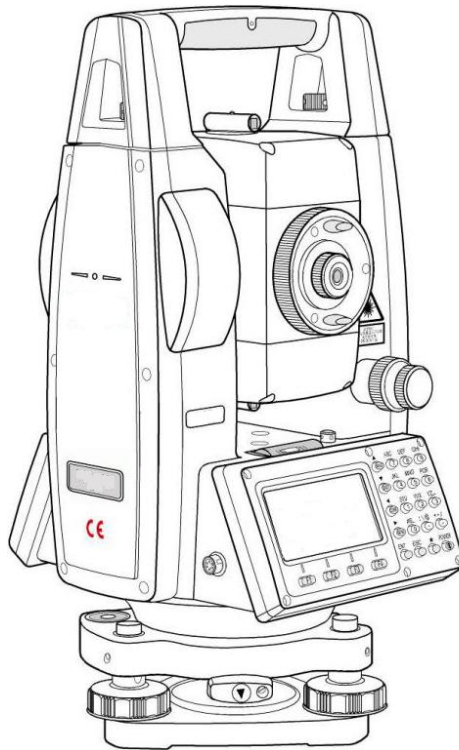


Gintec M8 Total Station User Manual



MENU

Chapter 1 Technical parameters of M8 Total Station	1
§1.1 Introduction	1
§1.2 Technical parameters	1
Chapter 2 Basic Operations and Settings	3
§2.1 M8 Total Station	3
2.1.1 Introduction of Total Station	3
2.1.2 Tribrach	5
2.1.3 Switch on and off operations and display the information of software and hardware	6
2.1.4 Placement of total station	6
2.1.5 Starkey Menu	7
§2.2 Angle Measurement	10
2.2.1 Function menu of Angle Measurement on page P1	10
2.2.2 Function menu of Angle Measurement on page P2	12
2.2.3 Function menu of Angle Measurement on page P3	14
§2.3 Distance Measurement	17
2.3.1 Functional menu of Distance Mode on page P1	17
2.3.2 Function menu on page P2 of Distance Mode	18
§2.4 Coordinate Measurement	23
2.4.1 Import/Export coordinates of control points to the known coordinate files from SD card	23
2.4.2 Function menu of Coordinate Measurement	26
2.4.3 SIDE SHOT	33
2.4.4 Resection	33
Appendix : Packing List	36

Chapter 1 Technical parameters of M8 Total Station





§1.1 Introduction

Welcome to use M8 Total Station products of GINTEC team(Guangzhou **Geosurv Information Technology Co.,Ltd**). Our team has been committed to popularize the advanced surveying and mapping technology and products to the hands of measurement users. If you want to know more about us, please visit the official website: <http://www.gintec.cn/>.

This manual takes M8 Total Station measurement system as an example, for how to install, set up, upgrade, daily maintenance, the use of accessories and how to use it. Even if you have used other products of our company, it is recommended that you read this instruction carefully before using the instrument for better use.

§1.2 Technical parameters

Model	M8
Angle Measurement	
Measurement Method	Absolute Encoding
Circle Diameter	79mm
Minimum Readout	0.1"/1"/5"/10"
Accuracy ⁻¹	2"
Telescope	
Magnification	30X
Image	Erect
Tube Length	154mm
Effective Aperture	45mm (EDM:50MM)
Field of View	1°30'
Minimum Focus Distance	1.4m
Resolving Power	3'
Dual-axis Compensator	
Working Range	±3'

Accuracy		1"
Distance Measurement (Good Conditions) *		
Measurement Range	Single Prism	5000m
	Reflective Sheet	800m
	Reflectorless ⁺³	800m
Accuracy	Single Prism	2mm+2ppm
	Reflective Sheet	2mm+2ppm
	Reflectorless ⁺³	Fine(< 200m): 3mm+2ppm Fine(> 200m): 5mm+2ppm Tracking: 10mm+2ppm
Measuring Time	Single Prism	< 0.3s
	Reflective Sheet	< 0.3s
	Reflectorless ⁺³	Typ. 0.3-3s max.10s
Communication		
Internal Data Memory		Approx. 120000Points/SD Card(max.8G)
Serial I/F port		USB Port/Bluetooth/SD Card
Plummet		
Laser plummet ⁺⁴		±1.5mm at 1.5m
Optical Plummet (Optional)		Erect Image
Magnification		3X
Focusing Range		0.5m~∞
Field of View		5°
Power		
Battery Type		Rechargeable Lithium battery
Voltage/Capacity		7.4V(DC)/ 3100mAh
Operating Time		8 Hours ⁺⁵  : fully charged  /  : able to continue to measure  : needed to finish the operations and replace the battery or charge it
Others		
Waterproof/Dustproof		IP65(IEC60529 Standard)
Display		Dual side, LCD 6 Lines
Keyboard		Dual sides Alphanumeric Keyboard
Operating Temperature		-20°C ~ +50°C
Weight (including battery)		5.2kg
Dimensions (W*D*H)		160*150*330mm

Chapter 2 Basic Operations and Settings

§2.1 M8 Total Station

2.1.1 Introduction of Total Station

Figure 2-1 and Figure 2-2 are the functional charts of M8 Total Station components

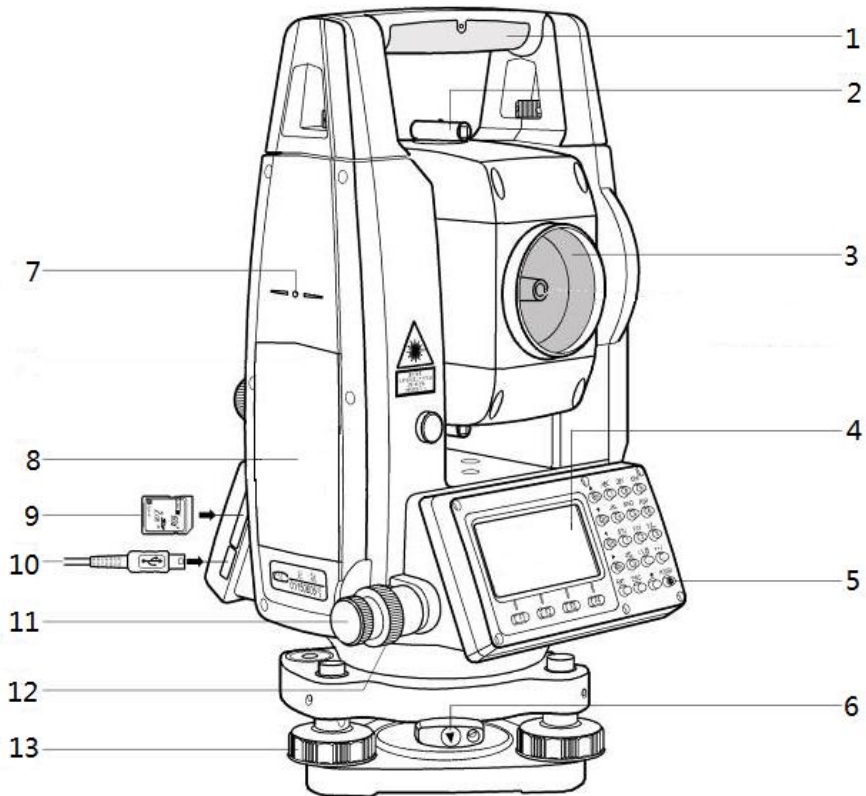


Figure 2-1: Functional chart of M8 Total Station components

1-Carrying handle; 2-Optical sight; 3-Object lens; 4-Display; 5-Power button; 6-Tribrach locking button; 7- Mark for height measures; 8- Battery; 9-SD card slot; 10-USB port; 11-Horizontal tangent knob; 12-Horizontal braking knob; 13- Tribrach foot screw.

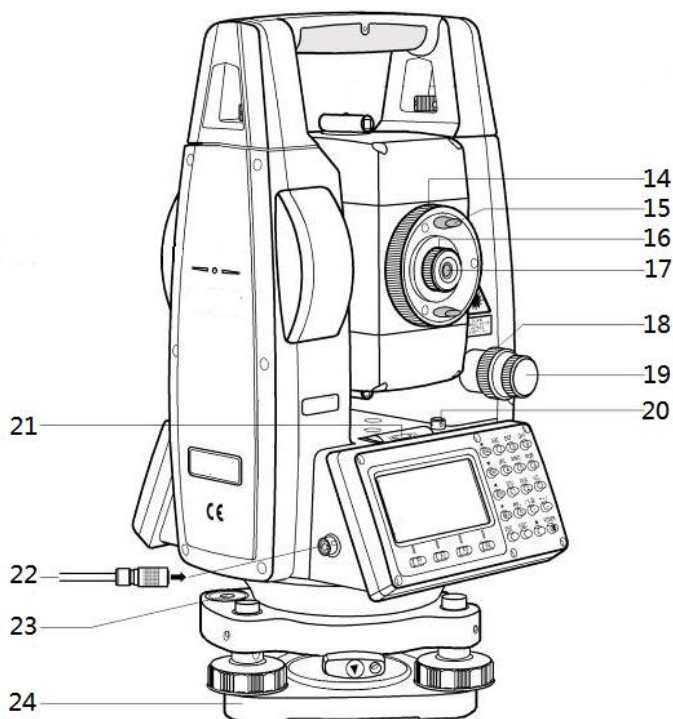


Figure 2-2: Functional chart of M8 Total Station components

14- Telescope focusing knob; 15- Telescope handle; 16- Eyepiece focusing knob; 17 - Eyepiece; 18- Vertical braking knob; 19- Vertical tangent knob; 20- Tube bubble adjustment nail; 21- Tube bubble; 22-RS-232C port; 23- Circular bubble; 24 - Tribrach

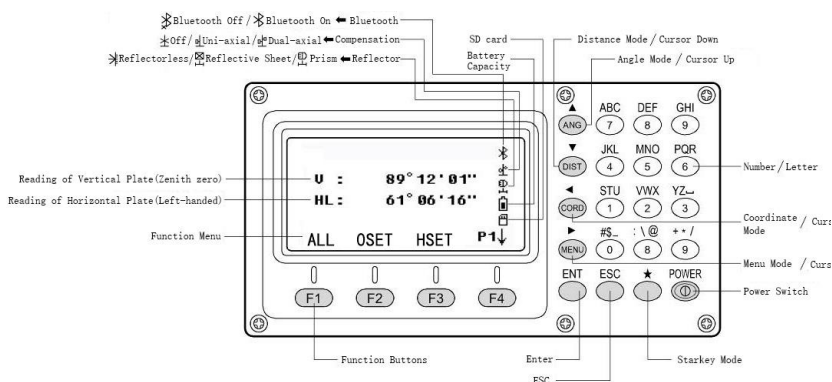


Figure 2-2: M8 Total station panel, display, and features buttons

Table 2-1 Keyboard features of the M8 total station panel

Buttons	Name	Features
	Starkey Mode Button	Enter Starkey Mode
	Angle Mode Button	Enter Angle Mode
	Distance Mode Button	Enter Distance Mode
	Coordinate Measurement Button	Enter Coordinate Measurement
	Menu Mode Button	Enter Menu Mode

	ESC Button	Back To Previous Menu
	Power Switch	Turn the device on or off
	Function Buttons	Check the prompts displaying at the bottom
	Numeric Buttons	Input a number or a letter, decimal point, symbol marked.
	Cursor Movement Buttons	Used to move the cursor when inputting
	Enter	Press this button after inputting the value
Press both button to turn on	Combination Key	Upgrade the on-board software (Need to copy the upgrade file in advance to the SD card root directory in advance)

Table 2-2: Meanings and setting methods of icons in the status bar on the right of screen

Icons	Meaning	Pressing buttons
	Dual-axis Compensation	
	Uni-axial Compensation	
	Compensation off	
	Bluetooth off/on	(Parameters) (Bluetooth) (Off)/ (On)
	Reflectorless/Prism/ Reflective Sheet	+ to switch the target mode
	Battery capacity	Full charged
	Battery capacity	When the icon first appears, the battery can continue to use for about 4 hours.
	Battery capacity	Battery is low and end the operation asap. Replace the battery and charge it.
	Battery capacity	The duration from blinking to automatic shutdown should last for several minutes. Please replace and charge the battery.
	SD card	SD card has been inserted.

2.1.2 Tribrach

Figure 2-3 shows the connection between the total station and the tripod base. Loosen the fixing screws of the base locking button with a flat-head screwdriver and turn the base locking button by counterclockwise rotation by 180° to pull out the instrument upward.

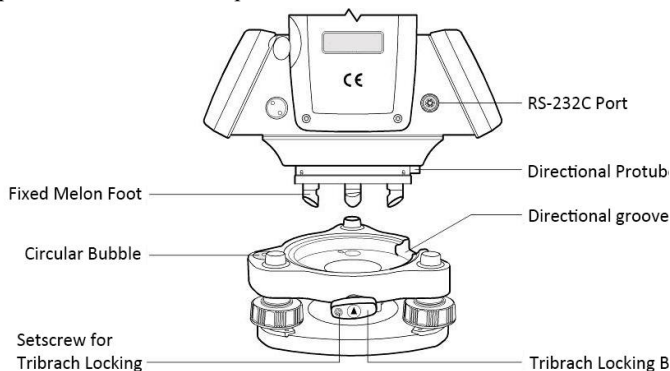


Figure 2-3 Connection between the M8 total station and Tribrach

2.1.3 Switch on and off operations and display the information of software and hardware

Press and hold Ⓢ for 2s to power on, and the factory setting is to enter the interface of Angle Mode [Figure 2-4(a)]. Press ESC to switch the display to the interface of instrument information and data as shown in Figure 2-4(b), and then press to return to the interface of Angle Mode. Press buttons MENU F4 ③ (for the hardware information) to display the instrument hardware information as shown in Figure 2-4(c).

In the power-on state, press and hold Ⓢ for 4s to power off.

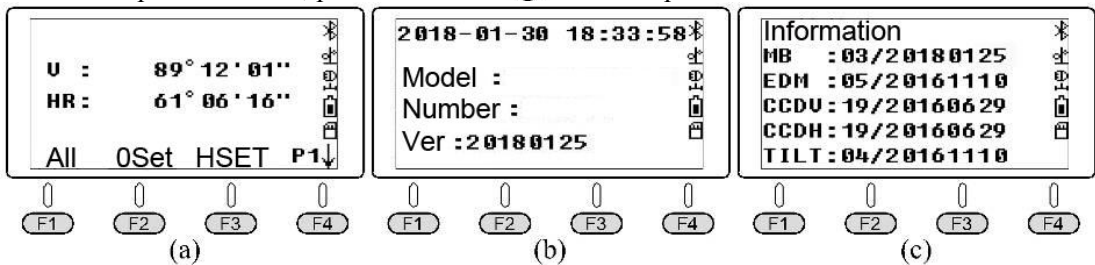


Figure 2-4 Angle Measurement, Instrument Model, Hardware and Software information of instrument

2.1.4 Placement of total station

The placement of the total station consists of centering and leveling so that the vertical axis of the instrument is located on the plumb line of the survey station point, the horizontal plate and axis are in a horizontal position, and the vertical plate is in the plumb plane. The M8 total station instrument of Gintec is equipped with laser alignment device as standard, canceling the optical alignment device (optional). The centering method is divided into laser and vertical plummet, and the leveling is divided into the rough one and refined one.

Followings are the operation steps of total station installation: adjusting the tripod legs to make its length and height suitable for the observer, and opening the tripod legs, put it on the surveying station, to make the tripod head roughly level. Take out the total station instrument from the instrument box and place it on the tripod head and make the center of the instrument base align with the center of the tripod head overall. After tightening the connecting screw, the operations of centering and leveling can be carried out.

Take the following laser plummet as an example to describe how to place the total station:

① Rough centering: Hold the tripod with both hands tightly, then observe the laser point on the ground with your eyes. Move the tripod legs to make the laser point is basically aligned with the center of the survey station (attention should be paid to keep the tripod head level), and step the toes of the tripod into the soil.

