point name, Press [F2](DIST) + [F3](REC) to save the centre point, the saved result will be directly put into calculation.</td>
<td>[F2]
+
[F3]</td>
<td>B: Get the target point by DIST+REC.


</td>
</tr>
<tr>
<td>C: Input point name, press [F4](↓) to shift to subscript function, press [F1](Find) to check if this point exists, 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.] dialog, 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>
<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>
</table>

④ After measuring centre point, you can measure the start point, the definition is same as centre point. ※[1]	[F1] or [F2]+[F3] or [F4]+[F1] or [F4]+[F2] or [F4]+[F3]	
⑤ After definition of RefArc, enter interface of [Reference ARC-Main Page];		
Press [F4](DIST) to enter [Measure Line&Offset] interface;	[F4]	
If it needs to define a new RefArc , press [F1](NewArc) to define.	[F1]	

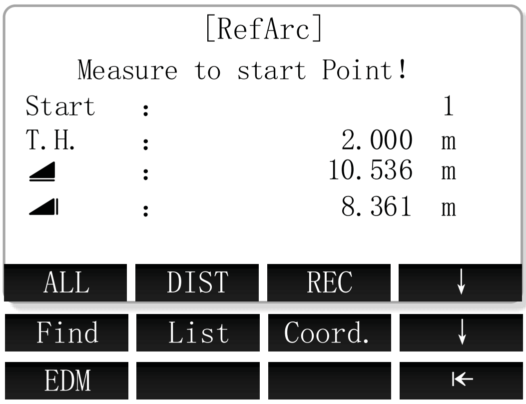
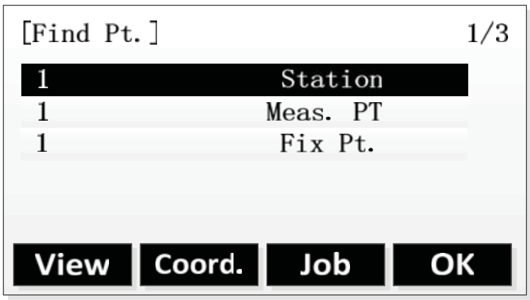
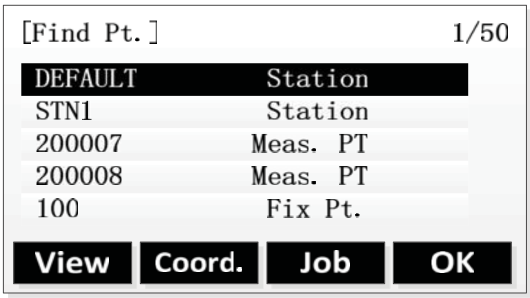
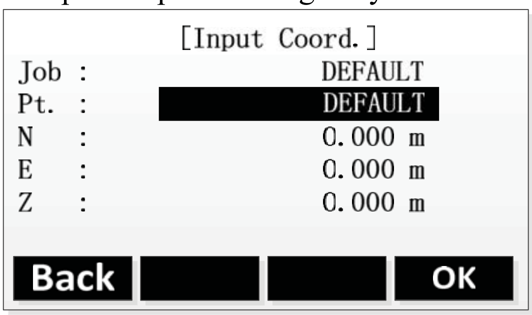
※[1] When the centre and start point coincide, the system error reporting "invalid target data, please input again, select "yes" or press [ESC], return to the measurement center interface, and restart the definition of arc.

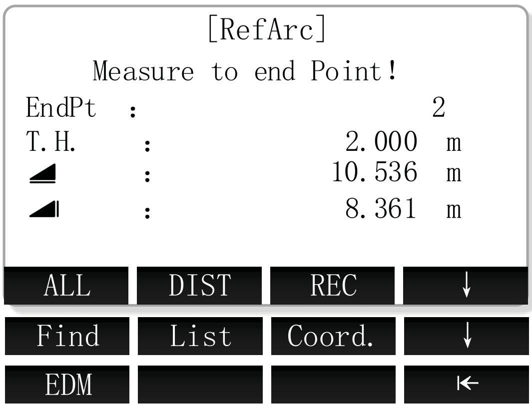
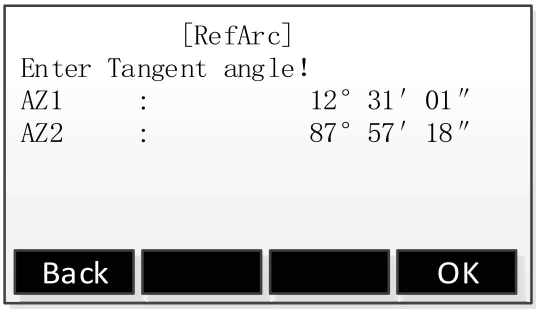
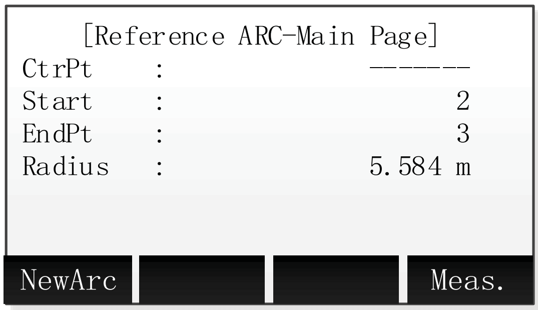
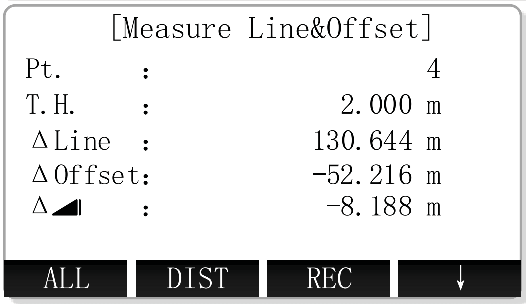
※ In above operation, press [ESC] to return to previous menu.

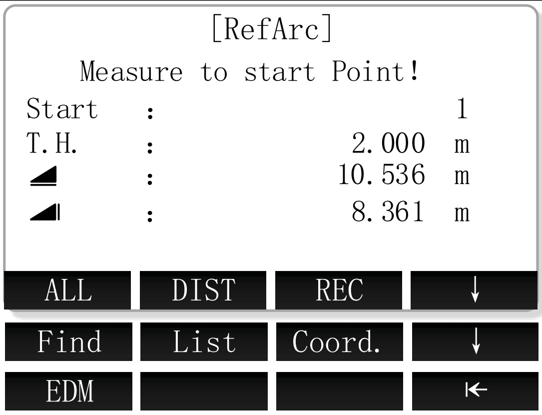
- **Start&End Pt, Angle**

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 [Reference Line/ARC] menu, then press the [F2] or the numeric key [2] to enter the definition of RefArc.	[F1] or [9] [F2] or [2]	[Program] 3/3 F1 Reference Element (9) F1 [Reference Line/ARC] F1 RefLine (1) F2 RefArc (2) F1 F2
② In [Define Ref-ARC method] screen, press the [F2] or the numeric key [2] to choose the [Star&End Pt, Angle], and measure start point.	[F2] or [2]	[Define Ref-ARC method] F1 Centre, Start Point (1) F2 Start&End Pt, Angle (2) F1 F2
③ There are several method to obtain the first point for baseline definition A: Enter point name, then press [F1](ALL) to define start point.	Input point name + [F1]	A: Get the target point by measure. [RefArc] Measure to start Point! Start : 1 T.H. : 2.000 m ◢ : 10.536 m ◢ : 8.361 m ALL DIST REC ↓ Find List Coord. ↓ EDM ⇤

<table>
<tr>
<td>B: Input point name, press [F2](DIST) + [F3](REC) to save target point , 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 if this point exists, if not exist, then should firstly input or measure 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>
<tr>
<td>E: Press [F3](Coord.), input point name, coordinate and press [F4](OK), it will be covered if the point name is repeated.</td>
<td>[F3]
+
Input point name coordinate+
[F4]</td>
<td>E: Input the point through keyboard.

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

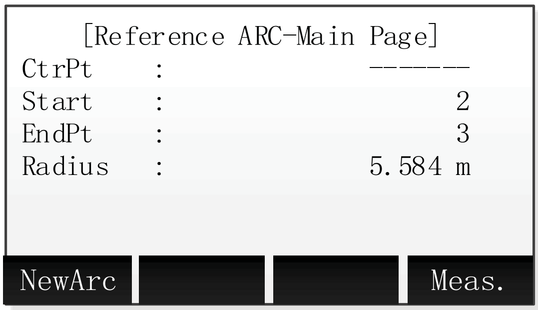
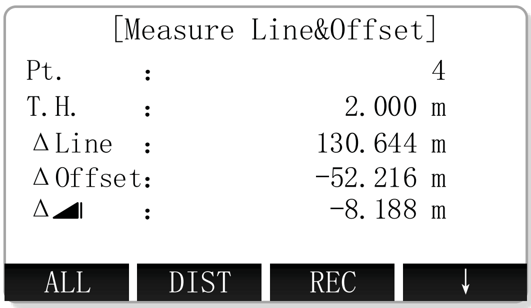
④ After definition of the start point, enter the interface of measure to end point, the definition of end point is same as start point.	[F1] or [F2]+[F3] or [F4]+[F1] or [F4]+[F2] or [F4]+[F3]	
⑤ After completing the definition of the start&end point, input the AZ1(start point), AZ2(end point) tangent angle respectively, then press [F4](OK) to next step.※[1]	Enter angle + [F4]	
⑥ Reference arc was defined, enter the [Reference ARC-Main Page] interface; Press [F4] (DIST) into the [Measure Line&Offset] function; If it needs to define a new RefArc , press [F1](NewArc) to define.	 [F4] [F1]	

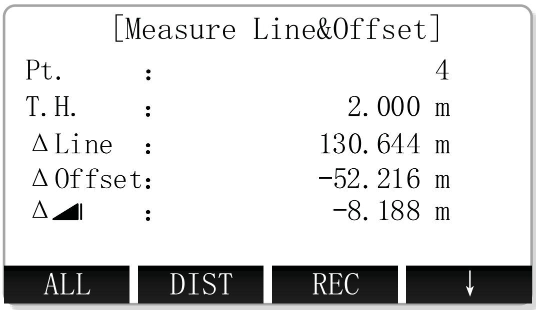
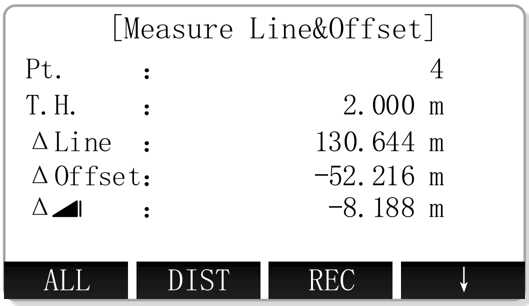
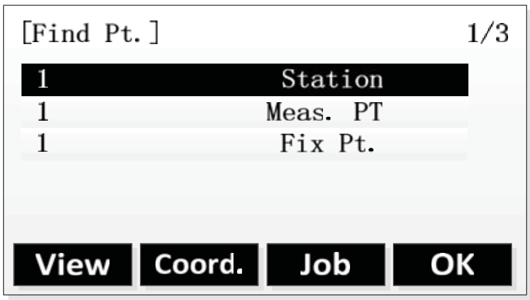
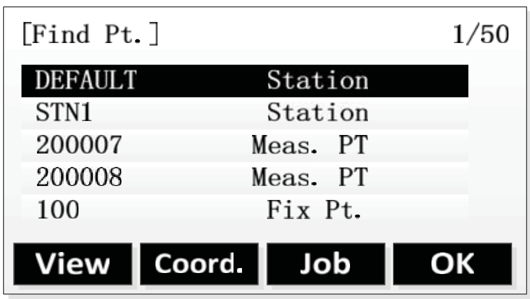
		

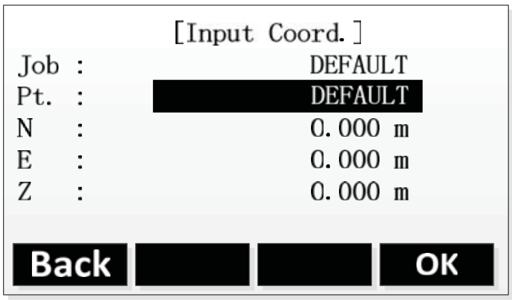
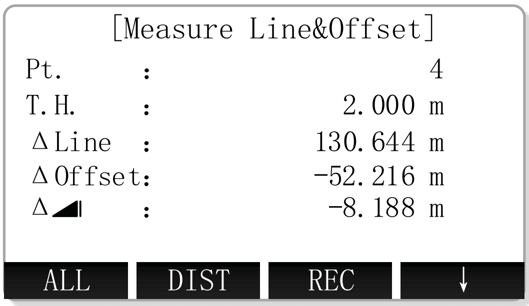
※1 AZ1 and AZ2 are start point, end point tangent azimuth respectively . If the input data is not in conformity with the requirements, the instrument will report "invalid target data, please input again", you can select "yes" or press the [ESC] to return to the interface of starting point measurement, 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] (DIST) 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. 
B: Input point name, Press [F2](DIST) + [F3](REC) to save the Pt, 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, press [F1](Find) to check whether this point was existed, if not exist, then should firstly input or measuring 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](List) , in [Find Pt.] screen, search the known points in job through [▲]\[▼] and press [F4](OK) to select.	[F2] + [F4]	D: Select the point by list in the instrument. 

