DTM-952R Windows CE Total Station

SMART MAX GEOSYSTEMS CO., LTD

Forward

Thank you for choosing our Wince total station!

This manual will introduce to you this new total station in detail. Please carefully read it before operating the instrument.

Features:

1. Menu graphics

   Wince total station adopts icon menu featured with high degree of intelligence, powerful functions and easy operation. Measuring programs can be customized for users, meeting the various professional and engineering surveying requirements.

2. Absolute encoder

   Absolute encoder is preinstalled and you can directly start measuring when the instrument is started. The angle data will not be lost even power supply is replaced halfway.

3. Powerful memory management

   The high-capacity FLASH adopted can store tens of thousands of measured data or coordinate data and facilitate memory management, namely, addition, deletion, modification and transmission of data.

4. Lighter telescope lenses

   As compared with the original model, the design of external and internal construction of this new generation of Wince total station is more scientific and rational and the telescope lenses are more compact, making it easier for measuring.

5. Preinstalled road measuring program

   In addition to the common basic measuring modes and special measuring programs (remote elevation measurement, offset measurement, missing line measurement, distance layout, coordinate layout, resection and area measurement), the road measuring program is preinstalled, significantly facilitating control survey, topographic survey and engineering lofting.

6. English display (only for English version)

   Wince total station (English version) adopts English display which is clear and beautiful, making it easy to operate the instrument.

Notes:

1. Avoid directly pointing the objective lens to the sun when exposed to sunlight. It is recommended to reduce the influence with sun filter lens.

2. When the laser goes to the target surface in a tilted manner, the measurement results may be inaccurate due to weakened or scattered laser.

3. In the case of road surveying, the instrument may not get the correct results due to interference from reflected laser from the front and rear.

4. Avoid storing the instrument at high or low temperature and temperature shock shall also be avoided (excluding temperature change during operation).

5. When the instrument is not working, set it into the case and place it in a dry place. Pay attention to prevent vibration, dust and damp.

6. If there is significant difference between temperature at working place and storage of the instrument, the instrument shall be left in the case until equilibrium is achieved.

7. If the instrument is not used for a long time, the battery shall be removed, separately stored and charged once every month.

8. The instrument shall be set in the case when transporting it and care shall be taken to avoid squeezing, collision and strenuous vibration during transport. For long-distance transport, it would be preferable to set cushions around the case.

9. When erecting the instrument, try to use a wood tripod, because a metal tripod may influence measuring accuracy due to vibration.

10. When exposed optical elements need to be cleaned, degrease cotton or lens tissue shall be used to gently wipe them. Do not use any other items to clean them.

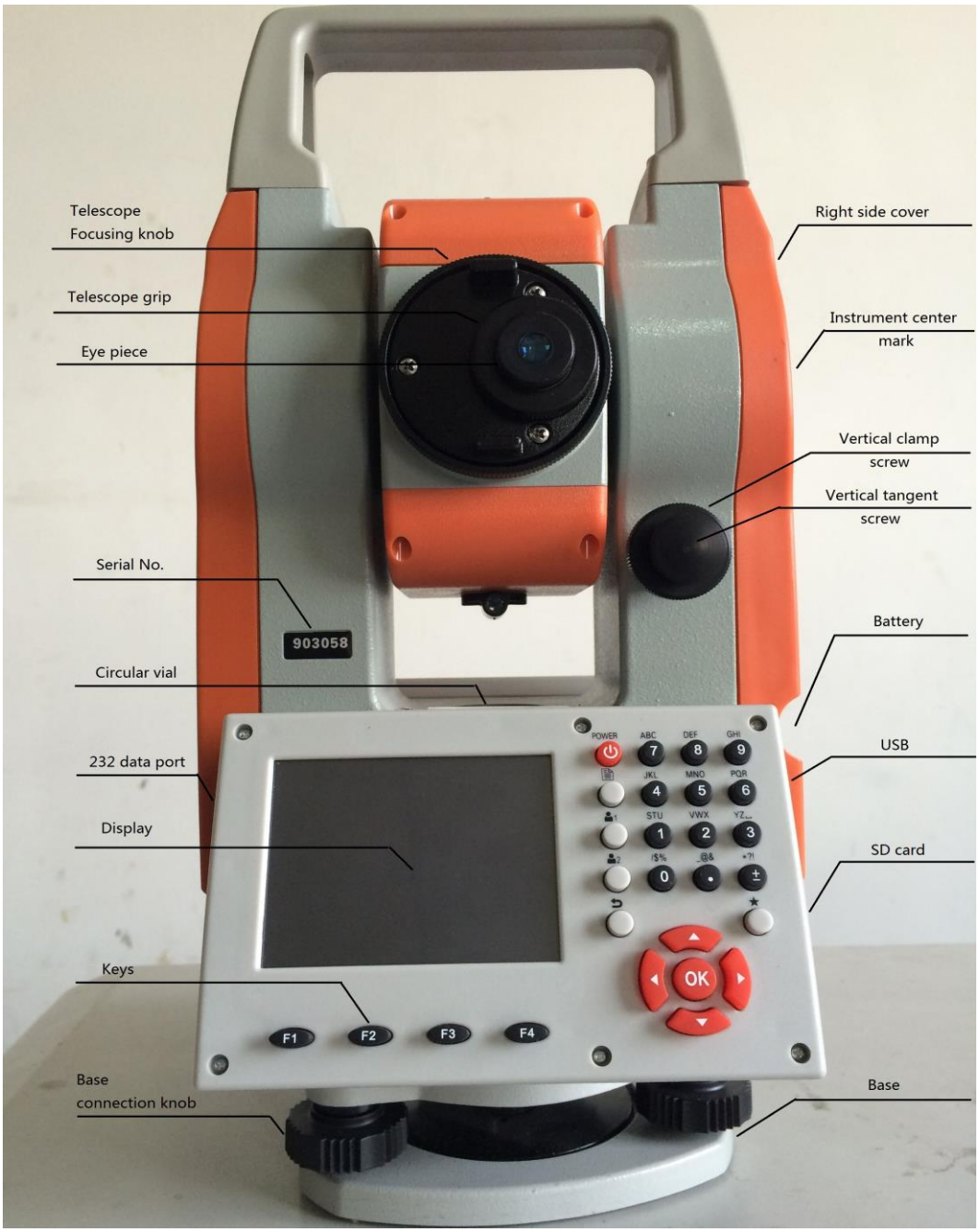
11. When the instrument finishes working, lint or hairbrush shall be used to remove surface dust on the instrument. If the instrument is soaked by rainwater, do not supply power or turn on it. Clean soft cloth shall be used to dry it and then set the instrument in a well-ventilated place for a while.

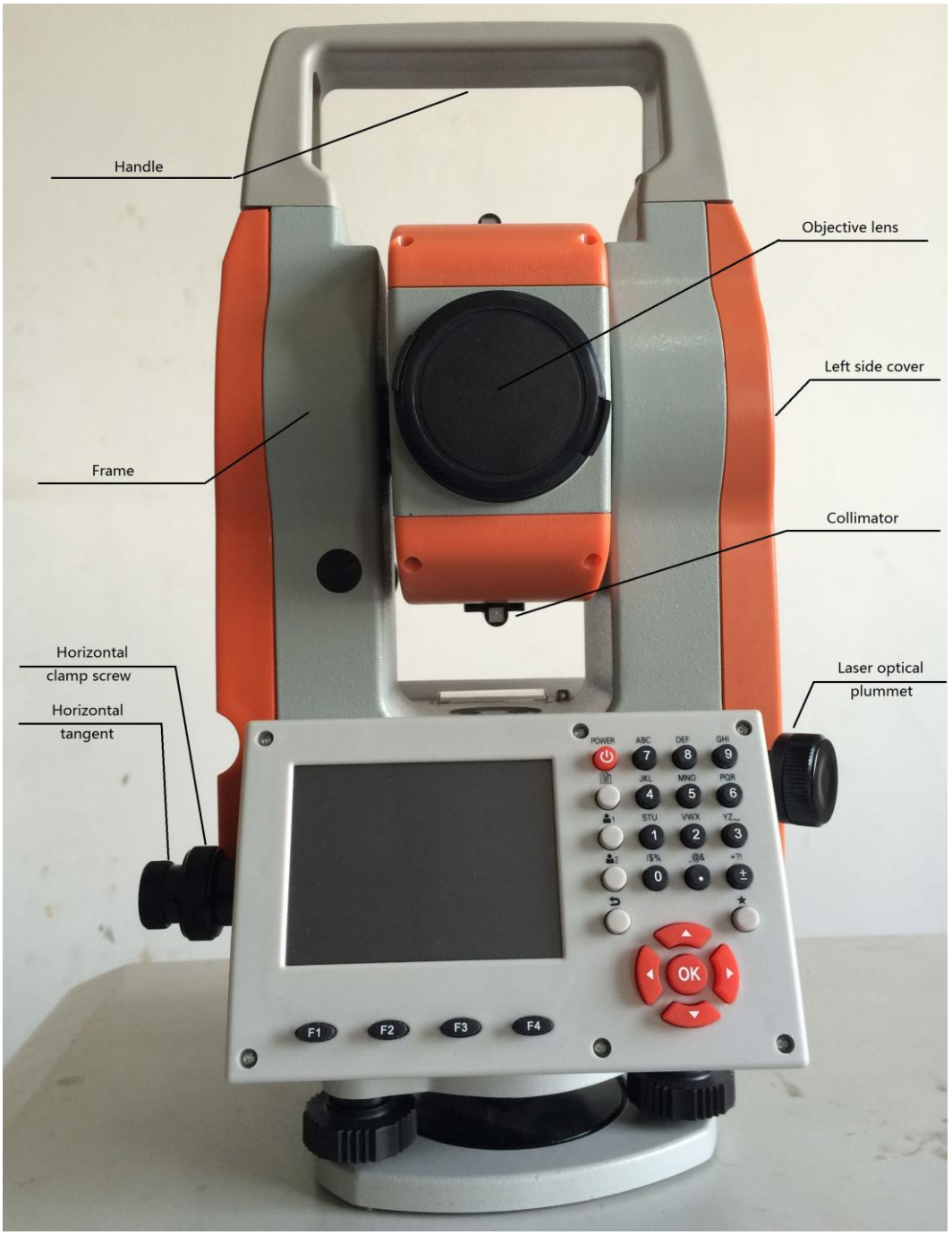
12. Carefully check the instrument prior to operation, to make sure that the various indices, functions, power supply, initial settings and correction parameters of the instrument all conform to the requirements.

13. If the instrument is found abnormal, nonprofessional maintenance personnel are not allowed to disassemble the instrument, in order to avoid unwanted damage.

1 Descriptions and functions of components of the instrument

1.1 Component descriptions

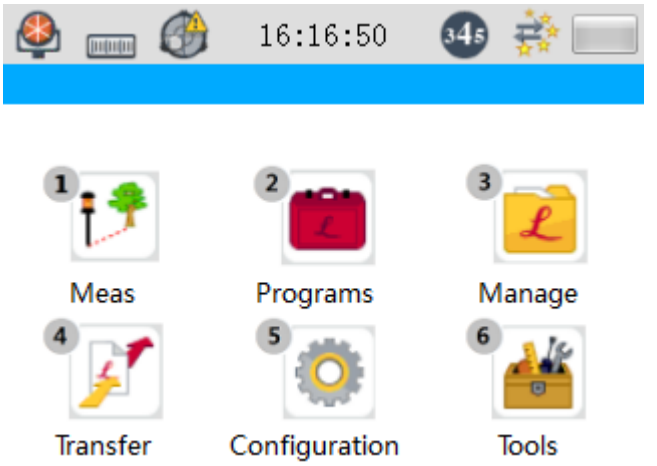



Handle
Objective lens
Left side cover
Frame
Collimator
Horizontal clamp screw
Horizontal tangent
Laser optical plummet
POWER
ABC
DEF
GHI
JKL
MNO
PQR
STU
VWX
YZ
OK
F1
F2
F3
F4

1.2 Display

1.2.1 Main menu

The main menu is as shown below. Press the keys to fulfill corresponding operations.



[Meas]: measurement mode

(See Chapter 5 “Meas mode” for details.)

[Programs]: application program mode

(See Chapter 6 “Programs mode” for details.)

[Manage]: management mode

Functions of this mode are as follows:

- Job
- Fixpoints
- Measurement data
- Code
- Memory initialization

(See Chapter 7 “Manage mode” for details.)

[Transfer]: transfer mode

(See Chapter 8 “Transfer mode” for details.)

[Configuration]: configuration mode

Functions of this mode are as follows:

- General work configuration
- Regional configuration
- Measurement parameter configuration
- Screen and audio configuration
- EDM configuration
- Interface configuration

The set parameters (excluding interface configuration) will be saved always and the Bluetooth defaults to inactivated state when the system starts.

(See Chapter 9 "Configuration mode" for details.)

[Tools]: tools mode

Functions of this mode are as follows:

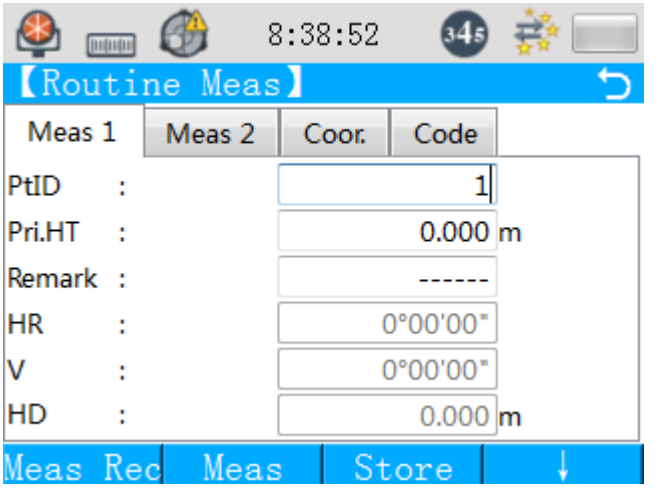
- Adjustment
- Exit
- System information

(See Chapter 10 "Tools mode" for details.)

1.2.2 Measurement menu

Example: routine measurement - Meas1

PtID: point name, 1
Pri.HT: prism height, 0.000m
Remark: note, ------
HR: horizontal (right) angle, 0°00′00″
V: vertical angle, 0°00′00″
HD: horizontal distance, 0.000 m



1.2.3 Display symbols

Symbol	Meaning	Symbol	Meaning
PtID	Point name	Code	Code
Pri.HT	Prism height	N	North coordinate
Remark	Note	E	East coordinate
HR	Horizontal angle (right)	Z	Zenith coordinate
HL	Horizontal angle (left)	m	In meters
V	Vertical angle	ft	In feet
V%	Grad	F	Fine mode
HD	Horizontal distance	T	Tracking mode (1mm)
VD	Elevation difference	ppm	Meteorological correction value
SD	Slope distance		

1.2.4 Screen operation keys

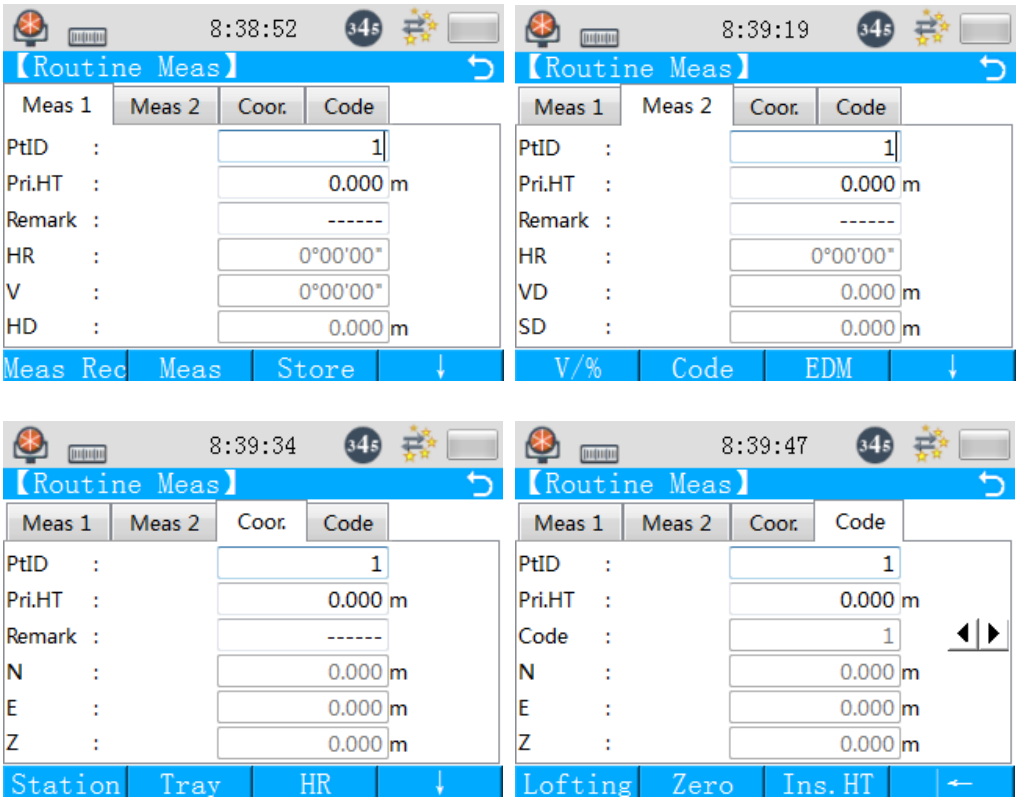
The keys on the screen can be operated by clicking them with a pen or fingers. Do not use a ballpoint pen or a pencil.

1.3 Operational keys

Key	Description	Function
0～/	Numeric key	To input numbers (for value presetting) and special symbols
A～/	Letter key	To input letters and special symbols
⮌	ESC key	To return to the previous screen or mode
★	Star key	To operate several common functions of the instrument
OK	Enter key	To end and confirm data input
🗎	Menu key	To directly enter main menu
👤1	USER key 1	To define USER key 1. Functions of this key may be defined with the "Work" menu under "Configuration" menu
👤2	USER key 2	To define USER key 2. Functions of this key may be defined with the "Work" menu under "Configuration" menu
	Navigation key	To control the cursor under editing or input mode or control the current operating cursor
POWER	Power button	To control ON/OFF of the power supply
F1-F4	Soft function buttons	Their functions change along with the bottom line on the screen.

1.4 Function keys (soft)

The upper lines on the screen indicate the observation data while the soft command and function keys are at the bottom line of the screen; the corresponding function button can be activated by pressing corresponding button. The actual meaning of each soft function button depends on the current activated application program and functions.



Display	Function
Meas Rec	To start measuring and record measured data
Meas	To start measuring
Store	To record measured data
V/%	Vertical angle/grad conversion
Code	To set the code
EDM	To set N measurements, fine measurement/tracking, prism/non-prism mode
Station	To set the station
Tray	To preset the horizontal angle
HR	To change between right and left horizontal angle

Lofting	Lofting measurement mode
Zero	To set horizontal angle to zero
Ins. HT	To set prism height and instrument height
↓	Next page
⏐←	Back to the first page

1.5 Symbols

A symbol indicates a specific operating state, according to the different software version.

Key	Meaning
	Indicating there are multiple choices

1.6 Icons

Display	Function
	It can activate EDM if the interface has EDM activation function
	It can start measuring if the interface has measurement boot function
	To launch leveling interface
13:55:30	To start time setting
	To switch between letter and number input at the interface with letter/number switch input mode
	To start communication setting
	To indicate battery level

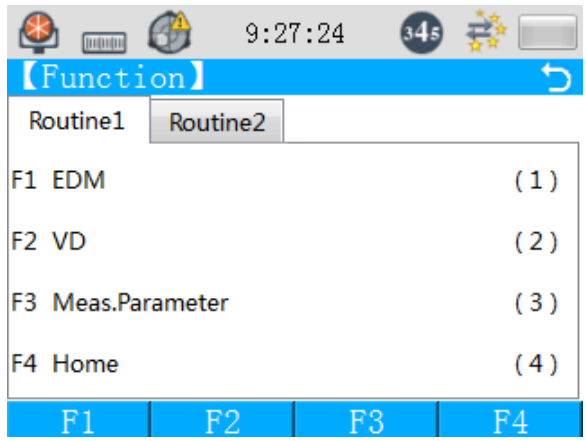
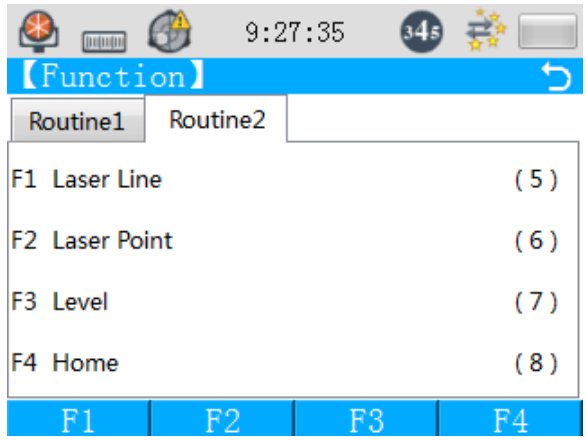
1.7 Star key (★) mode

Press ★ and several operation options of the instrument will be revealed. These options are displayed on two pages.

The following operations can be achieved with star key:

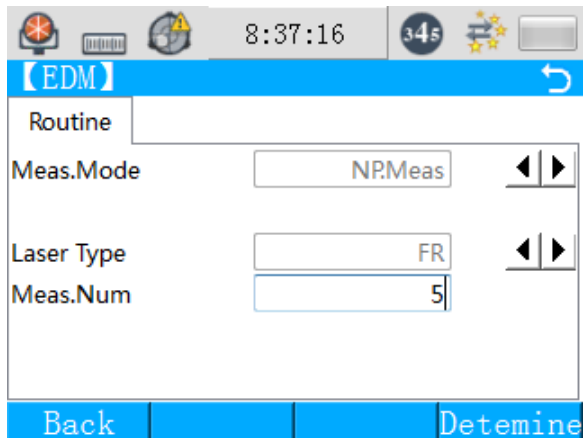
1. EDM
2. VD
3. Meas. Parameter
4. Laser Line
5. Laser Point

6. Level
7. Switch from Home to main menu

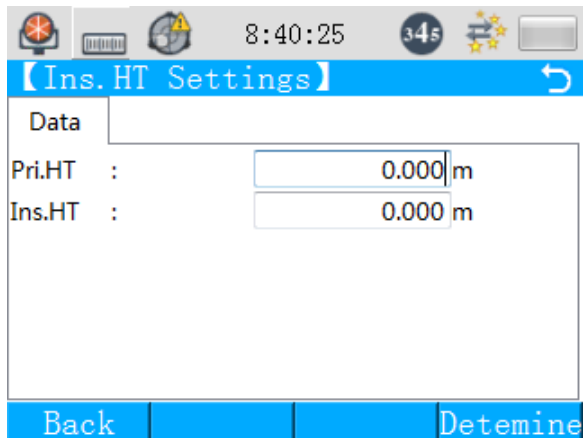
Procedure	Display
① Press ★. ② Press "Routine1" to show page 1; Press "Routine2" to show page 2. Press "⮌" to return to previous menu.	 

1.7.1 EDM

Procedure	Display

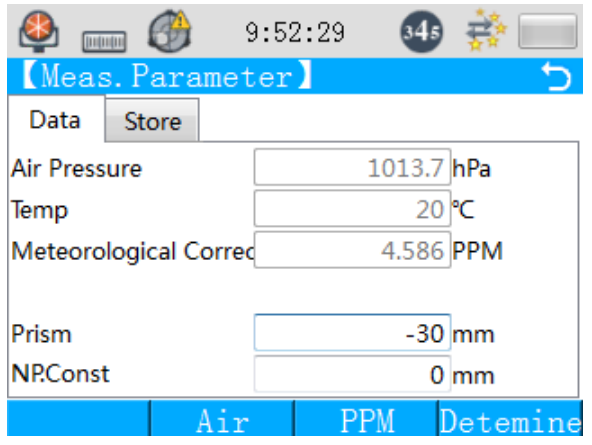
① Press ★. ② Press "F1" or "1" to enter EDM setting interface. ③ See "9.5 EDM" for related operation.	

1.7.2 VD

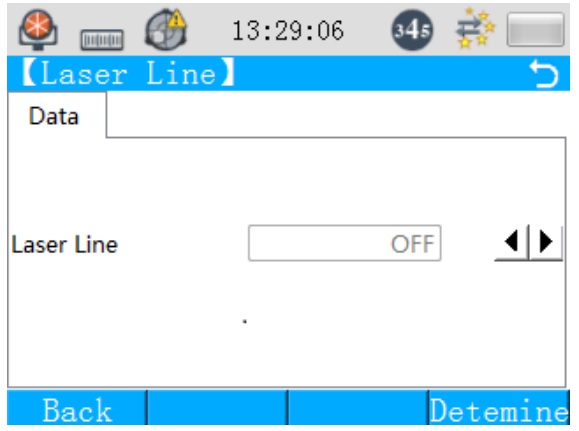
Procedure	Display
① Press ★. ② Press "F2" or "2" to enter VD setting interface. ③ Enter prism height and instrument height. ④ To save the modifications, press "F4" (Detemine). ⑤ Press "F1" (Back) to return to previous menu.	

1.7.3 Measurement parameter setting (temperature, air pressure, meteorological correction value (PPM), prism constant value (PSM) and reflector constant)

Procedure	Display

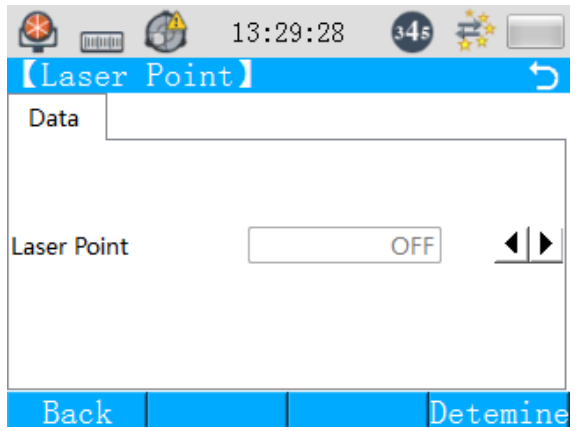
① Press ★. ② Press "F3" or "3" to enter Meas. Parameter setting interface. ③ See "9.3 Meas.Parameter" for related operations.	

1.7.4 Laser line

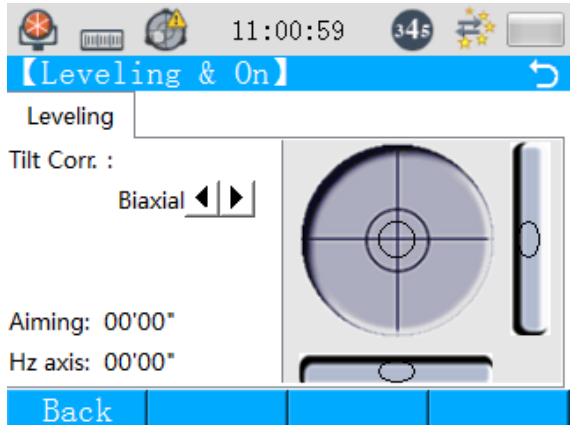
Procedure	Display
① Press ★. ② Press "Routine2" to show page 2. ③ Press "F1" or "5" to enter laser line setting interface. ④ Chose to turn on or off laser line. ⑤ Press "F4" (Detemine) to confirm the modification. ⑥ Press "F1" (Back) to return to previous menu.	

1.7.5 Laser point

Procedure	Display

① Press ★. ② Press "Routine2" to show page 2. ③ Press "F2" or 6 to enter laser point setting interface. ④ Choose to turn on or off laser point. ⑤ Press "F4" (Detemine) to confirm the modification. ⑥ Press "F1" (Back) to return to previous menu.	

1.7.6 Leveling

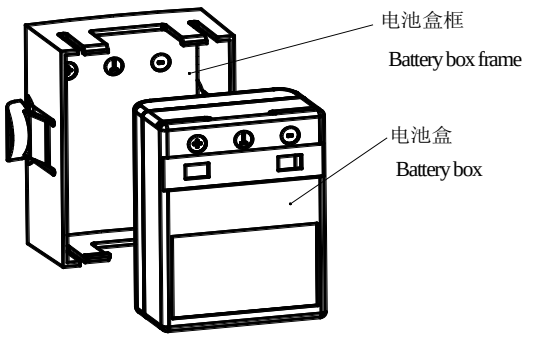
Procedure	Display
① Press ★. ② Press "Routine2" to show page 2. ③ Press "F3" or 7 to enter leveling interface. ④ Tilt compensation has the following options: OFF, uniaxial and biaxial. When biaxial is selected, aiming and horizontal axis values will be shown.	

2 Battery box mounting and charging

2.1 Battery box mounting

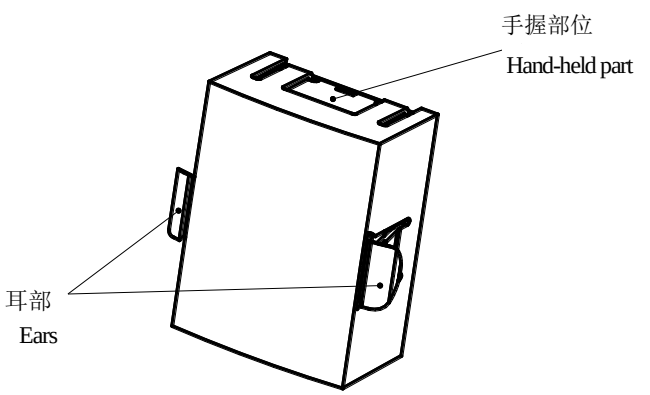
1. Battery mounting

Install the battery box into the frame according to the positive and negative symbols and direction, as shown in the following figure.



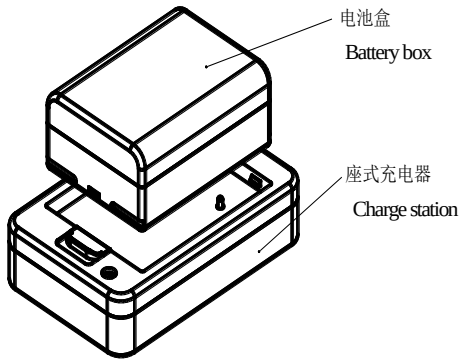
2. Battery disassembly

When removing the battery box for charging, hold the ears of the battery box frame with one hand and the battery box with the other hand, and pull it out.