② Refined centering: Slightly loosen the connecting screw, and hold the instrument base with both hands. Move the instrument on the tripod head, and rotate the foot screws so that the laser point is accurately aligned with the center mark of the survey station. The error should be less than 1mm. Then tighten the connecting screw.

③ Rough leveling: Rotate No. 1 and 2-foot screws to move the round bubble to the middle of the line connecting No. 1&2-foot screws [Figure 2-5(a)]. Rotate No. 3 foot screw to center circular bubble [Figure 2-5(b)], and finally centering is completed as shown in Figure 2-5(c).

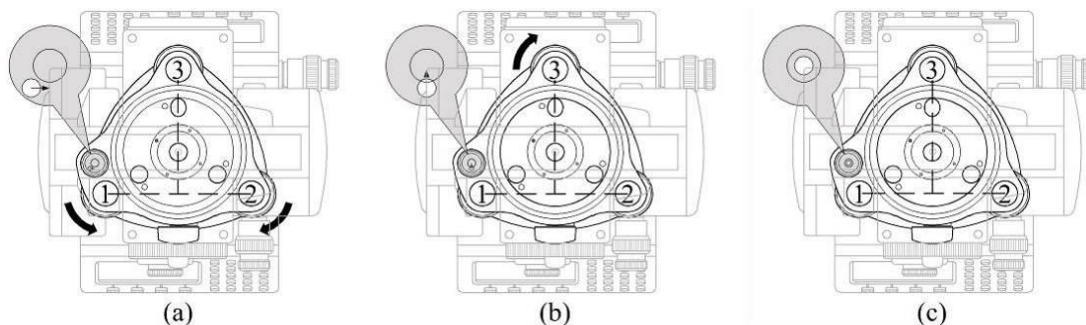


Figure 2-5 The relationship between the direction of rotating foot screws and the movement of the circular bubble

④ Refined leveling: Rotate the sighting parts so that the axis of tube bubble is parallel to the line connecting two feet screws. Figure 2-6(a) shows that the axis of tube bubble is parallel

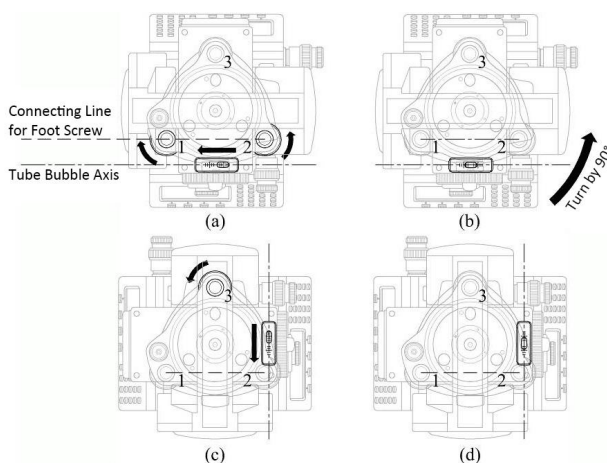


Figure 2-6 Center tube bubble in two mutually perpendicular directions

to the line connecting foot screw No. 1 and 2. Rotate foot screw No. 1 and 2 to center the tube bubble. Turn the sighting parts by 90° to make the axis of tube bubble perpendicular to the line connecting foot screw No.1 and No.2 [Figure 2-6(c)] and rotate the foot screw No.3 to center the tube bubble, as shown in Figure 2-6(d). When refined instrument is conducted, it will not destroy the previous completed alignment.

⑤ Check the centering of tube bubble in two mutually perpendicular directions by rotating the sighting parts. If it is still centered, the placement of instrument is complete. Otherwise, the above refined leveling operation should be repeated.

2.1.5 Starkey Menu

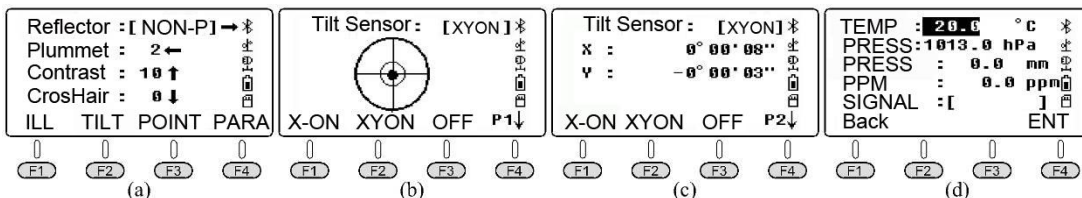


Figure 2-7 Starkey Menu of GINTEC M8 Total Station

Press **★** to open the main menu of Starkey [Figure 2-7(a)]. Use the four cursor movement buttons **→**, **←**, **↑**, **↓**, and four function buttons **F1**, **F2**, **F3**, **F4**. Press button **ESC** to close the Starkey menu.

(1) The operation methods of four cursor movement keys (◀, ▶, ▲, ▼)

① Reflector: Used to adjust reflector type, press button (▶) several times, so that it is allowed to achieve cycle switch among options of Single Prism → Reflectorless → Reflective Sheet → Single Prism in the reflector .

② Plummet: Used to adjust laser intensity, press button (▶) several times, so that it is allowed to achieve the cycle switch of the light intensity of the lower laser point among number 2→1→0→4→3→2. 0 is to close the laser plummet.

③ Contrast: Used to adjust contrast, press button (▲), so that it is allowed to achieve the cycle switch of the LCD contrast ratio among the number 10→11→..... - 16-00-01-02... →09→10.

④ CrosHair: Used to adjust telescope cross wire illumination intensity. Press button (▶) so that it is allowed to achieve the cycle switch of the light intensity of the telescope cross wire illumination intensity among number 0→1→2→3→4→0. 0 is to close the cross lighting.

(2) The functions and operation methods of the four function keys (F1), (F2), (F3), (F4)

① ILL(Illuminate): Used to adjust buttons and screen backlight. Press (F1) button to achieve the switch of background light between on and off.

② TILT: Used to turn the compensator on or off. Press (F2) to enter the 1/2 interface of the compensator [Figure 2-7(b)], and you can refer to the electronic bubble displayed on the screen. When the electronic compensator is open, the instrument will automatically decompose the vertical axis tilt into two components of alignment axis direction (X axis) and horizontal axis direction (Y axis) for tilt compensation, referred to be as biaxial compensation. Press button (F1) (single axis) to set the single axis compensation. Press button (F2) (double axes) to set the biaxial compensation. Press button (F3) (off) to turn off the compensator.

Press (F4) to turn to the interface P2 of the compensator [Figure 2-7(c)], and the screen displays the two components of the current inclination of vertical axis of the instrument in the alignment axis direction (X axis) and horizontal axis direction (Y axis).

Press button (ESC) to return to the main menu of Starkey.

③ POINT: Used to switch the pointing laser between on and off.

④ PARA(Parameters): Used to modify atmospheric correction parameters. Press (F4) to enter the parameters interface [Figure 2-7(d)]. Input the values of current measured atmospheric temperature and atmospheric pressure with the digital buttons. Then the system will automatically calculate the PPM value and will apply it to make meteorological correction on the measured distance.

• The reference meteorological point of M8 total station is: air temperature $t=20^{\circ}\text{C}$, air pressure $P=1013\text{hPa}$.

The calculation formula of meteorological correction PPM for M8 total station is:

$$\text{PPM} = 278.44 - \frac{0.294922P}{1 + 0.003661t} \quad (2-2)$$

In Formula (2-2), the unit of temperature t is $^{\circ}\text{C}$, the unit of pressure P is hPa, and the unit of PPM is ppm that is 1×10^{-6} , or one millionth. Since $1\text{km}=1 \times 10^6\text{mm}$, the PPM value calculated using Formula(2-2) is the meteorological correction proportional coefficient for 1km distance.

Assume that the value of oblique distance of a side length measured by total station is $S(\text{km})$, then the value of meteorological correction of this distance is $\Delta S=S \times \text{PPM}(\text{mm})$.

Substitute $t=20^{\circ}\text{C}$ and $P=1013\text{hPa}$ of reference meteorological point into equation (2-2):

$$\text{PPM} = 278.44 - \frac{0.294922 \times 1013}{1 + 0.003661 \times 20} = 0.0665 \approx 0\text{ppm} \quad (2-3)$$

• Assume that the current atmospheric temperature is $t=32.1\text{ }^{\circ}\text{C}$, and the atmospheric pressure is $P=1011.6\text{hPa}$, and substitute them into Equation (2-2), getting

$$\text{PPM} = 278.44 - \frac{0.294922 \times 1011.6}{1 + 0.00366 \times 32.1} = 11.4706 \approx 11.5 \text{ppm} \quad (2-4)$$

In the parameter interface [Figure 2-7(d)], press s (3) (2) (·) (1) (ENT) to input the value of atmospheric temperature [Figure 2-8(a)]. Press s (1) (0) (1) (1) (·) (6) (ENT) to automatically calculate PPM=11.5 PPM [Figure 2-8(b)], which is consistent with the calculation result of Equation (2-4).

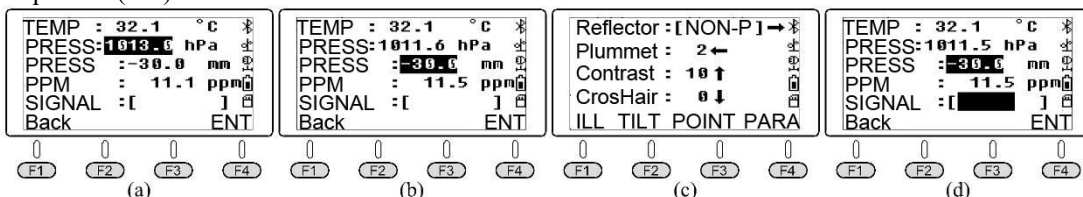


Figure 2-8 Input atmospheric temperature and pressure and then the instrument will automatically calculate PPM value.

Users can also apply Formula (2-2) to calculate the value of the current meteorological correction PPM, and then move the cursor down to the value column of PPM to directly input the calculated PPM value with the numeric buttons.

① Range of inputting atmospheric temperature is $-30\text{ }^{\circ}\text{C} \sim +60\text{ }^{\circ}\text{C}$, step size is $0.1\text{ }^{\circ}\text{C}$; range of inputting atmospheric pressure is $560 \sim 1066\text{hPa}$, step size is 0.1hPa . ② The range of PPM value directly entered by the user is from -999.9 PPM to 999.9 PPM . The PPM value beyond this range cannot be entered.

(3) SIGNAL

Signal is used to measure the intensity display of backlight signal at the center of photoelectric aiming prism. Before delivery of the instrument, the errors of telescope alignment axis, ranging emission optical axis and receiving optical axis, the three coaxial axes, are calibrated rigorously within the range prescribed by the factory. There may be relatively big errors of the different axes among the three axes after severe vibration in the process of transportation: when the telescope aims precisely at the center of the prism, but the emission optical axis doesn't aim at the center of prism. At this point, it is workable to use photoelectric aiming to make the emission optical axis aim precisely at the center of the prime. The method is to press buttons (★) (▶) (▶) to set the reflector to be "Prism" [Figure 2-8 (c)]. Press button (F4) (parameters) to make the telescope aim at the center of prism. At this point, the stripes length in the column of the "Signal" indicates the strength of the reflected ranging signal [Figure 2-8 (d)]. "Prism Constant" at -30 mm is the factory value of the instrument. Rotate the horizontal fretting screw or telescope fretting screw. When the strength of the heliogram reaches the maximum, it indicates that the emission optical axis has been precisely aimed at the center of the prism.

Photoelectric aiming method can also be used to test the three-coaxial errors of the instrument. When it is found that the three-coaxial error of the total station is big, the instrument should be sent to the distributor for inspection and correction in time.

§2.2 Angle Measurement

Every time M8 is normally power on, it will automatically jump to the Angle measurement interface. When the current mode is Distance Measurement or Coordinate Measurement, press ANG to enter Angle Measurement as shown in Figure 2-9, the Angle Measurement provides three menus. Press button F4 to turn the pages.

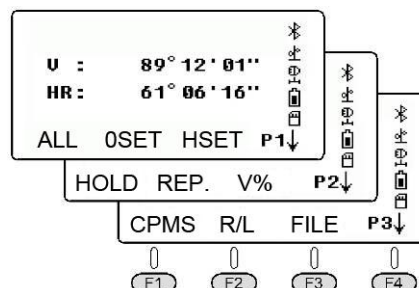


Figure2-9 Menus of Angle Measurement

2.2.1 Function menu of Angle Measurement on page P1

(1) F1 ALL

The function of "ALL" command is to save the current reading of horizontal dial and vertical dial into the current measurement file. If users want to change the current file or create a new file as the current file, they should first execute the "File" command in the function menu on page P3.

For example, if we set M8 at point A, and measure the horizontal angles of two points B and C by the method of observation set for twice are as follows:

① Target point B when face left. Press button F3 (HSET), and then press buttons $\text{0} \text{ } \text{.} \text{ } \text{0} \text{ } \text{.} \text{ } \text{3} \text{ } \text{0}$ and button F4 (Confirm) to set the reading of the horizontal angle to be $0^\circ 00'30''$ [Figure 2-11(d)].

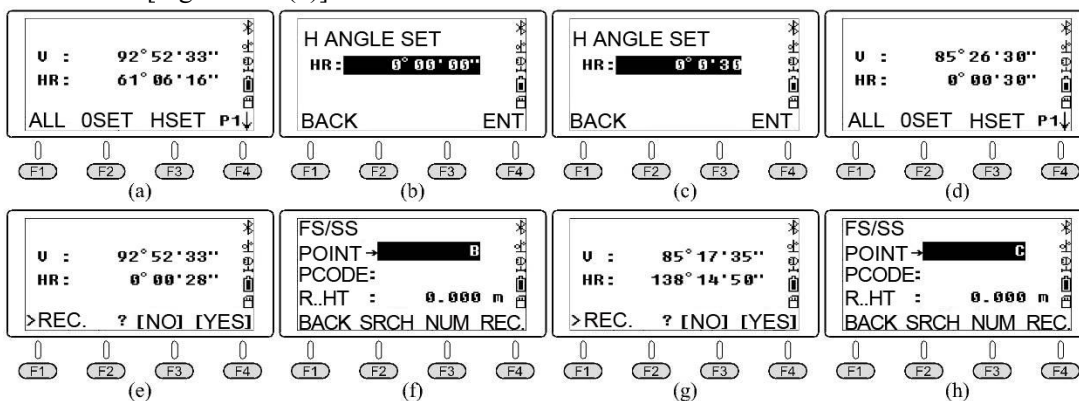


Figure2-10 The measurement of $\angle BAC$ by the method of observation set

Press F1 (ALL) and button F4 (ENT). Input the point name as B measured in face left [Figure 2-10(c)]. Press F4 (ENT) to save the reading of horizontal and vertical to the current file "180105_1".

② Turn the telescope clockwise, aiming at target point C. Press F1 (ALL) and button F4 (YES) [Figure 2-10(d-e)]. Input the observed point name as C [Figure 2-10(h)]. Press F4 (YES) to save the readings of horizontal and vertical angles to the current file.

③ Turn vertically the telescope to face right, and then turn the telescope counter clockwise to aim at the target point C. Press button F1 (ALL) and button F4 (ENT) to input the observed point name as C. Press button F4 (YES) to save the readings of horizontal and vertical angles to the current file.

④ Turn the telescope counter clockwise to aim at point B. Press button F1 (ALL) and button F4 (ENT). Input observed point name as B. Press button F4 (YES) to save the

readings of horizontal and vertical angles into the current file. Now we finished the first survey round.

In the second survey round, set the reading of horizontal plate at zero direction for point B as $90^{\circ} 00' 30''$. The observation method is the same as the above. The records of calculation data of the observed horizontal Angle $\angle BAC$ from the 2 survey rounds are listed in Table 2-3.