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.	[F3] + Input point name coordinat + [F4]	E: Input the point through keyboard. 
③ After measuring points in different ways, we can see the result of the high deviation, Δ Line and ΔOffset.※[1]		

※[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;

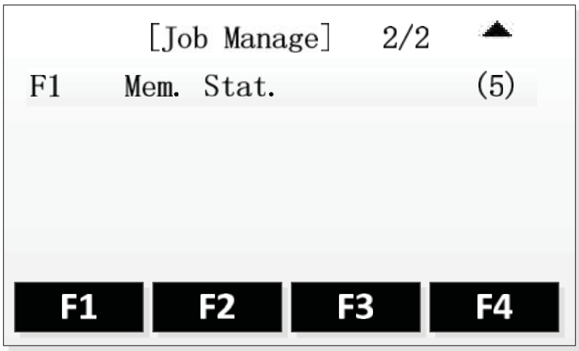
ΔOffset: the offset of the measuring point with respect to the arc in the direction of the radius.If the measuring point is in the circle, the ΔOffset will be positive, and on the contrary is negative.

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.

6. File manage

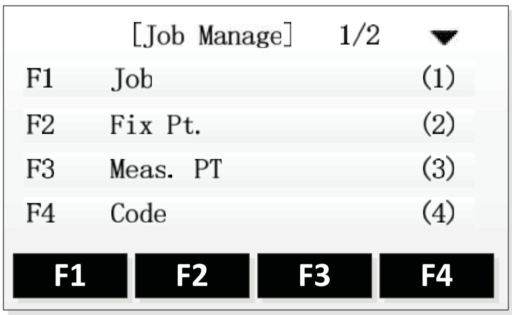
File manager contains all functions of input data, edit data and view data.

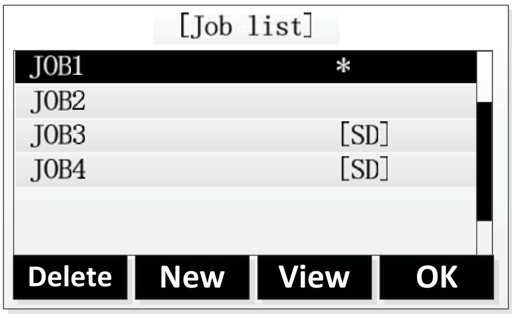


1. Job

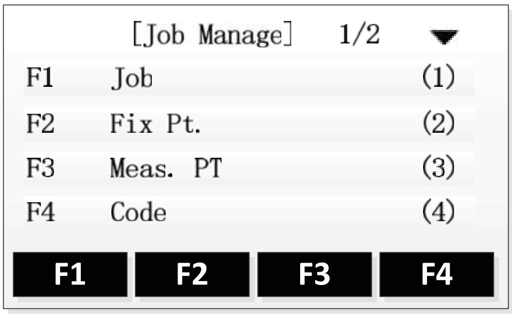
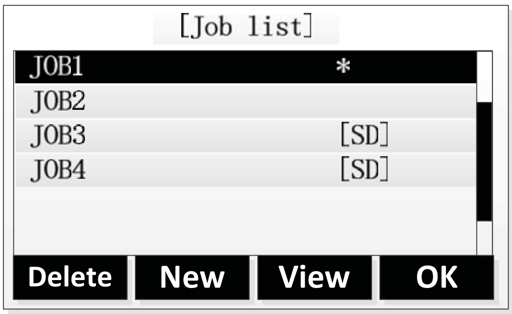
- All kinds of measurement data are saved in the selected job. Such as Fix Pt., Meas. PT and so on.
- The function can new a job, select a job and delete a job.
- The definition of the job contains the inputing of Job's name and Operator.

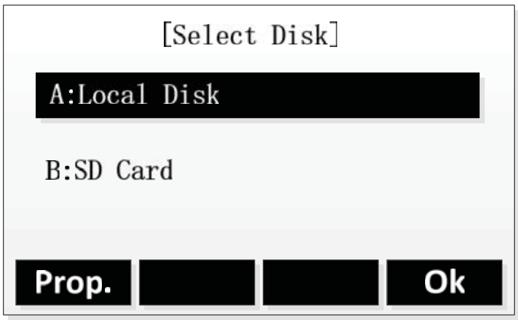
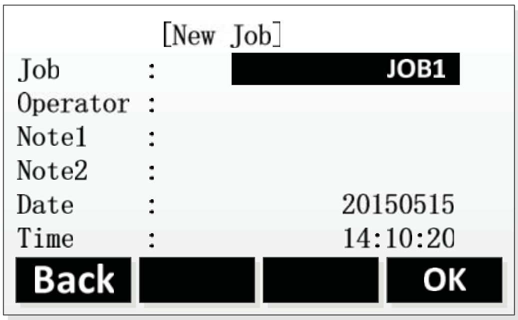
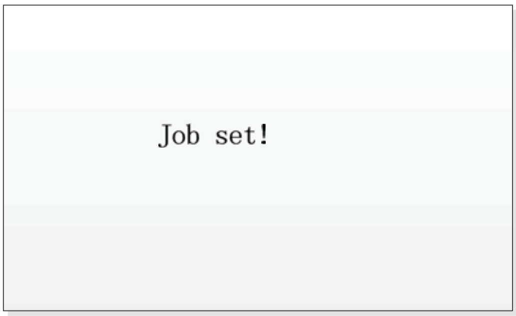
1.1 Select a Job

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. The jobs in the SD card have the mark of “[SD]” and the current job have the mark of “*”.		
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]	

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 newing 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]	
⑤ After finishing inputing, press [F4] (OK) to save the job and set it as the current job.	[F4]	
※[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.

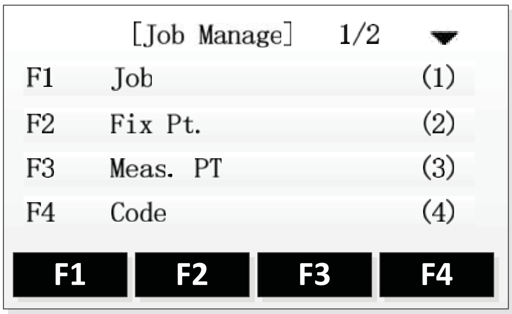
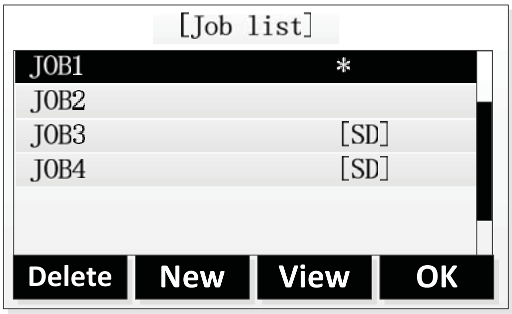
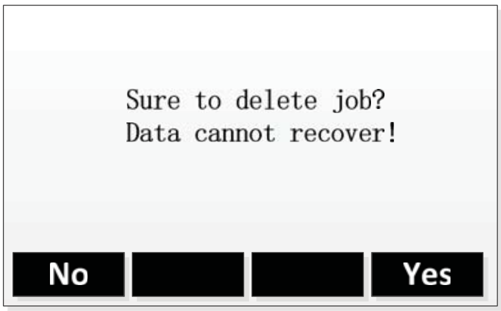
[Operator]: The name of operator and it can have the default value.

[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.

1.3 Delete a job

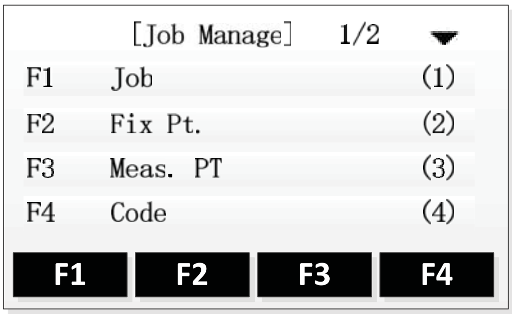
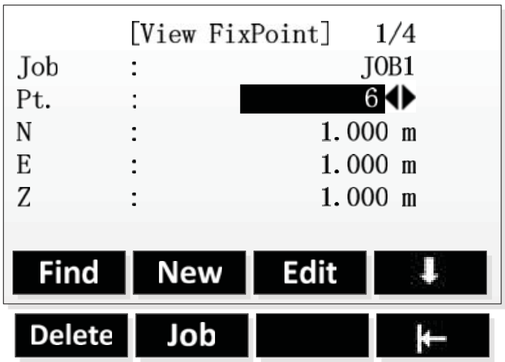
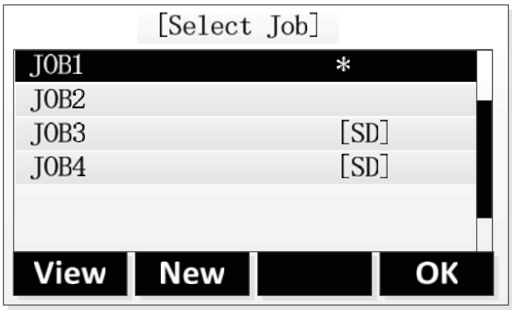
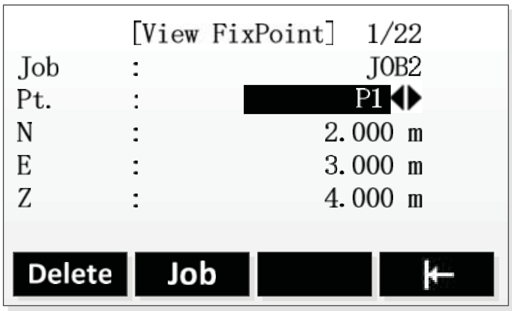
Steps	Key	Display

① In the menu of Job Manager, press [F1] to enter the menu of job function.	[F1]	
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 "*".		
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.		

2. Fix Pt.

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

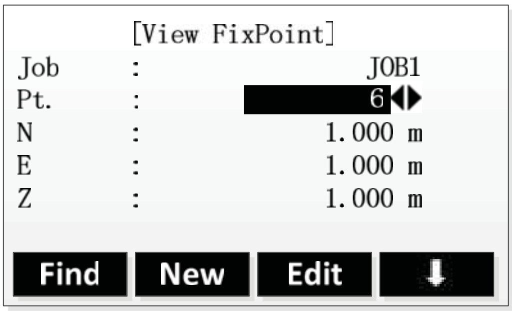
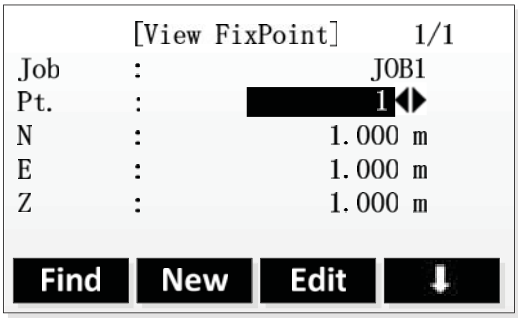
Steps	Key	Display

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 directon key of up or down to select the job which the viewed fixpoints exist, then press [F4] to make sure. ※[1]	[F4]	
④ Program displays the data of fixpoint in the corresponding job. Press the direction key of left or right can view all fixpoints in the job.	[←] [→]	
※[1]: The seleted job is only used to view fixpoints and it will not be set as current job.		