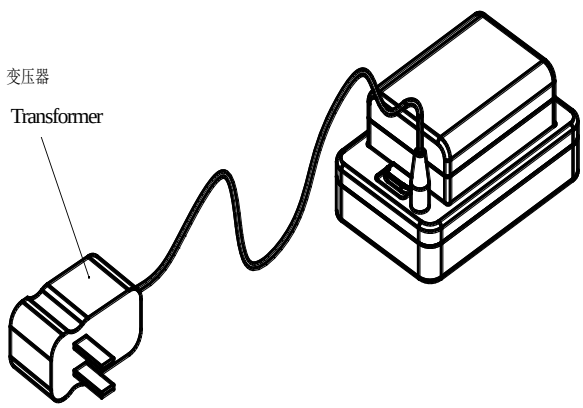


2.2 Charging of battery box

1. Load the battery box into the charge station for charging, as shown in the figure below.



2. Insert one terminal of the transformer into the charge station and the other into the power socket-outlet. Red light of the transformer indicates charging is underway and, when it turns green, it indicates charging is finished.



Notes:

1) If red light is normally on, it indicates it is charging.

2) Charging time is 7h and initial charging time is 12h to 15h.

3) Although the charger has overcharge protection circuit, the plug shall be removed from the socket-outlet when charging is over.

4) Charging shall be performed within the temperature range of 0 ~ ±45 ℃; a temperature out of this range may result in charge failure.

5) If the light is not on when the charger is connected to the battery, the charger or the battery may be damaged. Please repair.

6) If the red light flashes at relatively long intervals after the plug is inserted into the socket-outlet, please slightly turn the plug to ensure proper contact with the socket-outlet on the battery.

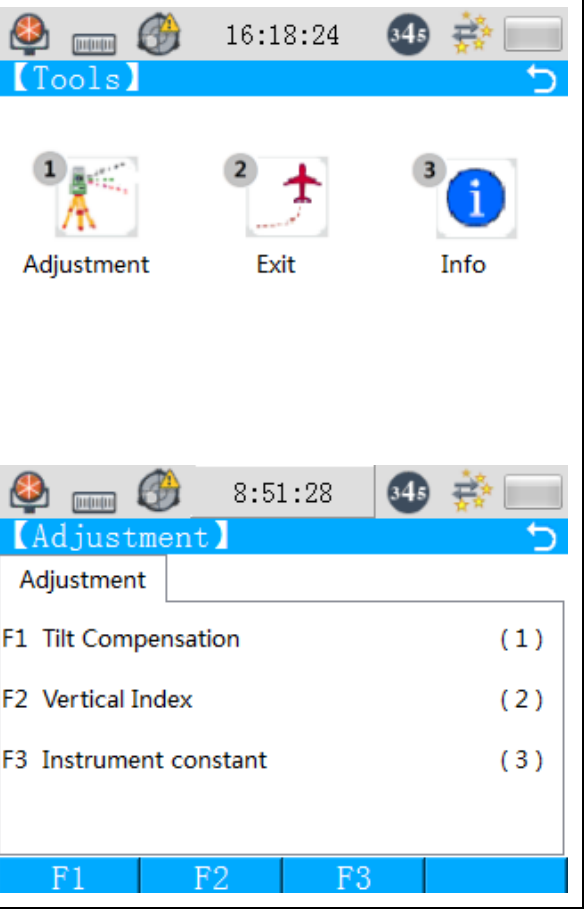
7) The battery can be repeatedly charged for 300 to 500 times and full discharge will reduce its service life.

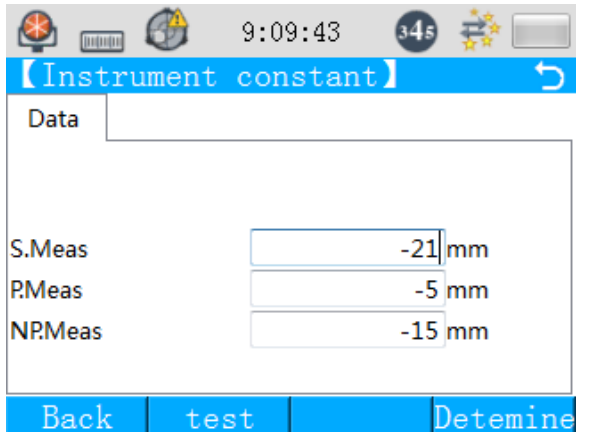
8) To better extend service life of the battery, please ensure to charge it every month.

3 Initial settings

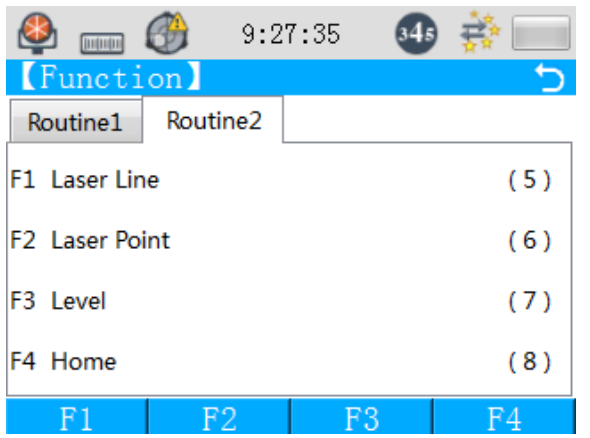
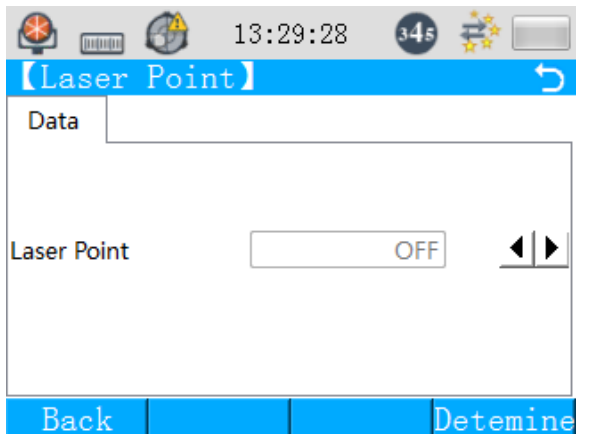
3.1 Instrument constant setting

The instrument constant obtained according to"11.8 Instrument constant (K)" can be set in the following way.

Procedure	Display
① Press "Tools" or "6" from the main menu to enter Tools mode. ② Press "Adjustment" or "1" to reveal the adjustment setting interface. ③ See "10.1.3 Instrument constant" for related operations.	

3.2 Laser plummet setting

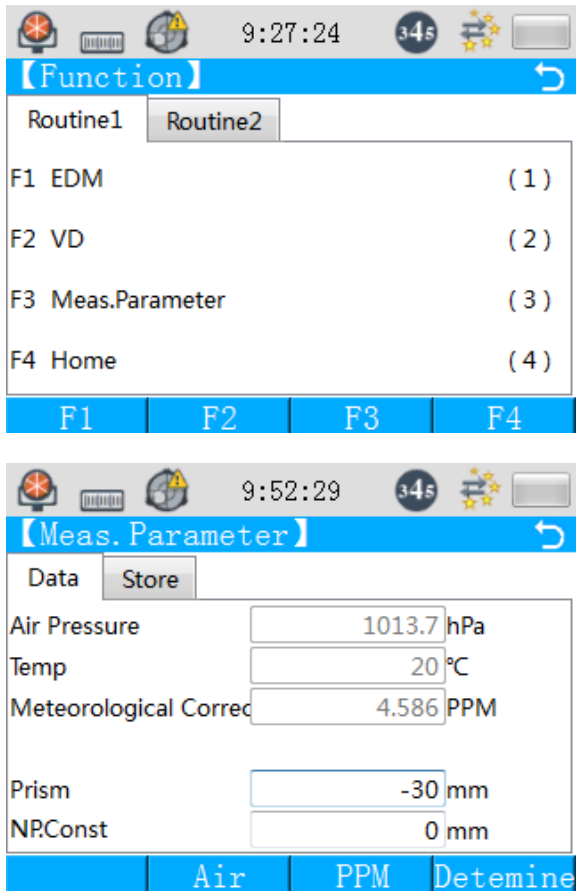
Procedure	Display
① Press ★. ② Press "Routine2" to show page 2. ③ Press "F2" or "6" to enter laser point setting interface. ④ Choose to turn on or off laser point. ⑤ Press "F4" (Detemine) to confirm the modification. ⑥ Press "F1" (Back) to return to previous menu.	 

3.3 Prism constant setting

If prism constant of the prism used is -30, the prism constant shall be set to -30. Hence, the prism constant shall be preset based on the prism used in actual applications. Once the prism constant is set, it will be saved when the instrument is shut down.

● Prism constant setting is completed under star key (★) mode or measurement parameter function.

● Example: prism constant: -30

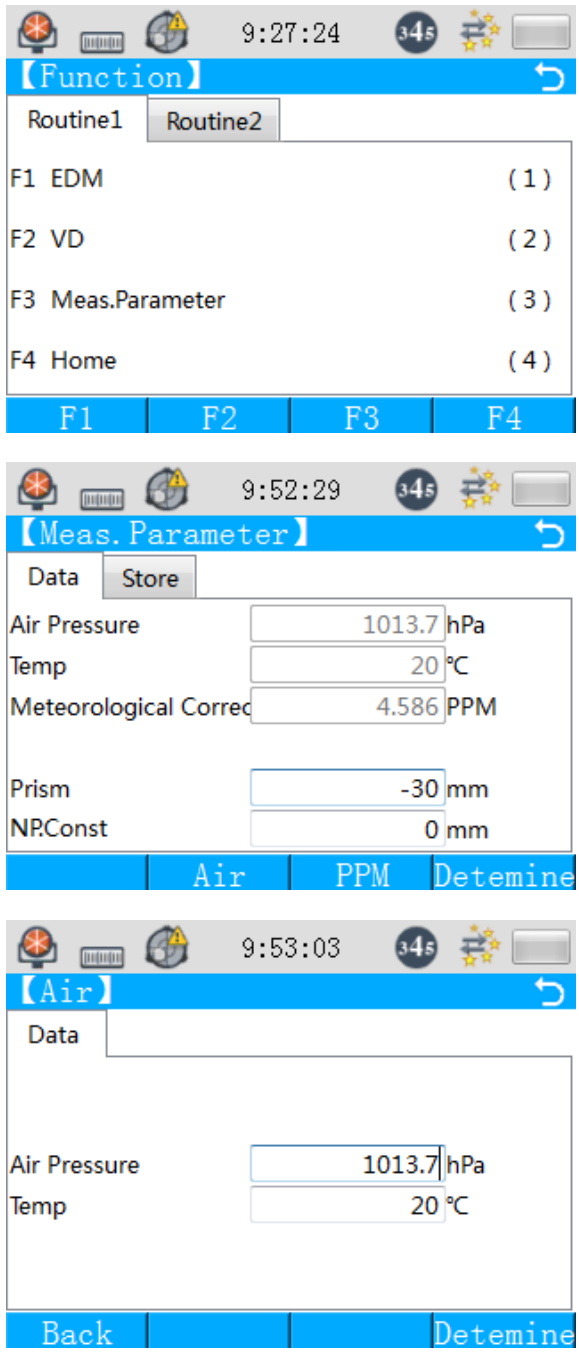
Procedure	Display
① Press ★. ② Press "Routine1" to show page 1. ③ Press "F3" or "3" to enter measurement parameter setting interface. ④ See "9.3 Meas.Parameter" for related operations.	

3.4 Meteorological correction setting

Light travels fast in the air and its speed varies together with air temperature and pressure. This instrument will automatically apply meteorological correction on the observation results once the meteorological correction value is set. When the temperature is 20℃, the barometric pressure is

1013hpa. The meteorological correction value will be saved even the instrument is shut down.

The meteorological correction value can be set under star key (★) mode.

Procedure	Display
① Press ★. ② Press "Routine1" to show page 1. ③ Press "F3" or "3" to enter setting interface. ④ Press "F2" (Air) to enter air pressure input interface. ⑤ See "9.3 Meas.Parameter" for related operations.	

※ 1) Data range: Temperature: -30 ~ +60 ℃ (step: 0.1 ℃)

Air pressure: 420 ~ 800 mmHg (step: 1 mmHg)

Meteorological correction value (PPM): -100 ~ +100 PPM (step: 1PPM)

Prism constant (PC): -100 ~ +100 mm (step: 1mm)

※2) The instrument will calculate meteorological correction value based on entered temperature and air pressure.

3.4.1 Calculation of meteorological correction value

The correction calculation formula is as follows: (in m)

$$PPM = 275.932302 - \frac{78.469981 \times \text{air pressure (hPa)}}{273.14941 + \text{temperature (℃)}}$$

·If meteorological correction is not considered, please set PPM to 0.

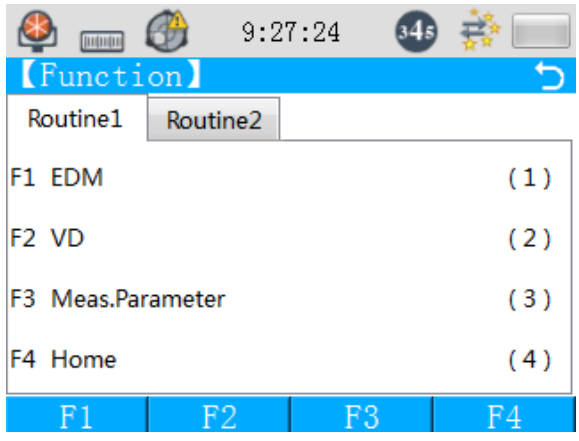
·Standard meteorological conditions for Wince total station (i.e.: meteorological conditions with meteorological correction value being 4):

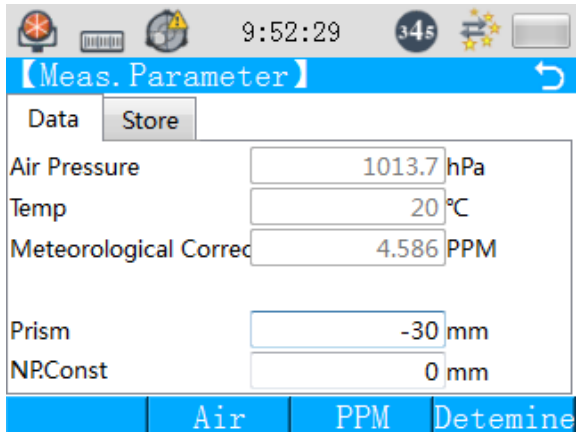
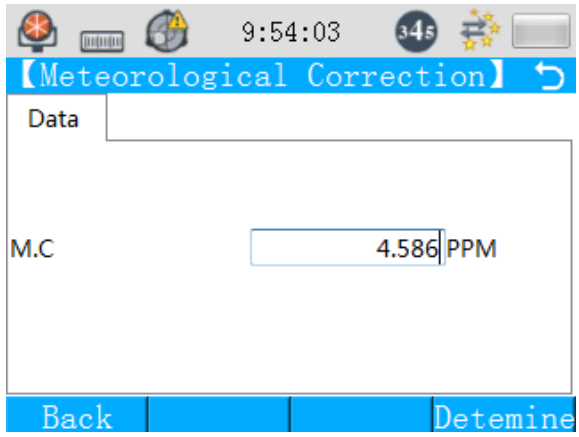
Air pressure: 1013 hPa

Temperature: 20 ℃

3.4.2 How to directly set meteorological correction value

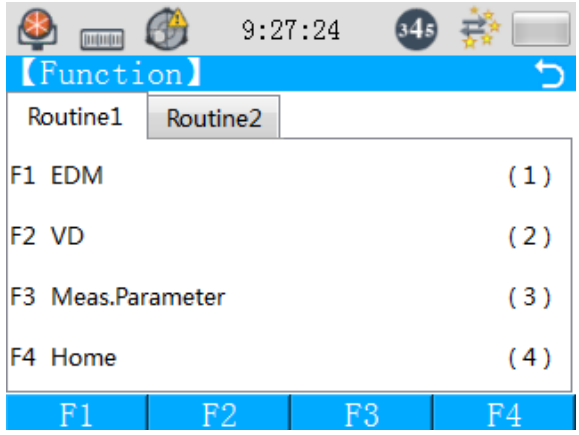
Measure the temperature and air pressure and calculate the meteorological correction value (ppm) with the above formula.

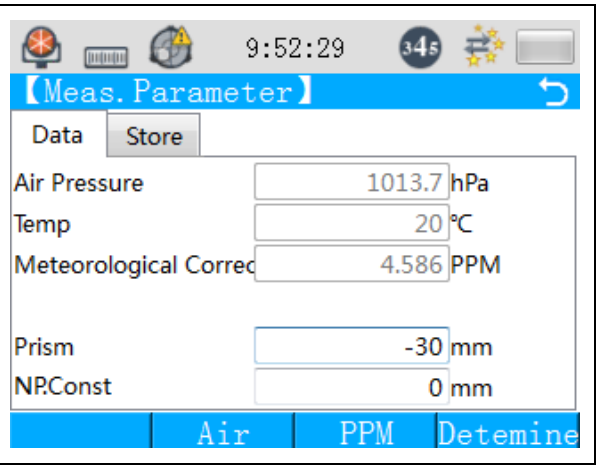
Procedure	Display
① Press ★. ② Press "Routine1" to show page 1. ③ Press "F3" or "3" to enter setting interface. ④ Press "F3" (PPM) to enter PPM input interface. ⑤ See "9.3 Meas.Parameter" for related operations.	

※1) Data range: -100 ppm ~ +100 ppm step 1ppm

3.5 Reflector constant setting

Procedure	Display
① Press ★. ② Press "Routine1" to show page 1. ③ Press "F3" or "3" to enter setting interface. ④ Enter the reflector constant and press "F4" (Detemine) to save the modification. ⑤ See "9.3 Meas.Parameter" for related operations.	



3.6 Atmospheric refraction and earth curvature correction

The instrument can automatically correct the influence of atmospheric refraction and earth curvature when conducting horizontal distance and elevation difference measurement.

The correction of atmospheric refraction and earth curvature is respectively calculated with the following formulas:

Horizontal distance after correction:

$D=S*[\cos\alpha+\sin\alpha*S*\cos\alpha(K-2)/2Re]$

Elevation difference after correction:

$H=S*[\sin\alpha+\cos\alpha*S*\cos\alpha(1-K)/2Re]$

● The formulas for calculating horizontal distance and elevation difference without atmospheric refraction and earth curvature correction are as follows:

$D=S\cdot\cos\alpha$

$H=S\cdot\sin\alpha$

Where: K=0.14 ····· atmospheric refraction coefficient

Re=6370 km ····· earth curvature radius

α (or β) ····· vertical angle from horizontal plane

S ····· slope distance

Note: Atmospheric refraction coefficient (K) of the instrument is set to 0.14 before it leaves factory.

4 Preparations prior to measurement

4.1 Unpacking and storage of the instrument

Unpacking

Gently lay the case down; with the cover facing upward, unlock the latch, open the cover and take the instrument out.

·Storage

Cover the telescope with the cap, so that the vertical clamp screw of the alidade and level of the base face upward; then horizontally place the instrument into the case (with the telescope objective lens facing downward). Gently tighten the vertical clamp screw, recover the case and lock it with the latch.

4.2 Erection of the instrument

Place the instrument onto the tripod; carefully level and align it, to ensure accuracy of the measurements (special tripod with central connection screw shall be used).

·Operation reference: Leveling and alignment of the instrument

1. Erect the tripod

① First spread the tripod, so that the three feet of the tripod are approximately equally spaced and the top surface is approximately level. Tighten the three fixing bolts.

② Adjust the tripod to make its center and the measuring point approximately on the same plumb line.

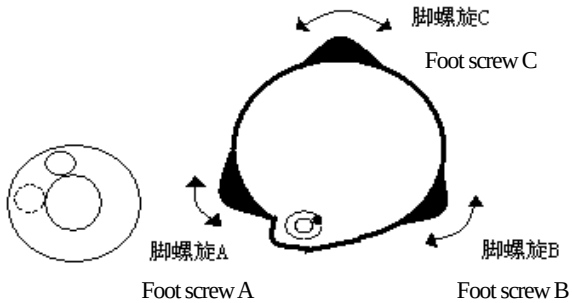
③ Step on the tripod to make it reliably fixed onto the ground.

2. Set the instrument onto the tripod

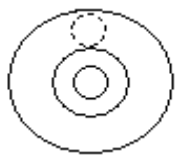
Carefully place the instrument onto top surface of the tripod. Hold the instrument with one hand and loosen the center connection screw with the other hand. Gently move the instrument until the plumb is aligned with the station mark. Then, gently tighten the connection screw.

3. Roughly level the instrument with the circular vial

① Rotate the two foot screws A and B, so that the bubble of the circular vial is on the line perpendicular to line of centers of the above two foot screws.



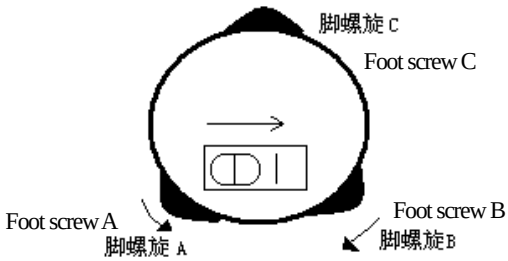
② Turn foot screw C to center the bubble of the circular vial.



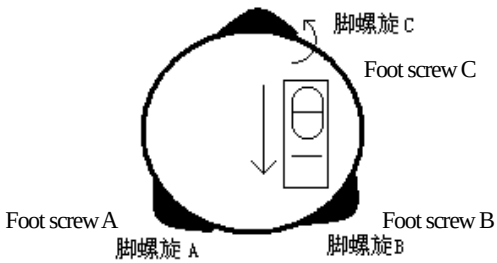
4. Level the instrument with level tube in a fine manner

① Loosen the horizontal clamp screw and then turn the instrument to make the level tube parallel

with the line formed by foot screws A and B. Afterwards, turn foot screws A and B to center the bubble of the level tube.



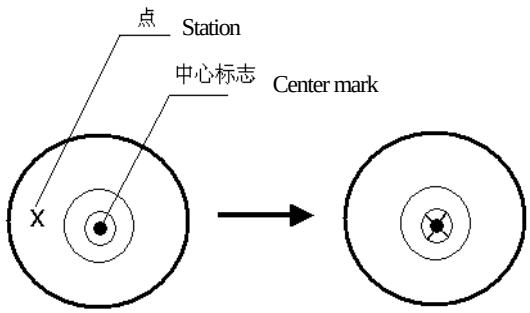
② Turn the instrument around the vertical axis for 90°; then turn foot screw C to center bubble of the level tube.



③ Turn the instrument for 90° again; then repeat steps ① and ②, until the bubbles on the four positions are all centered.

5. Center it with the optical plummet

Adjust objective lens of the optical plummet telescope based on vision of the observer. Loosen the central connection screw, carefully move the instrument to align the center mark of the optical plummet and the station and then tighten the connection screw. When moving the instrument, do not make it turn on the tripod, to prevent the bubbles from drifting.

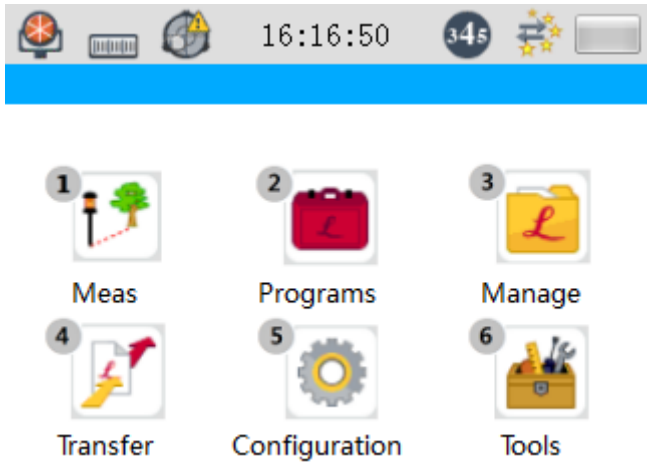


6. Final fine leveling of the instrument

Conduct fine leveling of the instrument according to step 4, until bubbles of the level tubes are always centered no matter how the instrument turns.

4.3 Turn on power switch

Press the button Power on the panel and the main interface will appear when the instrument starts:



Main Menu Icons

- Check the displayed battery level. When battery level is low, the battery shall be promptly replaced and charged. See "4.4 Battery level icon".

4.4 Battery level icon

The battery level icon is used to indicate battery level.

When it is empty, please replace the battery and charge it.

Battery level

Notes:

① Working hours of the battery depends on environmental conditions, for instance, instrument ambient temperature, duration of charging time and counts of charge and discharge. For your safety, it is recommended to charge the battery in advance or prepare charged batteries for backup.

② The battery level icon indicates the battery level under current measuring mode. The battery level indicated under angle measurement mode may not be sufficient for distance measurement, since distance measurement consumes more power than angle measurement. When it switches from angle measurement mode to distance measurement mode, the operation may be interrupted due to low battery.

- It is recommended to check the battery level before leaving for field survey.

③ The battery level icon may not promptly indicate decrease or increase of power when the observation mode changes. The battery level indicator system is used to show overall conditions of the battery and it cannot reflect immediate change in battery level.

·Notes for charging of battery

☆ The battery shall be charged with the charger supplied with the instrument.

☆ When charging the battery, first connect the charger to the 220V supply; then remove the battery box from the instrument and insert it into the charge socket. An orange light on the charger indicates it is charging. After 7h or when the light turns green, it indicates charging is over. Unplug the plug.

·Note for removing onboard battery box:

☆ The instrument power must be turned off each time you remove the battery box; otherwise, the instrument may easily get damaged.

·Notes for charging:

☆ The plug shall be removed from the socket-outlet, although the charger has overcharge protection circuit.

☆ Charging shall be performed within the temperature range of 0 ~ ±45 ℃; a temperature out of this range may result in charge failure.

☆ If the light is not on when the charger is connected to the battery, the charger or the battery may be damaged. Please call a professional to repair it.

·Notes for battery storage:

☆ The battery can be repeatedly charged for 300 to 500 times and full discharge will reduce its service life.

☆ To better extend service life of the battery, please ensure to charge it every month.

4.5 Reflecting prism

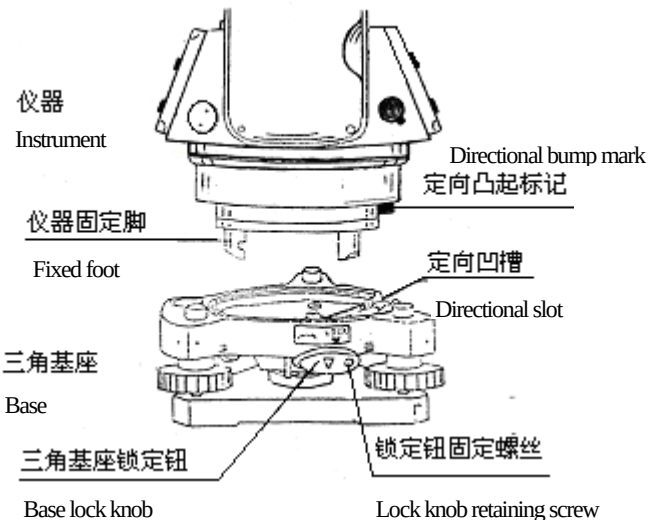
A reflecting prism shall be set at the target when the total station is conducting distance measurement and other work. A reflecting prism consists of a single (or triple) prism set and it can be connected to the base with the base connector and mounted onto the tripod or directly mounted onto the centering rod. The prism set is to be provided by the user based on actual work demand.

The prism set is as shown below:

4.6 Disassembly and assembly of base

·Disassembly

The triangular base can be removed from the instrument (including the reflecting prism base connector which has a same base), if required. First loosen the base lock knob retaining screw with a screwdriver; then turn the lock knob counterclockwise for about 180 ° and the base can be separated from the instrument.



·Assembly

Align the directional bump mark of the instrument with the directional slot of the base and place the three fixed feet of the instrument into corresponding holes on the base to load the instrument onto the base. Turn the lock knob clockwise for about 180 ° to lock the instrument and the base. Finally, tighten the lock knob retaining screw with a screwdriver.

4.7 Adjustment and aiming of telescope objective lens

Method for aiming (for reference only)

① Point the telescope toward a bright place and turn the eye piece. Focus it until the graticule is clear (first turn the eye piece toward you and then slowly adjust it to focus and make the graticule clear).

② Use the tip of the triangular mark in the collimator for aiming. Certain distance should be left between your eye and the collimator.

③ Make the target image clearly with the telescope focusing screw.

☆ If parallax is found when your eye moves vertically or horizontally over the eye piece, it indicates that focusing or eye piece diopter is not proper (this will affect measurement accuracy) and focusing shall be carefully conducted and eye piece adjusted to eliminate parallax.

4.8 Vertical angle tilt correction

When tilt sensor is activated, the correction to be automatically applied to the vertical angle due to relaxed leveling will be displayed.

The tilt sensor must be activated to ensure precise angle measurement (see 1.7.6 Leveling for related operations). The indicated tilt correction may also be used for fine leveling of the instrument.

● Wince total station can automatically compensate and correct the vertical angle error caused by tilt of instrument vertical axis in direction Y.

● The vertical angle shown will not be stable if the instrument is not stably situated or it is affected by wind. In this case, the automatic tilt correction function for vertical angle can be turned off.

4.9 Instrument system error compensation

1) Instrument vertical axis error (deviation of Y-direction tilt sensor)
2) Collimation axis error
3) Vertical angle zero reference error
4) Horizontal axis error

The above errors can be corrected by the software through internal calculation based on the compensation value for each of them. These errors can also be compensated when the instrument only serves as an independent device (circle left/circle right) and the method generally taken to eliminate these errors is to take the average of the observation values with normal and inverted telescope.

● For methods for adjustment or resetting of the above compensation values, see Chapter 11 "Inspection and calibration".