Table2-3 Observation table of angles measuring by the method of observation set

Survey Station	Targets	Position of Vertical Plate	Reading of Horizontal Angle /° ' "	Angles by Half of Survey Round /° ' "	Average Angles for One Survey Round /° ' "	Average Angles for Survey RoundS /° ' "
First Survey Round A	B	Face Left	0 00 28	138 14 22	138 14 19	138 14 19.5
	C		138 14 50			
	B	Face Right	180 00 31	138 14 16		
	C		318 14 47			
Second Survey Round A	B	Face Left	90 00 26	138 14 25	138 14 20	
	C		228 14 50			
	B	Face Right	270 00 31	138 14 15		
	C		48 14 46			

⑤ Export the data of the current file "180105_1" to the SD card: press buttons (F4) (F4) to go to the function menu on page P3. Press buttons (F3) (File) (F2) (List) (F3) (EXP.) (Figure 2-12) to export the data of the current file 180105_1 to the following four files:

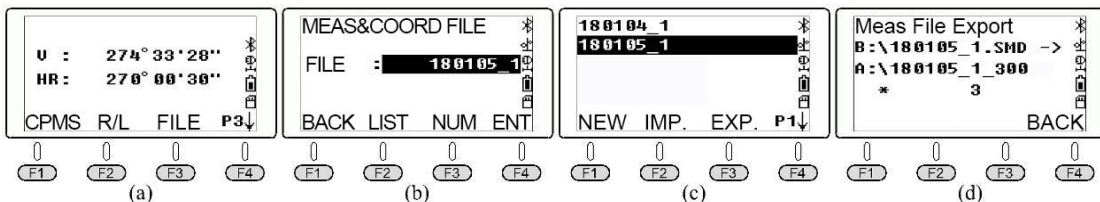


Figure2-11 Execute the commands of "File/List/Export" from the function menu on page P3 of Angle Measurement

- 180105_1_600.txt 600 format measurement file
- 180105_1_300.txt 300 format measurement file
- 180105_1.dat Cad coordinate file
- 180105_1.csv Excel table format measurement file

Among the above formats for measurement files, the latter two kinds of coordinate files are also text format files, with the same content but different extension names. But we only have angles until now, so these two coordinate files will be empty files without data stored.

The left image of Figure 2-12 shows the exported measurement file "180105_1_600.txt". The right image shows the content of the exported measurement file "180105_1_300.txt".

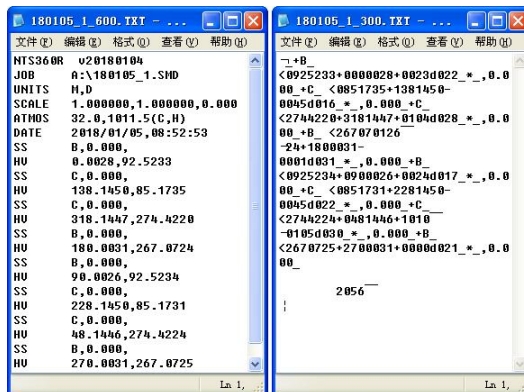



Figure2-12 Two exported measurement data files

The significance of data in the left image of Figure 2-12 is that there are two lines showing the data of each measuring point, among which the data format of line SS is "Point name, Target height, Code", and the data format of line HV is "reading of horizontal angle, reading of vertical angle".

Before running the command of "Export", ensure that the SD card has been inserted into the SD card slot of the device. The icon  is displayed in the status bar on the right of the screen.

(2) **F2** (OSET)

Press button **F2** (OSET) to set current angle into 00°00'00".

(3) **F3** (HSET)

Set the current horizontal angle into the inputted value. Press **F3** to separate the value of degrees, minutes, and seconds after completing the input value. For example, to set the reading of the horizontal plate to be 0° 00'30", press **F3** **0** **.** **0** **.** **3** **0** **ENT** (HSET), as shown in Figure 2-15(d).

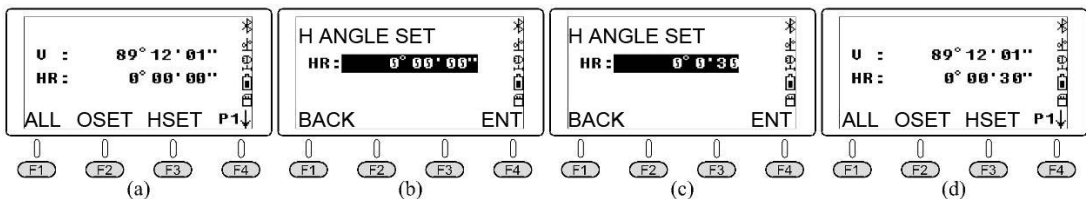


Figure2-13 How to Set Horizontal Angle Through “HSET” Function

2.2.2 Function menu of Angle Measurement on page P2

(1) **F1** (Hold)

The command "Hold" is used to hold the reading of horizontal angle to be current value. The reading of horizontal angle won't change when you turn telescope. So, the command "Hold" is also a way to set horizontal angle.

For example, the method to execute the command "Hold" to set the reading of the horizontal plate of an observed target to be 90° 00'35" is: rotating the telescope, tightening the horizontal braking screw and rotating the horizontal tangent knob to make the reading of the horizontal plate is 90° 00'35" [Figure 2-16(a)]; pressing **F1** (Hold) to enter the interface as shown in [Figure 2-16(b) and releasing the horizontal tangent knob to let the telescope can aim at the observation target accurately. At this point, the reading will not change. Press **F4** (Yes) to complete the operation like what shown in Figure 2-16(c). To set the reading of horizontal angle, it is commonly to use the command "HSET", but rarely use the command "Hold".

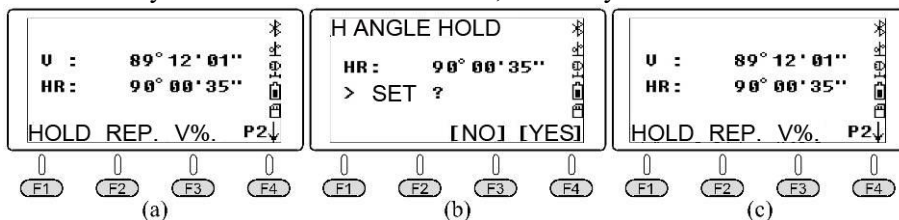


Figure2-14 Execute the command “Hold” in the function menu on page P2 of the Angle Measurement

(2) **F2** (REP.)

The command "REP." is a method of cumulative angle measurements that simulates the repetition measurement of a theodolite, usually in the Face Left.

Now we assume that M8 is located at point A, and the following steps are performed to

observe $\angle BAC$ three times using the REP function:

- ① For the first time, aim at target point B, and press **(F2)** (REP). The reading of horizontal plate, HR, is $0^{\circ} 00' 00''$ [Figure 2-17(b)].
- ② Turn the telescope clockwise, and aim at target point C for the first time [Figure 2-17(c)], and then press **(F4)** (Hold) [Figure 2-17(d)].
- ③ Turn the telescope clockwise, and aim at point B for the second time, and then press **(F3)** (Release) [Figure 2-17(e)].
- ④ Turn the telescope clockwise, aim at the target point C for the second time [Figure 2-17(f)], and then press **(F4)** (Hold) [Figure 2-17(g)]. The screen displays the average horizontal angle of $\angle BAC$ after twice repetition measurement, with average at $19^{\circ} 28' 24''$.
- ⑤ Turn the telescope clockwise, and aim at point B for the third time, and then press button **(F3)** (Release) [Figure 2-17(h)].
- ⑥ Turn the telescope and aim at target point C for the third time [Figure 2-17(i)], and then press **(F4)** (Hold) [Figure 2-17(j)]. The screen displays the horizontal angle value of $\angle BAC$ after triple repetition measurement, with an average value at $19^{\circ} 28' 26''$.
- ⑦ Press button **(F2)** (Exit) and button **(F4)** (Yes) to return to the function menu on page P2 of Angle Measurement [Figure 2-17(k)].

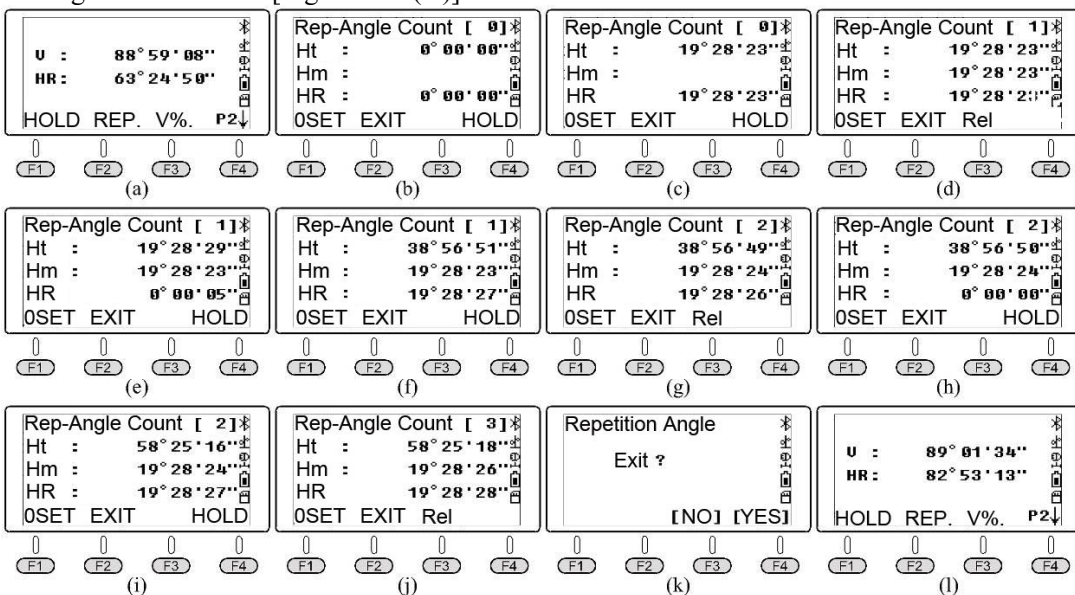


Figure 2-15 To use "REP." function to observe horizontal angle $\angle BAC$ for three times when facing left

- (3) **(F3)** (V%)

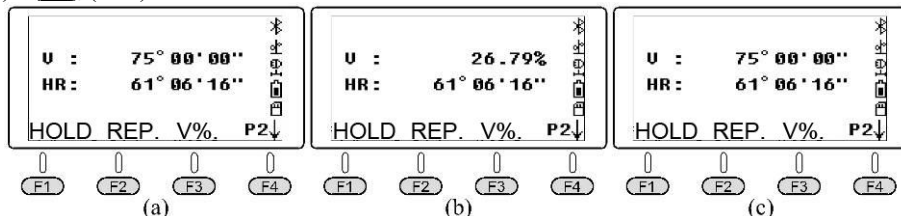


Figure 2-16 Execute repeatedly the command "V%" in the function menu on page P2 of Angle Measurement to switch the reading of vertical plate between zenith distance and slope gradient

Press button **(F3)** (V%) to switch the reading of vertical plate, namely V, between zenith distance and slope gradient (Figure 2-19). As shown in Figure 2-18, assuming reading of vertical

plate as $L=75^{\circ}00'00''$, and then vertical angle of the telescope in the direction of alignment axis is $\alpha=90^{\circ}-L=90^{\circ}-75^{\circ}00'00''=15^{\circ}00'00''$, and $V\%$ is $i=100 \times \tan 15^{\circ}00'00''=26.7949\% \approx 26.8\%$,

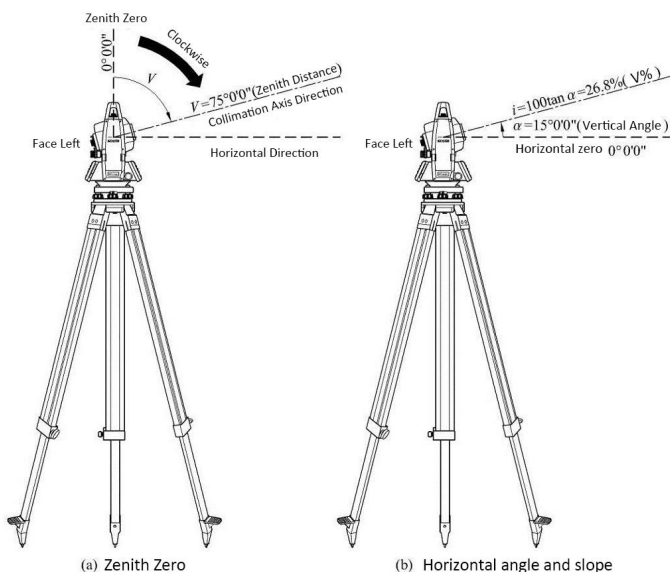


Figure 2-17 Execute repeatedly the command "V%" to switch the reading of vertical plate between zenith angle and slope which is consistent with the result indicated in Figure 2-19(b).

2.2.3 Function menu of Angle Measurement on page P3

(1) **F1** (CPMS)

As shown in Figure 2-17(b), Vertical Angle is defined as the angle between horizontal direction to the alignment axis of the telescope. Elevation angle is a positive angle while Depression angle is a negative angle. Press button **F3** (CPMS) to switch the reading of vertical plate between zenith distance (or slope) and Vertical angle, as shown in Figure 2-20.

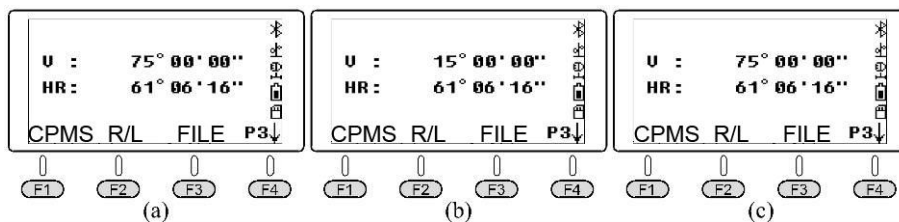


Figure 2-18 Execute repeatedly the command "CPMS" to switch the reading of vertical plate between zenith distance and vertical angle

The default vertical angle of M8 series total station is "Zenith zero". Set the reading of vertical angle in face left as L, and then the vertical angle in the direction of the telescopic alignment axis is $\alpha=90^{\circ}-L$. Insert the L as shown in Figure 2-20(a) and obtain the vertical angle $\alpha_L=90^{\circ}-75^{\circ}00'00''=15^{\circ}00'00''$. The results are equal to those in Figure 2-20(b).

(2) **F2** (R/L)

Press button **(F2)** (R/L) to switch the reading of horizontal angle between angle HR (The Angle increases clockwise) and angle HL (The Angle increases counterclockwise). In the same angle, $HR+HL=360^\circ$, that is, $HL=360^\circ-HR$, as shown in Figure 2-21.

(3) **(F3)** (File)

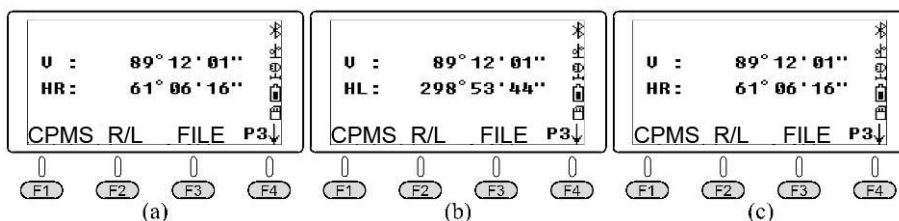


Figure 2-19 Press R/L to switch the reading of horizontal angle between right-handed angle HR and left-handed angle HL

This function can be used to: change current file, create file, rename file, delete file, export file and import coordinate data to the current file.

Press button **(F3)** (File) and button **(F2)** (List) to enter the interface of file list as shown in Figure 2-22(b). There are two pages of function menu. Press button **(F4)** to turn the pages.