2.1 Search Fix Pt.

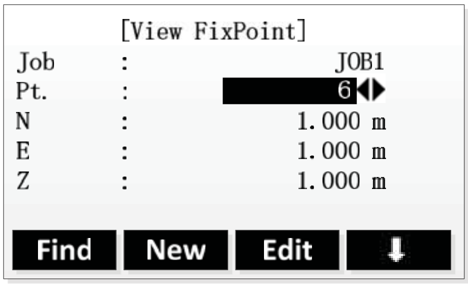
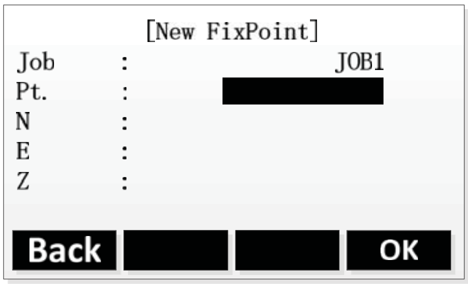
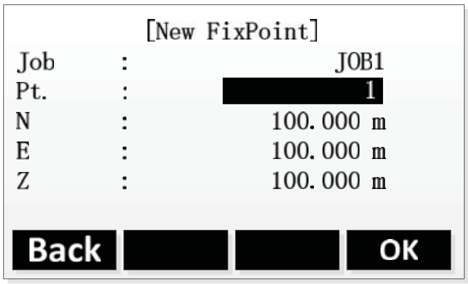
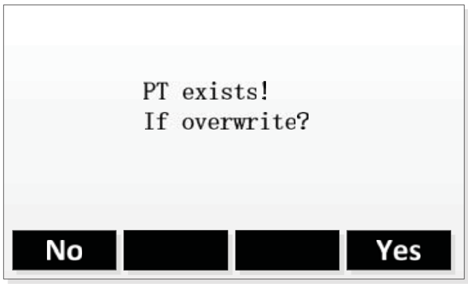
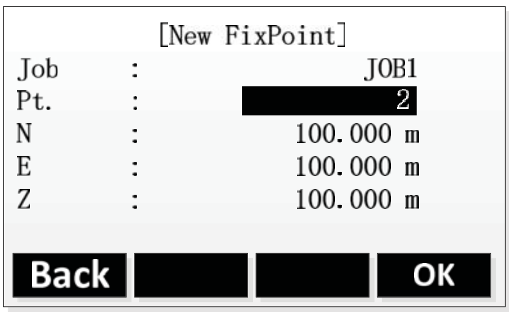
Input the name of point or "*" to view the fixpoints in the selected job.

Steps	Key	Display

① In the intertface of View FixPoint, 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.		

2.2 Add Fix Pt.

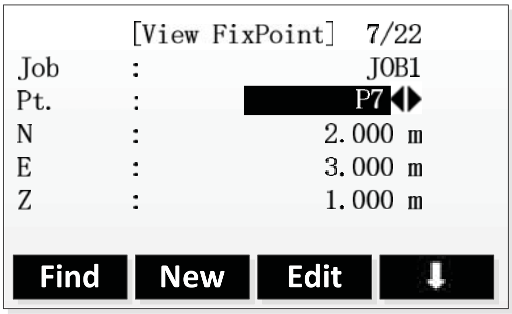
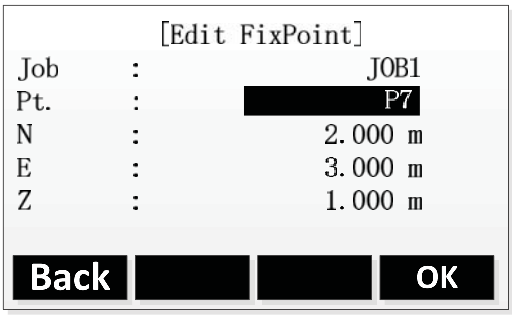
Steps	Key	Display

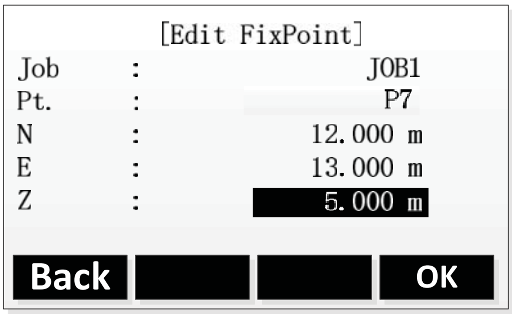
① In the interface of View FixPoint, pressing [F2] (New) to enter the function of newingfixpoint. If you want to change the job which need to new points, you can press [Job] to select the target job.	[F2]	
② There appears a dialog as shown in the picture on the right. If want to back to the previous menu, you can press [F1] (Back).		
③ Input the new name and coordinate of fixpoint, press [Ent] to finish inputing and press [F4] (OK) to save the fixpoint. If the inputted point name exists in the memory, the program will give a prompt of whethe to overwrite, press [F4](Yes) to overwrite or press [F1](No) to cancle the operation.		 
④ After finishing newing 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.		

2.3 Edit Fix Pt.

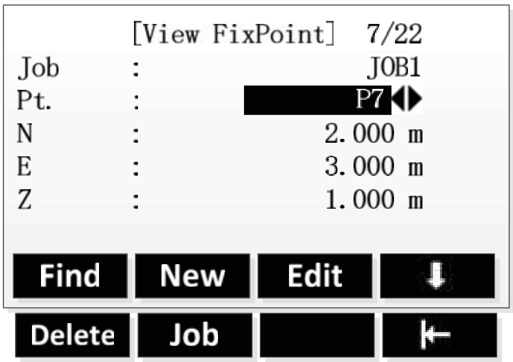
The function can edit the fixpoints in the memory.

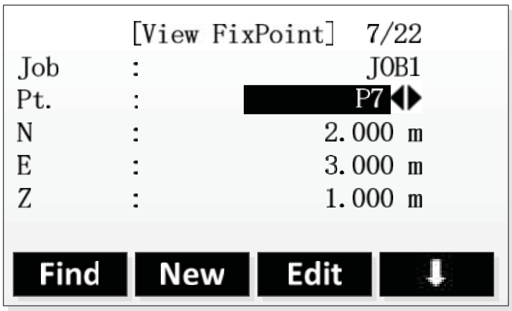
Steps	Key	Display
① In the interface of View FixPoint, you can find the data of need to be edited by pressing the direction key of left or right or in the function of finding. If you want to change the job which the point needs to be edited, you can press [Job] to select the target job.		
② Press [F3] (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 inputing. Program gives a prompt wheter to overwrite or not and press [F4] (OK) to overright and save.		

2.4 Delete Fix Pt.

Delete the selected fixpoint from the job.

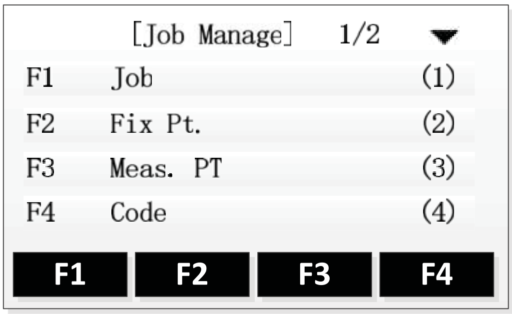
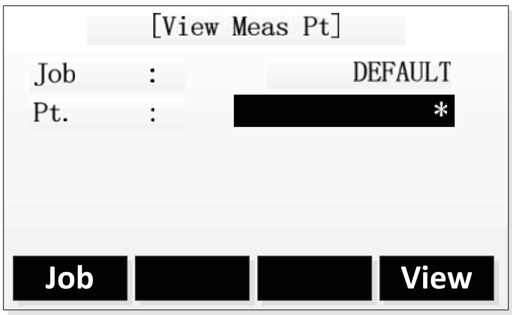
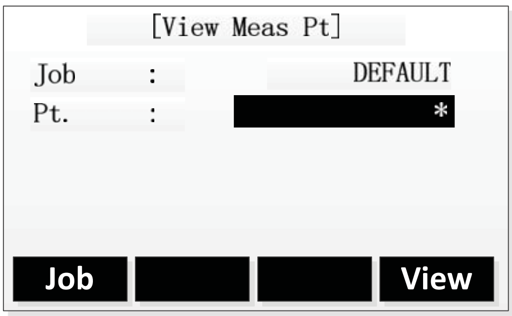
Steps	Key	Display
① In the interface of View FixPoint, you can find the data of need to be deleted by pressing the direction key of left or right or in the function of finding, then press [F4] to switch to the second page of soft key. If you want to change the job which the point needs to be deleted, 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 cancle the operation.	[F2]	

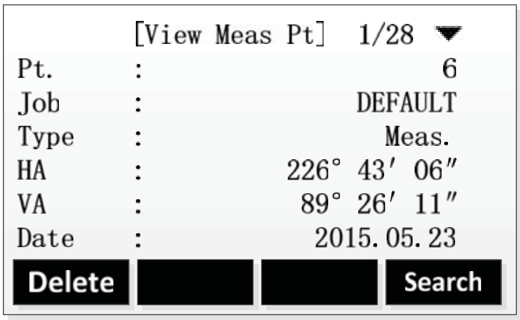
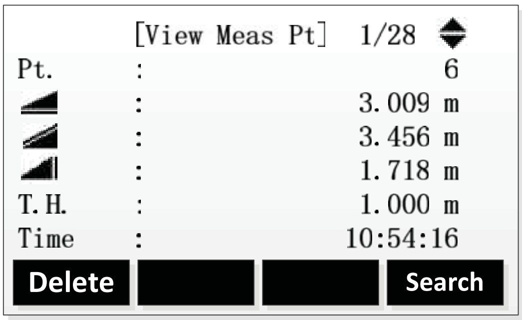
③ The interface backs to the previous menu.		

3. Meas. Pt.

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

3.1 View the measurement data

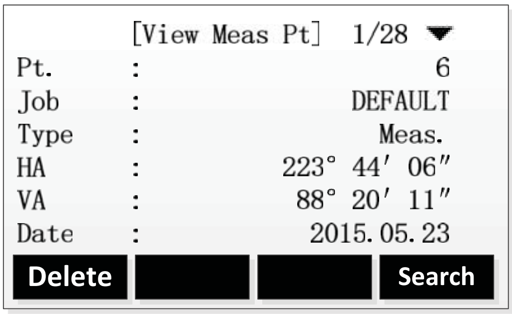
Steps	Key	Display
① In the menu of Job Manager, press [F3] to enter the function of Meas.PT.	[F4]	
② The default viewed job is the current job in the program, if you want to view the measurement data in other jobs, please press [F1] (Job) to enter the list of job to select.	[F2]	
③ The default viewed points are all points in the job and using the vildcard 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]	

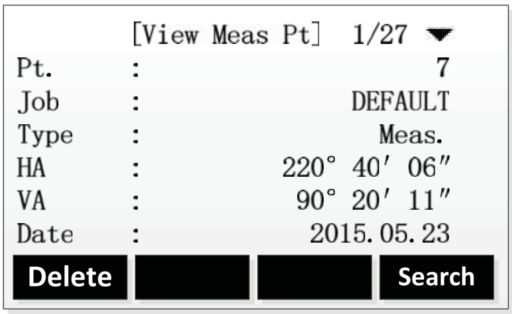
④ The screen starts to display the information of measurement data from the first piece of data in the job.Press the direction key of left or right can view the measurement point data which match the view condition one by one. Pressing [PAGE] can view a piece of measurement point data' other pages. Press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

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
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 cancle the operation.	[F4]	

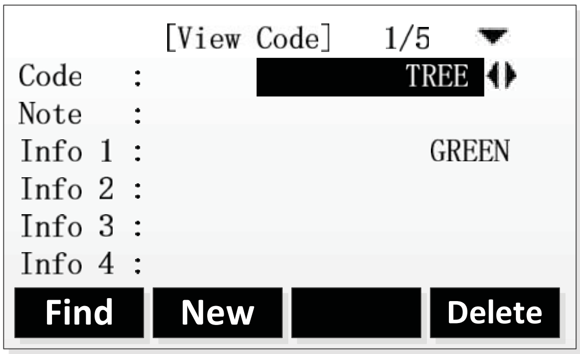
③ After the data is deleted, the screen displays the next piece of data.	[F4]	

4. Code.

Here can make operations on the code library, such as newing, finding and deleting.