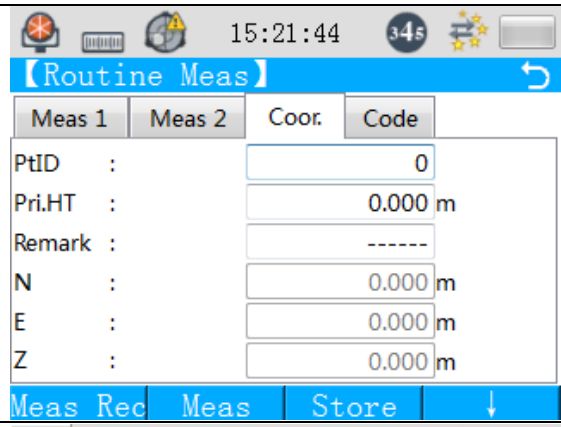
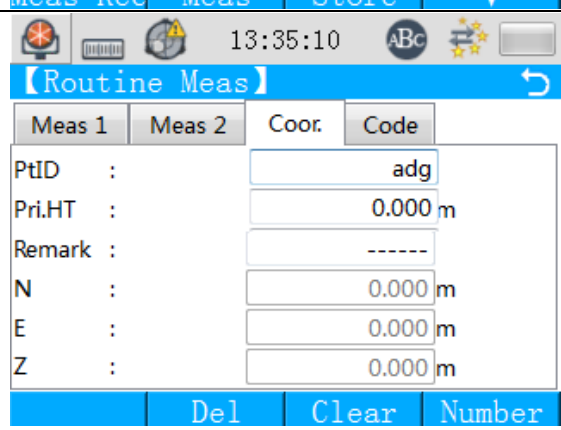
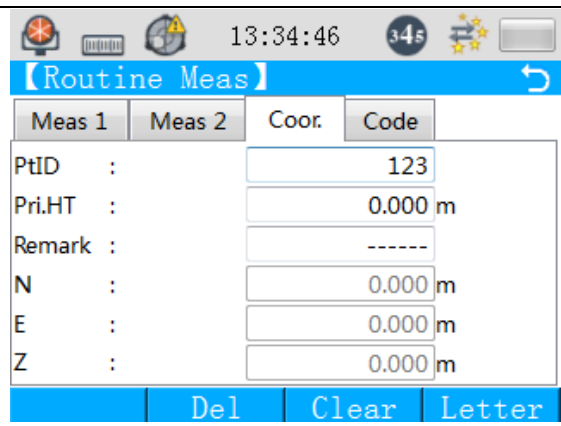
● For way to stop the tilt correction function, see "1.7.6 Leveling" or Chapter 11 "Inspection and calibration".

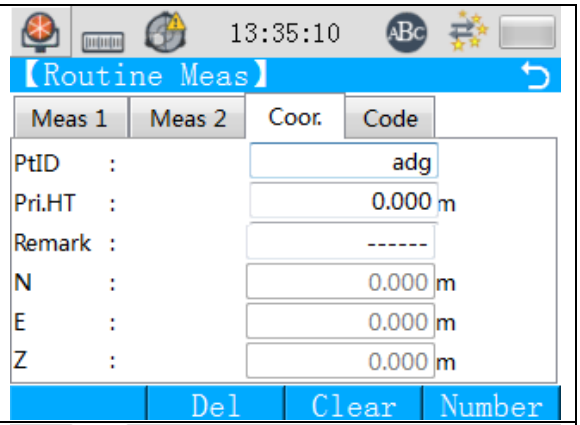
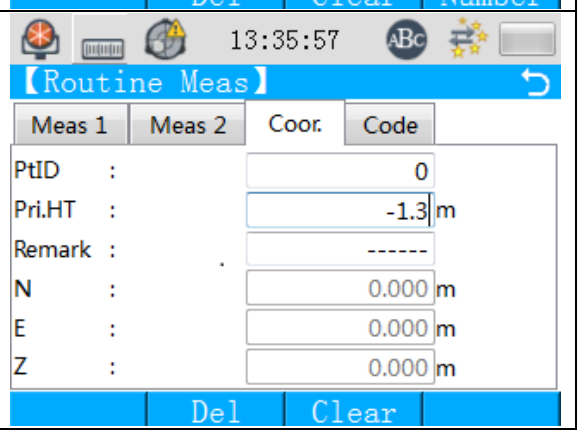
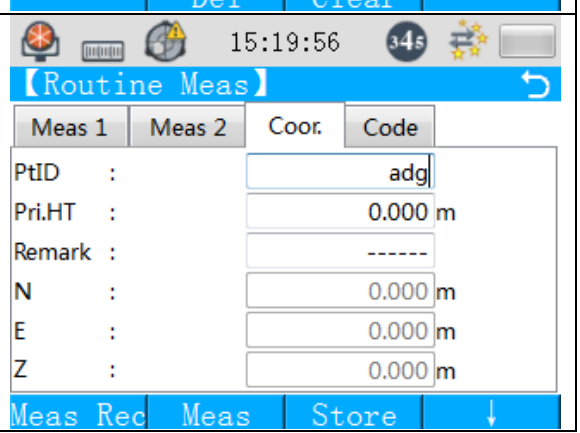
4.10 Methods for entering numbers and letters

Letters and numbers can be entered with the keypad, which is quite fast and convenient.

[Example]: input under measurement

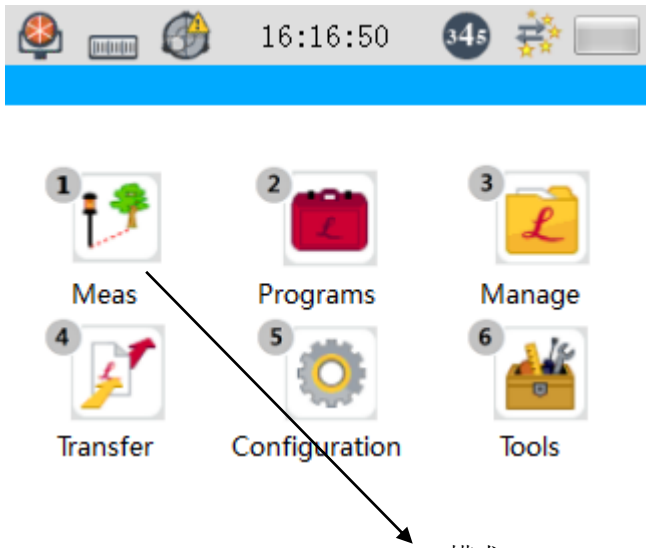
Procedure	Display

① Press "Meas" or "1" to enter routine measurement interface from main menu.	
② Press "OK" to enter input mode. When the cursor is in the field accepting letters, numbers or symbols, the character input state will be activated. When the cursor is in the field accepting numbers, "." or "-", the numeric input state will be activated.	
③ Under character input state: "F2" (Del): to delete character(s); "F3" (Clear): to clear all characters in the current field; "F4" (Number): to switch to numeric entry; please enter "123"; "F4" (Letter): to switch to letter input; please enter "adg".	

	
④ Under numeric input state: "F2" (Del): to delete character(s); "F3" (Clear): to clear all characters in the current field; Please enter "-1.3".	
⑤ Press "OK" to confirm the input, end the input mode and automatically jump to the next step; ⑥ Press "⮌" to cancel input and end the input mode.	

5 Meas mode

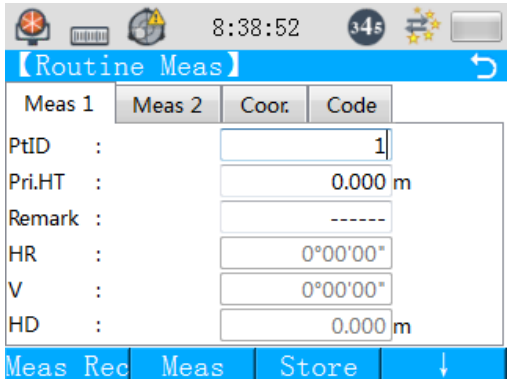
Press (1) or click "Meas".

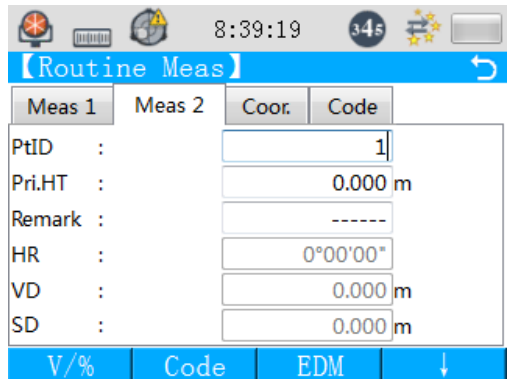


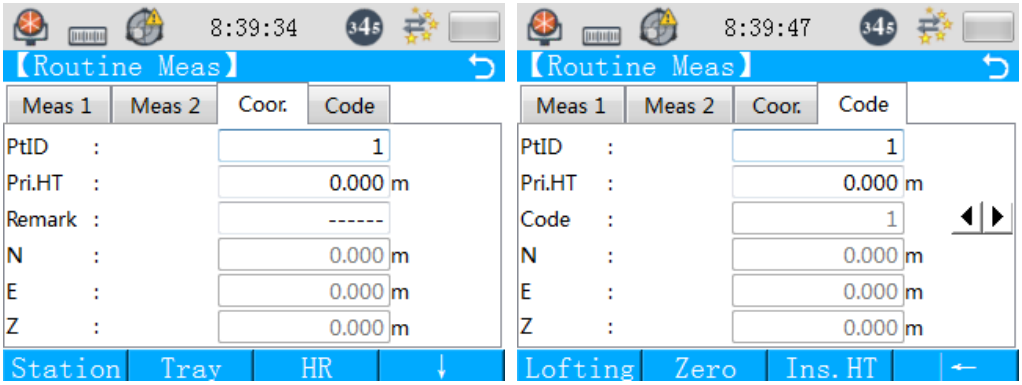
Meas 模式

Meas mode

Routine measurement menu consists of four pages and covers all common measuring functions, such as: angle measurement, distance measurement and coordinate measurement, as shown in the figures below.

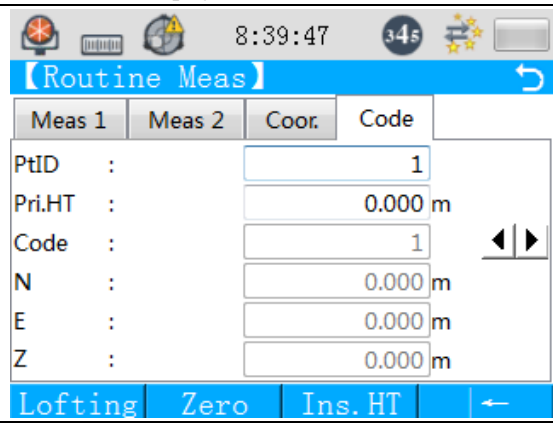
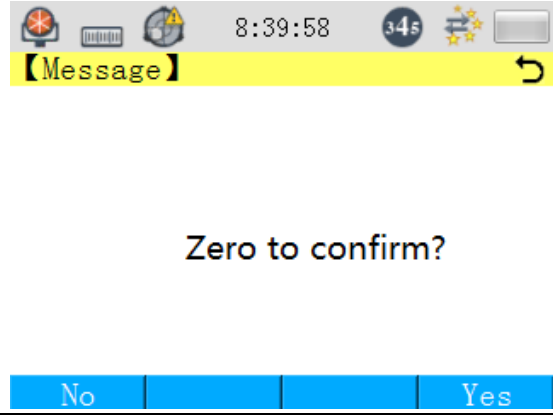


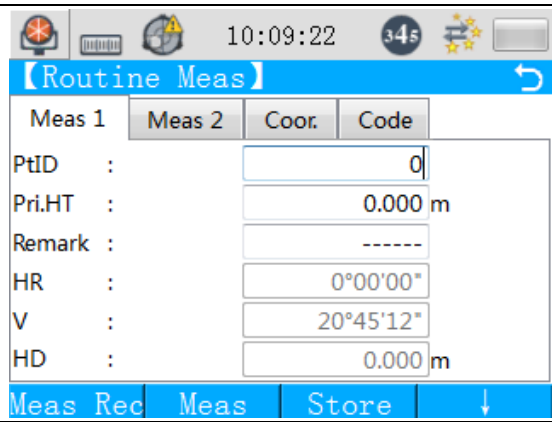
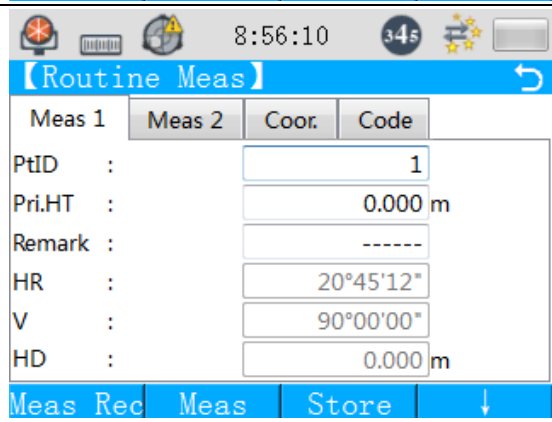




5.1 Angle measurement

5.1.1 Horizontal angle (right) and vertical angle measurement

Procedure	Display
① Sight the first target (A).	
② Set horizontal angle reading of target A to 0°00′00″. Press and hold "F4" (↓ or |←) until button "Zero" appears and then press "F2" (Zero). ③ In the zero confirmation window, press "F4" to confirm zero setting and return to previous menu.	

	
④ Sight the second target (B). The instrument will display horizontal angle and vertical angle of target B.	

Method for aiming (for reference only)

① Point the telescope toward a bright place and turn the eye piece. Focus it until the graticule is clear (first turn the eye piece toward you and then slowly adjust it to focus and make the graticule clear).

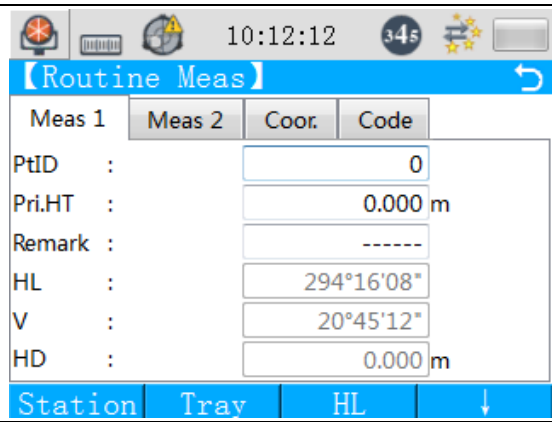
② Use the tip of the triangular mark in the collimator for aiming. Certain distance should be left between your eye and the collimator.

③ Make the target image clearly with the telescope focusing screw.

☆ If parallax is found when your eye moves vertically or horizontally over the eye piece, it indicates that focusing or eye piece diopter is not proper and this will affect measurement accuracy. Hence, focusing shall be carefully conducted and eye piece adjusted to eliminate parallax.

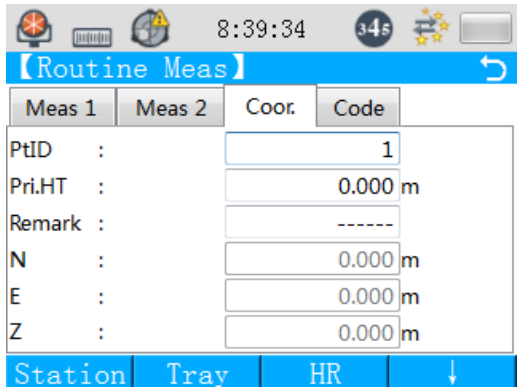
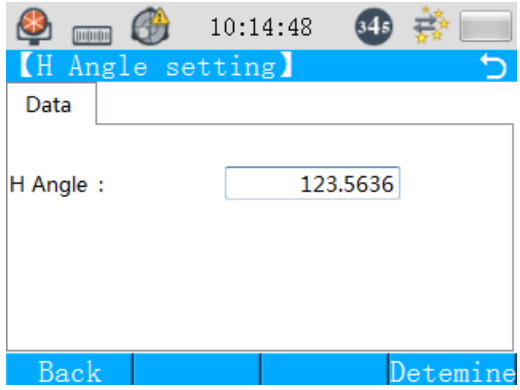
5.1.2 Horizontal angle measurement mode (right angle/left angle) switching

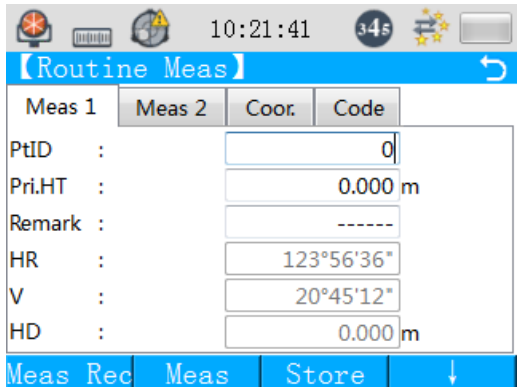
Procedure	Display

① Press and hold "F4" (↓ or ⏐←) until button "HR" appears. Press "F3" (HR) and it will switch from right angle mode to left angle mode of horizontal angle measurement.	
② Measure left angle in the way in which right angle is measured.	
● Each time "HR" is pressed, it will switch between right angle/left angle in turn.	

5.1.3 Setting of horizontal limb reading

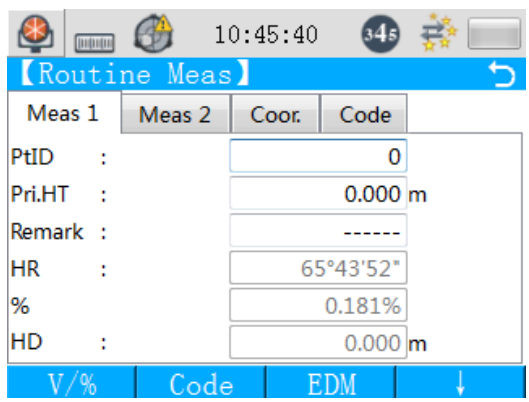
1）Setting with numeric keys

Procedure	Display
① Sight the target point for orientation.	
② Press and hold "F4" (↓ or ⏐←) until button "Tray" appears. Press "F2" (Tray). ③ Enter the required horizontal limb reading. ※ 1) Example: Enter 123.5636 and the horizontal limb is set to 123°56′36″.	

④ Press "F4" (Detemine). Now, you can proceed with normal angle measurement with orientation completed.	
※1) In the case of an input error, you can modify it or press "F1" (Back), re-enter the interface and input again.	

5.1.4 Vertical angle grad mode

Confirm the instrument is in angle measurement mode

Procedure	Display
① Press and hold "F4" (↓ or ｜←) until button "V/%" appears. Press "F1" (V/%) and the vertical angle will change from degree mode to grad mode. ※1)	
※1) Each time "V/%" is pressed, vertical angle display mode will switch in turn.	

5.2 Distance measurement

5.2.1 Laser type setting

Laser type and the constant setting are displayed below the distance measurement tag. For instance, when the constant is 0, reflector: S 0, non-prism: N 0, prism: P 0.

Under star key (★) mode, press F1 (laser type) to change laser type for measurement of the target .

① The laser types switch in the following sequence: prism distance measurement – non-prism distance measurement – reflector distance measurement.

② The chosen laser type will be saved even the instrument is shut down. Thus, next time the

instrument is started, you can directly enter the mode used last time.

③ Different laser types have different target constants. Hence, it shall be confirmed that the target type and the target constant are consistent when the target is changed.

1. Non-prism distance measurement

The range and accuracy of non-prism distance measurement depends on the laser emission conditions of the white surface perpendicular to the Kodak grey card. The range may also be affected by the target shape and its surrounding environment.

. Attention shall be paid to the following points when non-prism distance measurement is adopted: If distance measurement accuracy cannot be satisfied, reflector or prism shall be adopted for measurement.

. Do not stare at the laser during non-prism distance measurement; otherwise, it will hurt your eyes.

① When the laser goes to the target surface in a tilted manner, the measurement results may be inaccurate due to weakened or scattered laser.

② In the case of road surveying, the instrument may not get the correct results due to interference from reflected laser from the front and rear.

③ When measuring a slant target or ball or a rough target, the distance measured may become longer or shorter because the combined value is used for calculation.

④ When there are people or vehicles travelling back and forth in front of the target or there are tree branches, leaves or other objects swaying in front of the target, the instrument may not be able to receive the correct reflected signal and therefore cannot get the correct results.

2. Reflector distance measurement

. When measuring distance, reflecting surface of the reflector shall be perpendicular to the line formed by the instrument and the target and face toward the instrument. If angle of the reflector is not correct, the right distance may not be obtained due to scattered or weakened laser.

3. Actual measurement range of each laser type

. When a wrong laser type is chosen, you cannot get the correct distance. Hence, the right laser type must be selected.

. Reflecting prism distance measurement: reflector may also be used for distance measurement.

. Reflector and prism distance measurement: under this mode, distance measurement can be fulfilled without using the reflector or prism under specific conditions, such as: close range measurement or wall target. Nonetheless, there still will be certain error, so non-prism distance measurement shall be adopted.

. When reflector is used for distance measurement under prism mode or prism is used for distance measurement under reflector mode, special attention shall be paid to adopt the correct target constant and it shall be confirmed.

. For prism or reflector mode, the target distance must be longer than 1.6m, for ease of measurement.

5.2.2 Setting of meteorological correction, prism constant and non-prism constant

When setting meteorological correction, the temperature and air pressure must be measured, so as to calculate the meteorological correction value.

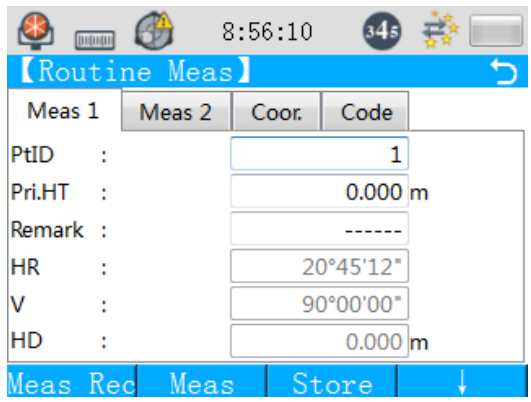
Setting of meteorological correction is performed under star key (★) mode. See "3.4 Meteorological correction setting".

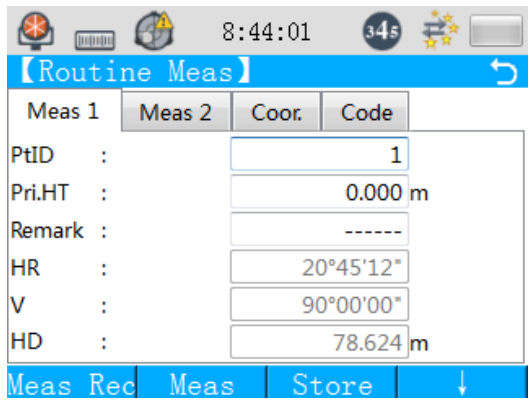
If prism constant of the prism used is -30, the prism constant shall be set to -30. Hence, the prism constant shall be preset based on the prism used in actual applications.

Prism constant setting is performed under star key (★) mode. See "3.3 Prism constant setting".

Non-prism constant setting is performed under calibration mode. See "3.1 Instrument constant setting".

5.2.3 Distance measurement (continuous)

<table>
<tr><th>Procedure</th><th>Display</th></tr>
<tr><td>① Sight prism center.</td><td> 
</td></tr>
<tr><td>② Press and hold "F4" (↓ or |←) until the button "Meas" appears. Press "F2" (Meas). ※1)

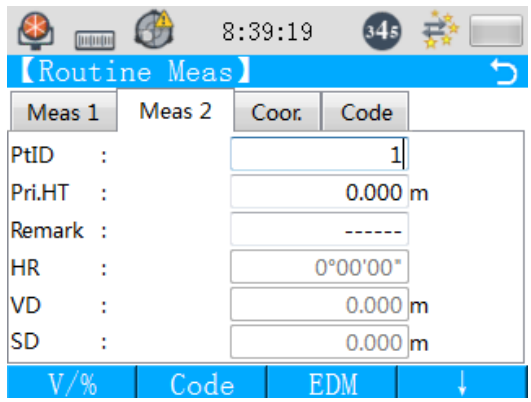
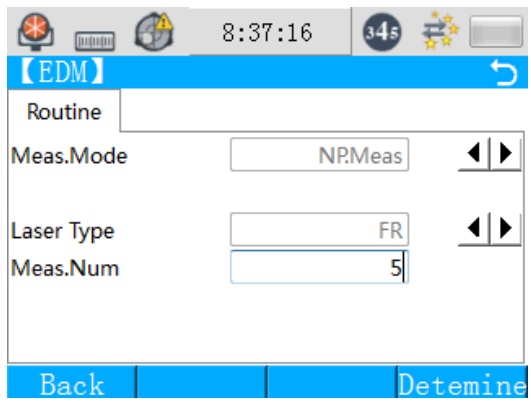
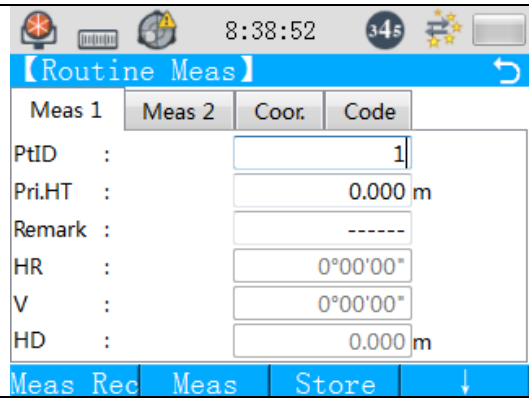
[Example]
The measurement results will be displayed. ※2）~※3)</td><td> 
</td></tr>
<tr><td colspan="2">※1) To change the measuring mode, press "EDM" to enter setting.
※2）Beeping will accompany the display of measurement results.
※3) Measurement will be automatically repeated if the results are affected by atmospheric refraction and other factors.</td></tr>
</table>

5.2.4 Distance measurement (N measurements)

When the number of measurements is set, the instrument will measure the distance for the set

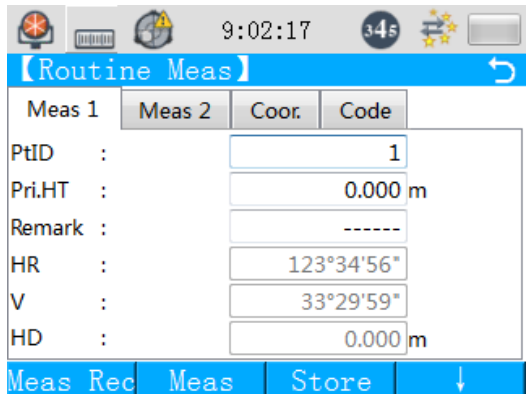
number of times. Factory default of the instrument is 1 measurement.

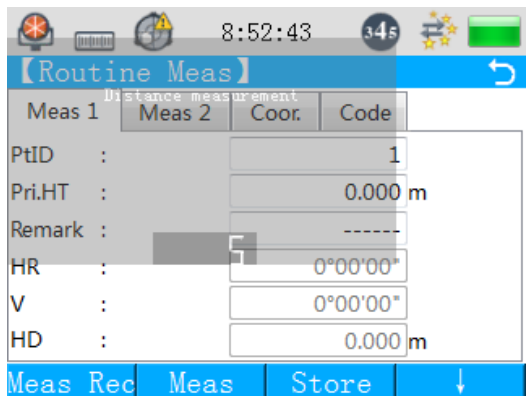
1) Setting of measurement number

Procedure	Display
① Press and hold "F4" (↓ or ↑) until the button "EDM" appears.	
② Press "F3" (EDM) to enter EDM setting interface. ③ You can enter a new measurement number.	
④ Press "F4" (Detemine) to save it and return to the previous menu.	

2) Measurement method

Procedure	Display

<table>
<tr><td>① Sight prism center.</td><td> 
</td></tr>
<tr><td>② Press and hold “F4” (↓ or ⏐←) until the button “Meas” appears. Press “F2” (Meas).

Example;
5 measurements start
Average distance, accompanied by beeping sound, is displayed and the screen shows the distance measurement progress interface. The figure “5” decreases by one and finally becomes 0, indicating the end of measurement. You can directly cancel the measurement by pressing “⮌”.</td><td> 
</td></tr>
<tr><td colspan="2">● When the measurement is over, press “F2” (Meas) and the measurement can be repeated.</td></tr>
</table>

5.2.5 Fine measurement/tracking mode

☆ Fine measurement mode: the normal distance measurement mode.

Measuring time: approx. 2s

Minimum display distance: 1mm

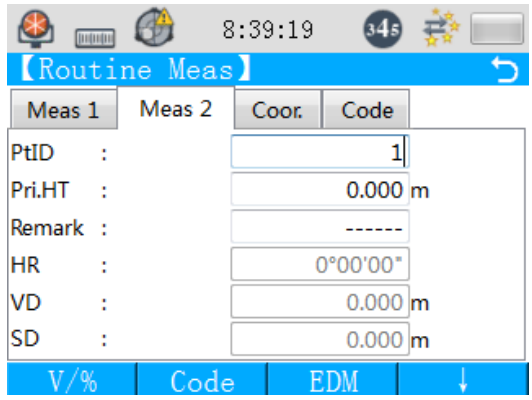
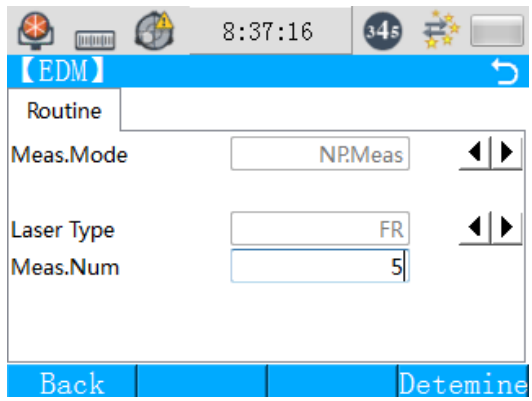
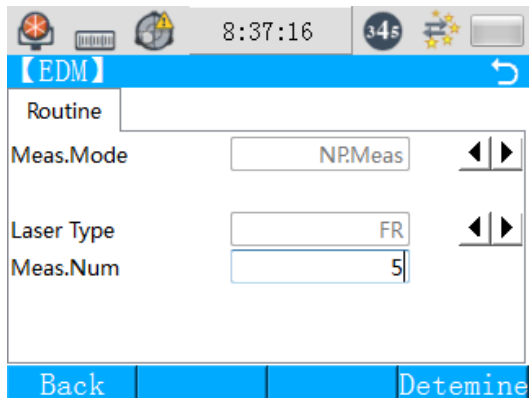
☆ Tracking mode: measuring time of this mode is shorter than that of fine measurement mode and it is mainly use for layout measurement. It is quite useful in tracking moving targets and engineering layout.