① List-New: Press button **(F1)** (New) to create a file and set it to be the current file, as shown in Figure 2-10. The name of the new file is 180105_1.

② List-ATTR(Attribute), RENAME, DEL(Delete): In the menu on page P2 [Figure 2-22(b)] of the FILE-LIST, press button **(F1)** (ATTR) to display the attribute data of measurement file 180105_1.SMD [Figure 2-22(d)]. Press **(F4)** to turn pages, and the screen displays the attribute data of the coordinate file 180105_1.SCD [Figure 2-22(e)].

In the interface shown in Figure 2-22(c), press button **(▲)** or **(▼)** to move the cursor to the file name needed to be modified. Press button **(F2)** (Rename) to modify the file name of the cursor line, or press buttons **(F3)** (Delete) and **(F4)** (OK) to delete the file of the cursor line.

③ Set the current measurement file: press button **(▲)** or **(▼)** to move the cursor to the required file name, and then press **(ENT)** to set the file of cursor line to be the current file and then back to the function menu on page P3 of Angle Measurement.

☞ In the commands of Angle Measurement, Distance Measurement, Coordinate Measurement and "Menu/Data collection", if the name of the current file is not changed and execute the command "All", the instrument always saves the measurement data into the measurement file of the current file. The default value of the name of the survey point is the

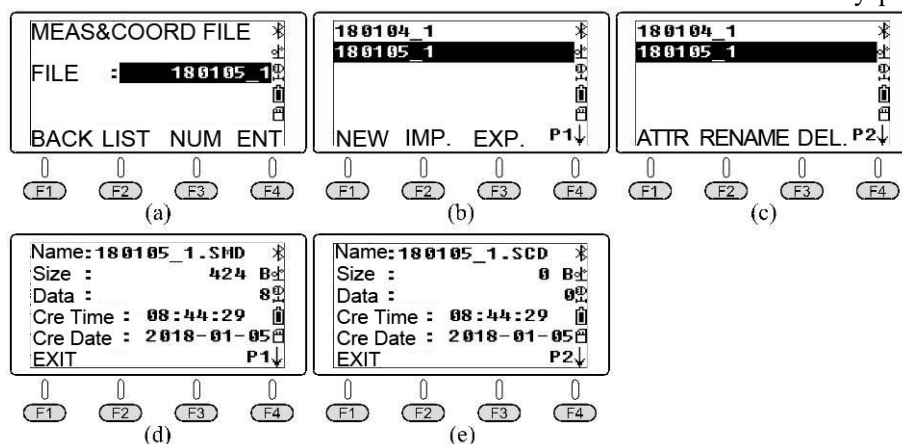


Figure 2-20 Commands of New and ATTR in the function menu of commands of "File/List" point name last inputted plus 1.

④ Export files to SD card: On the interface of file list [Figure 2-20(b)], press button **(▲)** or **(▼)** to move the cursor to the required name of the file. Press button **(F3)** (Export)

to export the data of the files of cursor line to the root directory of SD card. The two files with the file name extension TXT are measurement data files, as shown in Figure 2-12. The file name extension .dat and .csv are the coordinate files of CAD and coordinate files at table format respectively.

⑤ Import coordinate files from an SD card: This command is used to import the coordinate files of the stakeout points.

§2.3 Distance Measurement

When the current mode is Angle Measurement or Coordinate Measurement, press **(DIST)** to enter the Distance Mode, as shown in Figure 2-23. The distance mode has two pages of function menu. Press **(F4)** to turn the pages of function menu.

2.3.1 Functional menu of Distance Mode on page P1

(1) **(F1)** (All)

Store the reading of horizontal angle, vertical angle and value of oblique distance in the current measurement file in direction of the current alignment axis. Like Angle Measurement, the current file should be set up before executing the command "All".

Different from the Angle Measurement, because the distance value of the survey point is measured, M8 needs the coordinates of the current survey station, instrument height and target height and takes the reading of the horizontal angle as the azimuth angle between the survey station and the survey point, automatically calculating the coordinates of the survey point and saving them in a coordinate file against the same name with the extension "SCD".

To make the coordinates correct, the survey station and the rear-view orientation should be set correctly in the Coordinate Measurement. Please refer to the Coordinate Measurement.

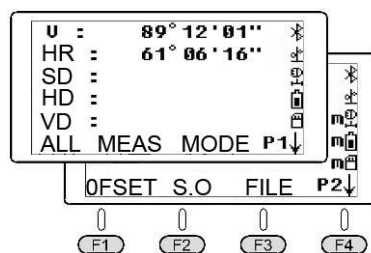


Figure 2-21 Function menus in the Distance Mode

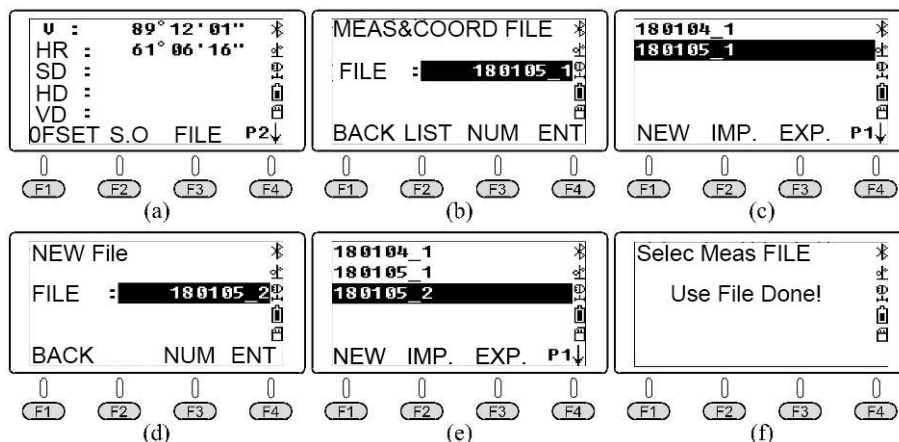


Figure 2-22 Execute the commands "File/List/New" in the function menu on page P2 of Distance Mode

Figure 2-22 shows the operation process of creating a file with name of 180105_2 and setting it as the current file by pressing buttons **(F3)** (File) **(F2)** (List) **(F1)** (New) in the function menu on page P2 of Distance Mode. The following results of executing command "All" are stored in this file.

Set the horizontal plate against the angle at HR, vertical plate V as zenith zero, reflector as "Reflectorless", and then aim at survey point P1. Press buttons **(F1)** (ALL.) and button **(F4)** (Yes), and input the name of survey point P1 [Figure 2-23(b)]. Press button **(F4)** (REC.) to complete the recording operation of survey point P1. Similarly, target survey point P2 and P3 respectively as the same steps. At this point, the default values in the column showing the names of survey point are to be P2 and P3, and you do not need to input the

name of the survey points. Figure 2-23 shows the operation process.

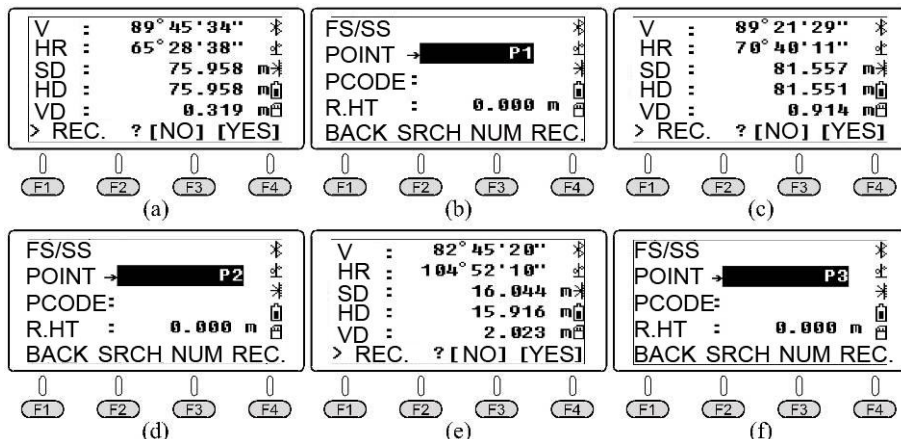


Figure2-23 Save All for the Distance Mode to measure three targets

(2) **F2** (MEAS: Measurement)

Measure current target but not to store the results to the current file.

(3) **F3** (MODE)

Press **F3** (Mode) continuously to switch the ranging mode among "F.R(Find Repeated)", "T.R (Tracking Ranging)", "F.S(Find Single)" and "F.3(Find 3 times)". Every time when pressing **F3** (Modes), it will automatically range at the switched mode. The operation process is shown in Figure 2-24.

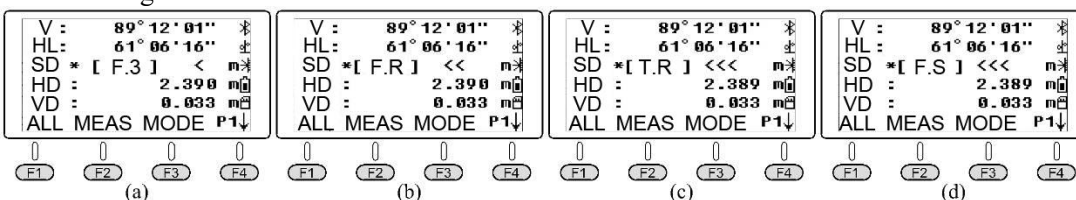


Figure2-24 Switch the ranging modes

2.3.2 Function menu on page P2 of Distance Mode

(1) **F1** (Offset)

Press **F1** (Offset) to enter the menu Offset function[Figure 2-27(b)]. Offset function is often used to measure coordinates of detail points that are inconvenient to place prisms.

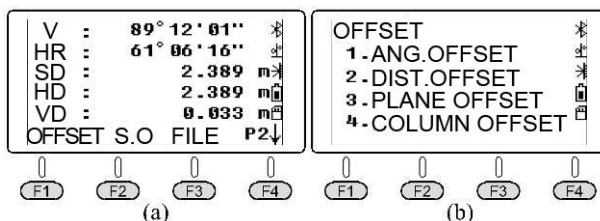


Figure2-25 Offset Menu of Distance Mode

① Angle Offset: As shown in Figure 2-25(a), the instrument is placed at the survey station O. When the target point P is inconvenient to place the prism, the prism can be placed at the point P' near point P, requiring the horizontal distance $OP=OP'=r$.

In the menu of Angle Offset [Figure 2-25(b)], press **1** (Angle Offset) and aim at the center of prism of point P' . Press **F1** (MEAS), the case data is shown in Figure 2-26(b). Turn the alignment part and aim at the target point P [Figure 2-26(c)]. Press **CORD** to switch the screen to display the 3D coordinates of the target point P [Figure 2-26(d)]. Press **CORD** to switch the

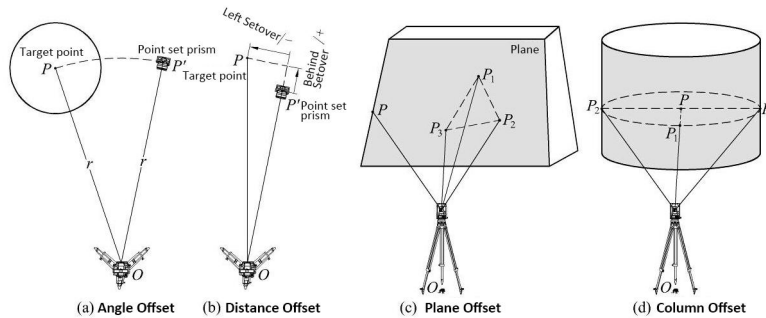


Figure 2-26 Principle of Offset measurement

screen to display the distance of the target point P [Figure 2-26(c)]. Press **F1** (Next) to continue Angle Offset of the next point. Press **ESC** to exit the Angle Offset.

Before executing the command "Angle Offset", the survey station and the back sight angle should be set in the command Coordinate Measurement, Data Collection or Stakeout in advance, and the height of the instrument and the prism should be input to make the 3D coordinates of point P displayed on the screen consistent with the actual value.

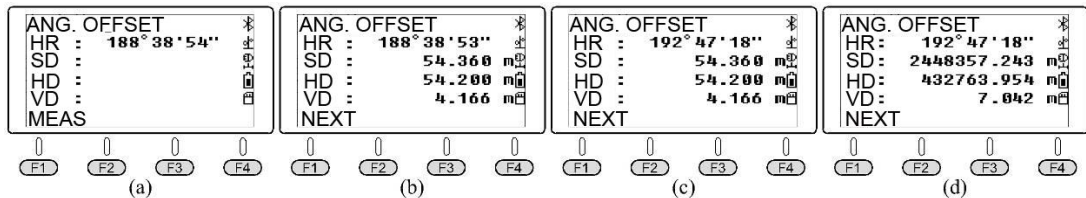


Figure 2-27 Operation steps to measure coordinates of the points inconvenient to set prism through command "Angle Offset"

② Distance Offset: As shown in Figure 2-26(b), when the point P to be measured is inconvenient to install a prism, a prism can be installed at point P' near point P . Input the left and behind setover of point P to point P' (left and right setover: the right one is positive; front and behind setover, the behind one is positive), and then execute the command of measurement.

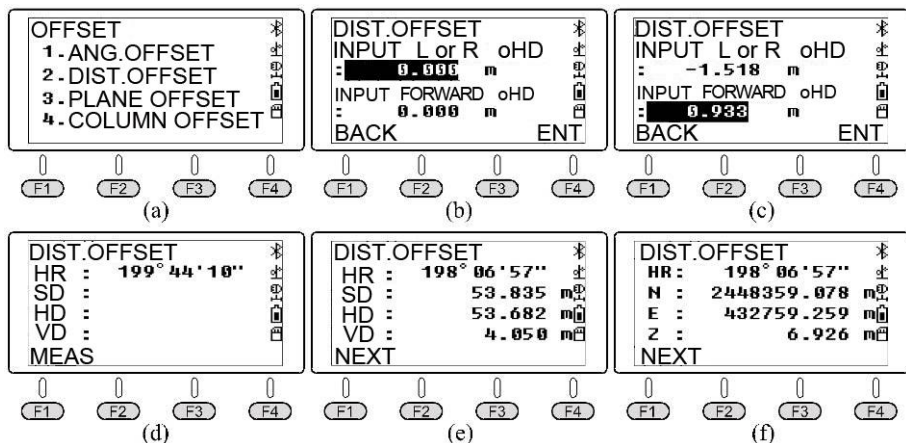


Figure 2-28 Operation steps to measure the coordinates of the points inconvenient to set prism through command "Distance Offset"

In the menu of Offset Measurement [Figure 2-28(a)], press ② (Distance Offset) to input the front and behind, left, and right setover, like what shown in Figure 2-28(c). Press F4 (OK) to enter the interface as shown in Figure 2-28(d). Aim at the prism center of point P' and press F1 (Measure). The case data is shown in Figure 2-28(e). Press CORD is to switch the screen to display the coordinates of the target point P [Figure 2-28(f)]. Press DIST is to switch the screen to display the distance of the target point P [Figure 2-28(e)]. Press F1 (Next) to continue the Distance Offset of the next point. Press ESC to exit Distance Offset function.

③ Plane Offset: As shown in Figure 2-26(c), because point P is located at the edge of the plane, the coordinates of point P cannot be measured directly. Execute the command "Plane Offset", and measure the coordinates of any three points P_1, P_2, P_3 that are not on the same line on the plane to determine the plane equation. Then aim at point P , the instrument will automatically calculate the three-dimensional coordinates of point P on the plane.

In the menu of Offset Measurement [Figure 2-29(a)], press ③ (Plane Offset). Aim at point P_1 and then press F1 (Measure). Please do the same as point P_1 for P_2 and P_3 by aiming at the points first and then press F1 (Measure), as shown in Figure 2-29(e). Turn the alignment part to make the telescope aim at point P , and the screen shows the distance from the surveying station to point P [Figure 2-29(f)]. The coordinates of the target point P are displayed by pressing CORD to switch screens [Figure 2-29(g)], and the distance of the target point P is displayed by pressing DIST to switch screens [Figure 2-29(f)]. Press F1 (Next) to continue the Plane Offset for the next point. Press ESC to exit the Plane Offset.