4.1 Input Code

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



GSI-The introduction of code' attributes:

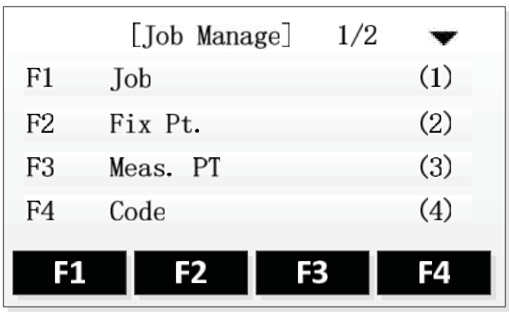
Code: Name of the code

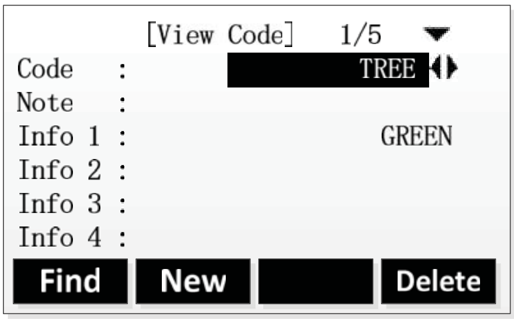
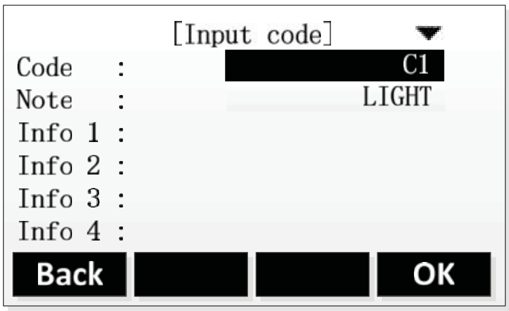
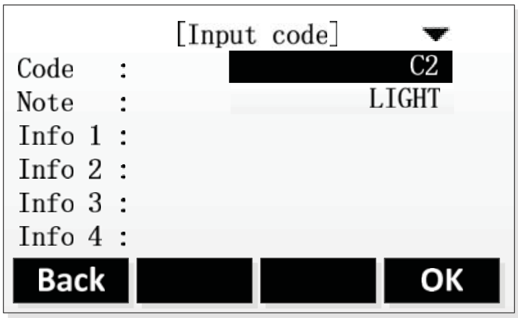
Note: Additional annotation

Info1: The other editable information

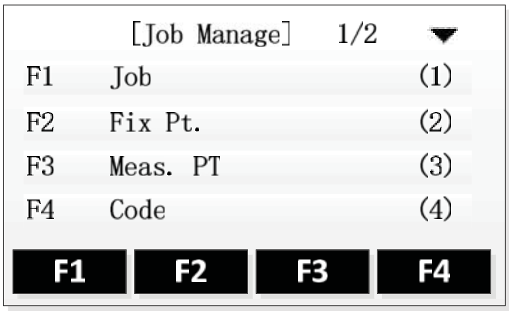
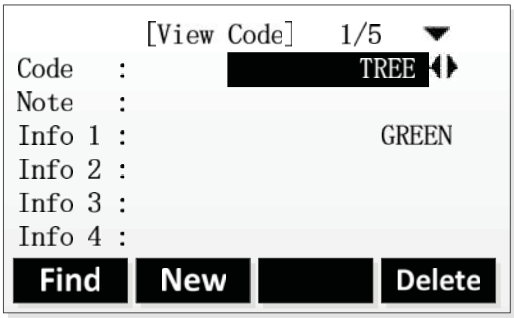
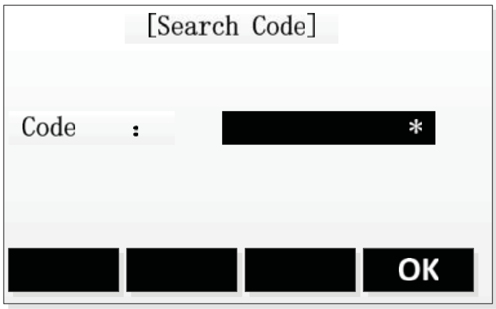
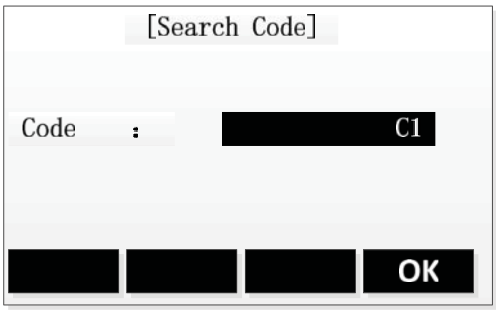
……

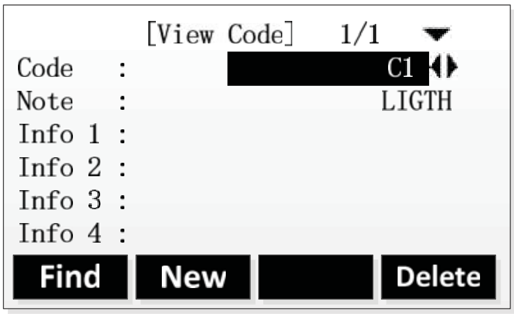
Info8: Other information

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

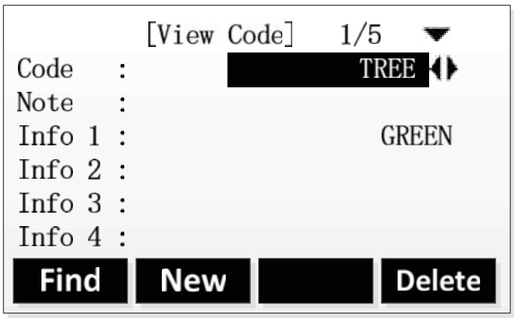
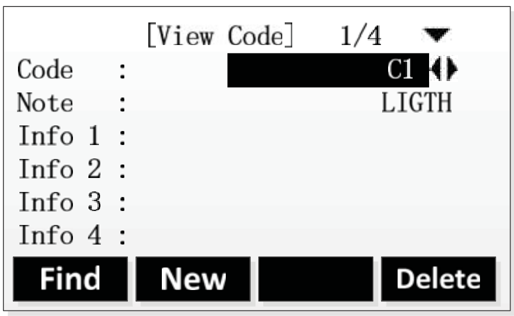
② In the interface of View Code, pressing [F2] to enter the function of newing code.	[F2]	
③ Input the name of code and the code information in the interface of Input code.		
④ After finishing inputting, press [F4] to save the code. Program makes the Code's name plus 1 automatically, and you can continue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

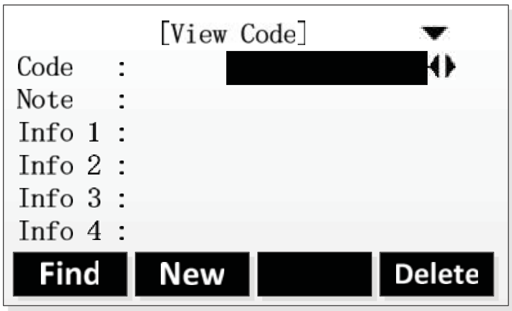
4.2 View Code

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.		
③ Press [F1] to enter the interface of Search Code. The default vaue is wildcard character, it stands for all codes.		
④ Input the certain code name and input [F4] to start to search.	[F4]	

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

4.3 Delete Code

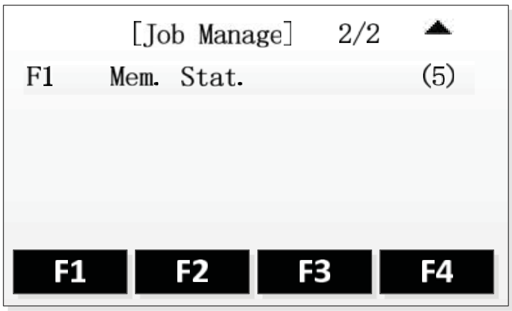
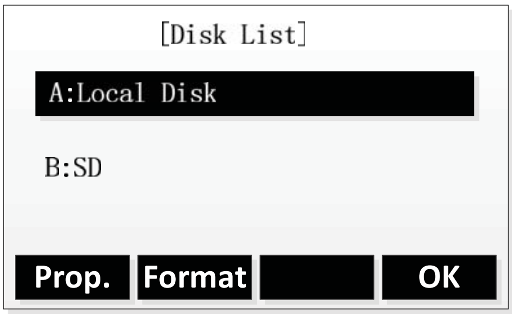
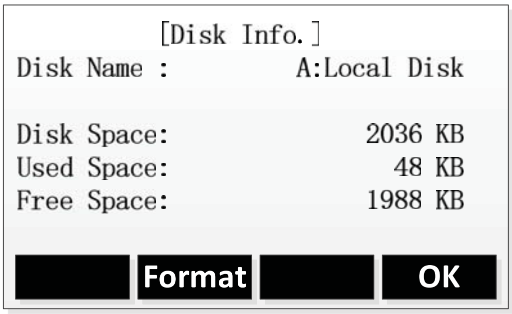
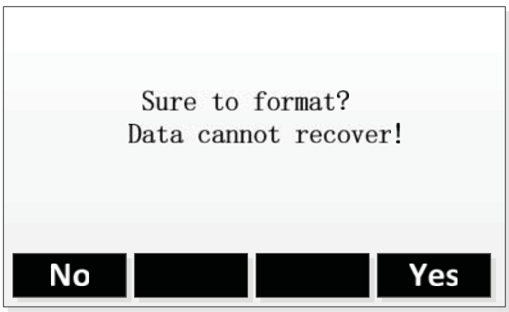
Steps	Key	Display
① After entering the dialog of code function, press the direction key of left or right to delete the code which need to be deleted. You can also press the key of [Find] to find the corresponding code.		
② After finding the code need to be deleted, press [F4] and program will give a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

[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.		

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 memoty statistics.	[F1]	
② Program displays the disk list of the instrument,the default are "A: Local Disk", if instrument has loaded the SD card, it will display the additional disk of " B: SD".		
③ Press [F1] (Prop.) can view the properties of the disk, including free space.	[F1]	
④ 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 cancle the operation.] ※1	[F2]	

※[1]: SD card does not support the formatting operation in the instrument.

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!

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 UDisk.