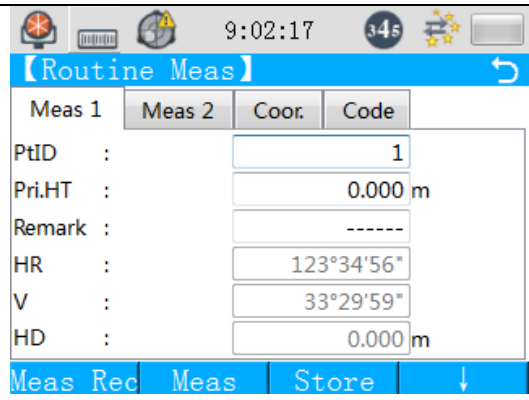
Measuring time: approx. 0.8s

Minimum display distance: 1mm

▶ Procedure

Procedure	Display

① Press and hold "F4" (↓ or ↑) until the button "EDM" appears.	
② Press "F3" (EDM) to enter EDM setting interface.	
③ EDM setting interface Press "◀|▶"in the row of Laser Type to switch between fine measurement or tracking mode. Press "◀|▶"in the row of Meas. Mode to change the laser type. ※1)	

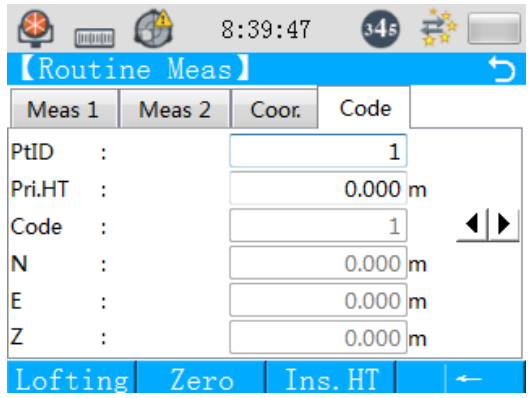
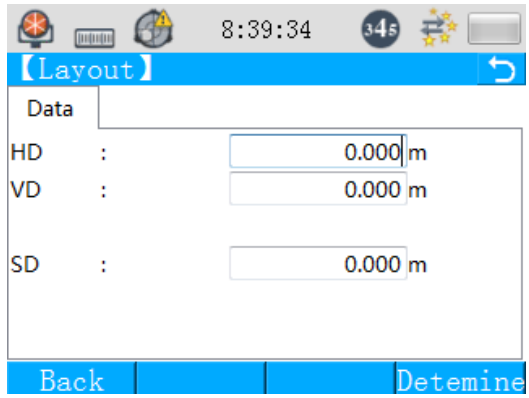
④ Press "F4" (Detemine) to save it and return to previous menu.	
※1) Each time the button is pressed, the laser type will change in turn.	

5.2.6 Lofting

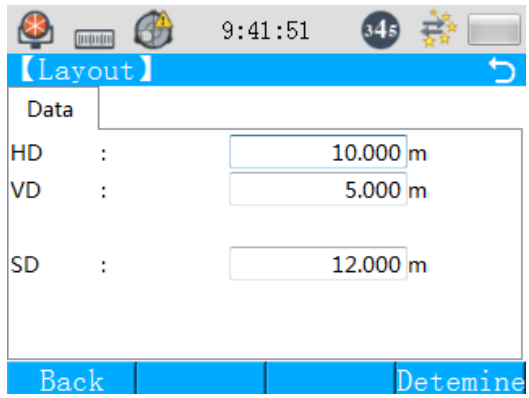
This function can displace the difference between measured distance and preset distance.

Displayed value = measured value – standard (preset) distance

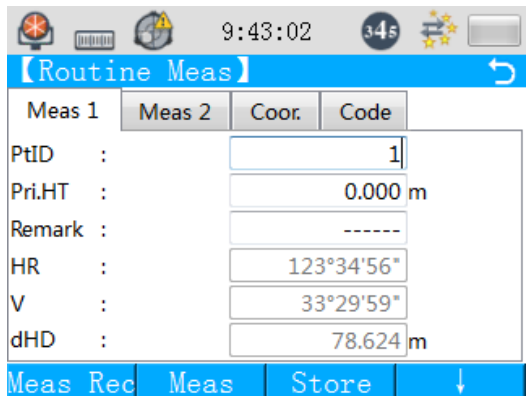
● It can achieve lofting for measurement modes of various distances, such horizontal distance (HD), elevation difference (VD) or slope distance (SD).

Procedure	Display
① Sight prism center.	
② Press and hold "F4" (↓ or | ←) until the button "Lofting" appears. Press "F1" (Lofting) to enter the layout setting interface.	

③ Enter the HD, VD and SD for the lofting and press "F4" (Detemine) to save the setting and return to previous menu.



④ Press and hold "F4" (↓ or |←) until the button "Meas" appears. Press "F1" (Meas) to start measuring.

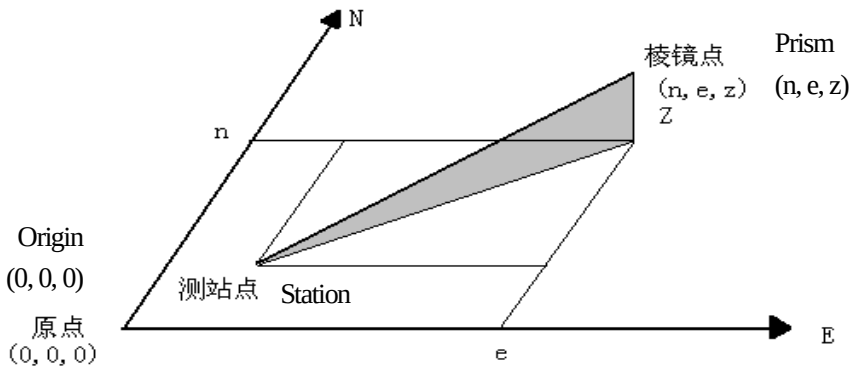


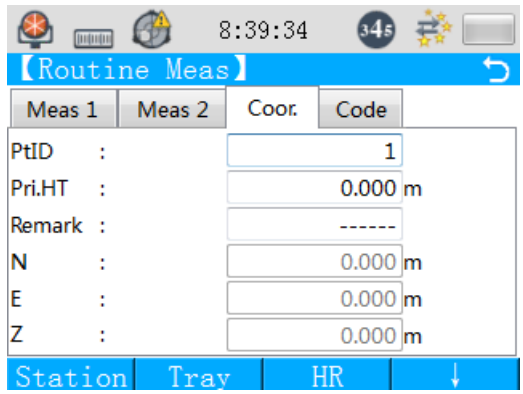
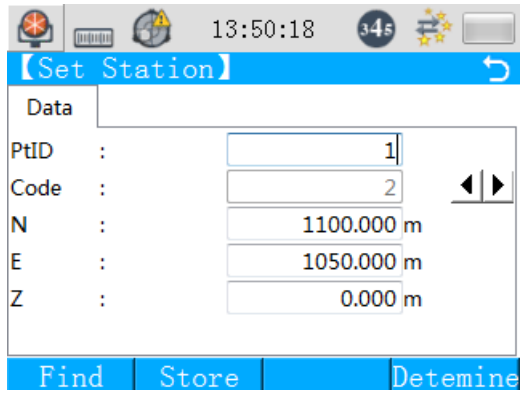
● Once the standard distance is again set to "0" or the instrument is shut down, it will return to normal distance measurement mode.

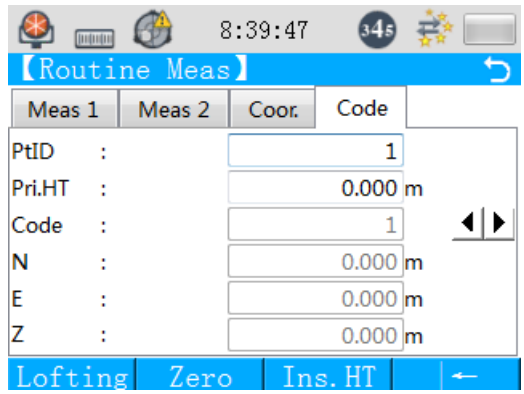
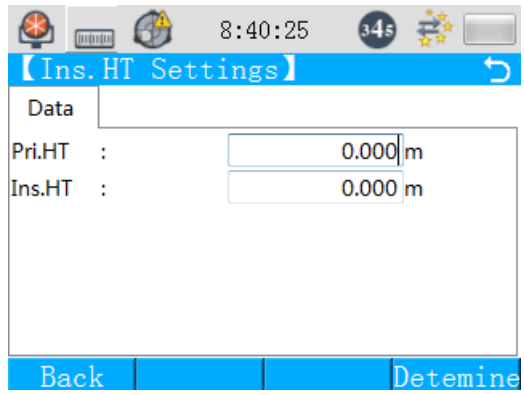
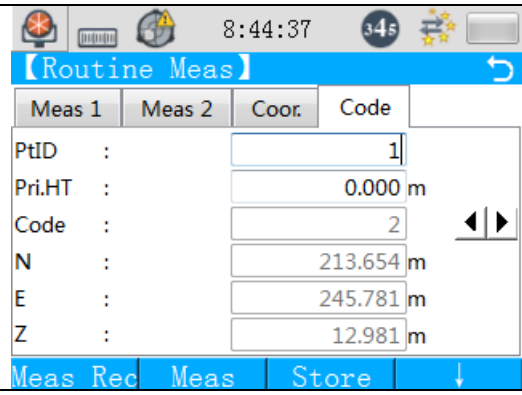
5.3 Coordinate measurement

5.3.1 Setting of station coordinate and instrument height

With station (instrument position) coordinate relative to the origin properly set, the instrument can determine coordinate of the unknown point (prism position).



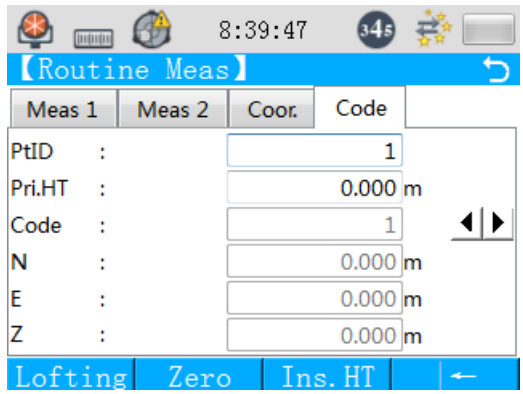
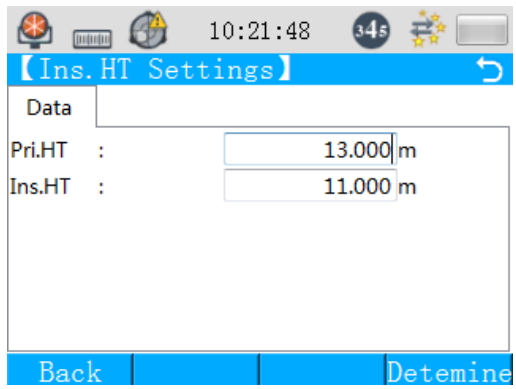
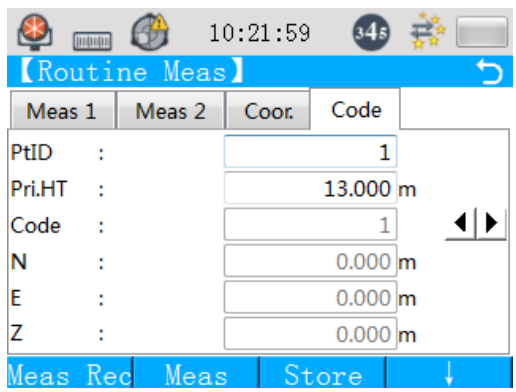
Procedure	Display
① Press and hold "F4" (↓ or |←) until the button "Station" appears. Press "F1" (Station).	
② Press "Station" to enter "Set Station". See "6.1.2 Orientation setting" for related operations.	

③ Press and hold "F4" (↓ or ←) until the button "Ins.HT" appears. Press "F3" (Ins.HT) to enter instrument height setting interface.	
④ Enter the instrument height.	
⑤ Press "F4" (Detemine) to save the settings and return to routine measurement interface. ⑥ Press and hold "F4" (↓ or ←) until the button "F2" (Meas) appears. ⑦ Press "F2" (Meas) to start coordinate measurement.	

5.3.2 Prism height setting

The prism height must be entered for coordinate measurement, so as to directly measure coordinate of the unknown point.

Procedure	Display

① Directly enter prism height into the "Pri.HT" field and press "OK" to confirm, or press and hold "F4" (↓ or ｜←) until the button "Ins.HT" appears and then press "F3" (Ins.HT) to enter prism height setting interface.	
② Enter prism height.	
③ Press "F4" (Detemine) to save the setting and return to routine measurement interface.	

5.3.3 Coordinate measurement operations

For coordinate measurement, it can directly determine coordinate of the unknown point with the station coordinate, instrument height and prism height that are entered.

- For station coordinate setting, see "6.1.2 Orientation setting".
- For instrument height and prism height setting, see "1.7.2 VD".
- The unknown point coordinate calculation and display process is as follows:

Station coordinates: (N0, E0, Z0)

Coordinate difference between instrument center and prism center: (n, e, z)

Coordinates of unknown point: (N1, E1, Z1)

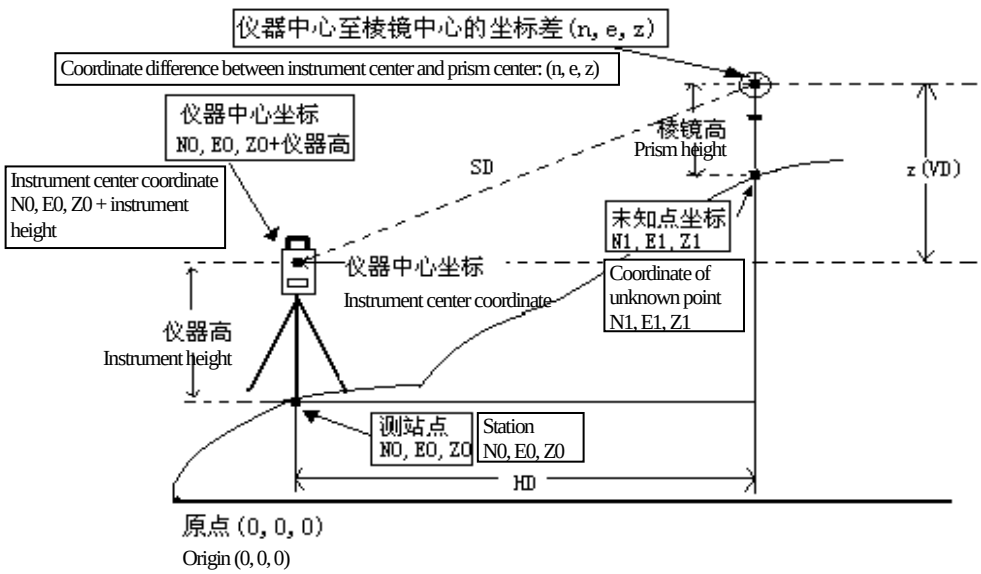
N1 = N0 + n

E1 = E0 + e

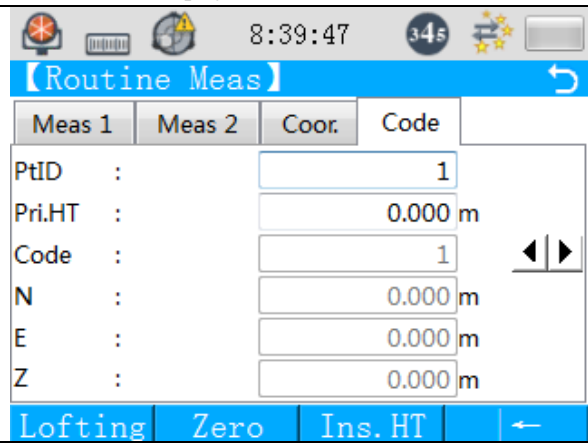
Z1 = Z0 + instrument height + z – prism height

N1 = N0 + n

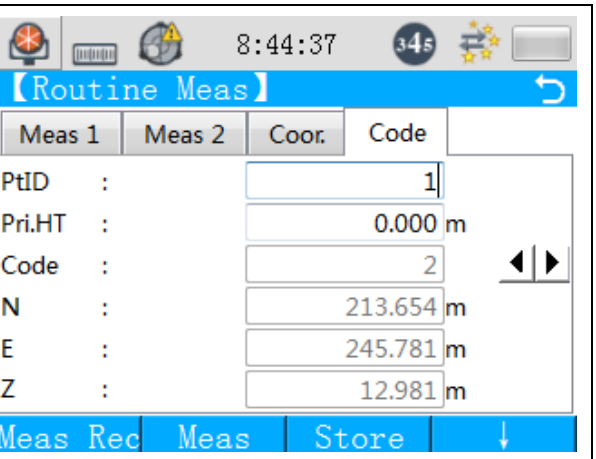
E1 = E0 + e



Confirm that it is in coordinate measurement mode

Procedure	Display
① Set station coordinate and instrument height/prism height. ※1) ② Set direction angle of fixpoint. ※2) ③ Sight the target point.	

④ Press and hold "F4" (↓ or ｜←) until the button "Meas" appears. Press "F2" (Meas) to display the measurement results. ※3)



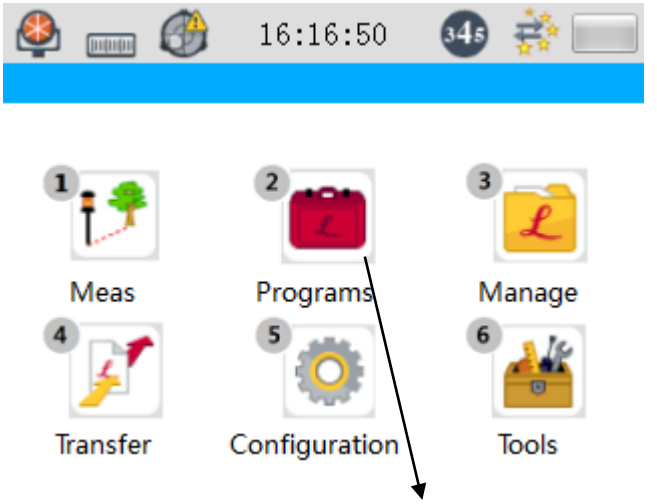
※1) If no station coordinate is set, the default value (0, 0, 0) will be used as station coordinate, or the set station coordinate (if any) will be used. If instrument height and prism height are not entered, 0 will be used as default.

※2) See "5.1.3 Setting of horizontal limb reading" or "6.1.2 Orientation setting".

※3) Press "EDM" and the distance measurement mode will be changed (single fine measurement/N measurements/repeated fine measurement/tracking measurement).

6 Programs mode (Applied measuring programs)

Press [2] or click "Programs".



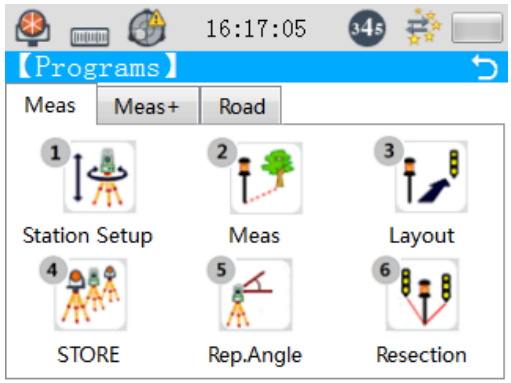
Programs mode (applied measuring programs)

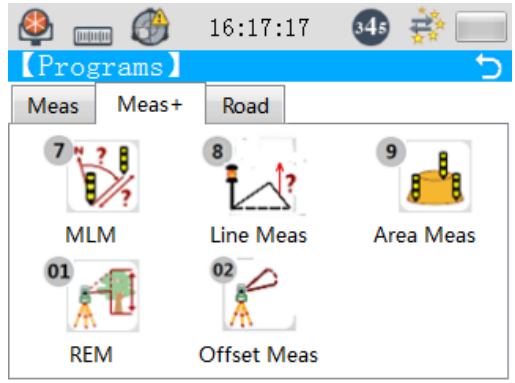
This mode covers the following items:

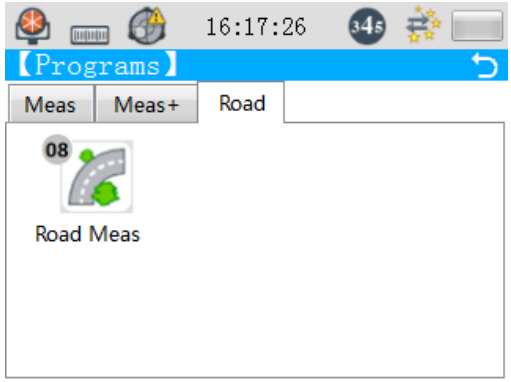
● Station setup

- Measurement
- Layout
- Traverse survey
- Repetition angle measurement
- Resection
- Missing line measurement
- Line measurement
- Area measurement
- Remote elevation measurement
- Offset measurement
- Road measurement

The menu lists all measuring programs installed in the instrument.

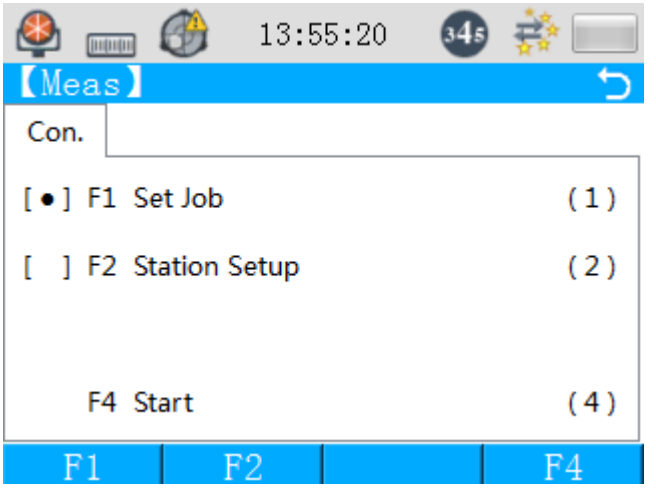






Preparation for program application:

Before starting a program, there is a procedure for setting station data (excluding road lofting). When the user selects a program, the set-up procedure dialog will appear. The user can set the contents of the set-up procedure one by one.



[●]: Item(s) already set

[ ]: Item(s) not set

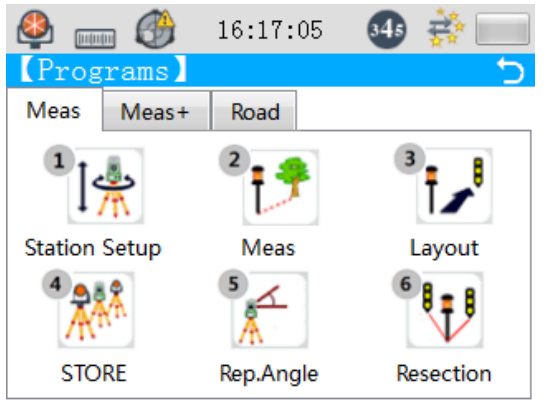
The following part will introduce the set-up procedure for each program in detail.

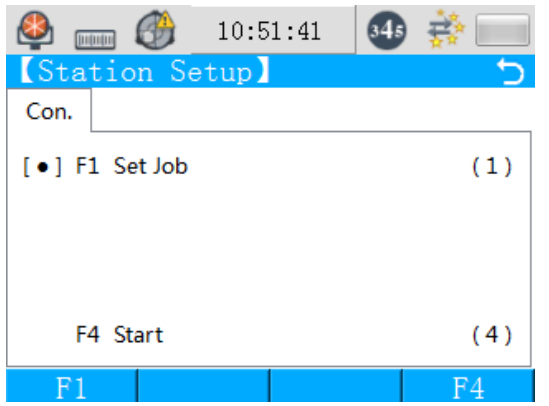
6.1 Station setup

(Select the job and enter the station and backsight point coordinates)

Display and select the job.

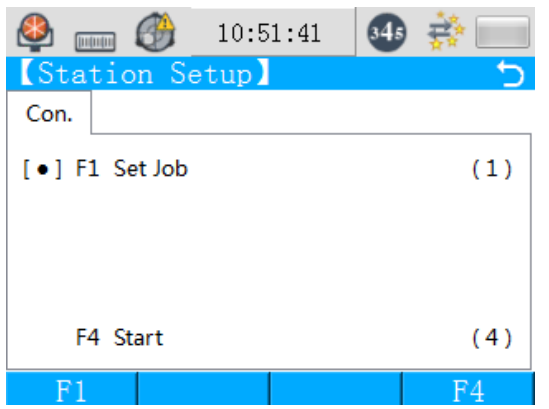
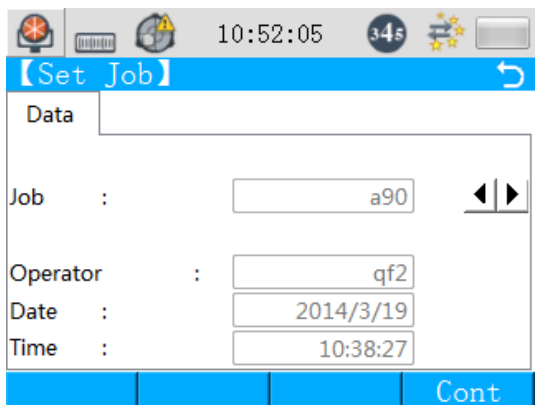
Display station coordinate and backsight point coordinate entry. With the coordinates entered, it can calculate the backsight orientation angle. If [Data Store] is set to [ON] under parameter mode, the station coordinate will be saved. See "9.3 Meas.Parameter".

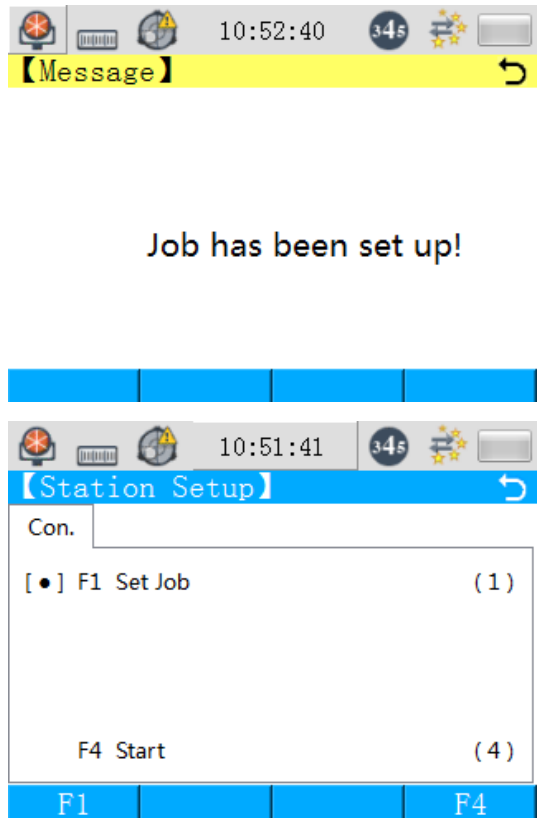
Procedure	Display
① Press "Meas" under Programs mode to reveal page 1 of the Programs interface. Press "⮌" to return to previous menu.	

② Press "Station Setup" or "1" to enter Station Setup interface.	

6.1.1 Select job

If there is an established job in the memory, it can be invoked and set as the current job. If no job is set, Wince total station will automatically save the data into DEFAULT job. See "7.1.2 New job" for creating new jobs.

Procedure	Display
① Enter the Station Setup interface. Press "⮌" to return to previous menu.	
② Press "F1" or "1" to enter job setting interface. ③ Press the button "◀ ▶" following "Job" to choose a job.	

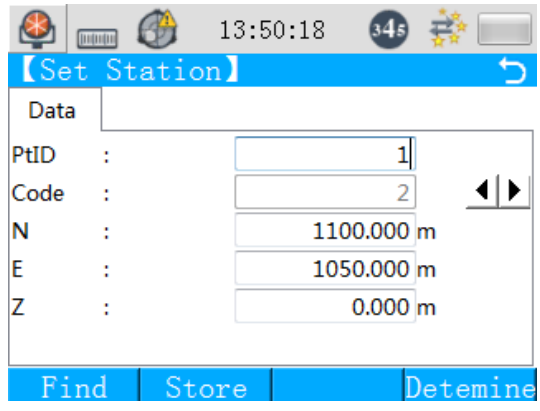
④ Press “F4” (Cont) to save the chosen job as the current job and return to the previous menu. Press “⮌” to cancel the selection and return to previous menu.	

6.1.2 Orientation setting

(Enter station and backsight point coordinates)

Display station coordinate and backsight point coordinate entry. With the coordinates entered, it can calculate the backsight orientation angle. If [Data Store] is set to [ON] under parameter mode, the station coordinate will be saved. See “9.3 Meas.Parameter”.

Example:

Procedure	Display
① Press “F4” or “4” to enter orientation setting interface from Station Setup interface.	