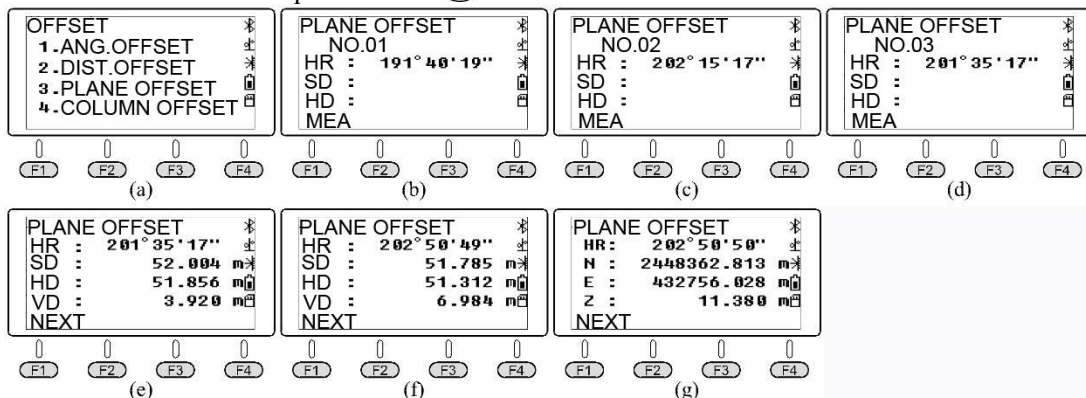


Figure 2-29 Operation steps to measure the coordinates of the points inconvenient to be measured through Reflecterless Distance by command "Plane Offset"

In the case shown in Figure 2-29, the reflector has been set to be "Reflectorless" before executing the command "Plane eccentricity". In advance, press **(F1)** (Instrument height) in the function menu on page P2 of Coordinate Measurement to set the target height to be 0.

④ Column Offset: It is often used to measure coordinates of the center of a cylinder. As shown in Figure2-26(d), set point *P* to be the center of the cylinder, point *P*₁ to be the intersection of line *OP* and the arc, and points *P*₂ and *P*₃ to be the left and right endpoints of the cylinder diameter respectively. Command "Column Offset" is to distance point *P*₁ first, and then aim at point *P*₂ and point *P*₃ respectively, after which the instrument will automatically calculate the 3D coordinates of the cylindrical center point *P*.

In Offset menu Figure2-30(a), press ④ (Column Offset) key, and press F1 (MEA) key at P1, as shown in Figure2-30(c). Press (Set) button when aiming at P2 and P3, as shown in Figure 2-30(f). Press the key to switch the screen to display the coordinates of point P of cylinder center Figure2-30(g) and press the key to switch the screen to display the distance of point P of cylinder center Figure2-30(f). Press the F1 to continue the Column Offset to next point.

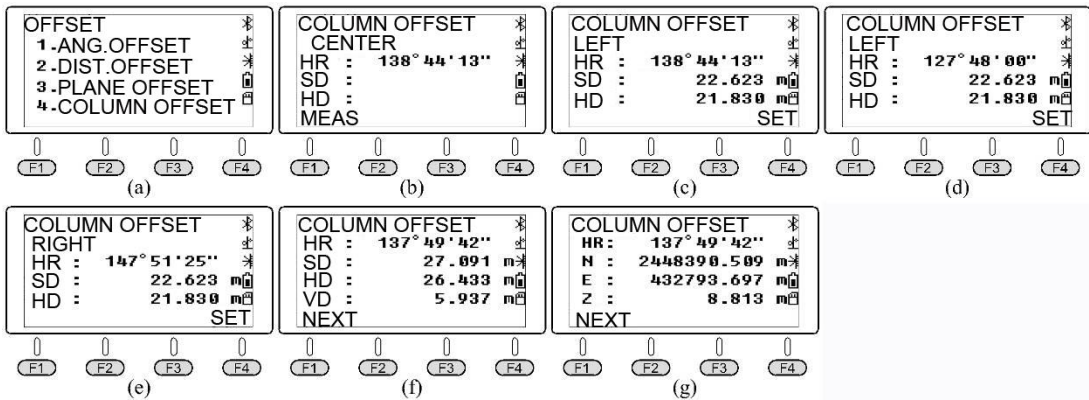


Figure 2-30 Operation steps to measure the coordinates of center of a cylinder by command " Column Offset "

(2) (S.O: Stakeout)

Used to stakeout slope distance, horizontal distance and height difference. In the function menu on page P2 of Distance Mode [Figure 2-31(a)], press **(F2)** (S.O) to enter the interface shown in Figure 2-31(b). Take stakeout for horizontal distance as an example. Press **(F1)** (HD) **(8)** **(.)** **(8)** to input the horizontal distance as 8.8m, and press **(F4)** (OK). Turn the alignment part to make horizontal angle to be 331°39'09"[Figure 2-31(d)]. Move the prism to the direction of alignment axis of the telescope, and tilt the telescope to aim at the center of the prism. Presses **(F4)** to turn to the function menu on page P1, and then press **(F2)** (Measure). The case results are shown in Figure 2-31(e).

As what displayed in the screenshot, dHD = Measured HD - Planed HD =-0.746m, indicating that the prism needs to move 0.746m away from the instrument along the alignment axis. After the prism is moved, tilt the telescope to aim at the center of the prism again and press button **(F2)** (Measure). The result is shown in Figure 2-31(f).

Execute the command Stakeout. After the horizontal distance is inputted, the screen displays the content. The screen of the original "HD"[Figure 2-31(a)] is switched to the column of "dHD" [Figure 2-31(d)]. If it is needed to recover the content what shown in column "HD", it shall execute the command "Stakeout/HD", and then input the HD of the stakeout to be 0. The operation processes are shown in Figure 2-31(g) and Figure 2-31(h).

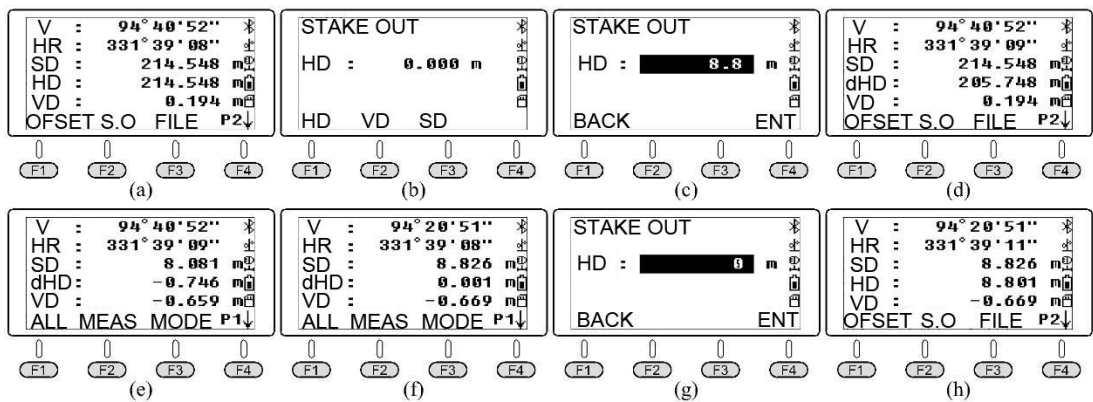


Figure 2-31 Used "S.O" function to stakeout and input the horizontal distance as 8.8m

(3) **F3** (File)

This File command has the same function as the command of the same name in Angle Measurement. You can change the current file, create a file, rename a file, delete a file, and export a file.

Perform the following steps to export the measured storage file: In the function menu on page P2 of the Distance Mode [Figure 2-32(a)]. Press **s F3** (File) and **F2** (List) to enter the interface of file list as shown in Figure 2-32(c). The cursor automatically locates in the line "180105_2" of the current file. Press **F3** (EXP.) to export the file data into the following four files of the SD card.

- 180105_2_600.txt 600 format measurement file
- 180105_2_300.txt 300 format measurement file
- 180105_2.dat Cad coordinate file
- 180105_2.csv Excel table format measurement file

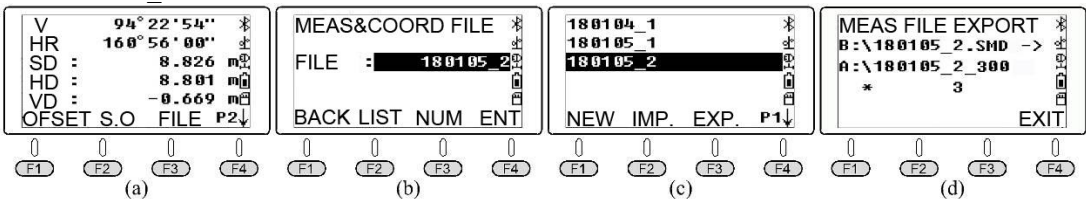


Figure 2-32 Execute the command "File/List/Export" to export the file "180105_2".

The left figure in Figure 2-33 shows the contents of the exported measurement file "180105_2_600.txt". It is the result of P1, P2 and P3 by Reflectorless distance respectively after executing the command "All" repeatedly for three times in Figure 2-23. The right figure in the figure 2-35 shows the contents of exported coordinate file "180105_2.dat".

The meanings of the data lines in the measurement file shown on the left in Figure 2-35 are as follows:

- STN K1,1.450,1J——Name of survey station K1, Height of instrument 1.45m, Code of Point K1 1J
- ENZ 432827.718,2448505.417,2.506——3Coordinates of survey station
- BS K2,0.000,1J——Name of back sight point K2, Target height 0, Code of K2 1J
- ENZ 432700.488,2448453.713,2.661——Coordinates of back sight point
- SS P1,000——Name of survey station P1, Target height 0
- SD 65.2838,89.4534,75.958 —— Reading of horizontal angle, vertical angle and value of plane distance of survey station P1

The meaning of the observed data of points P2 and P3 is same as the one of point P1.

The coordinate file data shown on the right in Figure 2-33 is the CAD Exhibition Point

coordinate file. The coordinate data of each test point occupies a line in the format of "Name of point, Code, E,N,Z".

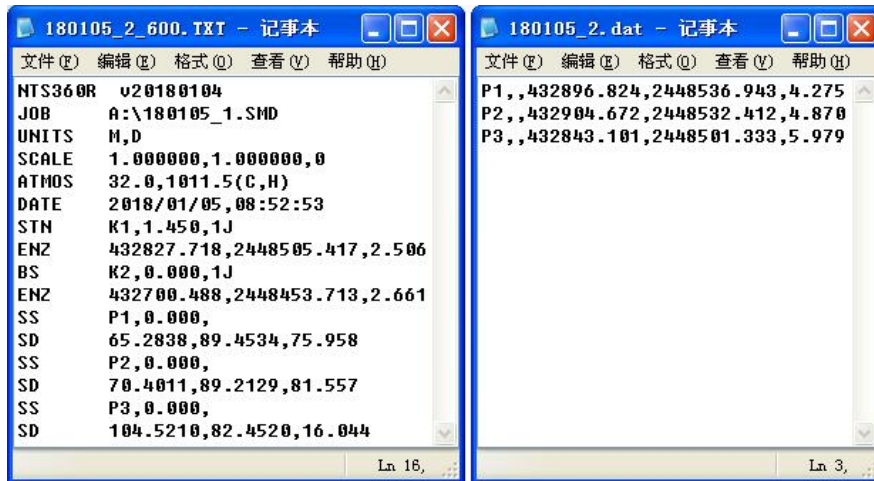


Figure 2-33 Contents of the two exported files

§2.4 Coordinate Measurement

When the current mode is Angle Measurement or Distance Measurement, press **CORD** to enter the Coordinate Measurement, as shown in Figure 2-34. In the Coordinate Measurement, there are three function menus. Press **F4** to turn the function menu.

For M8 total station, users can input the coordinates of all control points in Excel according to the format of "Name of the point, Code, E,N,Z" (up to that 200 control points are allowed to be inputted). Save them as comma-separated files with the extension name of csv and copy them to the SD card.

Insert SD card into M8 and execute the command "MENU/Memory MGR./File File Maintain/FIXED DATA/IMP.", import known coordinates files with extension of csv from the SD card to known coordinates file FIX. LIB in the instrument memory, which is for users to list when setting survey station and orientation from the near view in the commands of Coordinate Measurement, Data acquisition or Stakeout.

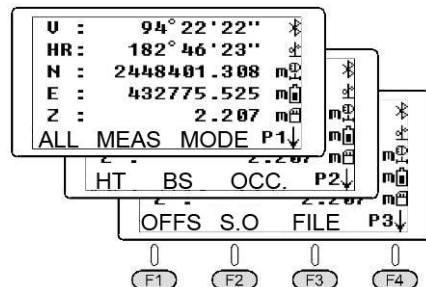


Figure2-34 Three function menus in Coordinate Measurement

2.4.1 Import/Export coordinates of control points to the known coordinate files from SD card

(1) Import control point coordinates into the known coordinate file

The left figure in Figure 2-35 shows coordinates of 19 first-level traverse points in Excel. The coding character "1J" represents first-level traverse points. M8 total station is allowed to input the code of 10 characters at most.

Save this file as a file "19con.csv". It is called that that the file with extension csv to be comma-separated file, which is the file at text format. Double-click the file in Windows Explorer,

and the system automatically starts MS-Excel to open the file [Left figure in Figure 2-37]. You can also use TXT to open it [Right figure in Figure 2-37].

	A	B	C	D	E
1	K1	1J	432827.718	2448505.417	2.506
2	K2	1J	432700.488	2448453.713	2.661
3	K3	1J	432775.951	2448410.099	2.946
4	K6	1J	432245.341	2447981.5	3.415
5	K7	1J	432379.595	2447811.533	2.754
6	K8	1J	432477.908	2447892.487	2.824
7	K9	1J	432579.817	2448033.342	2.525
8	K10	1J	432749.935	2448012.862	2.812
9	K12	1J	433083.798	2447954.529	3.102
10	K13	1J	433031.13	2447845.701	3.509
11	K14	1J	432924.153	2447707.044	3.082
12	K15	1J	432981.763	2447668.237	3.61
13	K16	1J	433061.771	2447723.838	3.545
14	K18	1J	433210.405	2447825.642	3.162
15	K20	1J	433184.813	2448038.449	3.147
16	K21	1J	433294.053	2448129.389	2.443
17	K22	1J	433166.748	2448341.426	3.438
18	K24	1J	432840.338	2448320.045	3.136
19	K26	1J	433033.716	2448562.441	10.736

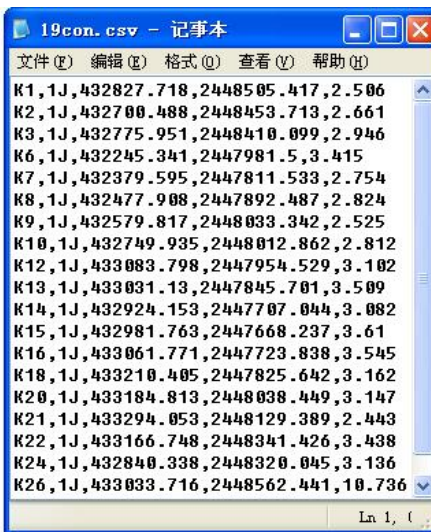


Figure 2-35 Input the coordinates of 19 first-level traverse points in Excel

Copy the file "19con.csv" to the SD card root directory. Insert the SD card into M8. Press **MENU** to enter the interface of "Menu 1/2" [Figure 2-36(a)]. Press **s** (MEMORY MGR.) (1) (File Maintenance) (4) (FIXED DATA) to enter the interface as shown in Figure 2-36(d). M8 use file "FIX. LIB" to store the coordinate data of known points imported by the user, and the number "[000]" on the right of the file indicates that the number of known coordinate points currently stored in the file is 0.