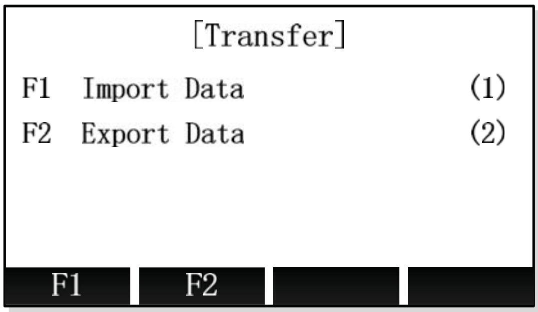
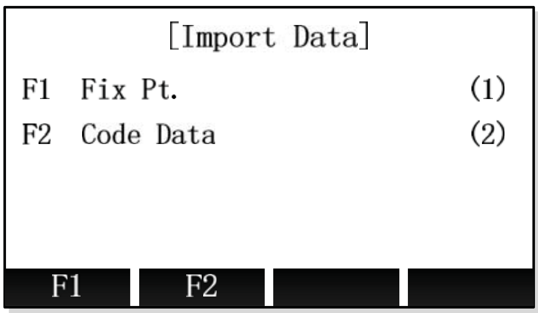
Import: Fixed Points, Code

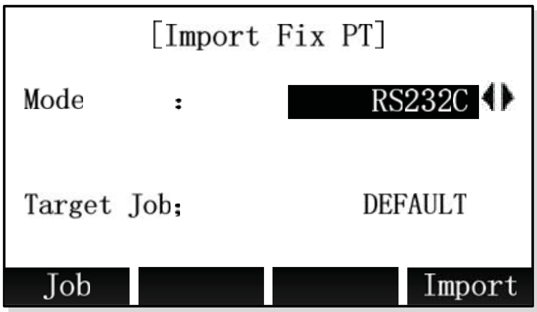
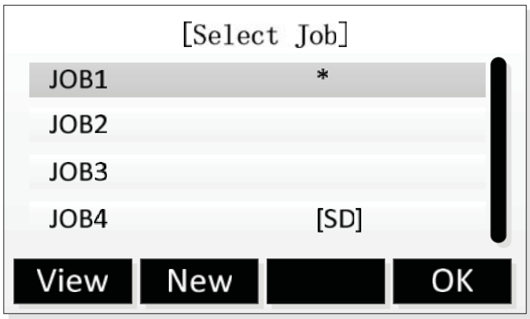
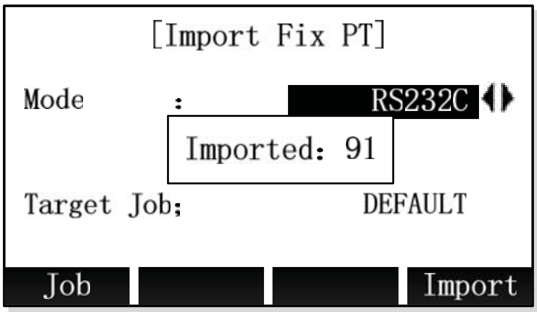
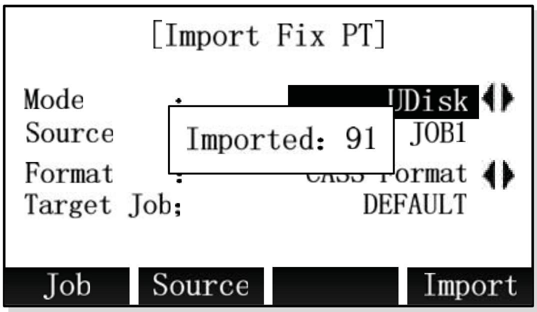
Method: RS232, UDisk

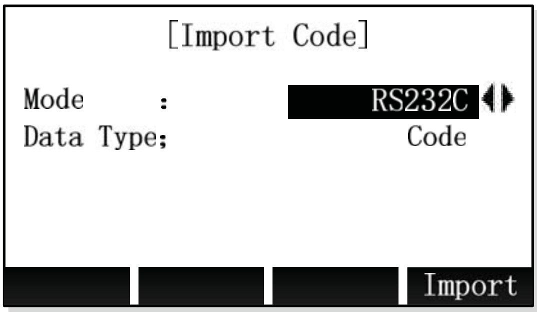
Format: CASS, GTS-7, CSV, GSI(For UDisk)

Source: Data file in UDisk (For UDisk)

Job: Target job that data been transfer to.

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

② In "Import Data"mene, press [F1] or [1] entering "Import Fix Pt" window.	[F1] or [1]	
③ Press [F1](Job) to select the job you want transfer data into, then press [F4] (OK).	[F1] [F4]	
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] (Import) on the instrument.	[F4]	
⑤ If choosing UDiskmethod, plugging udisk in the instrument usb port fisrt, then: 1. Press [◀], [▶] key to select "UDisk"; 2. Press [F2] to explore files in udisk 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 import.		
⑥ Import code can only use RS232C method. This is same to Step ④.	[F4]	

2. Data Export

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

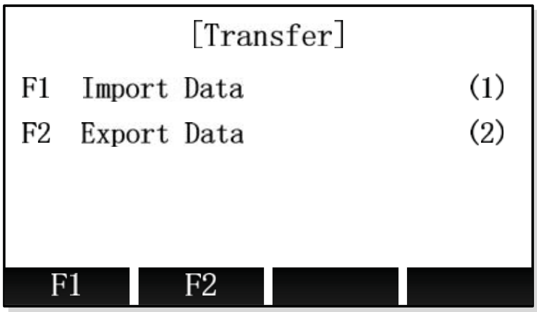
Export: Fixed points, measure data, and code.

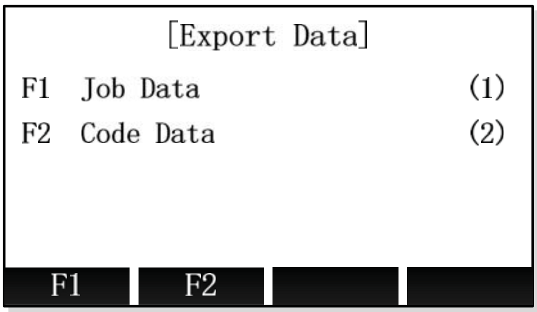
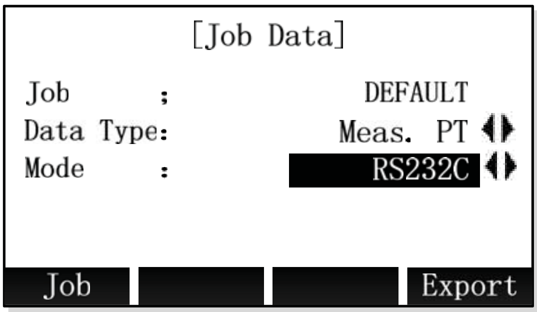
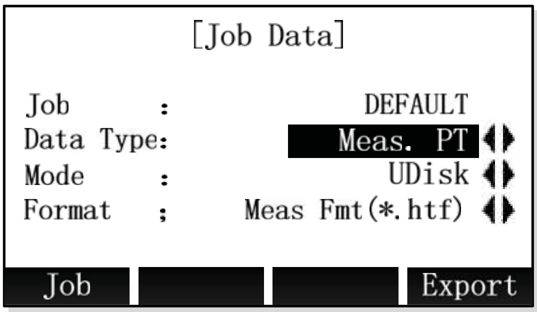
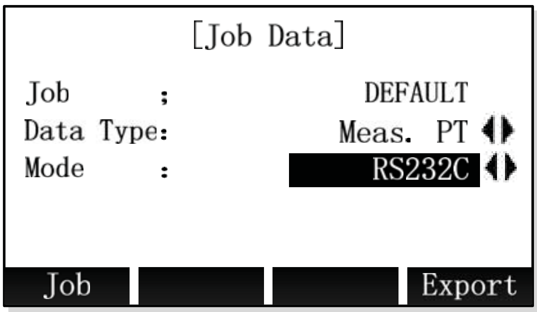
Method: RS232C, UDisk.

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

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

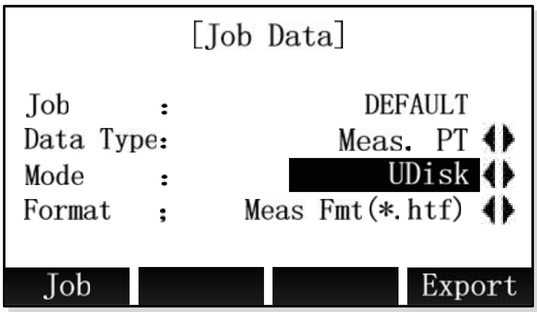
Job: Job needs to export.

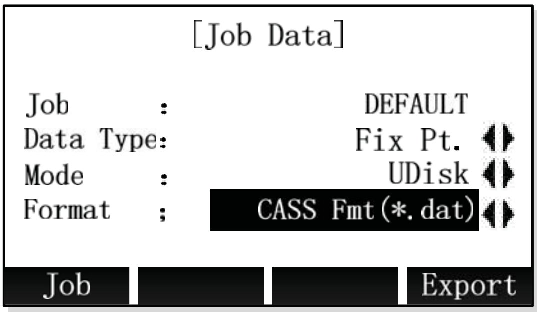
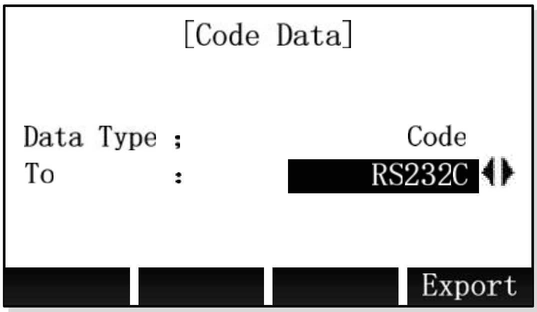
Steps	Key	Display
① In main menu, choose "4 Transfer" to enter "Data Transfer" menu. Pressing [F2] or [2] enters "Export Data".。	[4] [F2] or [2]	

		
② In "Export Data" menu, press [F1] or [1] entering "Export job data" function.	[F1] or [1]	
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, UDisk. Press [◄], [►] key to select transfer method (mode). If choosing RS232C, software on the	[◄] [►] [F4]	

<table>
<tr>
<td>computer should be ready, and then press [F4] to start export.

If choosing UDisk, the UDisk should have been plugged in, then press [F4] to start export.

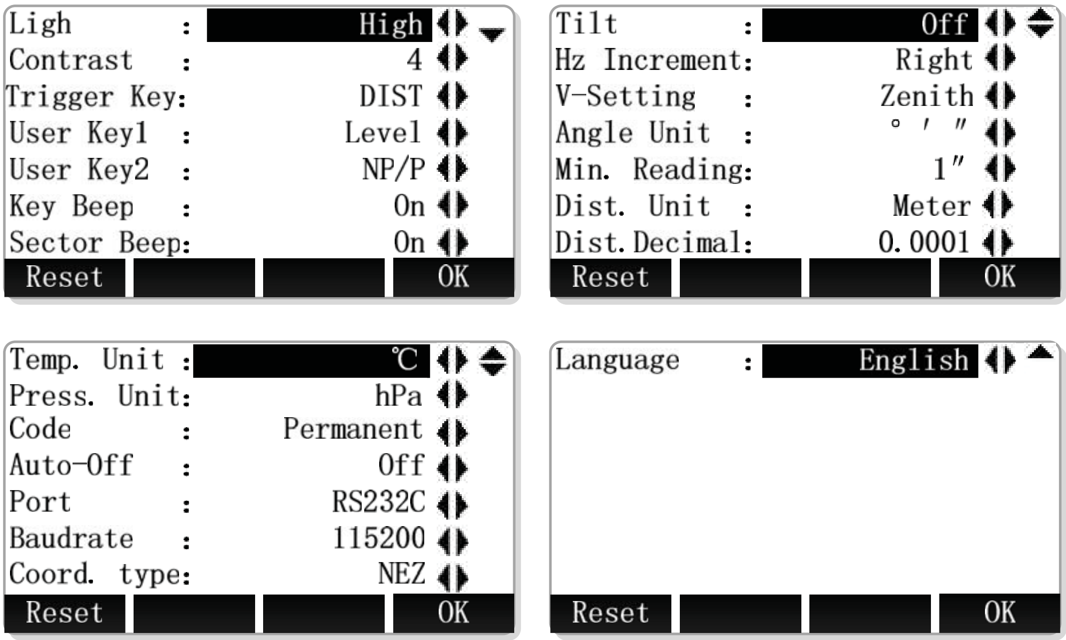
User can also use key [◄], [►] to select the format of export data. CASS, GTS-7 for fixed points data; HTF, GSI for measure data.</td>
<td></td>
<td>


</td>
</tr>
<tr>
<td>⑥ Export code can only use RS232C method. This is same to Step⑤.</td>
<td>[F4]</td>
<td>
</td>
</tr>
</table>

8. Instrument Setting

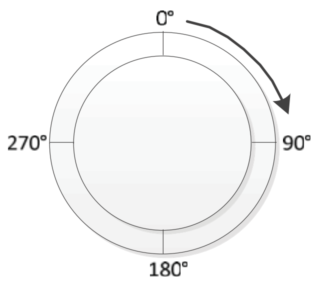
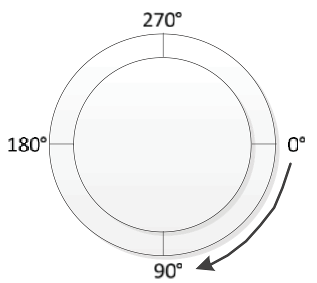
1. General Setting

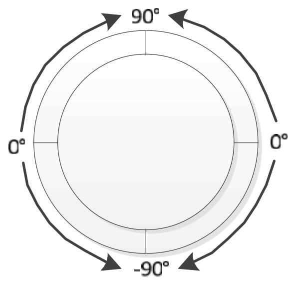
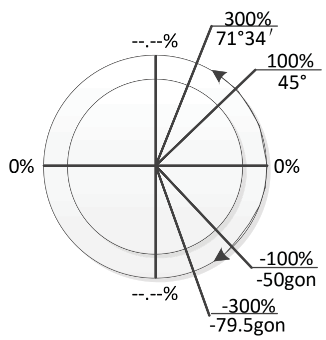
In Setting Menu, choose “1 General” to enter “General Setting”.