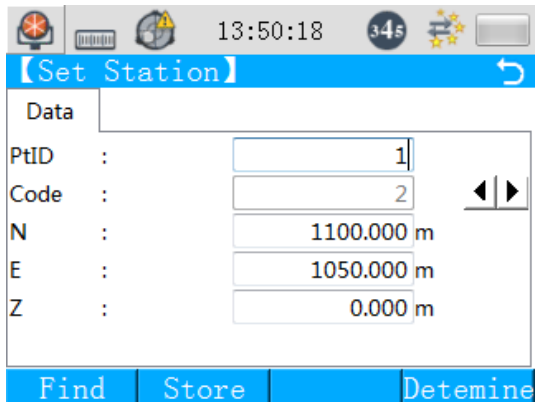
② Enter the station coordinate into the box and select the code; or, press "F1" (Find) to call the point coordinates stored in the coordinate data file in the memory and then operate as follows:

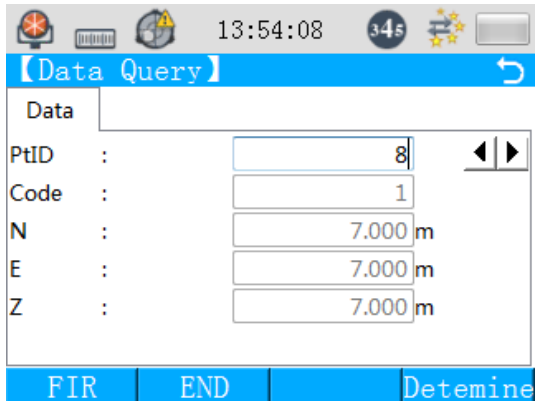
Press "F1" (FIR) to jump to the first point;

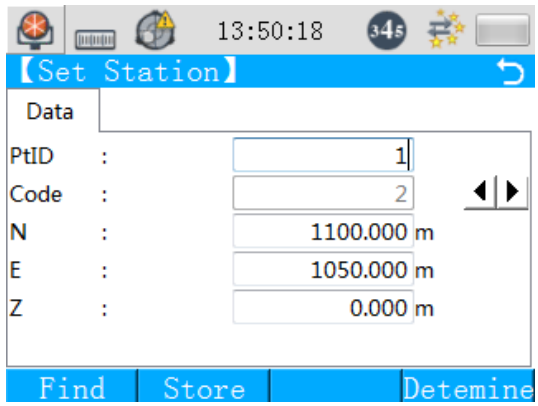
Press "F2" (END) to jump to the last point;

Press the button "◀|▶" following "PtID" to choose the point.

Press "F4" (Detemine) to confirm the point and return to previous menu, or press "⮌" to return to previous menu.

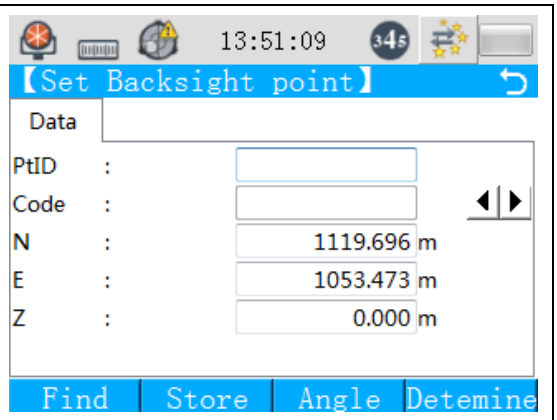






③ Press “Detemine” to enter “Set Backsight point”.

④ There are two ways to set the azimuth.



A: (enter station coordinate and backsight point coordinate to set the backsight orientation angle)

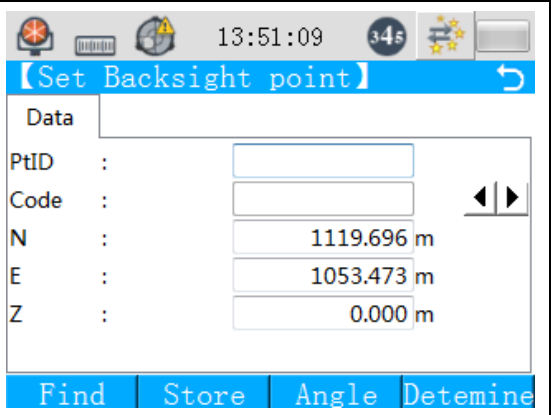
⑤ Enter the backsight point coordinate into the box and select the code; or, press “F1” (Find) to call the point coordinates stored in the coordinate data file in the memory and then operate as follows:

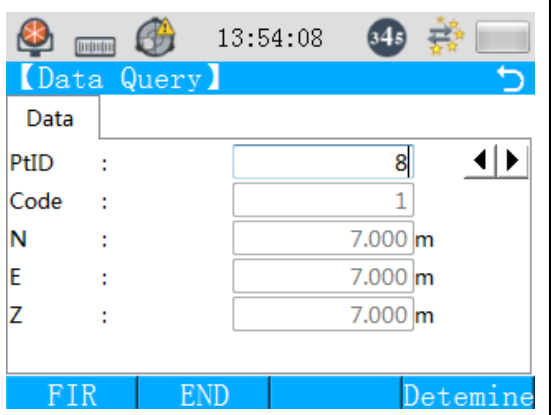
Press “F1” (FIR) to jump to the first point;

Press “F2” (END) to jump to the last point;

Press the button “◀ ▶” following “PtID” to choose the point.

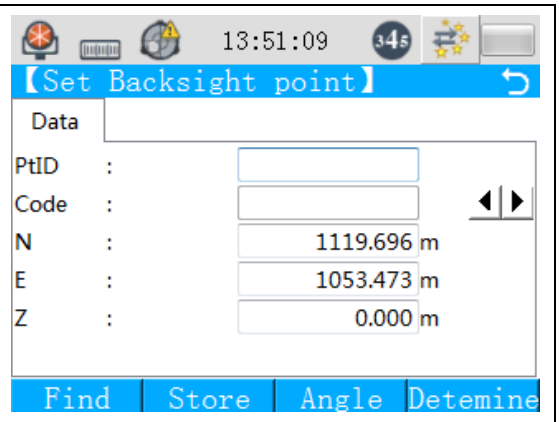
Press “F4” (Detemine) to confirm the point and return to previous menu, or press “⮌” to return to previous menu.

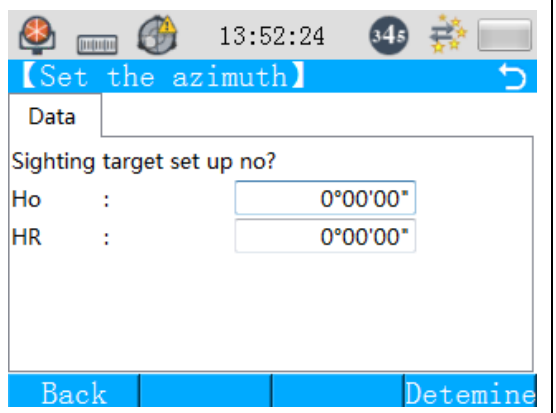




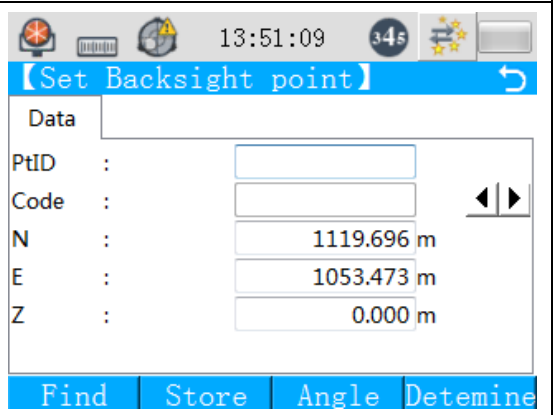
⑥ Press “F4” (Detemine) to enter “Set the azimuth”.

⑦ If the backsight point is correct, sight the backsight point and press “F4” (Detemine) to return.

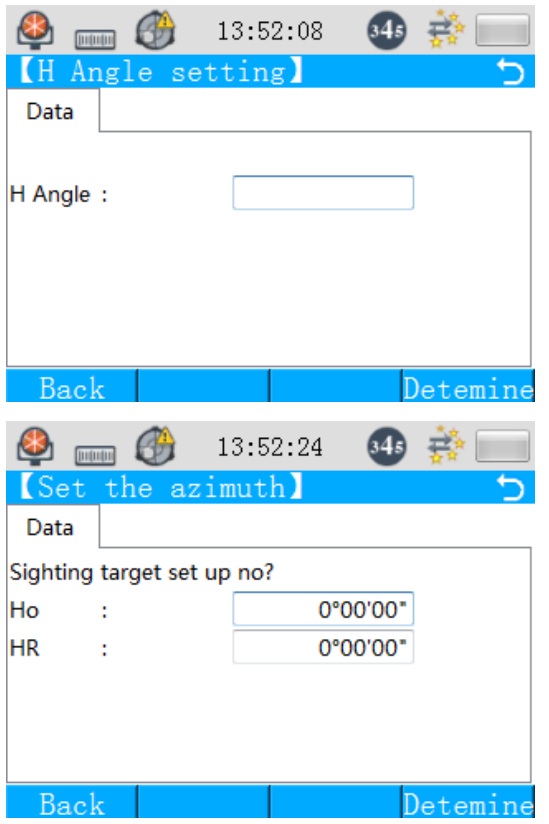




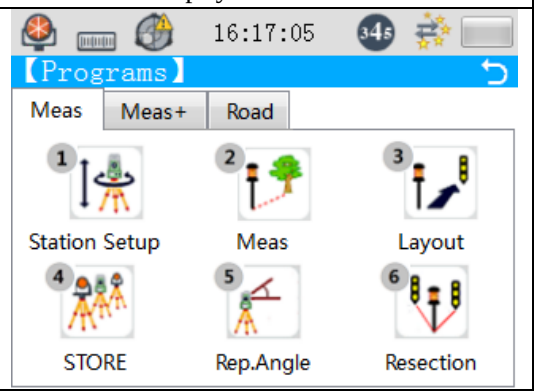
B: (enter station coordinate and azimuth to set the backsight orientation angle)



⑤ Press "F3" (Angle) to enter "H angle setting".

⑥ Enter H angle and press "F4" (Detemine) to enter "Set the azimuth". ⑦ If the backsight point is correct, sight the backsight point and press "F4" (Detemine) to return.	

6.2 Measurement

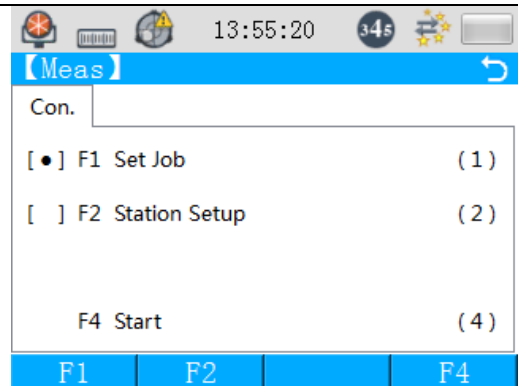
Procedure	Display
① Click "Meas" to reveal page 1 of the Programs interface. Press "⮌" and you can return to previous menu. ② Press "Meas" or "2" to enter measurement configuration interface.	

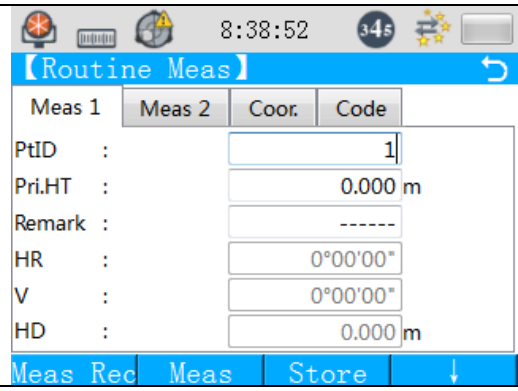
Press “F1” or (1) to set the job.

Press “F2” or (2) to set the station.

Press “⮌”to return to previous menu.

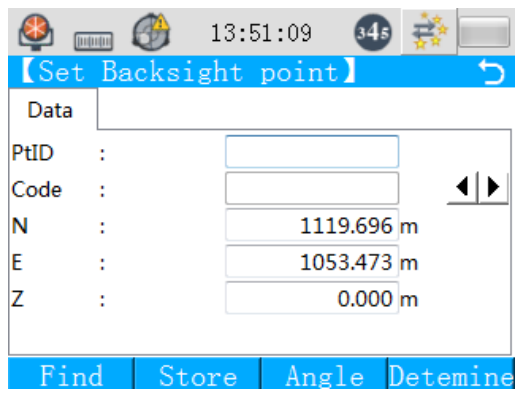
Station, azimuth, instrument height and prism height can be set in the measurement interface.

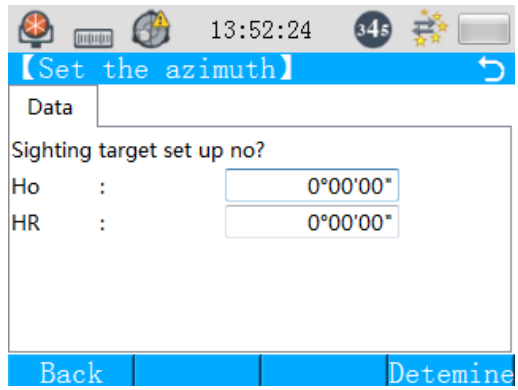
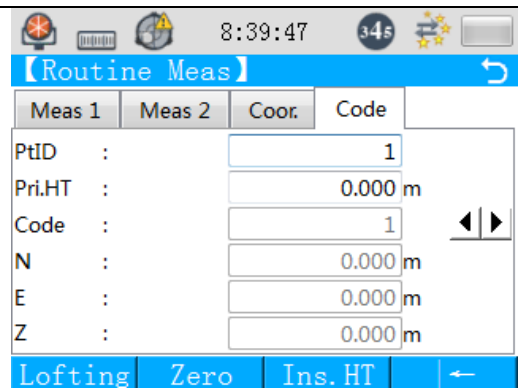


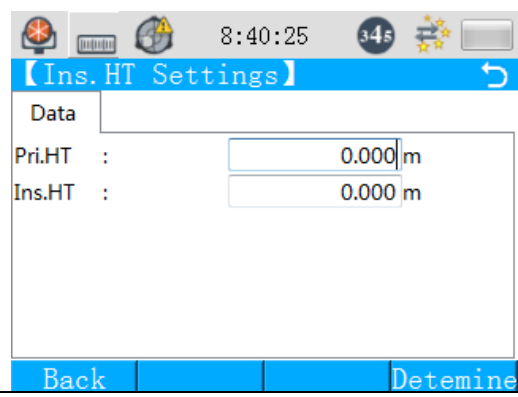


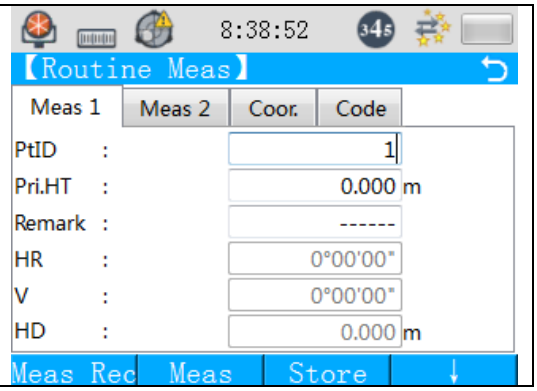
③ Set backsight point.

④ Sight backsight point, set the azimuth and press “F4” (Detemine) to return to previous interface.



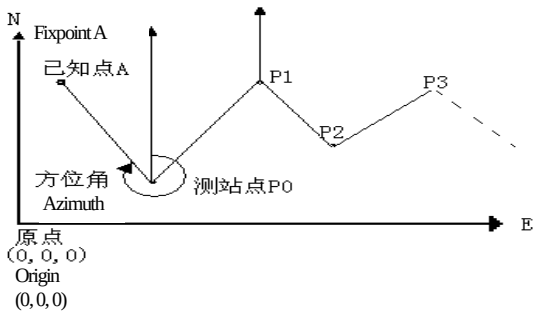
<table>
<tr>
<td></td>
<td> 
</td>
</tr>
<tr>
<td>⑤ To set prism height, press “F3” (Ins.HT) and enter prism height. Then press “F4” (Detemine) to save it and return to previous menu.</td>
<td> 


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

⑥ Press "F2" (Meas) to start distance and coordinate measurement. To record data measured this time, press "F3" (Store) to record data of the point.	

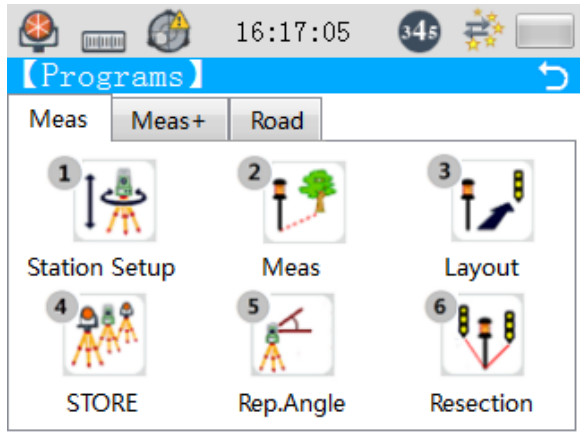
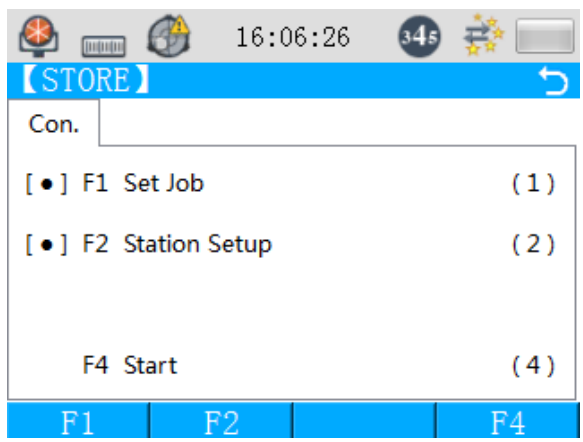
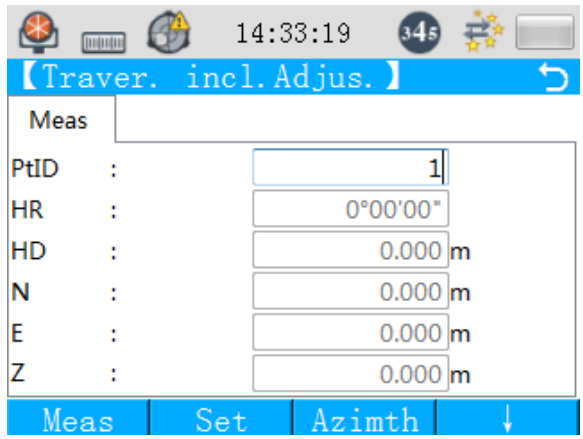
6.3 Traverse survey

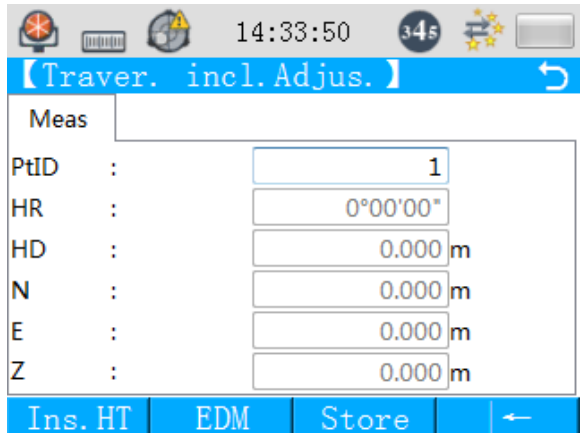
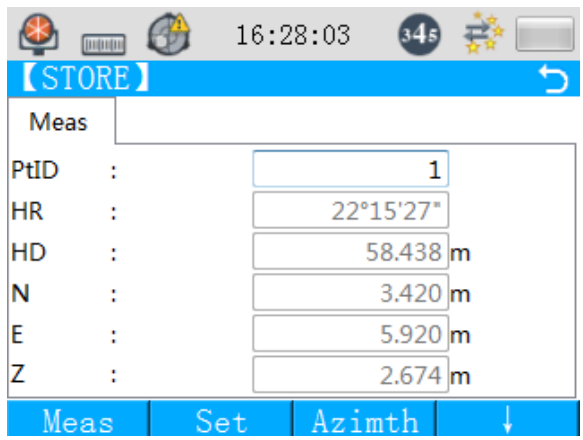
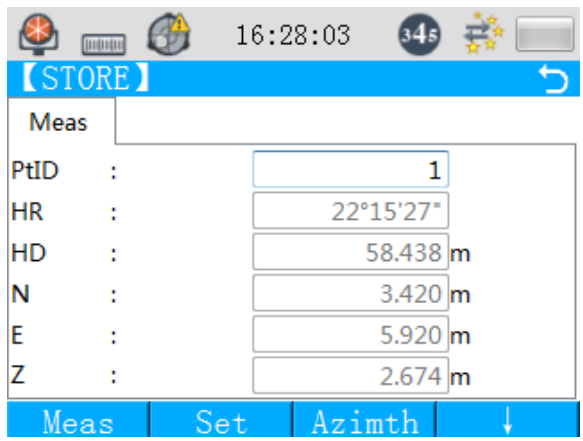
In this mode, the measured foresight point coordinate will be saved in the memory. When the user moves to the next station, the program will automatically use the previous station for the backsight orientation. When the instrument is moved to another station, erected and aimed at the previous station, it will show back azimuth of the backsight directed edge. If the station coordinate is not entered, it will be set to (0, 0, 0) or the last preset station coordinate will be used.

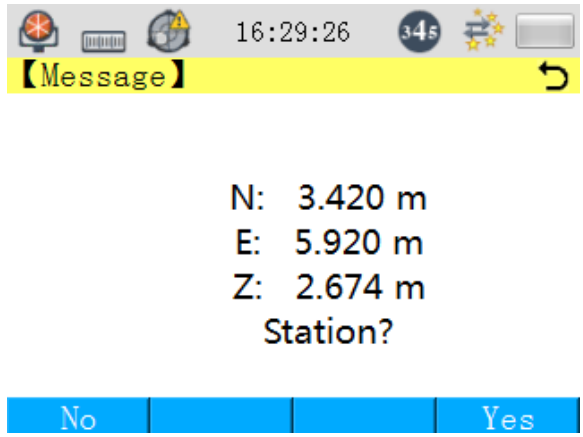
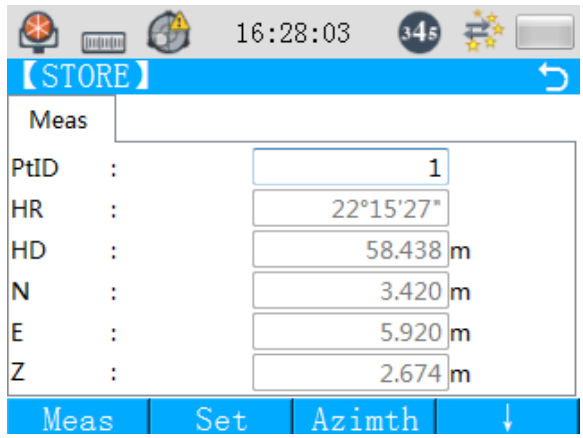
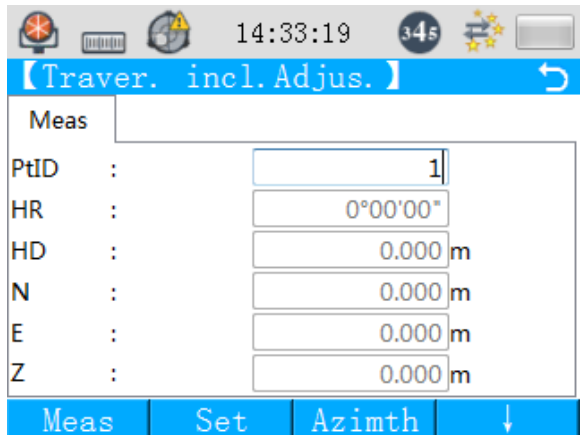


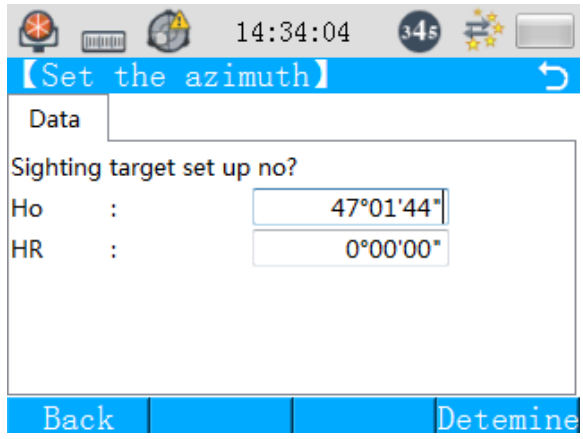
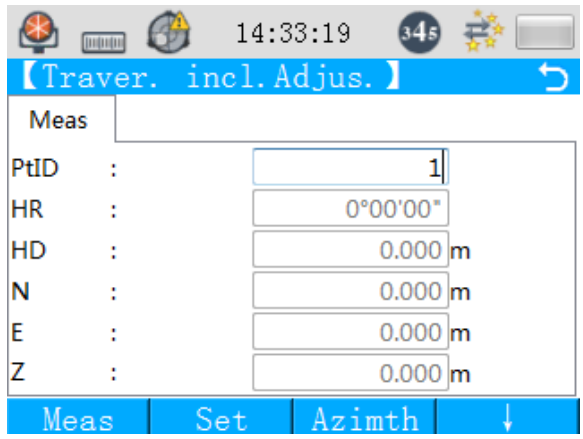
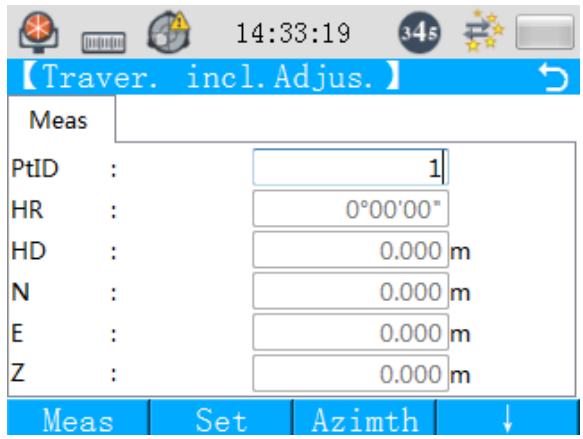
● Properly set coordinate of station P0 and azimuth between P0 and fixpoint A

Procedure	Display

① Under Programs mode, press "Meas" to reveal page 1 of the Programs interface. Press "⮌"to return to previous menu.	
② Press "STORE" or (4) to enter traverse survey configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌"to return to previous menu.	
③ Press "F4" or (4) to enter traverse survey interface. ④ Press and hold "F4" (↓ or |←) until the button "Ins.HT" appears. Press "F1" (Ins.HT) to reset instrument height or prism height. ⑤ Press and hold "F4" (↓ or |←) until the button "EDM" appears. Press "F2" (EDM) to reconfigure EDM.	

	
⑥ Sight foresight target point P1 prism. ⑦ Press and hold "F4" (↓ or |←) until the button "Meas" appears. Press "F1" (Meas) to start measuring.	
⑧ Display horizontal distance and horizontal angle.	

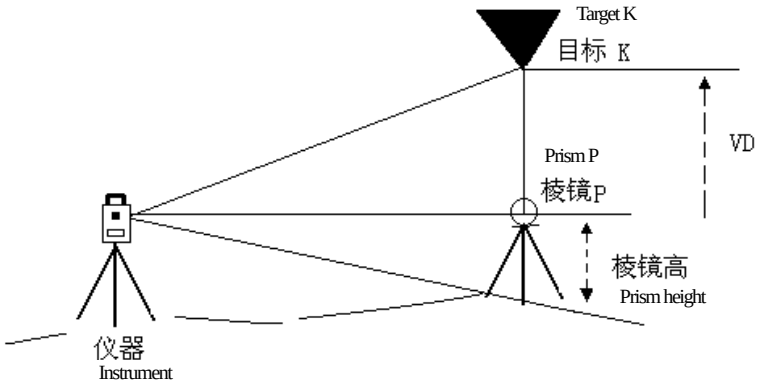
⑨ Press and hold "F4" (↓ or ↑) until the button "Set" appears. Press "F2" (Set) and coordinate of P1 and the question whether to set up the station will be displayed.	
⑩ Press "F4" (YES). Coordinate of P1 is set as the station.	
(11) Transfer the instrument to P1 and conduct leveling and centering.	

(12) Sight prism for previous instrument station P0. Press and hold "F4" (↓ or | ←) until the button "Azimuth" appears. Press "F3" (Azimuth).	
(13) Press "F4" (Detemine) and the azimuth between P1 and P0 is set.	
(14) Sight prism for foresight target point P2.	
(15) Repeat steps ⑦ ~(15) and the repeat count shall be determined as required.	