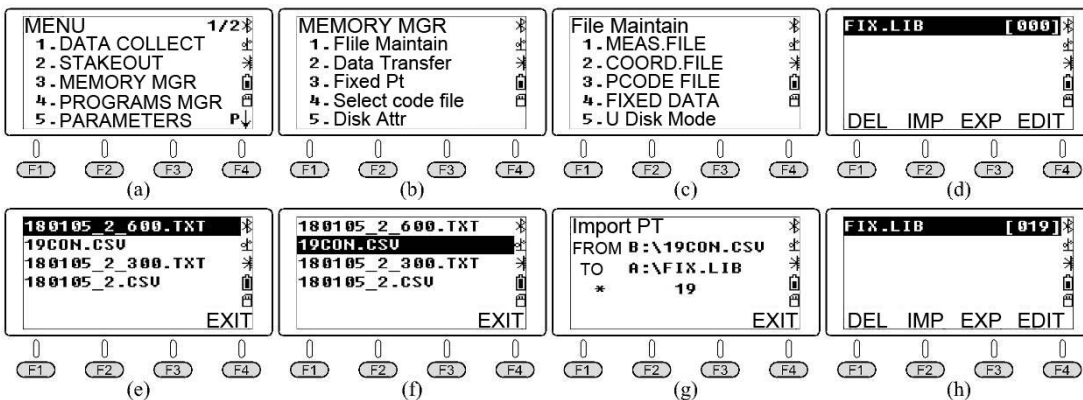


Figure 2-36 Import coordinates of file 19con. CSV into instrument memory

Press **F2** (IMP.) and the screen will display the files list against the extensions of dat, txt, and csv in the root directory of the SD card [Figure 2-36(e)]. Move the cursor to the file 19CON. CSV [Figure 2-36(f)]. Press **ENT** and the system starts to import coordinates data of 19 control points in the file to the known coordinate file FIX.LIB [Figure 2-36(g)]. By default, the drive letter of the SD card is B, and the drive letter of the instrument memory is A. Figure 2-36(h) shows the page after the coordinates data is imported. Reading at [019] on the right of the file name FIX.LIB indicates that the number of known points in the file is 19. Press **ESC** for four times to exit the Menu

①Coordinate files imported from SD cards should not have the same name; ②Importing file to FIX.LIB operation can be repeated. The system will automatically compare the instrument memory file with existing control points name. If there is a point with the same name, the system

automatically overwrites the existing control point coordinates with the points with the same name in the newly imported coordinate file without giving any prompt.

(2) Export the known coordinates files to the SD card

In the menu of "File Maintain" [Figure 2-37(a)], press **F4** (FIXED DATA) and **F3** (EXP.) to export the data of FIX.LIB to the two files in the root directory of the SD card. The FIX.dat file is Cad coordinate file, and the format of each row of coordinate data is "Name of the point, Code, E,N,Z". FIX.dxf is a graphics interchange file. Users can open the file with AutoCAD and

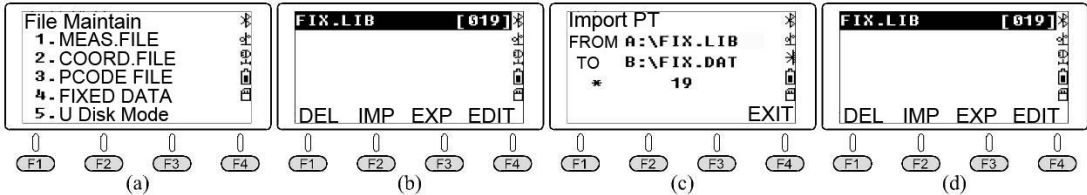


Figure 2-37 Export the known coordinates files to the SD card

save it as DWG graphics file.

Figure 2-38 shows the interface of opening the file FIX.dxf with software AutoCAD. After opening the file, execute the command of zoom "zoom/e" to see the full picture. The text of dot notes is "Name of the point/Code", as shown in Figure 2-38.

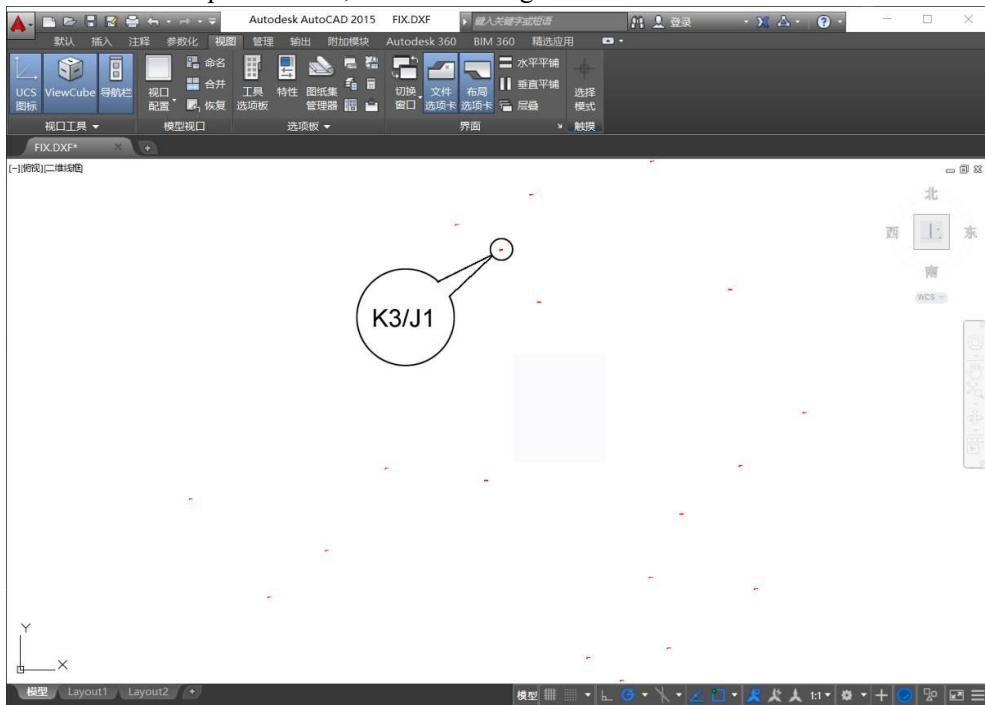


Figure 2-38 Open the graphics interchange file FIX.dxf of the SD card in AutoCAD

The full name of extension DXF in English is Drawing Exchange Format. It is a vector data file format developed by Autodesk for exchanging graphic data between AutoCAD and other drawing software. It can be divided into two codes, ASCII code and binary code. The dxf file exported from M8 total station to SD card is in ASCII format. Users can open the file by using any versions of software AutoCAD.

2.4.2 Function menu of Coordinate Measurement

Users can measure the coordinates of survey points in Coordinate Measurement. Before coordinate measurement and stakeout, it is necessary to select or create a file to store the coordinates, setting the survey station and orientation of back sight, and inputting instrument height and target height. Therefore, the commands for the function menus of Coordinate Measurement cannot be introduced in the order of the function menus on pages P1, P2, and P3. Now we use the designed coordinates of the four corner points of the building shown in Figure 2-39 as an example to explain how to execute the command "Stakeout" in Coordinate Measurement. The known coordinates of the control points K1, K2, and K3 are shown in Figure 2-35, and the known coordinates files has been imported into the instrument memory. The instrument has been installed at point K3 and point K2 is taken as the back sight point. It is necessary to stakeout the designed points 1, 2, 3 and 4 to the field.

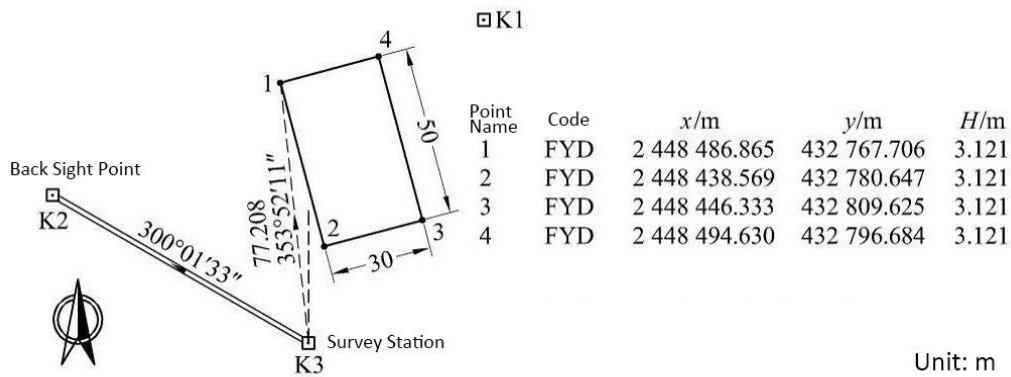


Figure 2-39 Design coordinates of the four corners of the building

Edit the stakeout point designing coordinate file on PC: Input the designed coordinates of the four stakeout points in Excel [Figure 2-40], saving them as file 4point.csv. Copy the file to

	A	B	C	D	E
1	1	FYD	432767.706	2448486.865	3.121
2	2	FYD	432780.647	2448438.569	3.121
3	3	FYD	432809.625	2448446.333	3.121
4	4	FYD	432796.684	2448494.63	3.121

\4points/

Figure 2-40 Input the designed coordinates of the four stakeout points the root directory of SD card and insert the SD card into total station.

(1) **F3** (File) Function menu on page P3

① Command "File-List-New": Create a stakeout point and design coordinate file in the total station. In the function menu on page P3 of Coordinate Measurement, press **F3** (File) **F2** (List) and **F1** (New) to enter the interface of the new file [Figure 2-43(c)]. Change the end of the file name "1" set by default to "FYD", as shown in Figure 2-41(d). Press **F4** (OK) to move the cursor to the new file [Figure 2-41(f)].

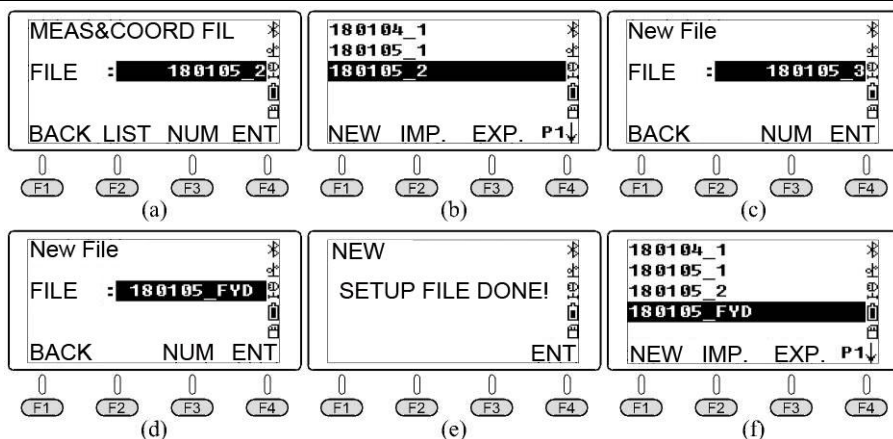


Figure 2-41 P3 Used "File-List-New" to create a file

② Command "Import": In the interface shown in Figure 2-41(f), press **F2** (Import) to display the file list in the root directory of SD card [Figure 2-42(a)]. Move the cursor to the file name 4POINT. CSV [Figure 2-42(b)] and press **ENT** to import stakeout coordinate data [Figure 2-42(c)]. After finishing to import, return to the interface of file list in the memory, and move the cursor to line 180105_FYD. Press **ENT** to set 180105_FYD as the current file and return to the function menu on page P3 of Coordinate Measurement.

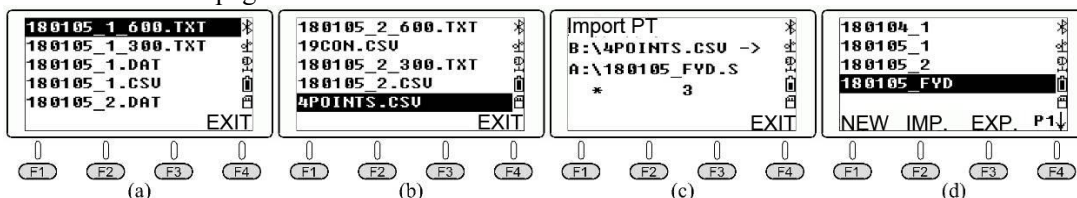


Figure 2-42 Import the coordinates of the stakeout point from the root directory of SD card to the current file

(2) **F3** (OCC.: Set survey station) Function menu on page P2

Set the coordinates of the survey station and the orientation of the back sight. In the function menu on page P2 of Coordinate Measurement, press **F3** (OCC) to enter the interface of the survey station [Figure 2-43(a)], and the screen displays the coordinates of the survey station set recently. Press **F2** (List) to enter the interface of list for names of the points. [Figure 2-43(b)].

In the interface of list for names of points, it displays first the names of the points in the known coordinate files (CORD means "known coordinate"), followed by the name of the survey point coordinate file (MEAS). Move the cursor to the known point K3 and press **ENT**, and the screen will display the code and coordinates of point K3 [Figure 2-43(c)]. Press **F4** (OK) to input the height of instrument in the survey station and press **F4** (OK) to enter the interface of "Set back sight point" as shown in Figure 2-43(e). Press **F4** (Yes) to display the name of the back sight point recently set [Figure 2-43(f)]. Since it shall be same as the back sight point to be set, press **F4** (OK) to enter the interface as shown in Figure 2-43(g). The value of reading of HR displayed on the screen is the azimuth angle of the K3 → K2 edge back calculated by the instrument using the coordinates of two points, survey station point K3 and back sight point K2. Figure 2-39 shows the geometric significance.

Turn the alignment part so that the telescope is aimed at the center of the prism erected at point K2. Press **F4** (Yes) to set the reading of the horizontal plate as the azimuth angle of survey station point K3 → back sight point K2, and enter the interface as shown in Figure 2-43(h).

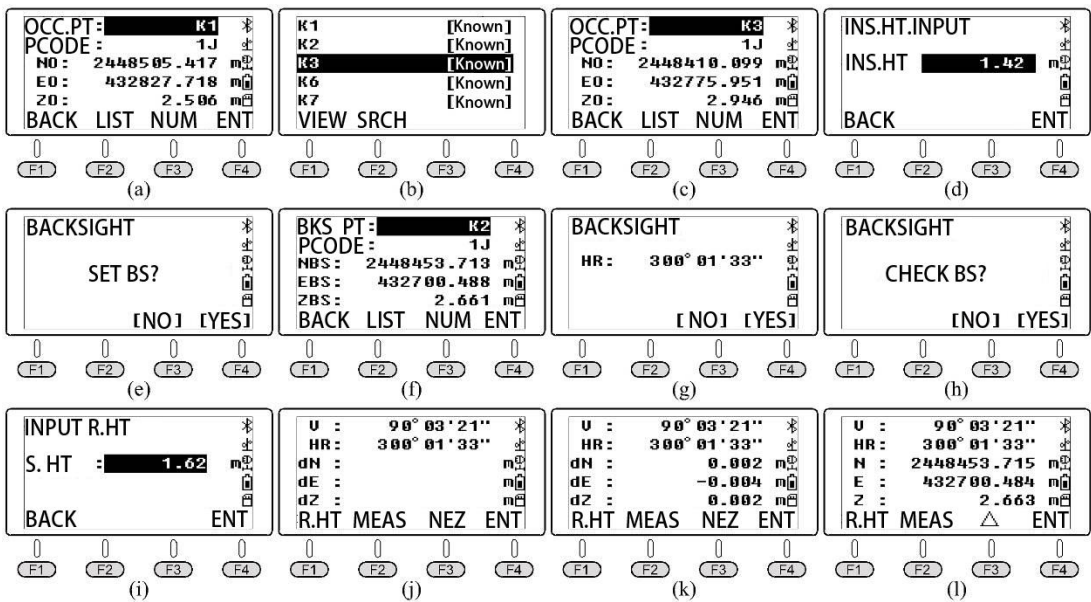


Figure2-43 "Set Survey Station" in the function menu on page P2 of Coordinate Measurement

To check the coordinates of the back sight point, press **(F4)** (Yes). Input the height of the prism for the back sight point and press **(F4)** (OK) to enter the interface as shown in Figure 2-43(j). After confirming that the telescope has aimed at the center of the back sight prism, press **(F2)** (Measure). The result is shown in Figure2-43(k). The screen shows the coordinate differences between the surveying point measured in the back sight inspection and the known point K3. The formula is as the following:

$$\left. \begin{aligned} dN &= N_{\text{Measured K3}} - N_{K3} \\ dE &= E_{\text{Measured K3}} - E_{K3} \\ dZ &= Z_{\text{Measured K3}} - Z_{K3} \end{aligned} \right\} (2-5)$$

Press **(F3)** (CORD) to switch the screen to display the measured 3D coordinates of the back sight point [Figure 2-45(l)]. Press **(F3)** (Δ) to switch the screen to display the measured 3D coordinates differences of the back sight point [Figure 2-45(k)]. Press **(F4)** (OK) to return to the function menu on page P2 of Coordinate Measurement.