Fields of General Setting

Field	Description
Light	**Hight, Medium, Low, Off.** 4 Levels of background light.
Contrast	**1~9.** Set the display contrast.
Trigger Key	**Off:** Disable trigger key. **ALL:** Disting and record. **DIST:** Only disting.
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 diabled.
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 gonto 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	Setes the number of decimal places shown for all distance fields. This is for data display and does not apply to data export or storage. **3**Display 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 poweroff after 30min's no operation. **Off** Disable auto-off.

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

2. EDM Setting

See Chapter "3.2 EDM Setting".

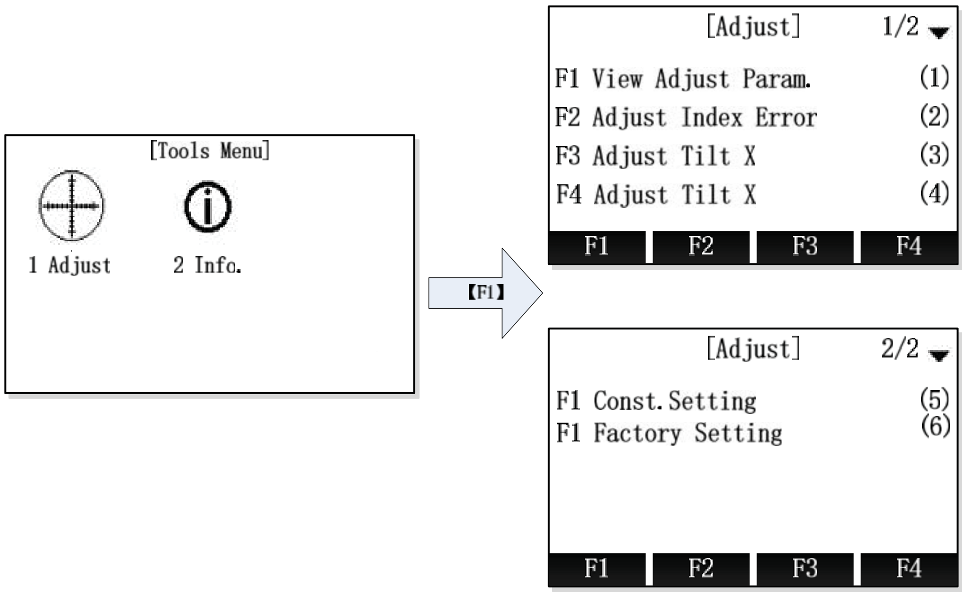
9. Adjust and Tools

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!

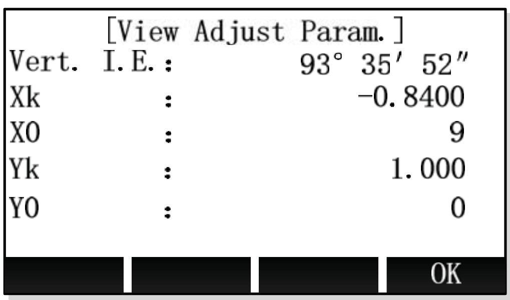
Through Main Menu →"6 Tools"→"1 Adjust", entering adjust menu,Like below:



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.



1.2 Adjust Index Error

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

Steps:

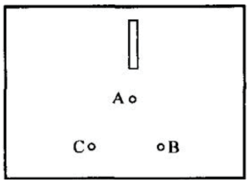
Steps	Key	Display
① After leveling the total station, aim at target with face left, then press [F4](OK).	[F4]	[Adjust Index Error] F1 reading: 342° 11′ 59″ F2 reading: Vert. I.E.: Take positive!! OK
② Aim at the same target with face right, and press [F4] (OK).	[F4]	[Adjust Index Error] F1 reading: 342° 11′ 59″ F2 reading: 191° 26′ 31″ Vert. I.E.: Take reverse! OK
③ Program will show the result value, press [F4](OK) to save.	[F4]	[Adjust Index Error] F1 reading: 342° 11′ 59″ F2 reading: 191° 26′ 31″ Vert. I.E.: 93° 10′ 45″ Press OK to save. OK

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

1.3 Adjust Tilt X

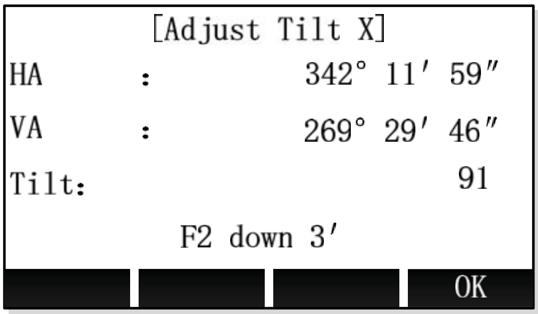
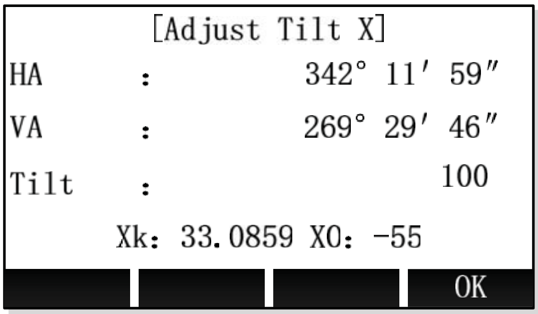
Before compensating for the compensator, make sure that the indicator difference is recalibrated in accordance with 9.1.2 procedure in the closed compensator state.

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 calibaration of x-diretion of compensator’s vertical axis.

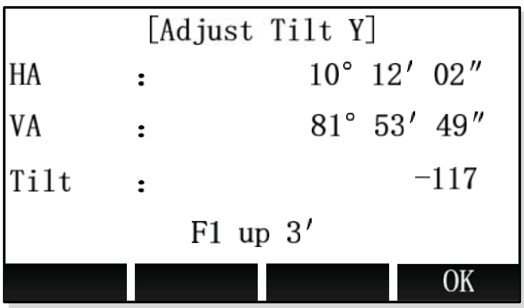
Steps	Key	Display
① Level instrument, focus on the reticle of collimator, record the vertical angle V0. Use fine tuning to set vertical angle to V0+3’,focus on the reticle center accurately, wait for stable value,press [F4](OK).	[F4]	[Adjust Tilt X] HA : 10° 12′ 02″ VA : 81° 53′ 49″ Tilt : -117 F1 up 3′ OK
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]	[Adjust Tilt X] HA : 10° 12′ 02″ VA : 81° 59′ 50″ Tilt : -86 F1 down 3′ OK
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	[F4]	[Adjust Tilt X] HA : 190° 25′ 38″ VA : 269° 23′ 45″ Tilt: 96 F2 up 3′ OK

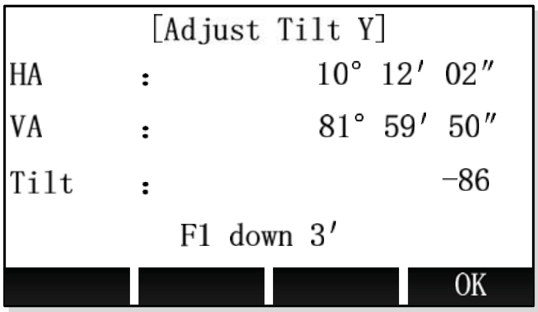
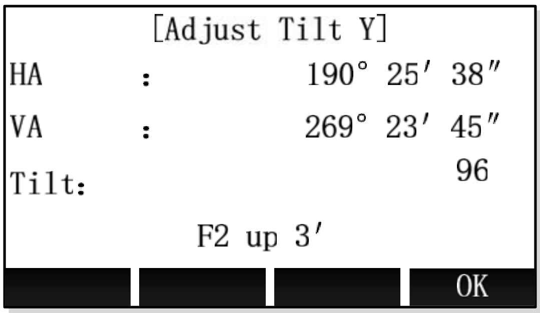
V1-3’,focus on the reticle center accurately, wait for stable value, pressF4(OK).		
⑤ Use fine tuning to set the vertical angle as V1+3’, focus on the reticle center accurately, wait for stable value, press [F4](OK).	[F4]	
⑥ After finishing, it will display the results, press [F4](OK), save and back to menu.	[F4]	

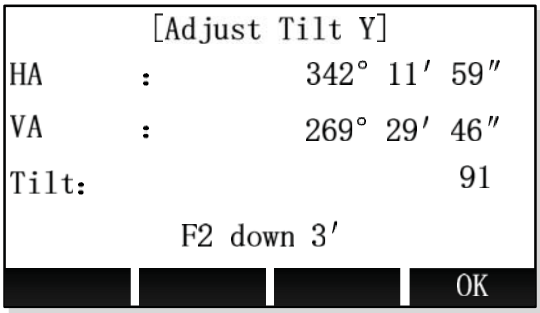
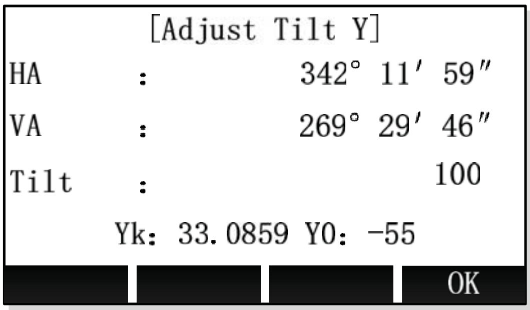
Note: CoK (linear coefficient): If absolute value > 1.5, you need to re-calibrate; In the correction process by pressing the ESC key, will exit, holding compensator parameters unchanged.

1.4 Adjust Tilt Y

In Tools Menu, choose “1 Adjust”, and then press [F4] to enter “Adjust Tilt Y”. These are the calibaration of y-diretion 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, then turn the instrument counterclockwise 90 °, wait for stable	[F4]	

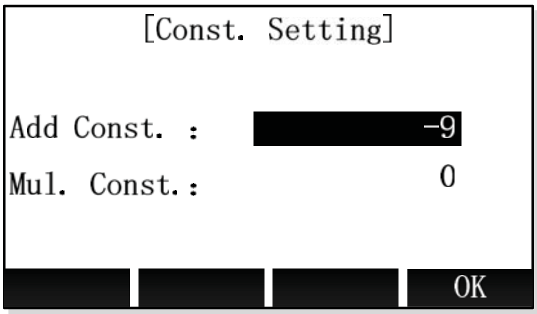
value,press [F4](OK) ,and then turn 90 ° clockwise back to the original direction.		
② Use fine tuning to set the vertical angle to V0-3’, focus on the reticle center accurately, then turn the instrument counterclockwise 90 °, wait for stable value, press [F4] (OK) ,and then turn 90 ° clockwise back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

1.5 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.