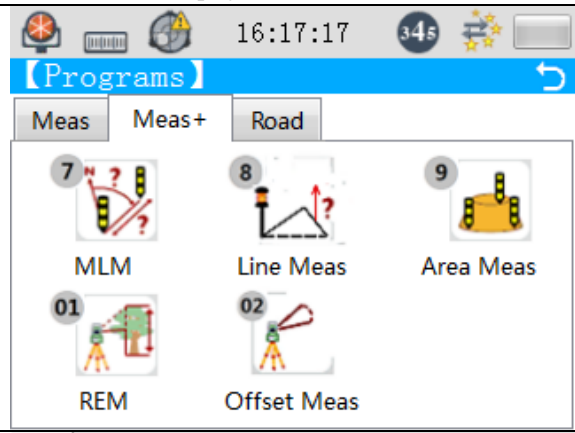
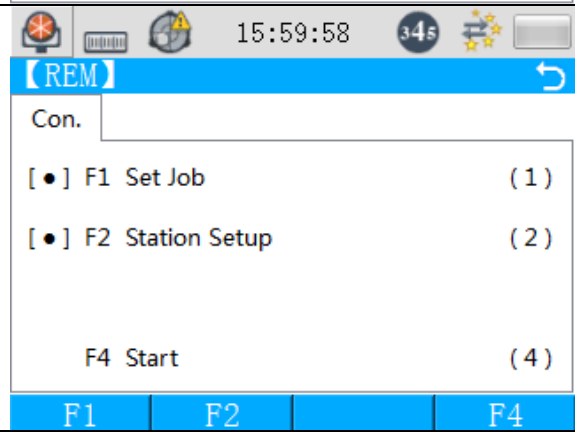
6.4 Remote elevation measurement

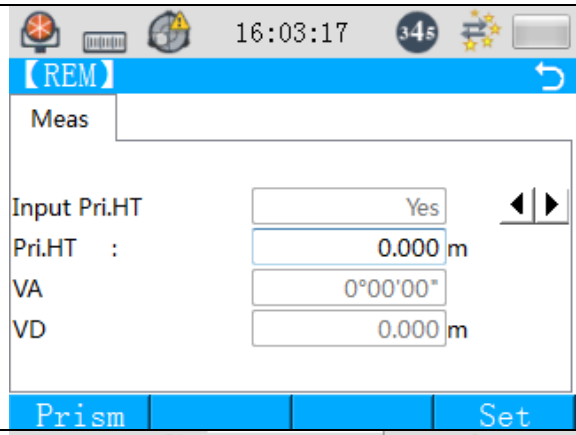
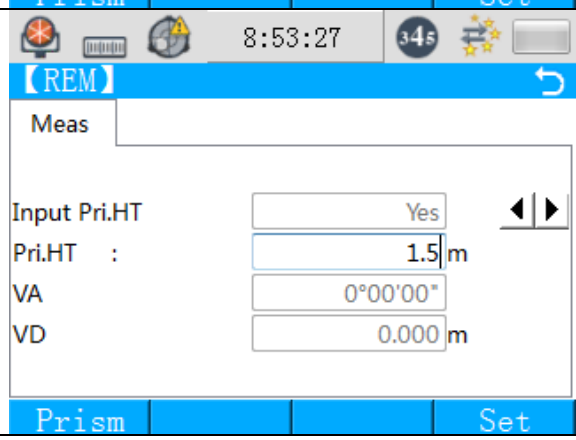
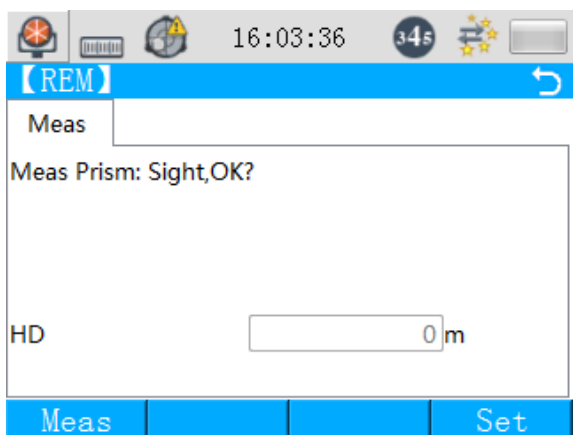
This program is intended for remote measurement of vertical distance (height) of target from the

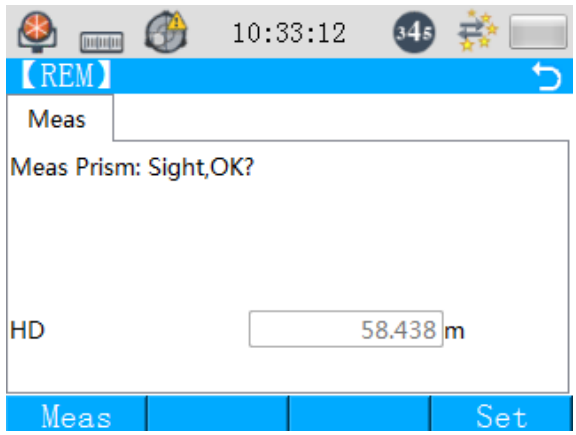
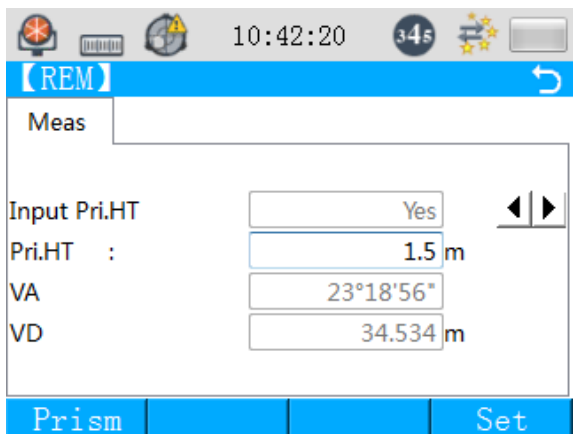
prism and its elevation from the ground (prism height not required). If prism height is used, the prism is taken as the base point for remote elevation measurement. When prism is not used, the ground point for vertical angle measurement will serve as the base point. Based points for the above two cases are both on the plumb line of the target point.



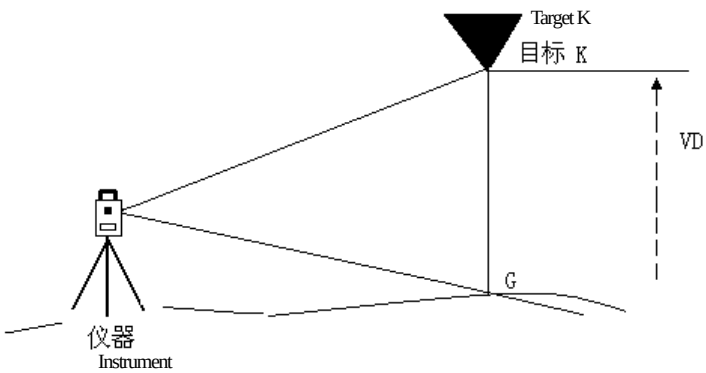
1) Enter prism height (h) (e.g.: h=1.5m)

Procedure	Display
① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "⮌"to return to previous menu.	
② Press "REM" or (0) and (1) to enter remote elevation measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌"to return to previous menu.	

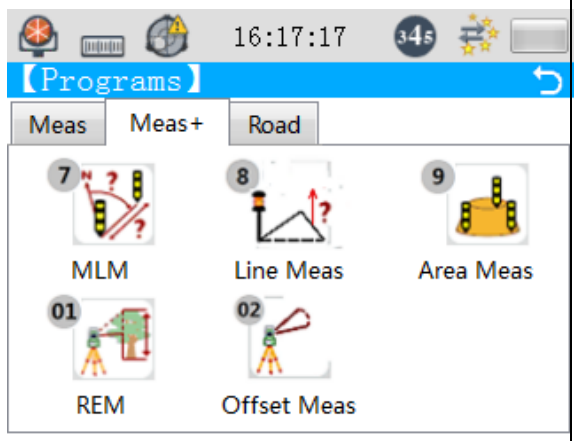
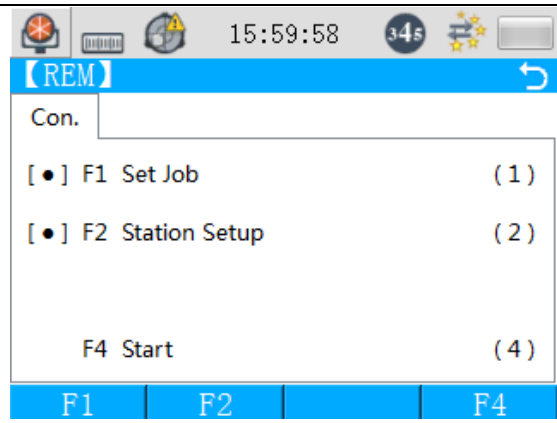
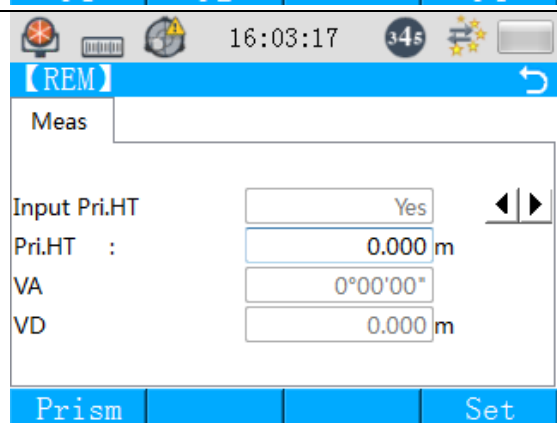
③ Press "F4" or (4) to enter remote elevation measurement interface.	
④ Press the button" ◀|▶ " following Input Pri.HT and select "YES". ⑤ Enter prism height into the field of Pri.HT and press "F4" (Set) to set the prism height.	
⑥ Sight prism P and press "F1" (Prism). ⑦ Press "F1" (Meas) to start measuring and the horizontal distance (HD) between instrument and prism will be displayed.	

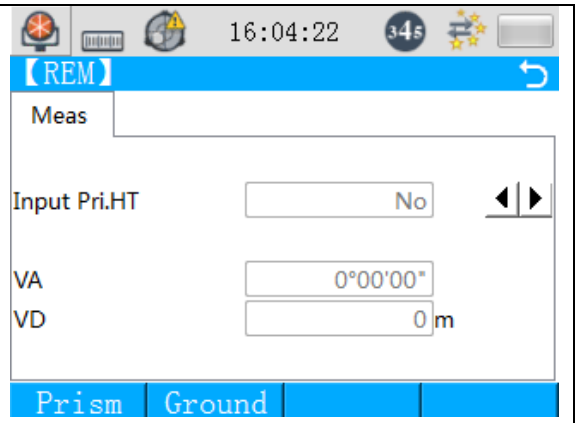
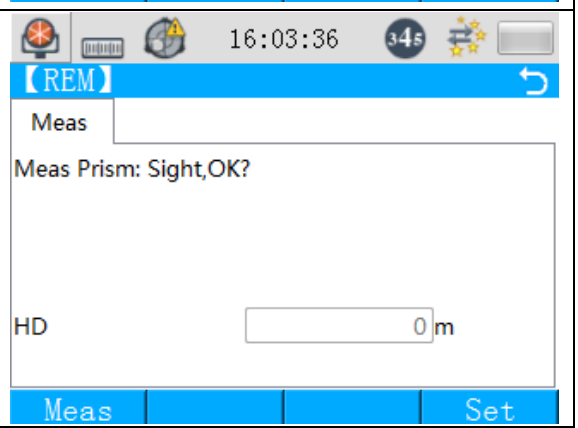
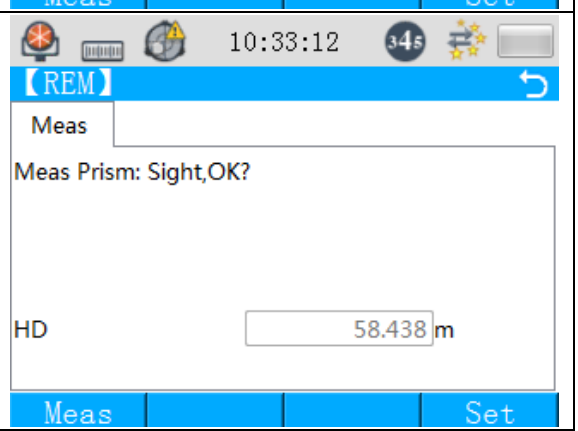
<table>
<tr><td></td><td> 
</td></tr>
<tr><td>⑧ Press “F4” (Set) to return to remote elevation measurement interface.
⑨ Sight target K and the vertical distance (VD) will be displayed. ※1)</td><td> 
</td></tr>
<tr><td colspan="2">※1) Press “⮌”to return to previous menu.</td></tr>
</table>

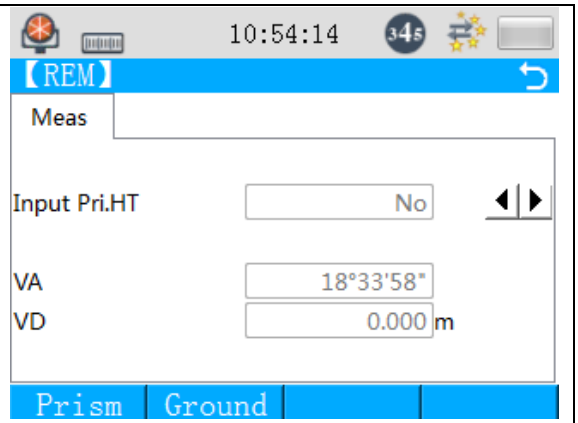
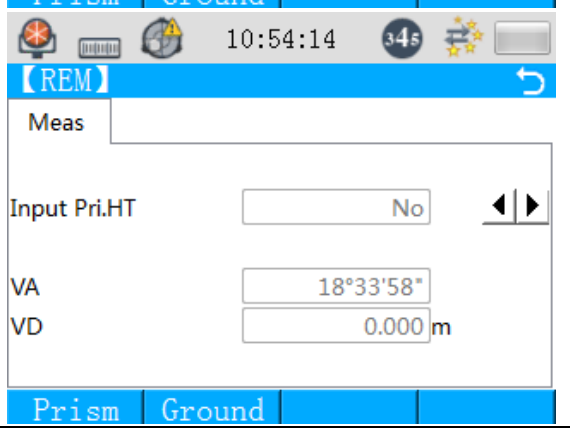
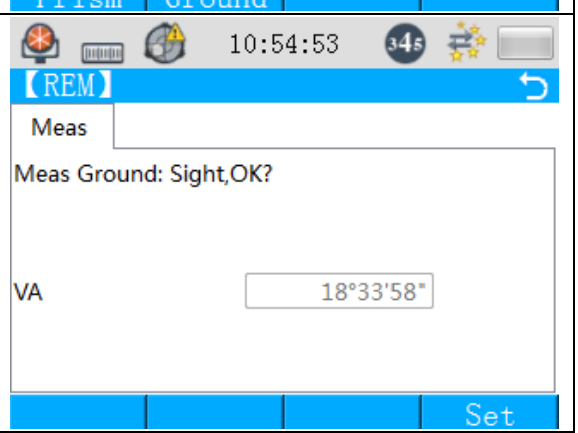
1) No prism height entered

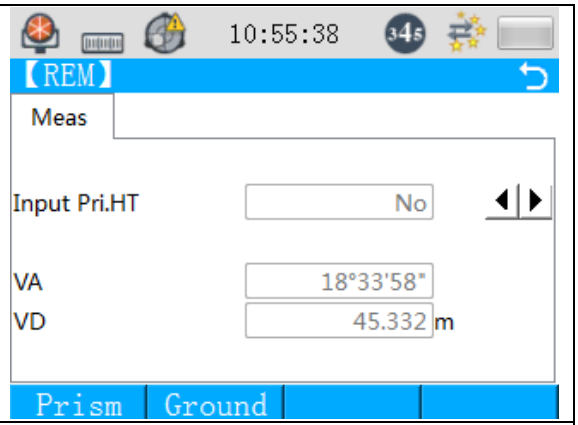


Procedure	Display

① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "⮌"to return to previous menu.	
② Press "REM" or (0) and (1) to enter remote elevation measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌"to return to previous menu.	
③ Press "F4" or (4) to enter remote elevation measurement interface.	

④ Press the button“◀▶” following Input Pri.HT and select “NO”.	
⑤ Sight prism P and press “F1” (Prism).	
⑥ Press “F1” (Meas) to start measuring and the horizontal distance (HD) between instrument and prism will be displayed.	

⑦ Press “F4” (Set) to return to remote elevation measurement interface and the prism position is determined.	 
⑧ Sight ground point G and press “F2” (Ground). ※1) ⑨ Press “F4” (Set) and the position of G is determined. ※1)	

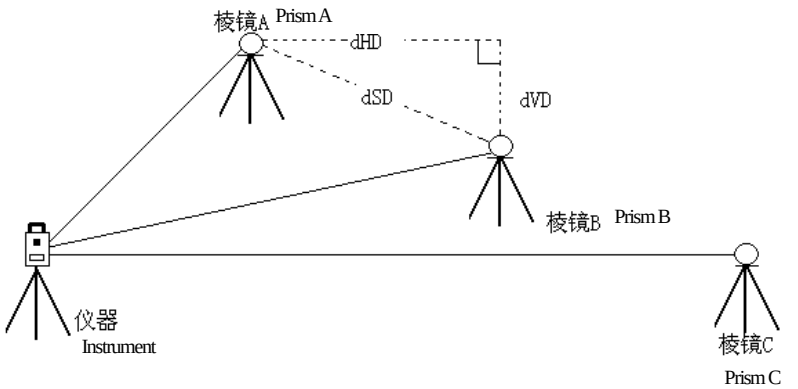
⑩ Sight target K. The vertical distance (VD) will be displayed. ※1)	
※1) Press "⮌" to return to previous menu.	

6.5 Missing line measurement

Horizontal distance (dHD), slope distance (dSD) and elevation difference (dVD) between two prisms can be measured.

Missing line measurement mode has two functions:

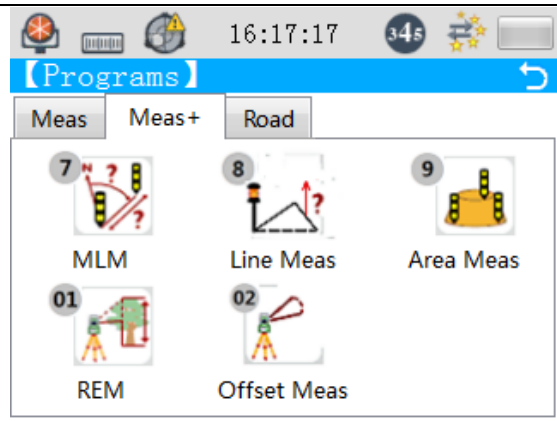
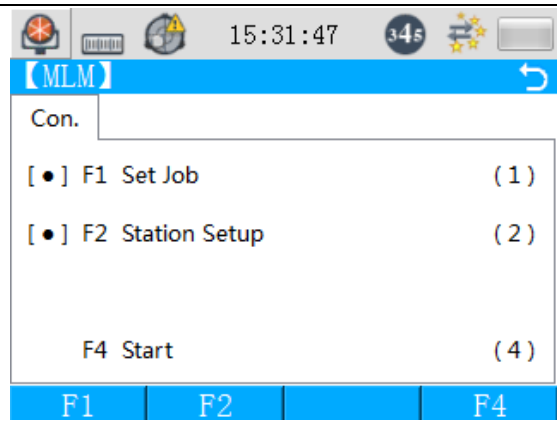
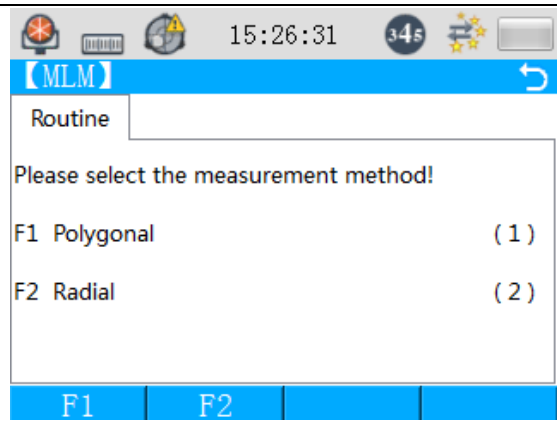
1. (A-B, A-C): to measure A-B, A-C, A-D……
2. (A-B, B-C): to measure A-B, B-C, C-D……



[Example] 1. (A-B, A-C)

- **Measurement procedure for 2. (A-B, B-C) is the same as that for 1. (A-B, A-C).**

Procedure	Display

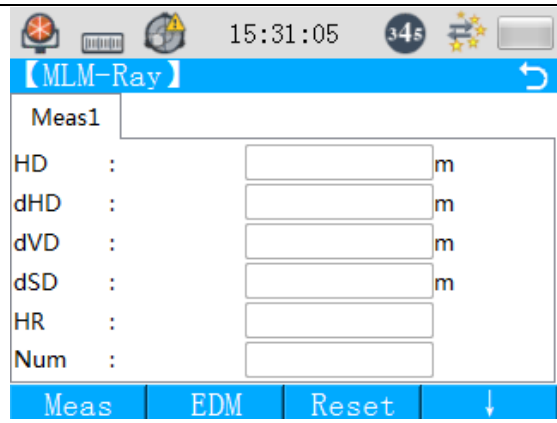
① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "↩"to return to previous menu.	
② Press "MLM" or (7) to enter missing line measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "↩"to return to previous menu.	
③ Press "F4" or (4) to enter missing line measurement method selection interface.	

④ Press “F2” or (2) to enter missing line measurement interface.

In missing line measurement interface:

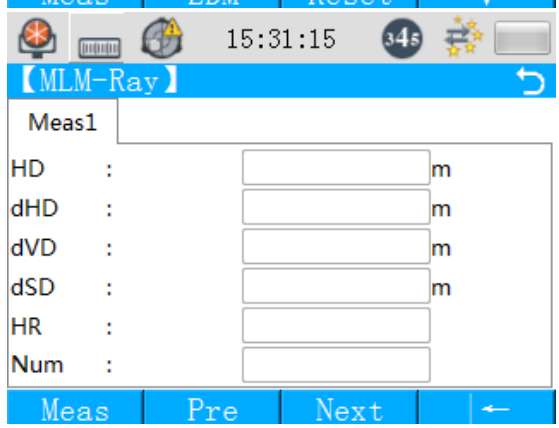
Press and hold “F4” (↓ or |←) until the button “EDM” appears. Press “F2” (EDM) to enter EDM setting interface to configure EDM.

Press and hold “F4” (↓ or |←) until the button “Reset” appears. Press “F3” (Reset) and you can reset missing line measurement.

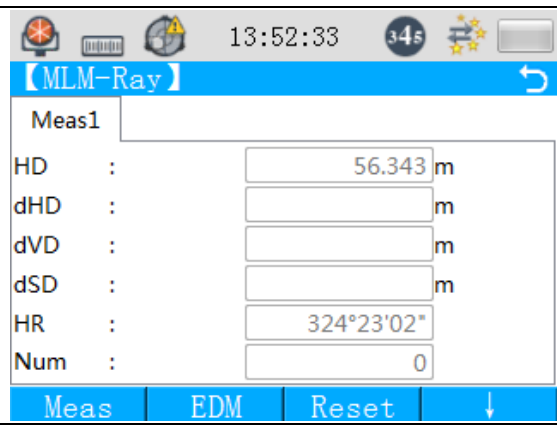


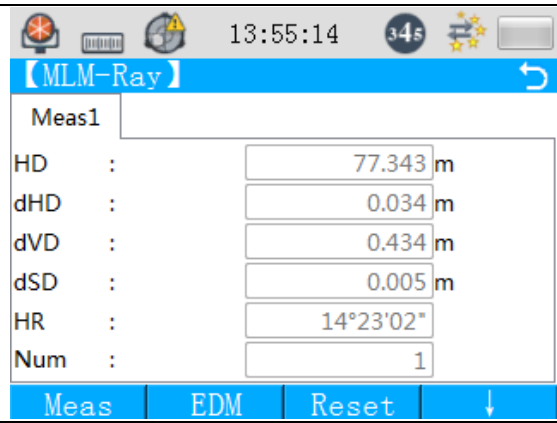
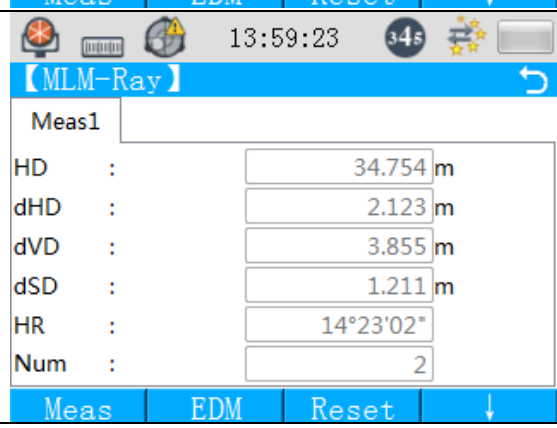
Press and hold “F4” (↓ or |←) until the button “Pre” appears. Press “F2” (Pre) and you can check the previous missing line measurement result until the first missing line measurement result.

Press and hold “F4” (↓ or |←) until the button “Next” appears. Press “F3” (Next) and you can check the next missing line measurement result until the last missing line measurement result.



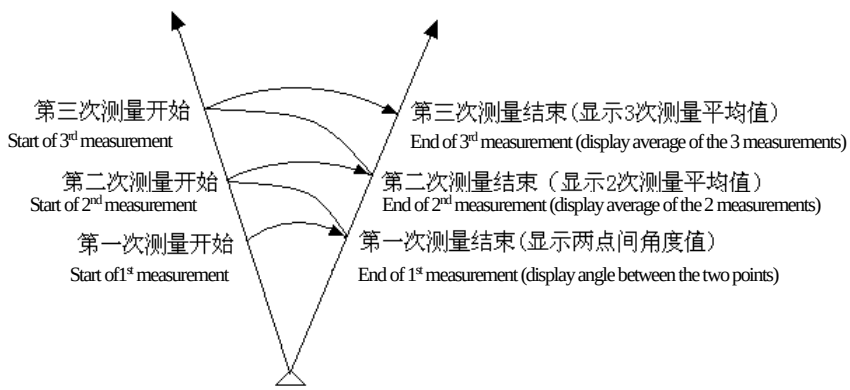
⑤ Sight prism A and press “F1” (Meas). The horizontal distance between instrument and prism A will be displayed.

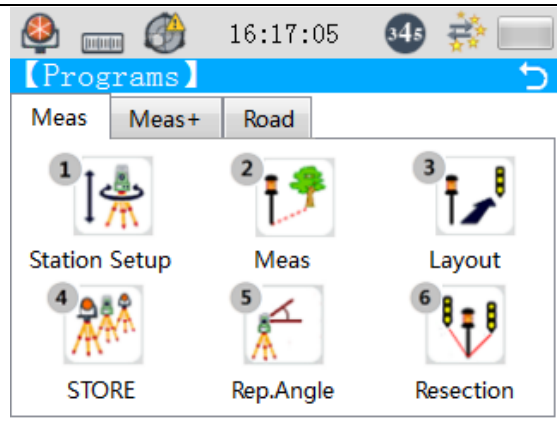
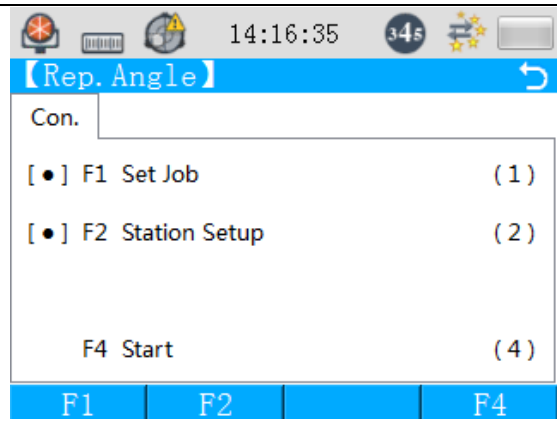
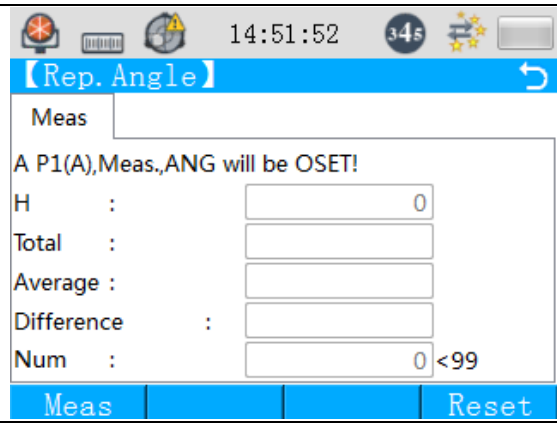


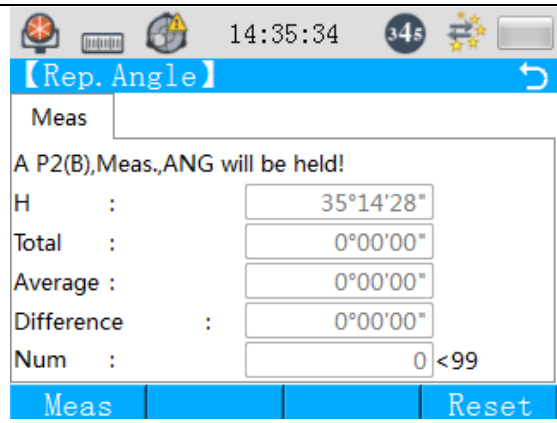
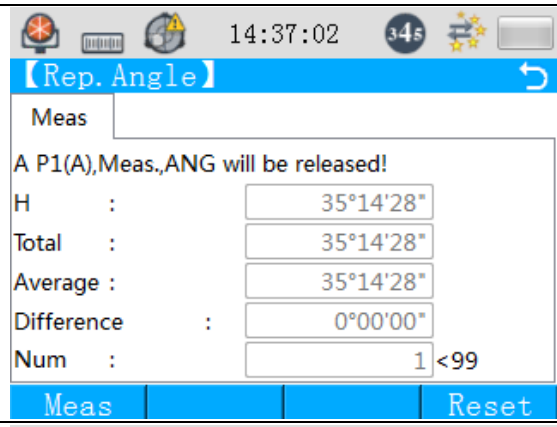
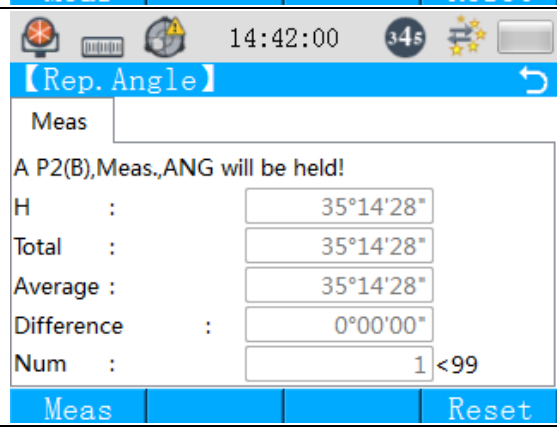
⑥ Sight prism B and press "F1" (Meas). The horizontal distance between instrument and prism B as well as horizontal distance (dHD), elevation difference (dVD) and slope difference (dSD) between prism A and prism B will be displayed.	
⑦ To measure distance between point A and point C, sight prism C and press "Meas". Then, the horizontal distance between instrument and prism C as well as horizontal distance (dHD), elevation difference (dVD) and slope difference (dSD) between prism A and prism C will be displayed.	
● Press "⮌" to return to previous menu.	