(3) **(F2)** (Back sight) Function menu on page P2

Set the reading of horizontal plate in the back sight direction by using point coordinates or azimuth of the back sight. As shown the above, the command "OCC." can be used to set the coordinates of the survey station points and the reading of the horizontal angle in the rearward direction at the same time. After the command "OCC." is executed, the command "BS" can be used separately to redirect the instrument in case of suspected changes in the rearward direction during the process of measurement or stakeout.

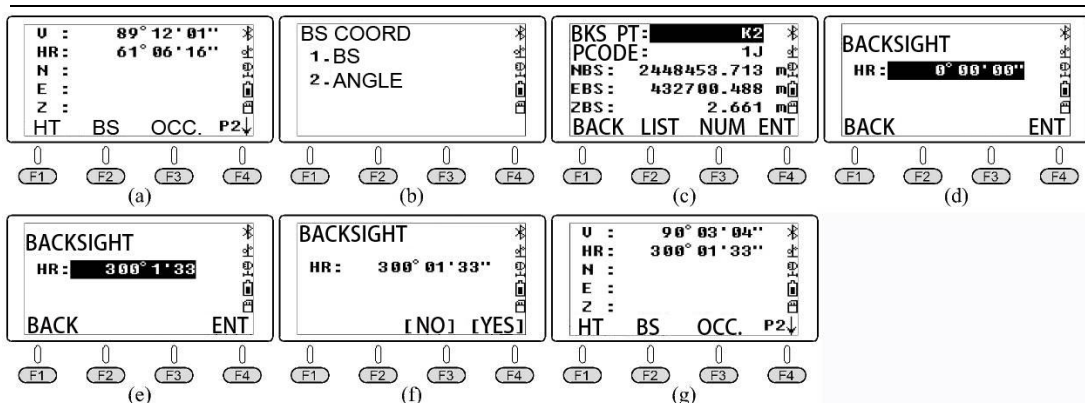


Figure 2-44 Execute the command "Back sight"

In the function menu on page P2 of Coordinate Measurement [Figure 2-44(a)], press **(F2)** (BS) to enter the interface of menu "BACKSIGHT"[Figure 2-44(a)]. There are two ways to set the rearward direction: Press **(1)** (BS COORD) to enter the interface of back sight points' coordinates [Figure 2-44(c)]. Press **(F2)** (LIST) to complete the back sight orientation from the known coordinate files and call points from the name list of the current coordinate file, and the operation method is the same as executing the command "Set site"; or press **(2)** (Fix back sight through rim angles) to enter the interface of "Input azimuth". Press **(3)** **(0)** **(0)** **(.)** **(1)** **(.)** **(3)** **(3)** to enter the back sight azimuth 300°01'33"[Figure 2-44(e)] and press **(F4)** (OK) to enter the interface as shown in Figure 2-44(f). Turn the alignment part so that the telescope is aimed at the target point K2. Press **(F4)** (Yes) to set the reading of horizontal plate to be the azimuth of survey station point K3 → back sight point K2, and return to the function menu on page P2 of Coordinate Measurement [Figure 2-44(f)].

(4) **(F1)** (HT: Height of instrument and target) Function menu on page P2

Check or set the height of instrument and the target. In the function menu on page P2 of Coordinate Measurement [Figure 2-45(a)]. Press **(F1)** (HT) to enter the interface as shown in Figure 2-45(b). You can check the latest setting of height of instrument and the target, or re-input the height of instrument and the target and then press **(F4)** (OK). If it needn't to revise the above two heights, press **(ESC)** to return to the function menu on page P2 of Coordinate

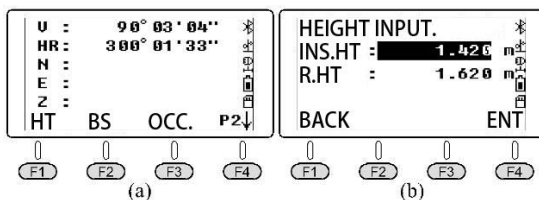


Figure 2-45 Execute the command "Height"

Measurement [Figure 2-45(a)].

(5) **(F2)** (S.O: Stakeout) Function menu on page P3

In the function menu on page P3 of Coordinate Measurement [Figure 2-46(a)], press **(F2)** (S.O) to enter the menu "Stakeout 1/2"[Figure 2-46(b)]. Press **(F4)** to turn pages repeatedly.

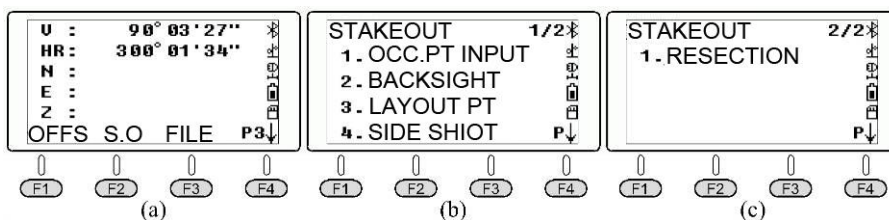


Figure 2-46 Execute the command “Stakeout” in the function menu on page P3 in Coordinate Measurement,

In the menu "Stakeout 1/2" [Figure 2-46(b)], the function of pressing ① (OCC. PT INPUT) is the same as the command "OCC." in the function menu on page P2 of Coordinate Measurement, and the function of pressing ② (BACKSIGHT) is the same as the command "BS" in the function menu on page P2 of Coordinate Measurement, which will not be repeated here. The following describes how to execute the command “LAYOUT PT” to stakeout point 1,

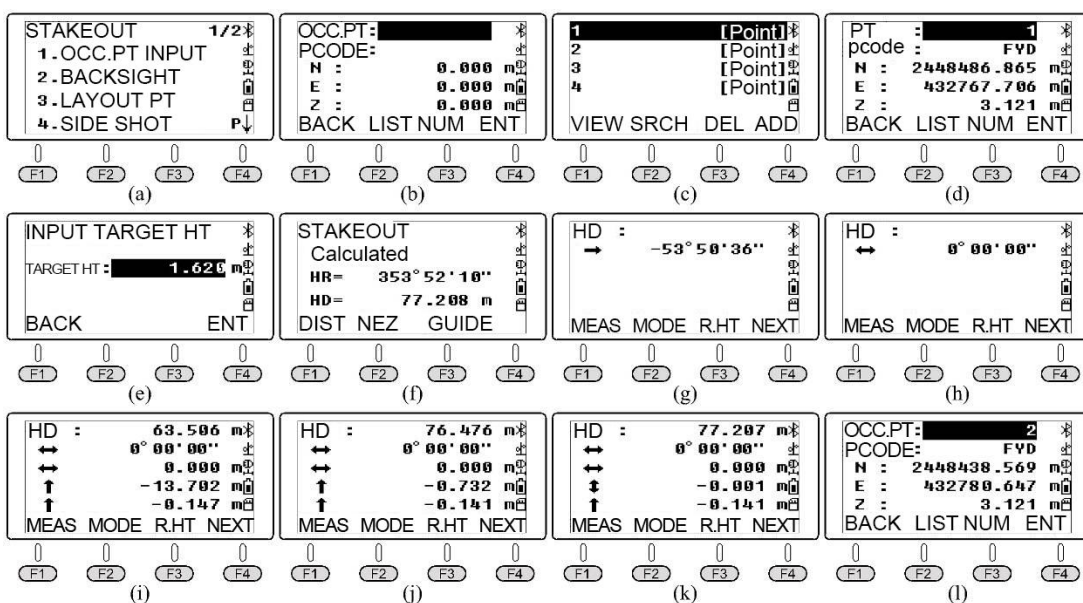


Figure 2-47 Execute the command “S.O/LAYOUT PT” to stake point 1

as shown in Figure 2-39.

In the menu "Stakeout 1/2" [Figure 2-47(a)], press ③ (LAYOUT PT) to enter the interface as shown in Figure 2-47(b). Press F2 (LIST) to enter the interface of list for point names in the current file, and the cursor automatically locates at point 1 [Figure 2-47(c)]. Press ENT, and the screen displays the designed coordinates of point 1 [Figure 2-47(d)]. Press F4 (ENT), input the target height and press F4 (ENT). The screen will display the values of azimuth HR and stakeout horizontal distance HD from survey station K3 to Point 1 [Figure 2-47(f)]. Press F3 (GUIDE) to display the difference among the reading of the current horizontal plate, the designed azimuth, and the rotation direction of the alignment part [Figure 2-47(g)]. Rotate the alignment part according to the screen prompt to make the angle difference of the second line on the screen equal to 0°00'00" [Figure 2-47(h)]. Direct the prism to move to the alignment axis of the telescope and place the prism and centering rod. Point the telescope at the center of the prism and press F1 (DIST). The case results are shown in Figure 2-47(i).

Direct the prism to move about 13m away from the instrument. Place again the prism and centering pole. Tilt the telescope to aim at the center of the prism, and press F1 (Measure). The case result is shown in Figure 2-47(j). At this point, the distance to be moved is less than 5m. The prism should use a steel ruler to accurately measure the horizontal distance to be moved in

the alignment axis of the telescope.

As shown in Figure 2-48, the current prism point is set as 1'. To move the prism to the designed position 1 accurately, prism can direct an orientation point 1" about 1m behind the current prism point 1', pull the steel tape from 1' to 1" to move the prism to the 0.732m mark on the steel ruler accurately and place the prism. Point the telescope at the center of the prism again and press (F1) (MEAS). The case result is shown in Figure 2-47(k). Currently, the plane position of the prism is the design position of Point 1. Mark the site to complete the stakeout of point 1, and press (F4) (Next) to call stakeout coordinates of point 2 [Figure 2-47(L)].

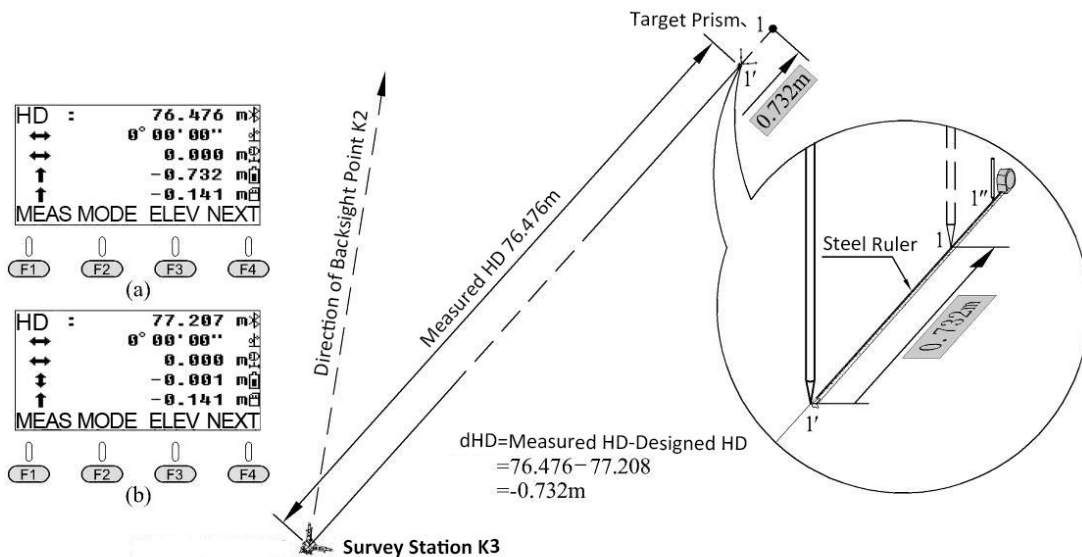


Figure 2-48 Relationship between dHD, difference of measured HD minus designed HD, and the moving direction of target prism

(6) (F1) (ALL: Survey and Record) Function menu on page P1

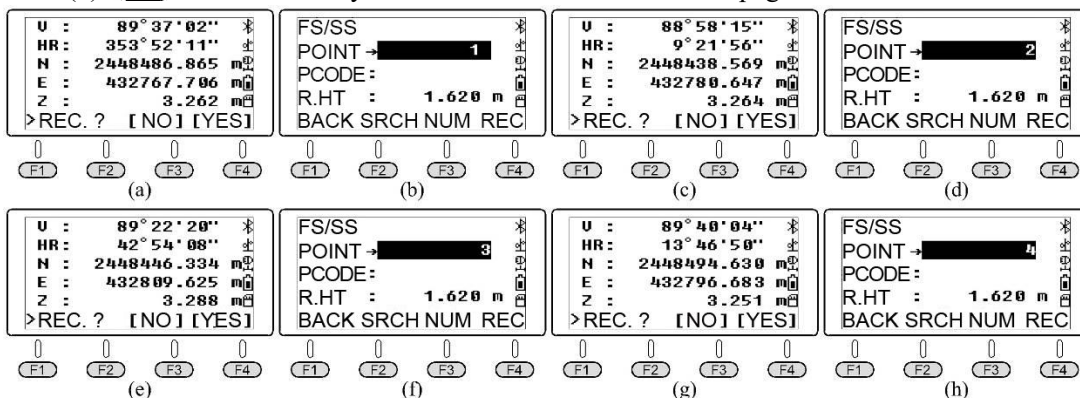


Figure 2-49 Used "ALL" function on page P1 of Coordinate Measurement to measure the coordinates of stakeout points 1 to 4

To compare the difference between the actual and designed coordinates of stakeout points 1-4, you can execute the command "ALL." in the function menu on page P1 of Coordinate Measurement. Measure the coordinates of stakeout points 1-4 and save them to the current file. Export the current file to SD card. Open the csv coordinate file of SD card in Excel on PC. Compare the difference between the measured and designed coordinates of stakeout points in Excel to check the accuracy of stakeout.

Aim at the center of the prism of stakeout point 1 with M8. In the function menu on page P1 of Coordinate Measurement, press **F1** (ALL), as shown in Figure 2-49(a). Press **F4** (Yes) and input the name of the point as 1 [Figure 2-49(a)], Press **F4** (Yes) to save the measured coordinates of Point No. 1 to the current file. Similarly, the coordinates of points 2, 3, and 4 are measured and recorded, and the results are shown in Figure 2-49(c) to (h).

① Check list of point names in the current file: In the function menu on page P3 of Coordinate Measurement, press **F2** (S.O), **3** (LAYOUT PT), and **F2** (LIST) to enter the interface of list of point names [Figure 2-50(c)]. It can be found from the figure that points 1-4 in the first 4 lines are the original stakeout points of the current coordinate file, and the character "CORD" is noted on the right side. After finishing stakeout for points 1-4 in the last 4 lines, You please execute the command "REC." on the coordinates of measured points 1 to 4 and the character marked on the right is "MEAS".