1.6 Factory setting

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

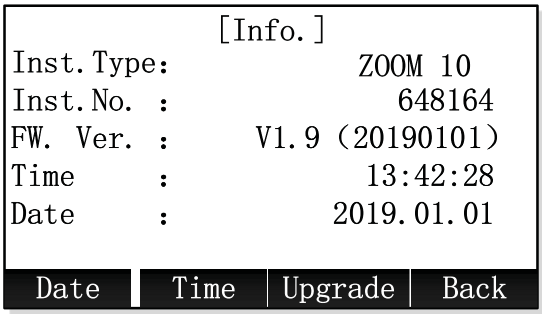
If you need to reset the instrument parameters to factory state, you can use this function, press key [F4] (Yes) and then the instrument will auto power off.

2. System infomation

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.



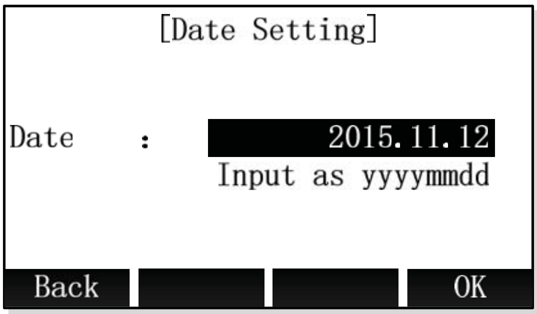
System Infomation

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.



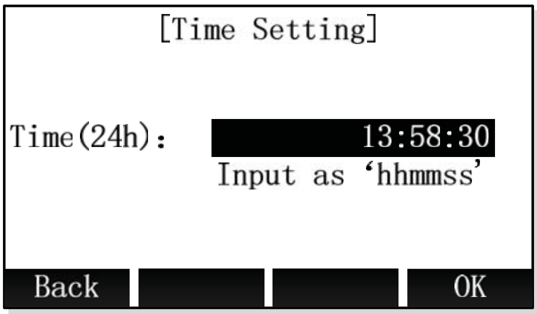
Date Setting

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

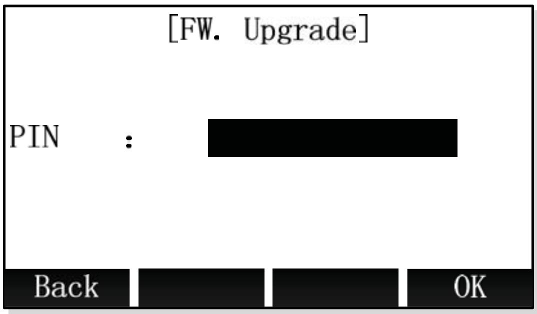
2.4 Firmware Upgrade

Warning:

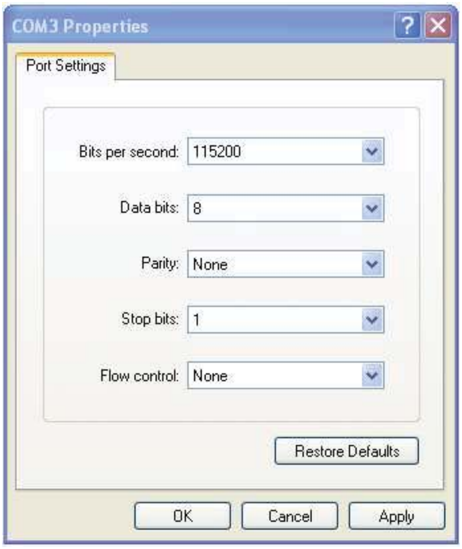
The following functions must be carried out under the guidance of professionals, if the operation is wrong, it may lead to the instrument can’t work properly!

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

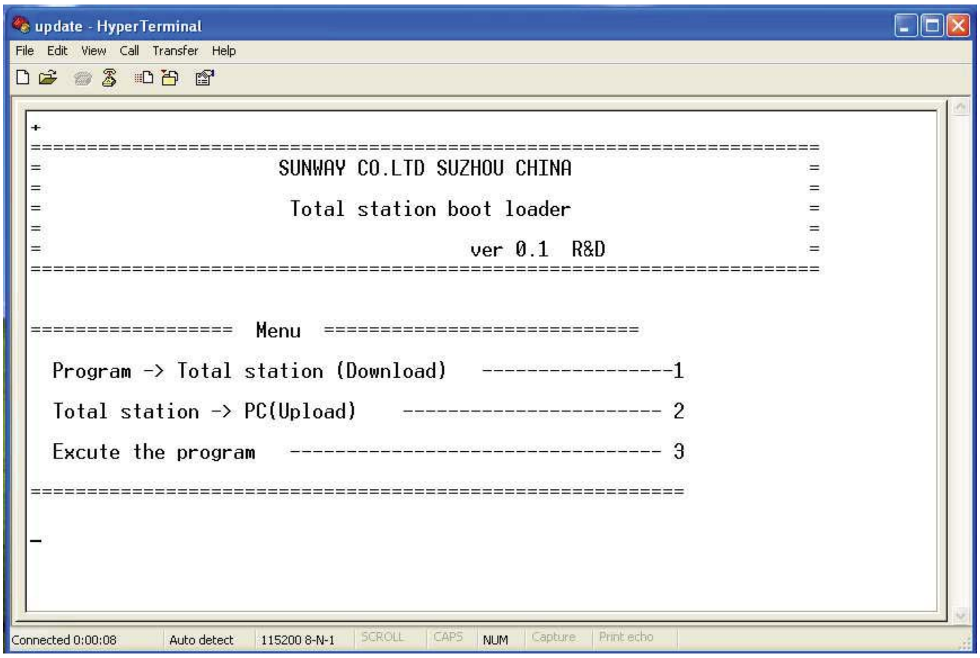
1. Input PIN code(82543), and then press key ENT,the instrument will be turned off.



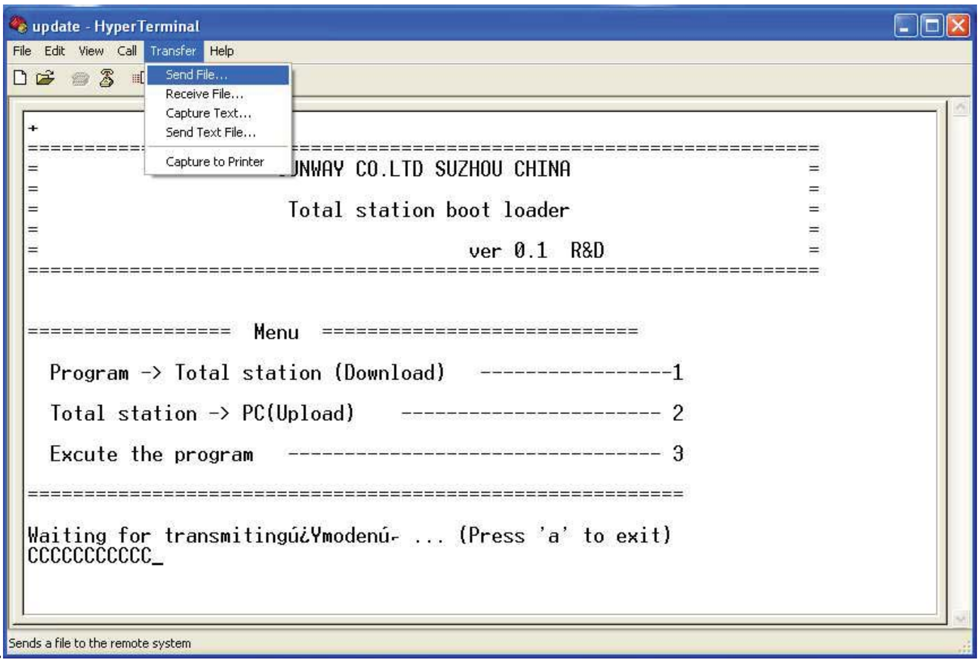
2. Connected to the computer through a serial cable, after installing the correct driver premise, open a HyperTerminal software, configure the correct serial port, it will "bits / sec" is set to 115200, "Data Flow Control" is set to "None" and press OK.



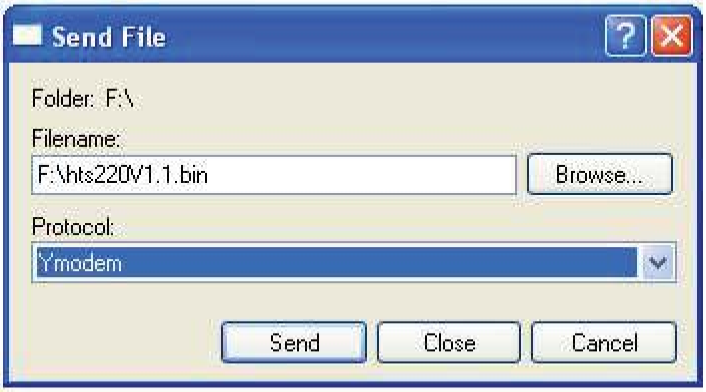
3. Press the power key of the instrumentin Hyper Terminal , shown as follows:
   Note: Software upgrade operation must be carefulonce you select the instrument into the upgrade status; if press "3" in the picture below, you can also resume running the previous program.



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

file".
update - HyperTerminal
File Edit View Call Transfer Help
Send File...
Receive File...
Capture Text...
Send Text File...
Capture to Printer
UNWAY CO.LTD SUZHOU CHINA
Total station boot loader
ver 0.1 R&D
Menu
Program -> Total station (Download) ----------------1
Total station -> PC(Upload) ---------------------- 2
Excute the program -------------------------------- 3
Waiting for transmitingú¿Ymodenú- ... (Press 'a' to exit)
CCCCCCCCCCC_
Sends a file to the remote system

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

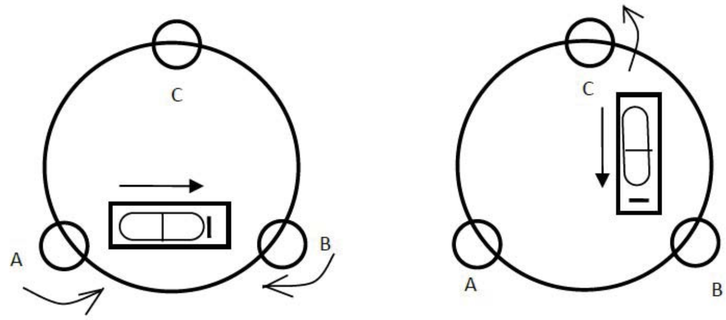


6. It will display the sending application process, and then close the super terminal, starting up after removing theinstrument battery and then putting in again. The current software is the new version updated previously.

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.

3.1 Tube level



- **Checkout**

Refer to the chapter "Leveling instrument accurately by tubelevel"of" Setting up theinstrument”

- **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.

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

- **Calibration**

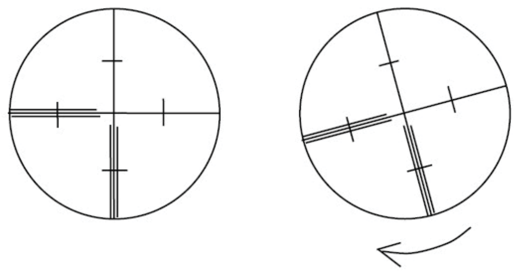
If the bubbles is not in the center, use the correction needle or six angle wrench to adjust the correction screw which under the bubble to make the buble to the center. For calibration, you shall first loosen the calibration screw (1 or 2) which opposite to the direction of the bubble offset, then tighten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

3.3 Telescope reticle

- **Checkout**

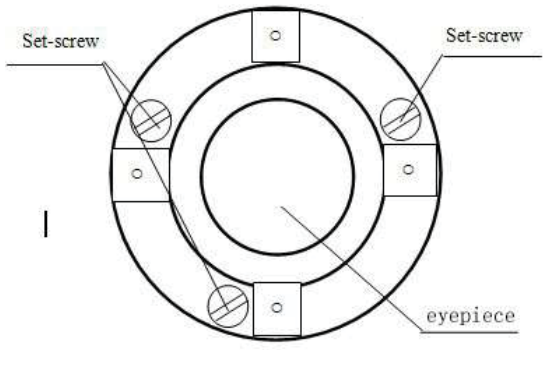
After leveling the instrument find a target A with the telescope, make the center of the crosshair focused on target A and fixed horizontal and vertical brake handwheel.