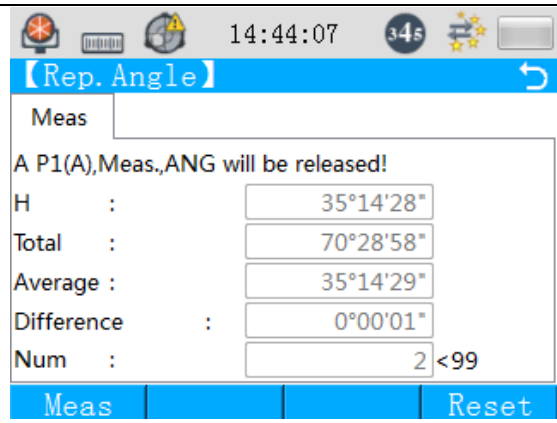
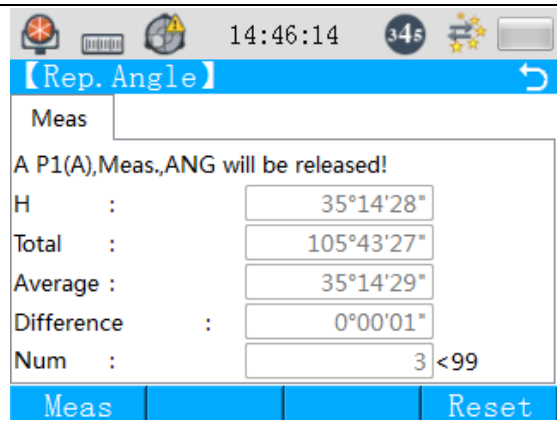
6.6 Repetition angle measurement

This program is intended for cumulative repeated angle measurements, display the sum of angle measurements and average value of all angle measurements and record the number of measurements.



Procedure	Display
① Under Programs mode, press "Meas" to reveal page 1 of the Programs interface. Press "⮌" to return to previous menu.	
② Press "Rep.Angle" or "5" to enter repetition angle measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌" to return to previous menu.	
③ Press "F4" or (4) to enter repetition angle measurement interface. In repetition angle measurement interface: Press "F3" (Reset) to reset repetition angle measurement.	

④ Sight the first target A; press "F1" or (Meas) and the angle will be set to zero.	
⑤ Sight the second target B with horizontal clamp screw and horizontal tangent. Press "F1" or (Meas) and the angle will be held.	
⑥ Sight the first target A again with horizontal clamp screw and horizontal tangent. Press "F1" or (Meas) and the angle will be released.	

⑦ Sight the second target B again with horizontal clamp screw and horizontal tangent. Press "F1" or (Meas) and the angle will be held. The angle total, average angle and angle difference will be displayed.	 二倍的角度值 Two times the angle
⑧ Repeat steps ⑥ and ⑦, as required, to conduct repetition angle measurement.	 三倍的角度值 Three times the angle
● Press "⮌" to return to previous menu.	

6.7 Coordinate layout

The layout program can calculate the layout elements based on layout point coordinate or manually entered angle, horizontal distance and height and the layout difference will be continuously displayed.

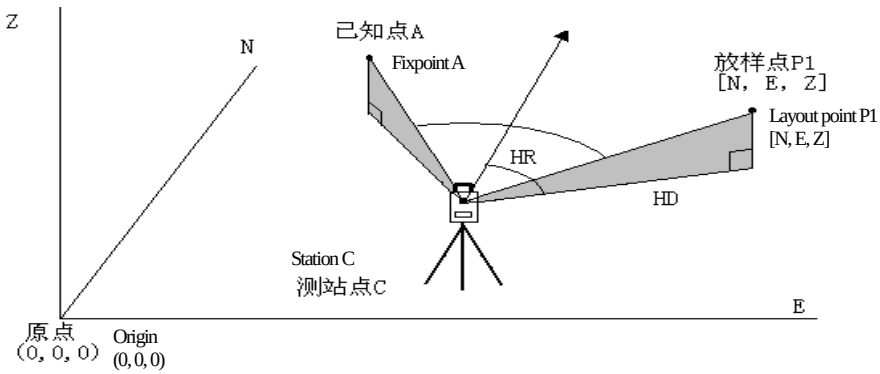
Layout procedure:

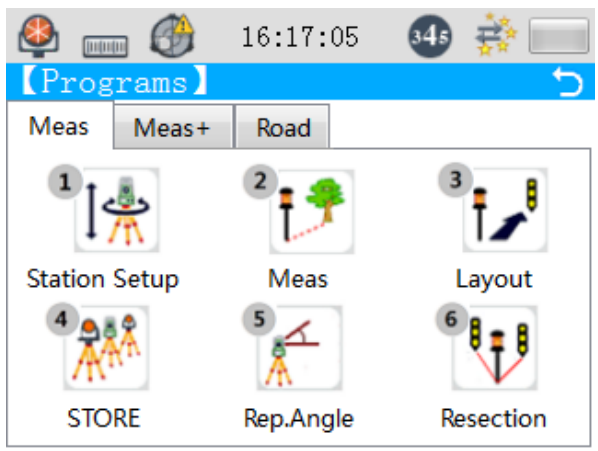
1. Job setting
2. Station setup
3. Backsight azimuth setting
4. Extract coordinates from the memory and the coordinates here can be either measured or coordinates of a fixpoint that have been entered.

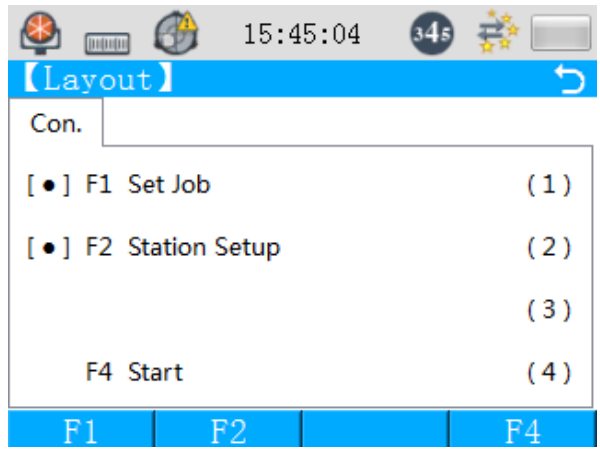
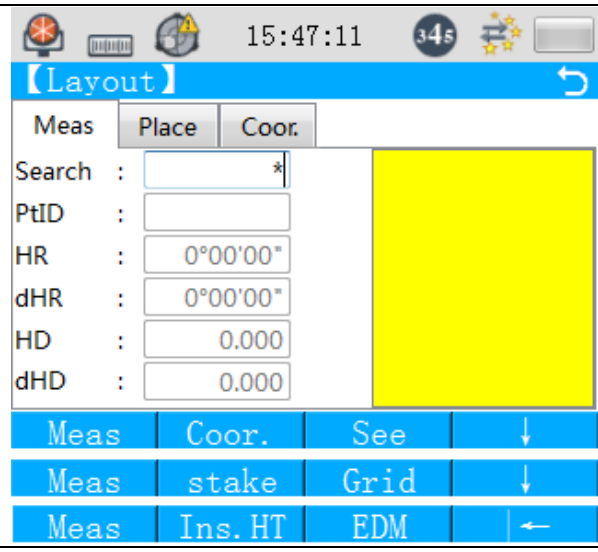
The layout program can help users loft each point number based on the point number and

coordinates at work site. The coordinate data can be transmitted between instrument memory and a computer and the Bluetooth of the instrument can be activated for this.

Coordinate data consist of point number (N, E, Z) and stored in the job name which can have a maximum length of 7 characters. 20 job names can be stored in the instrument and the job name may comprise numbers and characters.

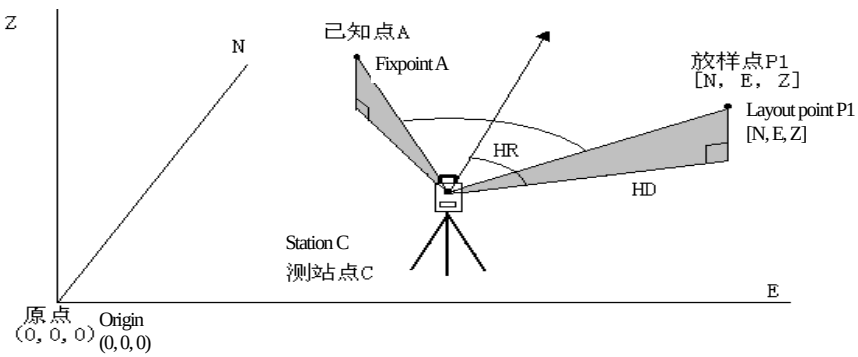


Procedure	Display
① Under Programs mode, press "Meas" to reveal page 1 of the Programs interface. Press "⮌" to return to previous menu.	

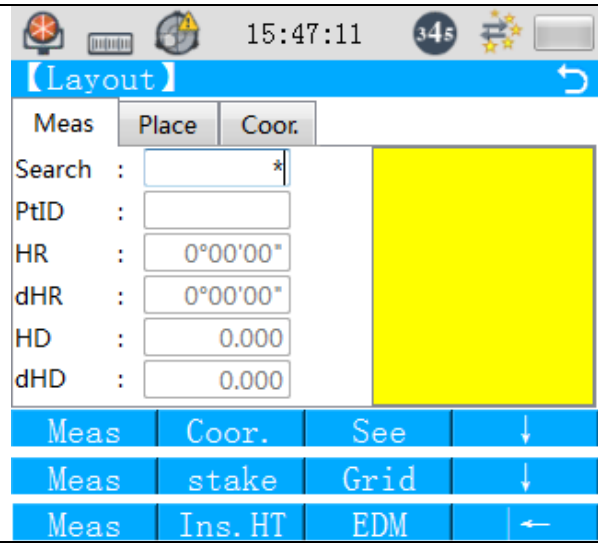
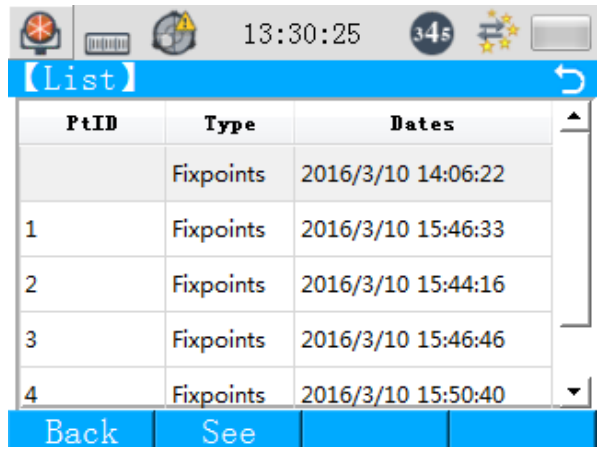
② Press "Layout" or (3) to enter coordinate layout configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌" to return to previous menu.	
③ Press "F4" or (4) to enter coordinate layout interface.	

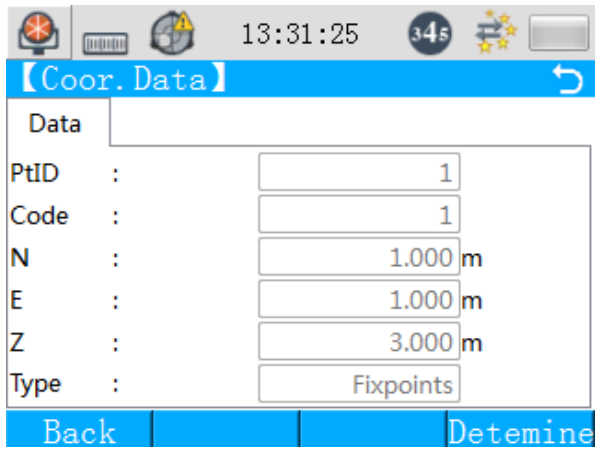
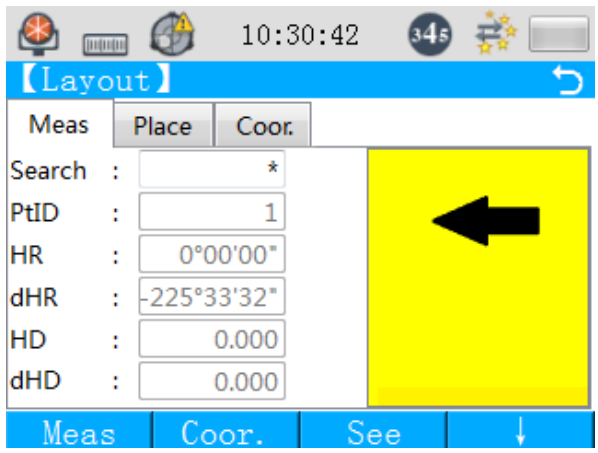
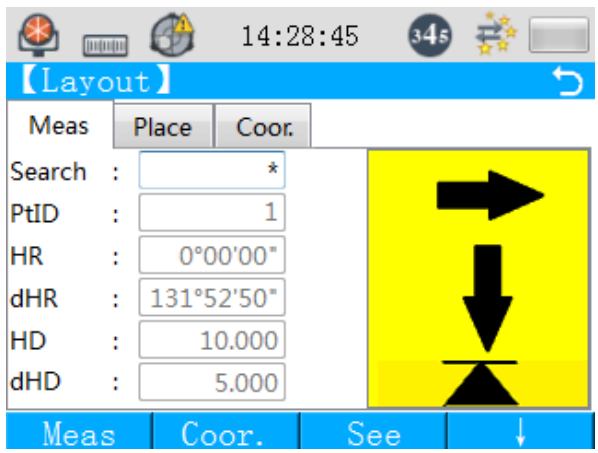
6.7.1 Layout point setting

With backsight azimuth set, coordinate layout can be carried out.



6.7.1.1 Coordinate extraction from job

Procedure	Display
① Enter coordinate layout interface by following the procedure of 6.7. ② Enter point name to be lofted into the field of "Search" and press "OK" to start point searching function. (You may also enter the wildcard "*" and start wildcard searching.)	
③ The program will search for point names in the job and display the result dialog to list all point names that have been found. (If wildcard "*" is entered, all data in the job will be displayed.) Select a point by clicking it.	

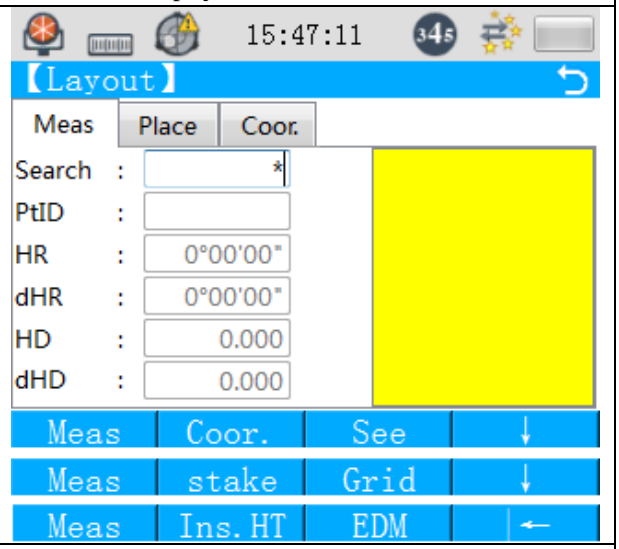
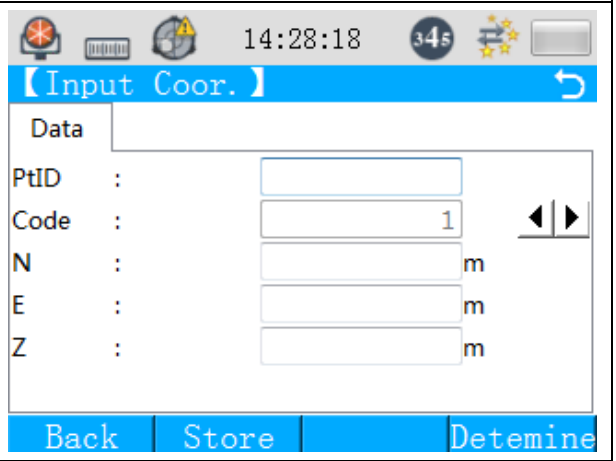
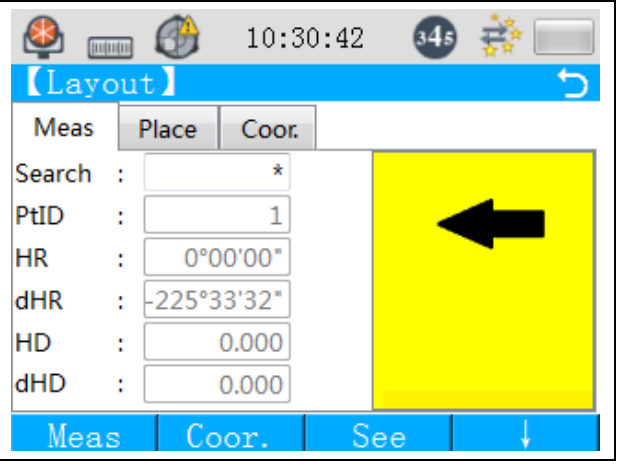
④ Press “F2” (See) to view the coordinate data.	
⑤ Press “F4” (Detemine) to select the layout point and enter the layout interface. Press “F1” (Back) to give up and return to previous interface.	
⑤ Press “F1” (Meas) to start layout.	

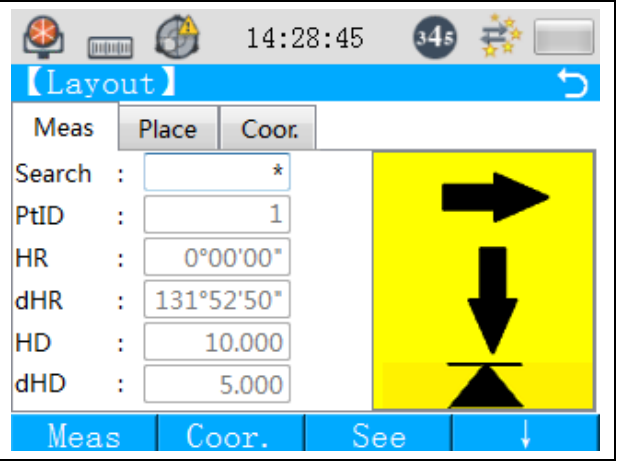
6.7.1.2 Manual entry of layout point

A layout point can be manually entered with buttons [Coor.] and [stake].

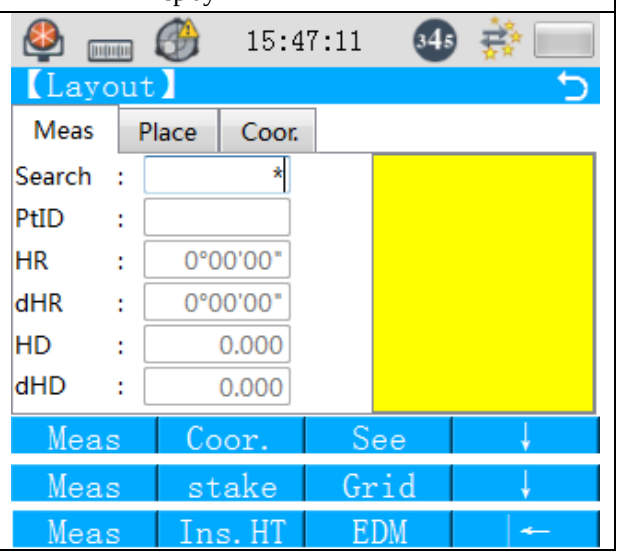
Method 1: Press “F2” (Coor.) to enter coordinates of the point to be staked and confirm to promptly

enter the layout procedure for this entered point.

Procedure	Display
① Enter coordinate layout interface by following the procedure of 6.7.	
② Press "F2" (Coor.) to enter coordinate input interface. ③ Enter the point name, N, E and Z and chose the code. Press "F2" (Store) and you can save to store the data of this point in the job. Press "F1" (Back) to give up and return to previous menu.	
④ Press "F4" (Detemine) to confirm to make the entered point the layout point.	

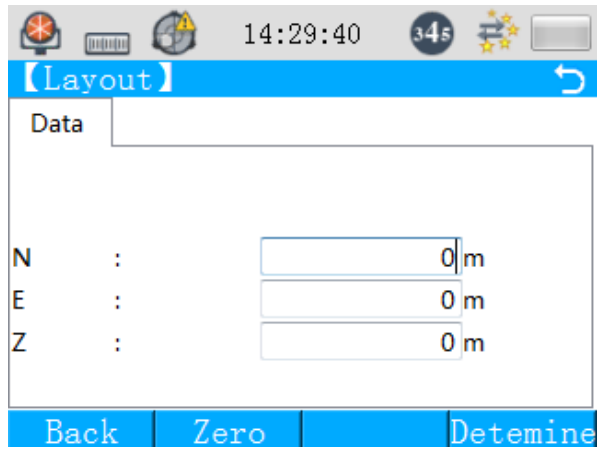
⑤ Press "F1" (Meas) to start layout.	

Method 2: Press "F2" (stake) to enter a layout point without point name and the need to store its data.

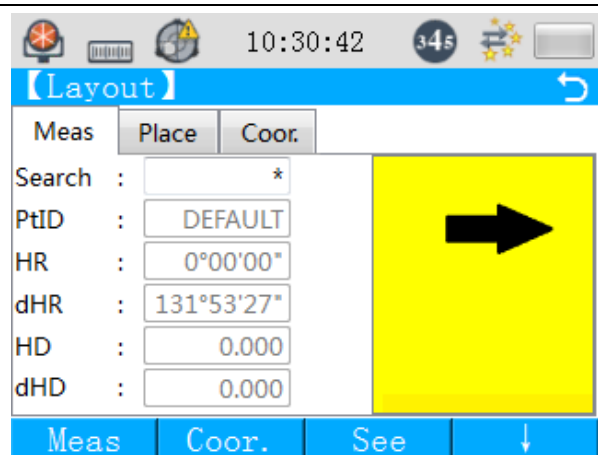
Procedure	Display
Enter coordinate layout interface by following the procedure of 6.7.	

② Press “F2” (stake) to enter layout point input interface.

③ Enter N, E and Z. If N, E and Z are all set to 0, directly press “F2” (Zero). Press “F1” (Back) to give up and return to previous menu.

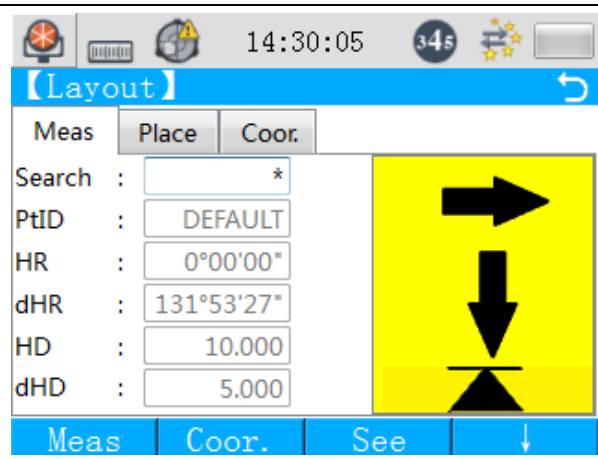


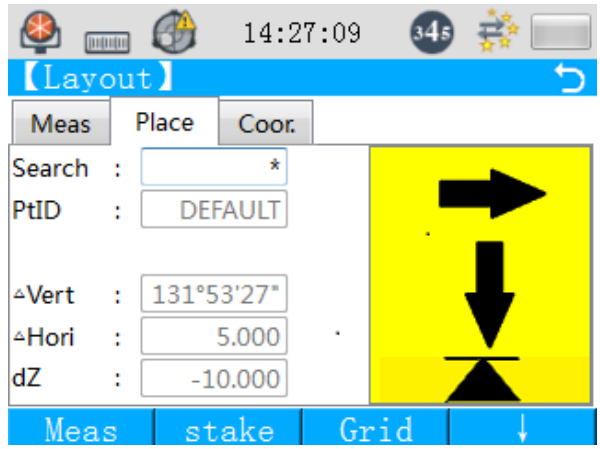
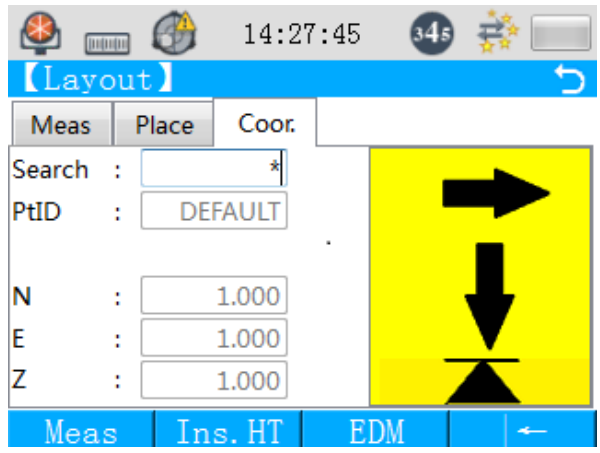
④ Press “F4” (Detemine) to confirm to make the entered point the layout point.



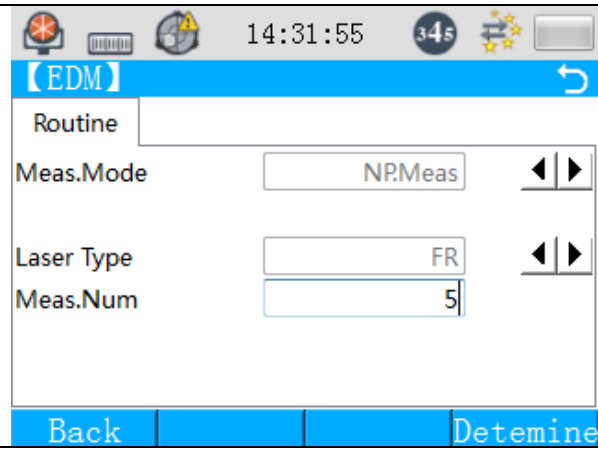
⑤ Press “F1” (Meas) to start layout.

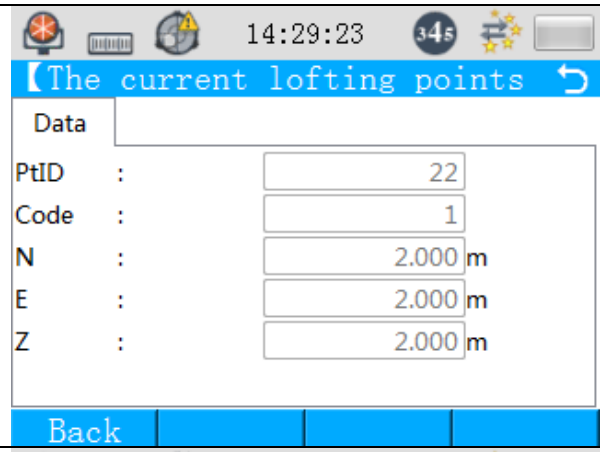
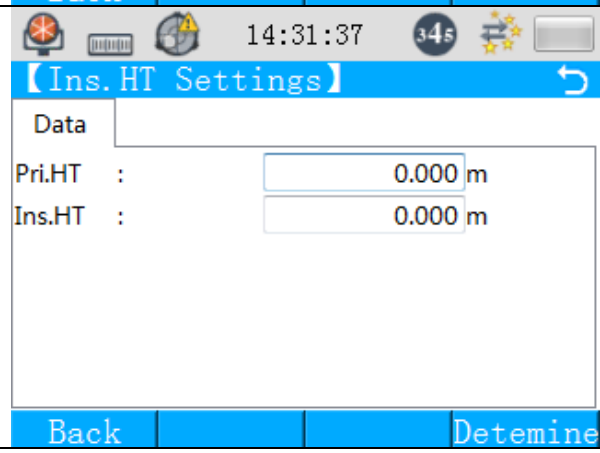
“Meas” interface: display the measured horizontal angle (HR), layout angle (dHR), measured horizontal angle, difference between measured horizontal distance and theoretical horizontal distance (dHD) and difference between actual height and theoretical height (dZ). When the instrument turns to the direction of the layout point, the HR displayed is the angle to be staked out and the dHR displayed is zero (0°00′00″).



"Place" interface: Display the horizontal situation, horizontal distance direction and vertical direction of the point being searched. / : vertical direction / : horizontal distance direction / :horizontal direction "Cloor." Interface: Display coordinates of the point after layout.	 

Explanations for the buttons below:

"F3" (EDM): to enter EDM setting interface.	

"F3" (See): to view layout point coordinates, point name and code.	
"F2" (Ins.HT): to enter instrument height setting interface to change instrument height and prism height.	

6.7.2 Grid factor

For the purpose of layout, the grid factor can be set. The following formula shows how to calculate the grid factor used for calculation of distance.