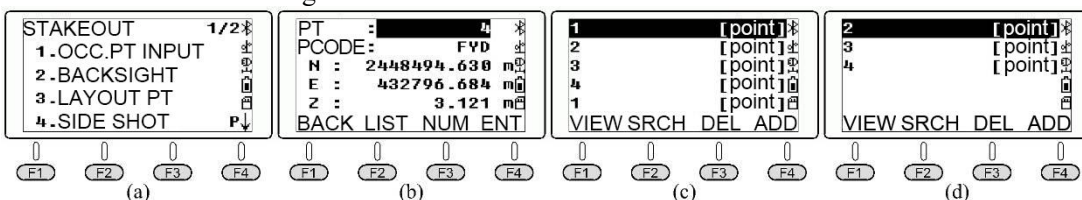


Figure 2-50 Execute the command "S.O-LAYPUT PT-LIST" to view the coordinate to check the coordinates and points' name of the current file

② Export the current file to the SD card: In the function menu on page P3 of Coordinate Measurement, press **F3** (File) **F2** (LIST) **F3** (EXP.) to export the current file "180105_FYD" to five files in the root directory of the SD card. Extension dxf means a graphic exchange file, which can be opened with AutoCAD and saved as a dwg format file, as shown in Figure 2-38.

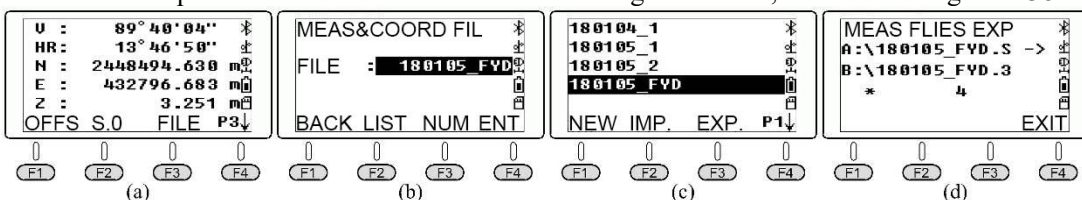


Figure 2-51 Execute the command "FILE-LIST-EXP." to export the current file data

Figure 2-52 shows the interface for opening the file "180105_FYD.dat" with Windows Notepad on the left, and the interface for opening the "180105_FYD.csv" with MS-Excel on the right.

	A	B	C	D	E
1	1	FYD	432767.706	2448486.865	3.121
2	2	FYD	432780.647	2448438.569	3.121
3	3	FYD	432809.625	2448446.333	3.121
4	4	FYD	432796.684	2448494.63	3.121
5	1		432767.706	2448486.865	3.262
6	2		432780.647	2448438.569	3.264
7	3		432809.625	2448446.334	3.288
8	4		432796.683	2448494.63	3.251

Figure 2-52 Exporting the contents of two coordinate files dat and csv of file 180105_FYD right. Save the file "180105_FYD.Csv" as the file "180105_FYD.xls".

The difference results of comparison between the coordinates of the measured stakeout points and the designed values in MS-Excel, are shown in Figure 2-55.

	A	B	C	D	E	F	G	H	I	J	K
1	放样点坐标				实测放样点坐标				坐标差		
2	点名	编码	y/m	x/m	H/m	y/m	x/m	H/m	$\Delta y/m$	$\Delta x/m$	$\Delta H/m$
3	1	FYD	432767.706	2448486.865	3.121	432767.706	2448486.865	3.262	0	0	0.141
4	2	FYD	432780.647	2448438.569	3.121	432780.647	2448438.569	3.264	0	0	0.143
5	3	FYD	432809.625	2448446.333	3.121	432809.625	2448446.334	3.288	0	0.001	0.167
6	4	FYD	432796.684	2448494.63	3.121	432796.683	2448494.63	3.251	-0.001	0	0.13

Figure 2-53 Difference results of comparison between the coordinates of the measured stakeout points and the designed values in the file 180105_csv edited and exported with MS-Excel

2.4.3 SIDE SHOT

In the function menu on page P3 of Coordinate Measurement [Figure 2-54(a)], press (S.O) to enter the menu "Stakeout 1/2" [Figure 2-54(b)]. If there is no visibility between the survey station and the stakeout points, you can execute the command "SIDE SHOT" or "RESECTION" to add survey station points.

In the menu "Stakeout 1/2" [Figure 2-54(b)], press (4) (SIDE SHOT) to enter the interface as shown in Figure 2-54(c). Input the name of the traverse point as P1 to aim the telescope at the center of the prism erected at point P1. Press (MEAS), and the screen will display the coordinates of P1 [Figure 2-54(d)]. Press (F4) (Yes) to save the coordinates of point P1 to the current coordinate file and return to the menu of "Stakeout 1/2" [Figure 2-54(e)].

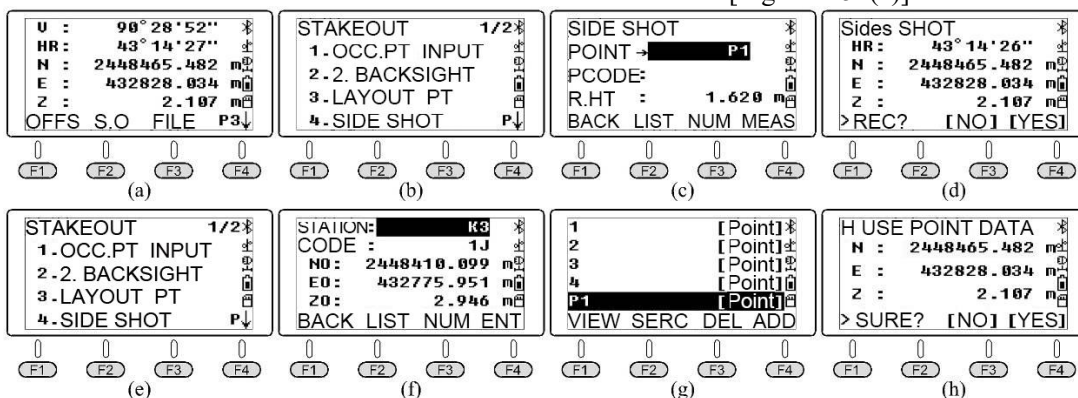


Figure 2-54 Execute command "S.O-SIDE SHOT-MEAS" in the function menu on page P3 of Coordinate Measurement to measure and save traverse point P1

Move the instrument to point P1 and place it well. In the menu "Stakeout 1/2" [Figure 2-54(e)], press s (1) (OCC.PT INPUT) (F2) (List) to enter the interface of name list of known points and coordinates of the current file. Move the cursor to point P1 [Figure 2-54(g)] and press (ENT) to find that the screen displays the coordinates of point P1 [Figure 2-54(h)]. Press (F4) (Yes). The further setting methods are same as command "OCC." in the function menu on page P2 of Coordinate Measurement.

2.4.4 Resection

Resection is also called free station. The instrument is placed at the unknown point where the station is needed. The system calculates the coordinates of the unknown station point by the least square method by ranging from 2 to 7 known points or measuring angles from 3 to 7 known points.

(1) Angle Resection

In the menu "Stakeout 2/2" [Figure 2-55(a)], press (1) (Resection) to enter the interface as

shown in Figure 2-55(b). At least 3 known points should be observed to calculate coordinates of the survey station in Angle Resection.

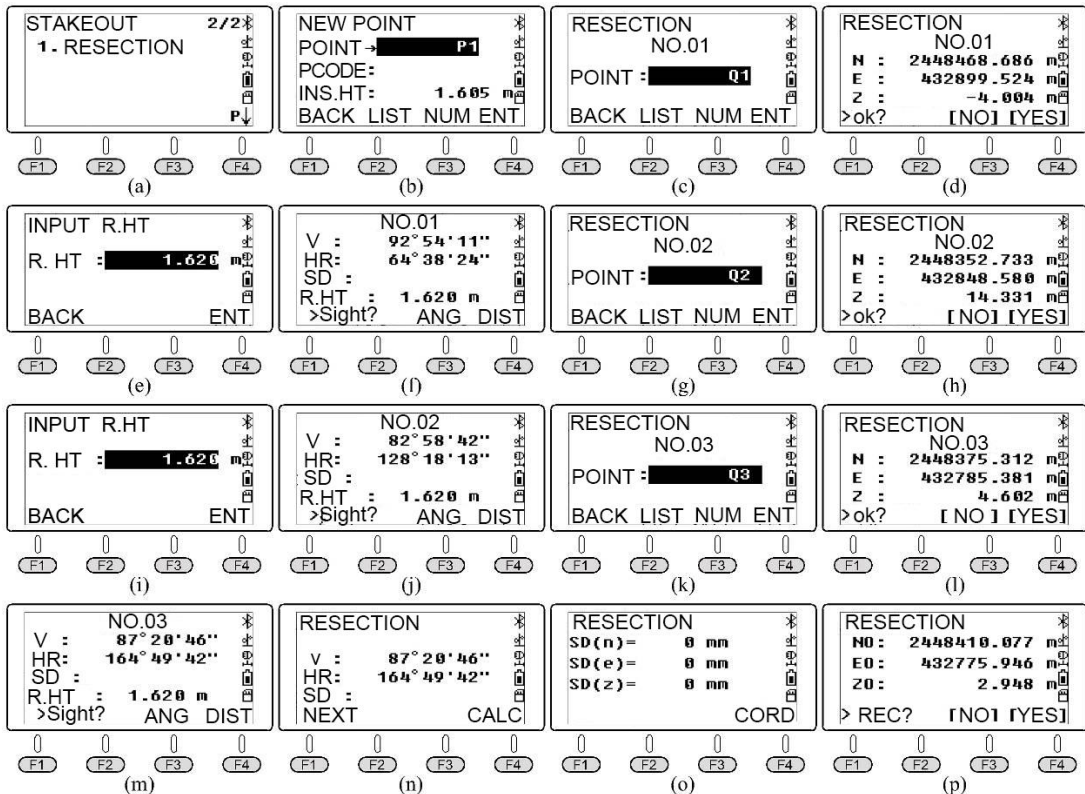


Figure 2-55 Execute the command "S. O - Resection " command to observe three known points and calculate the coordinates of the survey station (Angle Resection)

- ① Observe the first known point: Input name of new survey station as P1 and instrument height [Figure 2-55(b)]. Press **(F4)** (ENT) to enter the observation interface of the first point of resection and input the name of known point as Q1[Figure 2-55(c)]. Press **(F4)** (OK), the system will call the coordinate of point Q1[Figure 2-55(d)] from the known coordinates and the current coordinate file. Press **(F4)** (Yes) and input the prism height of point Q1 [Figure 2-55(e)]. Press **(F4)** (ENT) to make the telescope aim at the center of prism at point Q1 [Figure 2-55(f)]. Press **(F3)** (ANG.) to complete the observation of the first known point and enter the observation interface of second point. In the interface shown in Figure 2-55(c), you can also press **(F2)** (LIST) to call the coordinate of point Q1 from the list of points names.
- ② Observe the second known point: The operation process is shown in Figure 2-55(g)~(j).
- ③ Observe the third known point: The operation process is shown in Figure 2-55(k)~(m).
- ④ After completing the angle observation of the three known points Q1, Q2 and Q3, enter the interface as shown in Figure 2-55(n): Press **(F1)** (Next) to continue the observation of the fourth known point, and the operation process is the same as above. Or press **(F4)** (CALC), and the result is shown in Figure 2-55(o). Press **(F4)** (NEZ), and the screen displays the calculated result of coordinates of the survey station point [Figure 2-55(p)]. Press **(F4)** (Yes) to save the coordinates of the survey station point to the current coordinate file.

(2) Distance Resection

At least two known points should be observed for distance resection to calculate the

coordinates of unknown survey station point. The operation method is the same as that for angle intersection. The operation process is shown in Figure 2-56. The only difference is that **F4** (Distance) should be pressed to range after centering the prism at the observation interface Figure 2-56(f/i). For example, Figure 2-56(f) shows the result of focusing on the prism center of point Q1. Figure 2-56(i) shows the result of focusing on the center of prism at point Q2. Press **F4** (Distance) for distance measurement.

After completing the ranging of two points Q1 and Q2, enter the interface as shown in Figure 2-56(j): Press **F1** (NEXT) to continue observing the third known point, and the operation process is the same as above. Or press **F4** (Calculate), and the result is shown in Figure 2-56(k). Press **F4** (NEZ), and the screen displays the calculated result of the coordinate of the survey station point[Figure 2-56(L)]. Press **F4** (Yes) to save the coordinates of the survey station point to the current coordinate file.

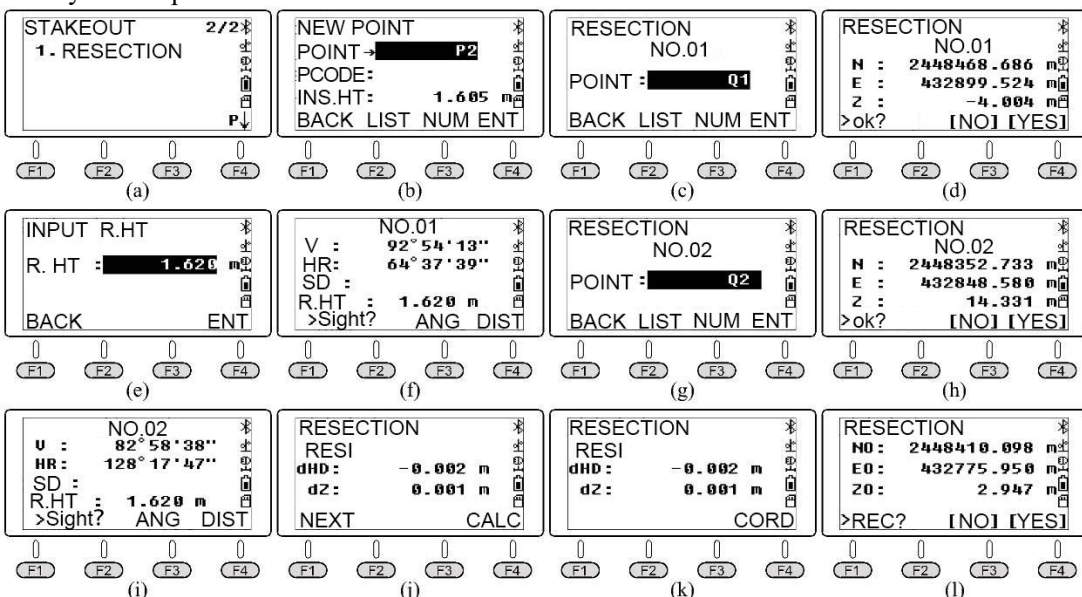


Figure 2-56 Execute the command "S. O - Resection " to observe two known points and calculate the coordinates of the survey station point (Distance intersection)

Appendix : Packing List

M8 Total Station						
1.Main body						
Name	Type	Description	Picture	Size (L*W*H)	Weight	QTY
Total station	M8	2", 2+2ppm 800m Reflectorless EDM		160*150*330mm	5.2KG	1
2.Accessories						
Name	Type	Description	Picture	QTY		
Carrying Case	/	/		1		
Battery	LB-01	7.4V 3100mAh		2		
Charger and Cable	LC-10	Charger Adapter 8.4V-1.2A&Charging cable		1		
Communication cable	AWM-2725	Data transmission cable		1		
Tool Pack	/	Tool Pack, Wipe Cloth, Wrench*2, Hex Wrenches*2, Screwdriver, Blush		1		
Desiccant	/	Silica-Gel Drier		1		
SD Card	SanDisk	16GB		1		
Reflective sheet	RP60, RP40, RP30, RP20	/		1		
Plumb Bob	/	/		1		
Lens Cap	/	/		1		
Dust Cover	/	/		1		

NOTE:

These designs, figures and specifications are subject to change without notice.

We shall not be held liable for damages resulting from errors in this instruction manual.