1. Rotate telescope vertical micrometer handwheel, 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 handwheel, 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 evently, test the calibration results with the above methods.
4. Put the protective cover back.



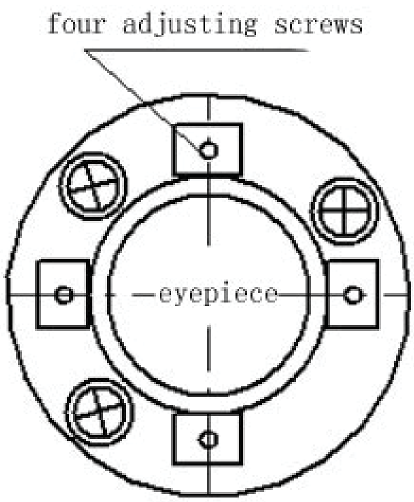
3.4 The verticality of collimation axis and horizontal axis(2C)

- **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 handwheel, turn the telescope, rotate the alidade to face right and focus on the same target A. Before aiming please tighten the horizontal and vertical brakehandwheel 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 handwheel 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 handwheel, adjust the calibration screw of the crosshair on the left and right. First, loosen the screw on one side, and screw up the screw on the other side, move the reticle and focus on target A.
3. Repeat the test Steps, calibrate it to | 2 C | < 10.
4. Tighten the calibration screws, put the protective cover back.



Notice: Check the photoelectric coaxiality after calibrating.

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 handwheel, 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 verticalaxis 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.

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 goalA, 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.

3.7 Plummet

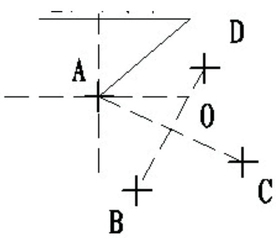
- **Checkout**

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 handwheel.
2. Fix the white paper with a cross, and mark the points when the instrument rotates 90 °, as the figure shows A, B, C, D points.
3. Connect the diagonal points A、C and B、D with a straight line, the intersection name of the two line is 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 therequirements.
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.

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 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.

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.

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 cann'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 pointsposition 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 ZOOM 10
Telescope	Imaging		—	Erect
	Magnification		×	30
	Field of view		—	1 ° 20′
	Min.target distance		m	1.5
	Effective aperture		mm	40/50(EDM)
Angle measurement (Hz, V)	2C index error		(″)	1.4
	Angle i index error		(″)	2.0
	Angle measurement method		—	Absolute encoder
	Minimum reading		(″)	1
Distance measurement (IR)	Range	Single prism	km	3
		Triple prism	km	5
		No- prism1	m	400
	Time	Repeated	s	2(first 3)
		Tracking	s	0.8
	Minimum display		mm	0.1
	Accuracy	Prism	mm	$\pm(2+2\times10^{-6}D)$
		No- prism		$\pm(3+2\times10^{-6}D)$
Tilt compensator	Compensation method		—	Biaxial type
	Compensation range		(′)	±3
Communication Port			—	RS232C
U disk interface			—	Yes
Bluetooth			—	Yes
Temperature and pressure sensor			—	No
SD card			—	Yes

Display	Screen		—	Both sides（280*160, Black and white screen）
	Illumination		—	Support
Laser Plumb	Laser (optional) Laser Plumb		—	Wavelength 635nm Maximum output power (adjustable): not less than 0.4 m W, not more than 1.0 m W
Level	Tubular level		(″)/2 mm	30
	Round level		(′) /2 mm	8
Built-in application			—	Support
Battery supply	Type		—	Rechargeable High-energy lithium battery
	Voltage		V	7.4
	Power		W	＜ 2.2
	Battery capacity		mAh	3000
	Working duration	Angle	h	18
		Dist+Angle	h	8（At + 20 ° C, constant measuring mode）

1: Refers to good weather conditions (visibility is not less than 30km), the goal of KODAK CAT NO.E1527795 (90% of reflecting surface)

11. Attachment A Road calculation example

● Horizontal Curve

1.Element

(1)Input elements

NO.	Element	Start X	Start Y	Azimuth	Length	Radius
1	Line	1099877.123	4578452.654	120.30250	88.12	
2	Tran.Curve				100	200
3	Circular Curve				80	200
4	Tran.Curve				50	200
5	Tran.Curve				45	-150
6	Circular Curve				125	-150
7	Tran.Curve				62	-150
8	Line				30	

(2)Calculate Middlepile coordinate interval: 25

Calculated value

NO.	Pile	X	Y
1	0.000	1099877.123	4578452.654
2	25.000	1099864.432	4578474.193
3	50.000	1099851.741	4578495.732
4	75.000	1099839.050	4578517.272
5	88.120	1099832.390	4578528.575
6	100.000	1099826.347	4578538.804
7	125.000	1099813.310	4578560.134
8	150.000	1099799.305	4578580.839
9	175.000	1099783.746	4578600.395
10	188.120	1099774.794	4578609.984
11	200.000	1099766.173	4578618.155
12	225.000	1099746.535	4578633.600
13	250.000	1099725.125	4578646.476
14	268.120	1099708.688	4578654.087
15	275.000	1099702.279	4578656.588
16	300.000	1099678.498	4578664.280

17	318.120	1099661.029	4578669.092
18	325.000	1099654.388	4578670.891
19	350.000	1099630.474	4578678.158
20	363.120	1099618.263	4578682.949
21	375.000	1099607.584	4578688.147
22	400.000	1099586.640	4578701.745
23	425.000	1099568.243	4578718.630
24	450.000	1099552.901	4578738.333
25	475.000	1099541.041	4578760.307
26	488.120	1099536.325	4578772.546
27	500.000	1099532.962	4578783.937
28	525.000	1099528.087	4578808.446
29	550.000	1099524.876	4578833.238
30	550.120	1099524.862	4578833.357
31	575.000	1099521.947	4578858.066
32	580.120	1099521.347	4578863.151

2. Intersection

⑴Input element

NO.	X	Y	A1	Radius	A2	Mileage
1	126595.622	326532.868				
2	127029.195	328544.441	711.09	2528.248	711.09	2057.769
3	126270.297	330165.767	550.05	2017.0340	0	0
4	126797.134	331957.950	0	1699.1193	504.844	0
5	129306.674	332294.008	636.169	2023.5527	550.938	0
6	130014.424	334370.388	0	0	0	0

⑵Calculate Middle pile coordinate Interval： 500

Calculated value

NO.	Pile	X	Y
1	0.000	126595.622	326532.868
2	500.000	126700.972	327021.643
3	1000.000	126806.322	327510.418
4	1105.563	126828.565	327613.611
5	1305.563	126868.121	327809.646

6	1500.000	126894.146	328002.286
7	2000.000	126892.623	328501.469
8	2500.000	126793.052	328990.623
9	2749.107	126707.910	329224.621
10	2949.107	126625.526	329406.849
11	3000.000	126604.016	329452.973
12	3099.107	126563.629	329543.472
13	3500.000	126444.885	329925.686
14	4000.000	126406.074	330422.894
15	4483.815	126485.817	330898.918
16	4500.000	126490.455	330914.423
17	5000.000	126703.815	331364.622
18	5500.000	127038.580	331733.585
19	6000.000	127465.969	331989.592
20	6365.804	127816.349	332092.209
21	6500.000	127949.036	332112.201
22	6515.804	127964.700	332114.301
23	6516.206	127965.099	332114.355
24	6716.206	128162.844	332144.159
25	7000.000	128437.402	332215.044
26	7500.000	128887.275	332430.323
27	8000.000	129270.830	332749.096
28	8500.000	129564.769	333151.998
29	8785.668	129685.352	333410.708
30	8935.668	129735.494	333552.069
31	9000.000	129756.249	333612.961
32	9500.000	129917.564	334086.224
33	9800.219	130014.424	334370.388

Theoretical value

NO.	Pile	X	Y
1	0.000	126595.622	326532.868
2	500.000	126700.972	327021.643
3	1000.000	126806.323	327510.419
4	1105.563	126828.565	327613.611
5	1305.563	126868.121	327809.646
6	1500.000	126894.146	328002.286
7	2000.000	126892.623	328501.469

8	2500.000	126793.051	328990.623
9	2749.107	126707.910	329224.621
10	2949.107	126625.526	329406.849
11	3000.000	126604.016	329452.974
12	3099.107	126563.629	329543.472
13	3500.000	126444.885	329925.686
14	4000.000	126406.074	330422.895
15	4483.815	126485.817	330898.918
16	4500.000	126490.455	330914.424
17	5000.000	126703.815	331364.622
18	5500.000	127038.580	331733.585
19	6000.000	127465.969	331989.592
20	6365.804	127816.349	332092.209
21	6500.000	127949.037	332112.201
22	6515.804	127964.700	332114.301
23	6516.206	127965.099	332114.355
24	6716.206	128162.844	332144.159
25	7000.000	128437.402	332215.044
26	7500.000	128887.275	332430.323
27	8000.000	129270.830	332749.096
28	8500.000	129564.769	333151.999
29	8785.668	129685.352	333410.708
30	8935.668	129735.494	333552.069
31	9000.000	129756.249	333612.961
32	9500.000	129917.564	334086.224
33	9800.219	130014.424	334370.388

- **Vertical Curve**

Input Intersection

Intersection	Mileage Of Slope changing PT	Elevation of Slope changing PT	Length
Start	0	324.325	0
1	508.36	329.247	84.560
2	1000.48	325.689	52.806
3	1320.236	320.563	120.000
4	1524.265	323.215	28.585
5	1699.888	324.585	31.445
End	1800.244	325.999	0

Piles elevation

NO.	Mileage (Pile)	Calculated Value	Theoretical Value
1	0.000	324.325	324.325
2	100.000	325.293	325.293
3	200.000	326.261	326.261
4	300.000	327.230	327.230
5	400.000	328.198	328.198
6	500.000	329.051	329.051
7	600.000	328.584	328.584
8	700.000	327.861	327.861
9	800.000	327.138	327.138
10	900.000	326.415	326.415
11	1000.000	325.636	325.636
12	1100.000	324.094	324.094
13	1200.000	322.490	322.491
14	1300.000	321.079	321.079
15	1400.000	321.600	321.600
16	1500.000	322.900	322.900
17	1600.000	323.806	323.806
18	1700.000	324.611	324.611
19	1800.000	325.996	325.996
20	1900.000	0.000	0.000
21	2000.000	0.000	0.000
22	2100.000	0.000	0.000

12. Attachment B File format introduction

These following example to instruct exported file format:

STAST001,1.205,AD
XYZ 100.000,100.000,10.000
BKB BS001,45.2526,50.0000
BS BS001,1.800
HVD98.2354,90.2314,10.235
SC A1,1.800,CODE1
NEZ 104.662,99.567,10.214
SD A2,1.800,CODE1
HVD 78.3628,92.4612,4.751
SA A3,1.800,CODE1
HV 63.2349,89.2547
NOTE this note

The first record consists of two lines:
The information of first line: record type, name, elevation, code
Such as:

STA refers to test site
BKB refers to back sight Angle data
BS refers to back sight
SC refers to coordinate data
SD refers to distance measurement data
SA refers to Angle measurement data

The second line information: data types, data records
Such as:

NEZ refers that the following data are coordinates
ENZ refers that the following data are coordinates
HVD refers thatthe following data are horizontal Angle and vertical Angle and slope distance
HV refers that the following data are horizontal Angle and vertical Angle