Formula:

1. Elevation factor = $\frac{R}{R+ELEV}$

Where: R – mean radius of the earth;

ELEV – elevation above mean sea level

2. Scaling factor

Scaling factor: scaling factor on the station

3. Grid factor

Grid factor = elevation factor X scaling factor

Distance calculation:

1. Grid distance

HDg = HD X grid factor

HDg: grid distance

HD: ground distance

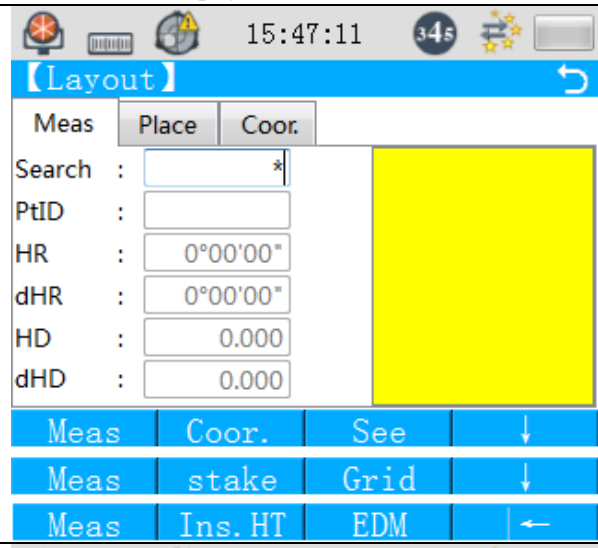
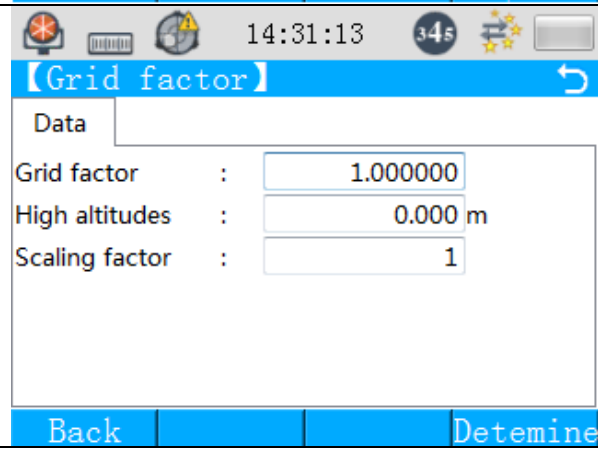
2. Ground distance

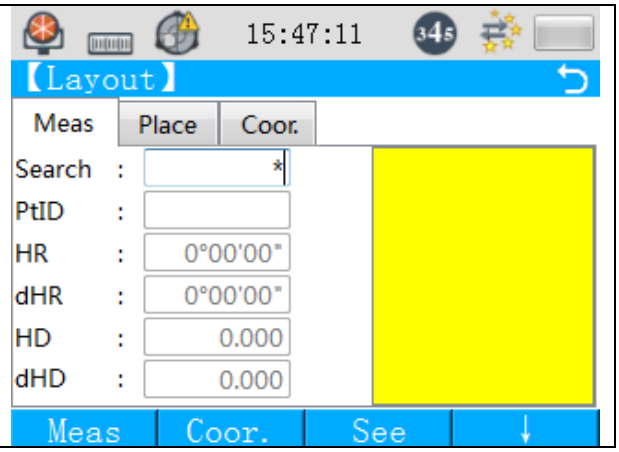
$$HD = \frac{HDg}{Gridfactor}$$

Notes: 1. Input range of scaling factor: 0.0900000 ~ 1.0100000; default value is 1.00000

2. Input range of altitude: -1000.000 ~ 10000.000

Keep three decimal places for altitudes and the default altitude is 0.

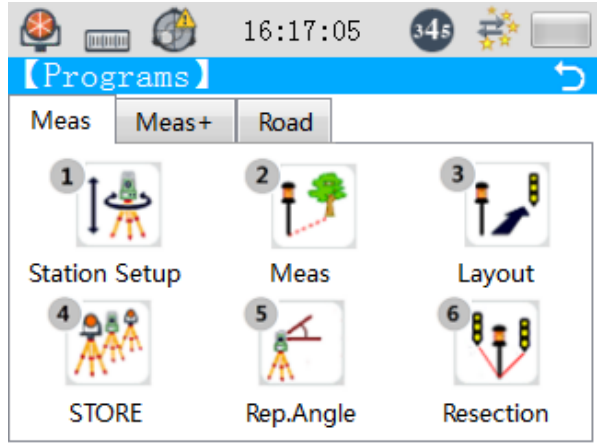
Procedure	Display
① Enter coordinate layout interface by following the procedure of 6.7.	
② Press "F3" (Grid) to enter grid factor setting interface. ③ Enter altitudes and scaling factor.	

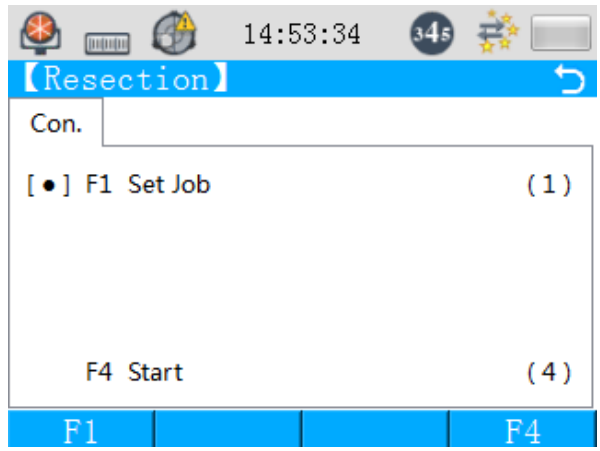
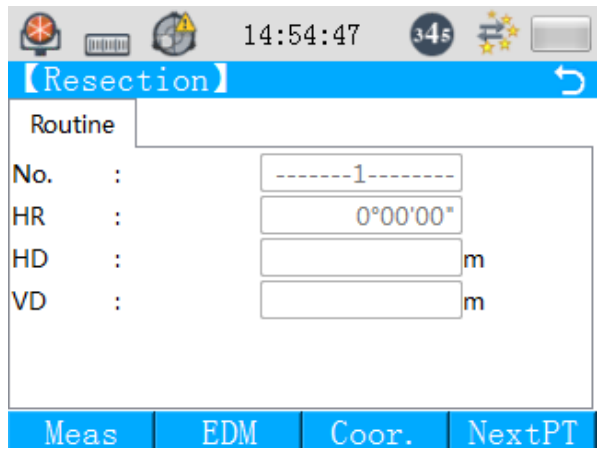
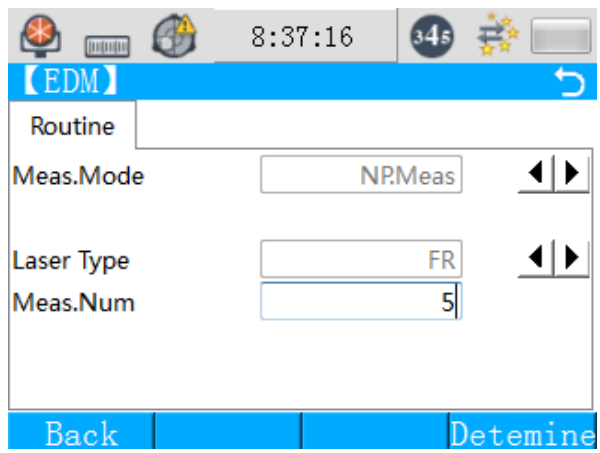
④ Press "F4" (Detemine) to save the settings and return to previous menu. Press "F1" (Back) to return to previous menu without saving the settings.	

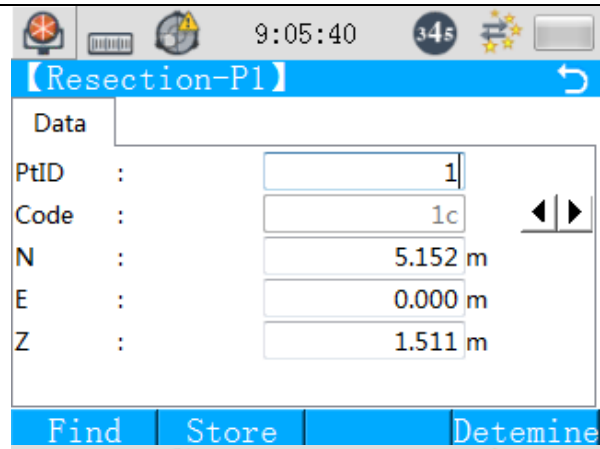
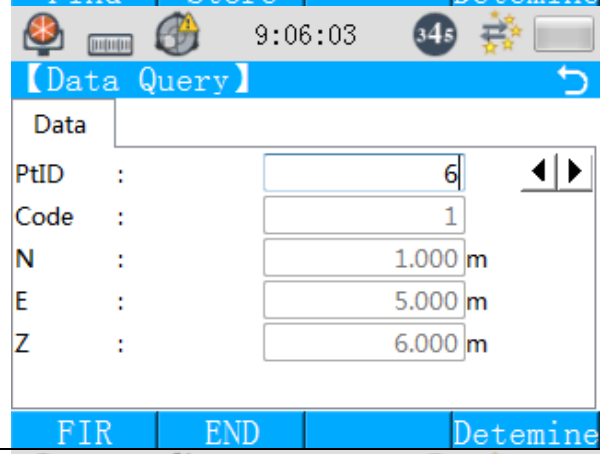
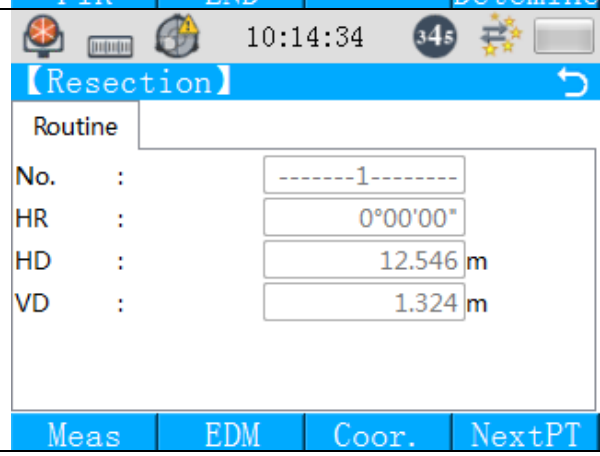
6.8 Resection

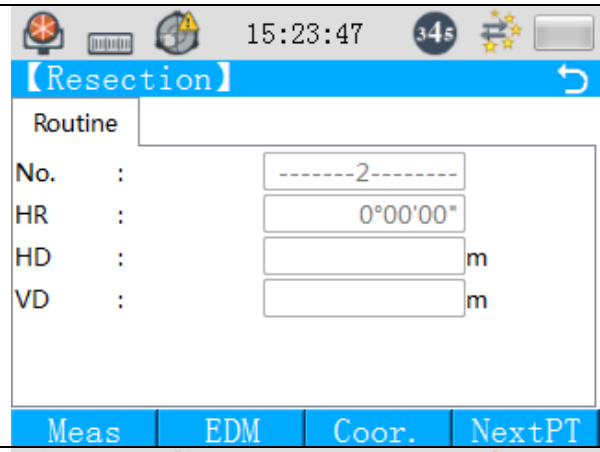
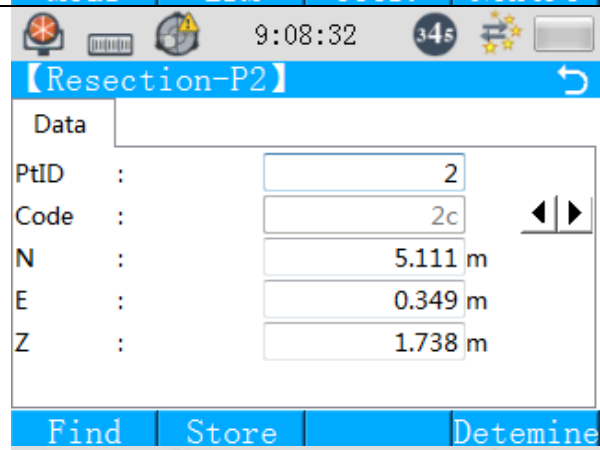
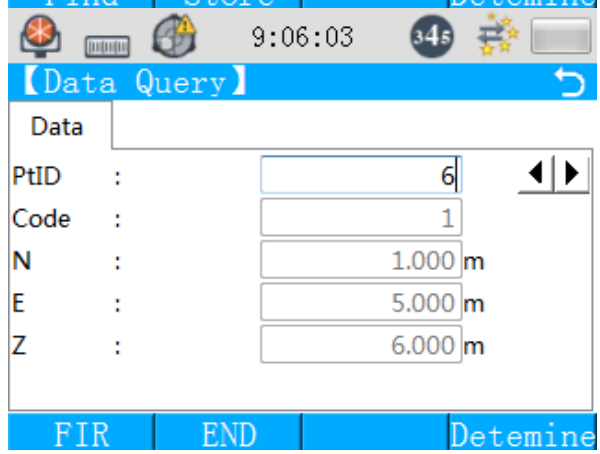
The resection program calculates coordinates of the new station with two points whose coordinates are known and stored in the job. It will display the measured angel and distance between the station and each fixpoint as well as horizontal distance and elevation difference residual errors. If the software cannot calculate coordinates of the new point, it will display "OUT!". If it accepts the displayed residual errors, coordinates of the new point will be displayed on the next screen.

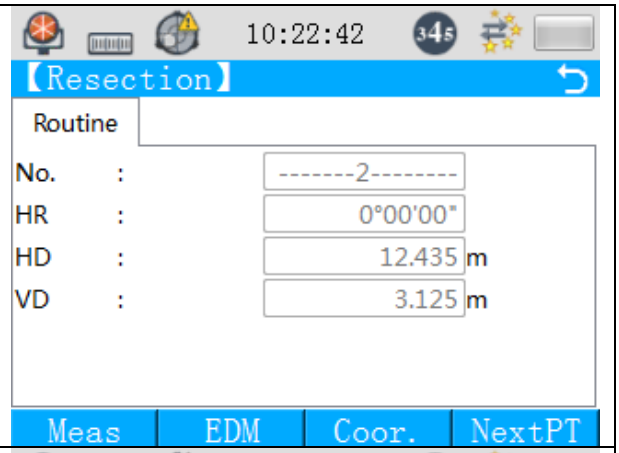
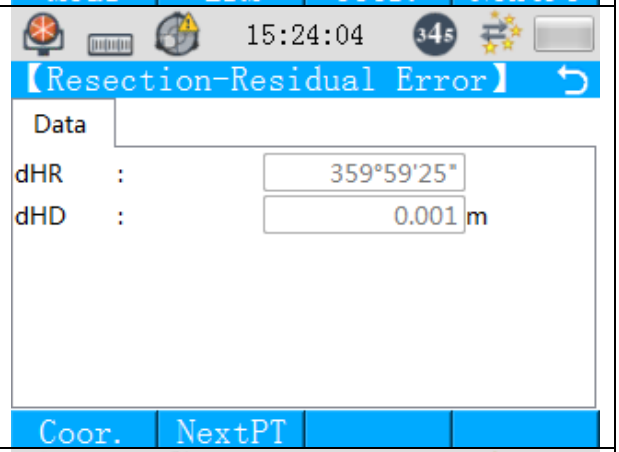
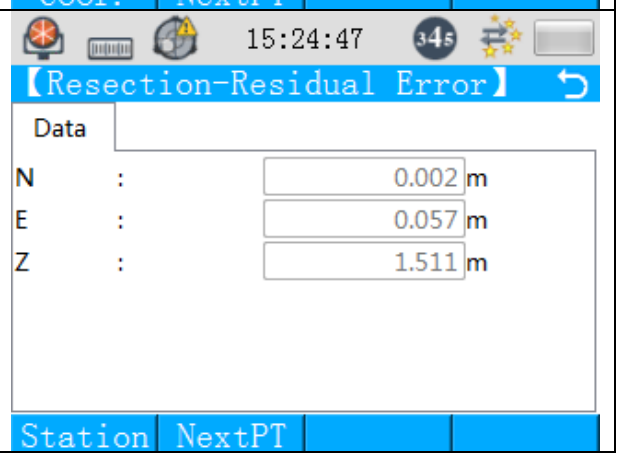
Calculation of resection point coordinates will be explained in detail in the following part (with the instrument erected on the new point)

Procedure	Display
① Under Programs mode, press "Meas" to reveal page 1 of the Programs interface. Press "↩" to return to previous menu.	

② Press "Resection" or (6) to enter resection configuration interface. Press "F1" or (1) to enter job setting interface. Press "↩" to return to previous menu.	
③ Press "F4" or (4) to enter resection interface. Press "↩" to return to previous menu.	
Press "F2" (EDM) and you can enter EDM setting interface.	

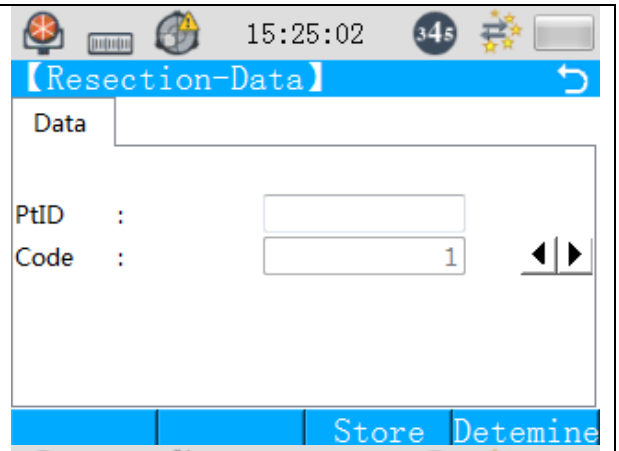
④ Press “F3” (Coor.) to enter point 1 coordinate setting interface. ⑤ Directly enter coordinates of the point or press “F1” (Find) to search for its coordinates in the file.	 
⑥ With coordinates of the point entered, press “F4” (Detemine) to return to point 1 measurement interface. ⑦ Press “F1” (Meas) to measure coordinates of point 1.	

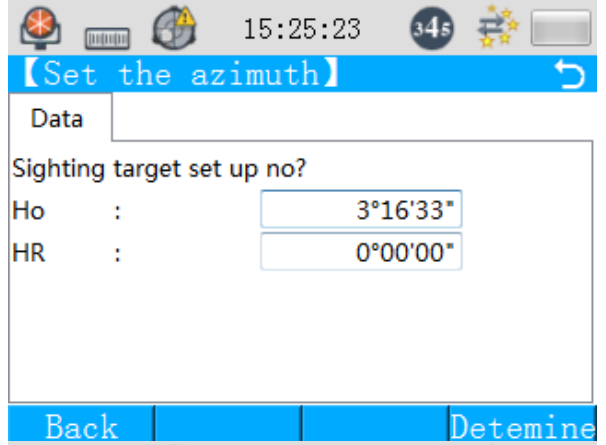
⑧ When measurement is finished, press "F4" (NextPT) to enter point 2 measurement interface.	
⑨ Press "F3" (Coor.) to enter point 2 coordinate setting interface. ⑩ Directly enter coordinates of the point or press "F1" (Find) to search for its coordinates in the file.	 

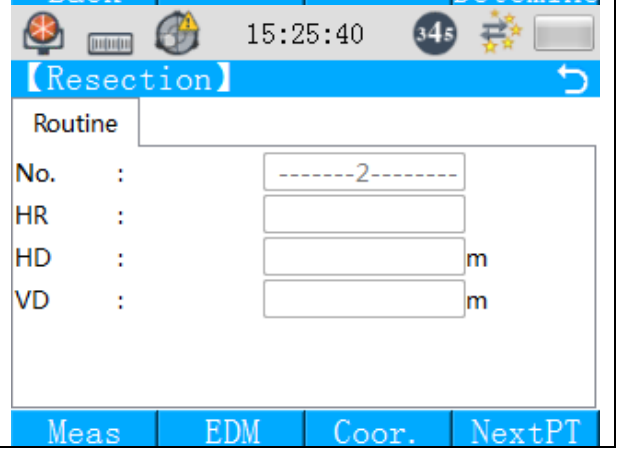
(11) With coordinates of the point entered, press "F4" (Detemine) to return to point 2 measurement interface. (12) Press "F1" (Meas) to measure coordinates of point 2.	
(13) When measurement is finished, press "F4" (NextPT) and the residual errors will be displayed.	
(14) If residual errors are within allowed ranges, press "F1" (Coor.) and coordinates of the point will be displayed.	

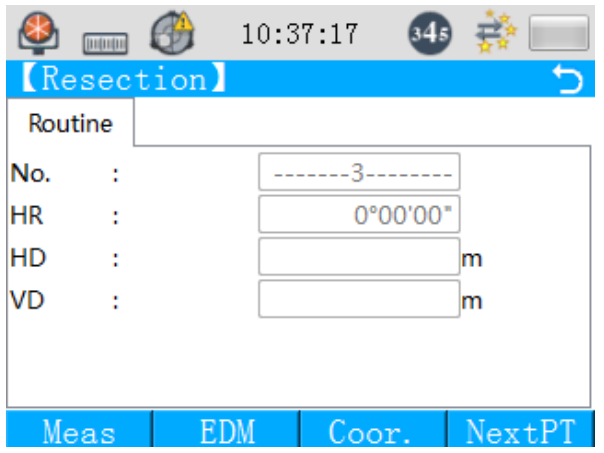
(15) To record or set coordinates of the station, press "F1" (Station). Enter the point number, select the code and, if you want to save it, press "F3" (Store).

Press "F4" (Detemine) and the point will be set as the station.



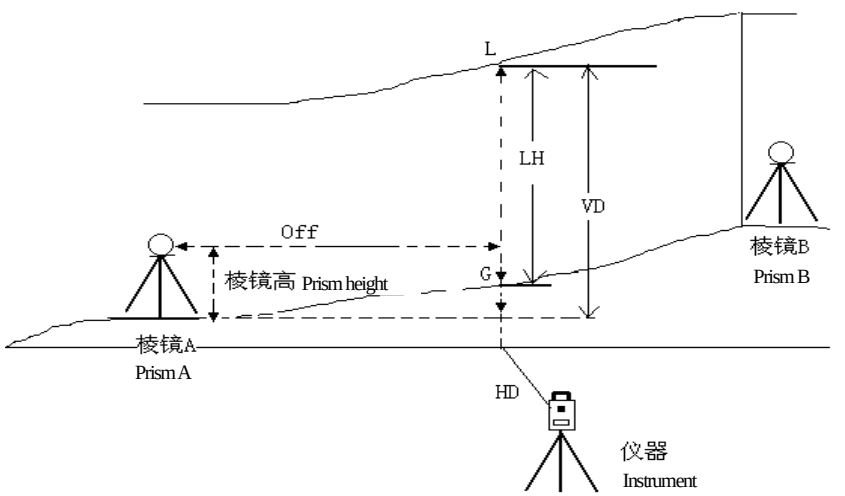




(16) If you want to continue resection, press "NextPT".	

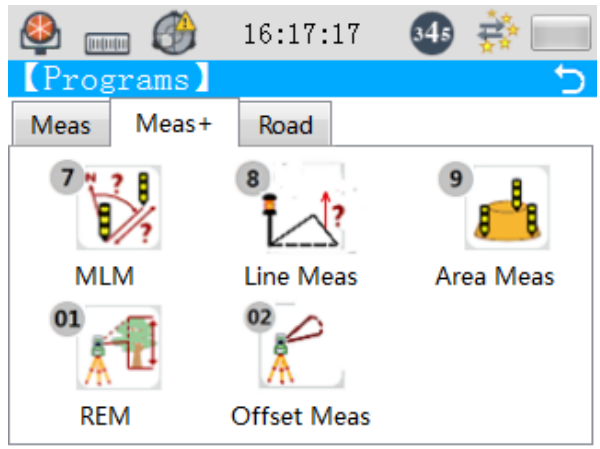
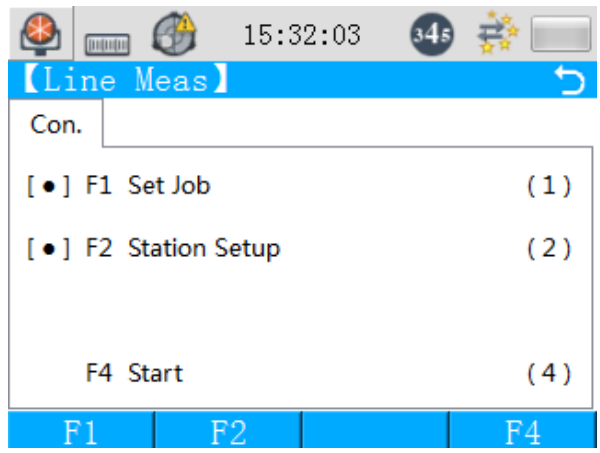
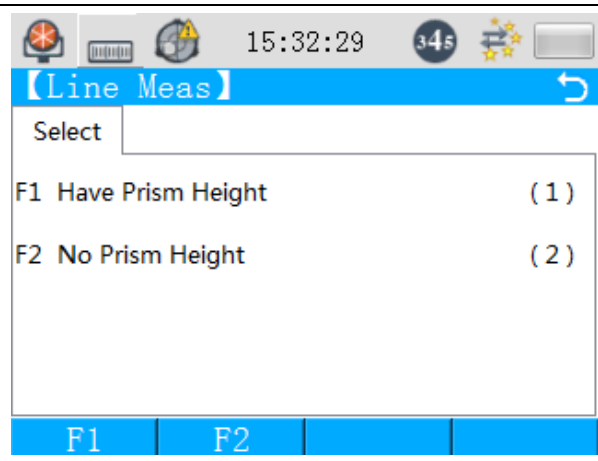
6.9 Line measurement

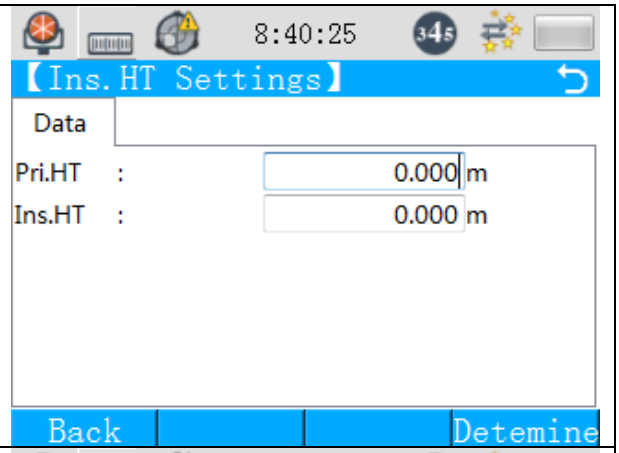
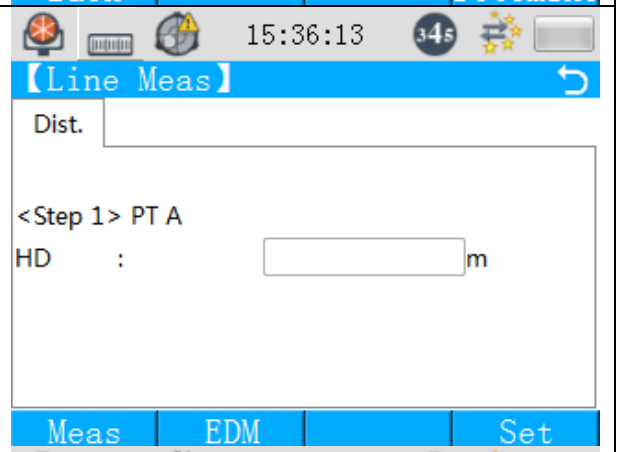
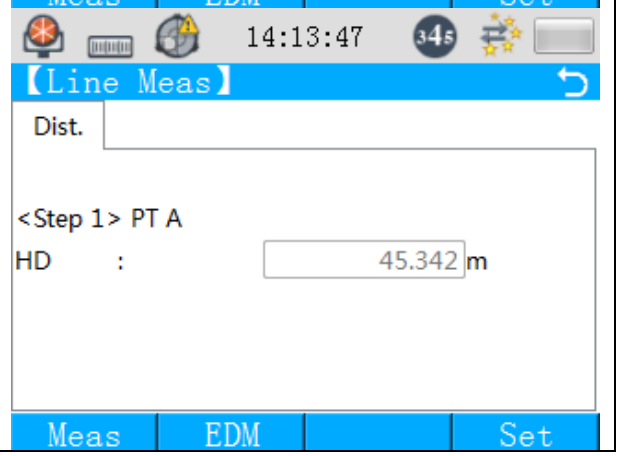
It is used to measure the unattainable target height above a ground point. Not only the target overhead but also all points along the ground base line are all unattainable. Set prisms A and B below the overhead line to form a base line, with certain distance between prisms A and B. Respectively measure horizontal distances between instrument and prism A and between instrument and prism B and store them in the instrument. The display will show vertical distance between prism A and B， horizontal distance between instrument and prism B, distance along base line direction as well as vertical distance and horizontal distance between prism A and the target point. Thus, the vertical distance between both ends of the base line and vertical distance between point G and point L in the figure below can also be measured.

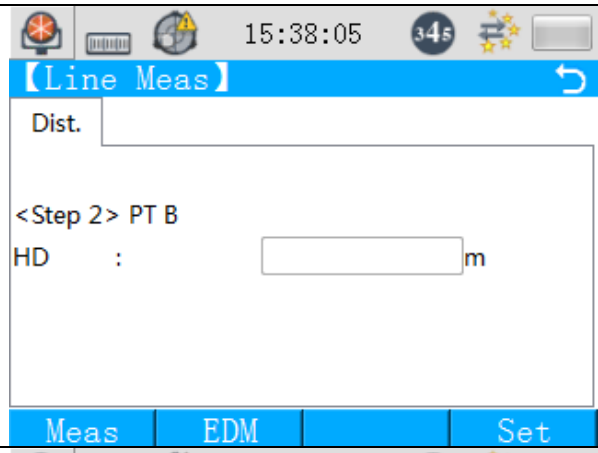
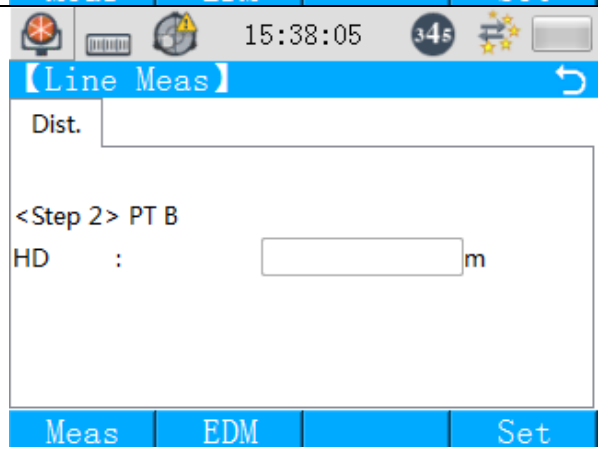
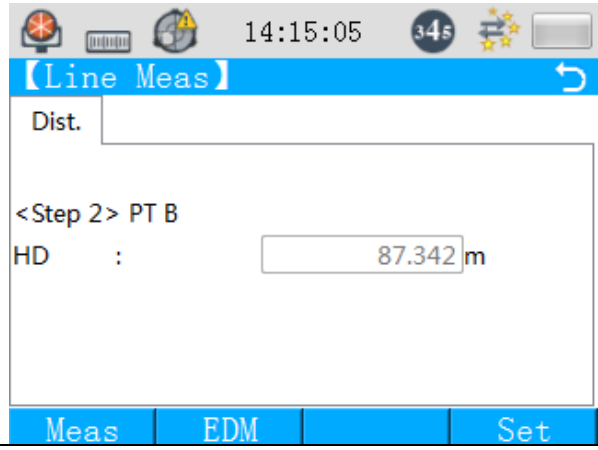


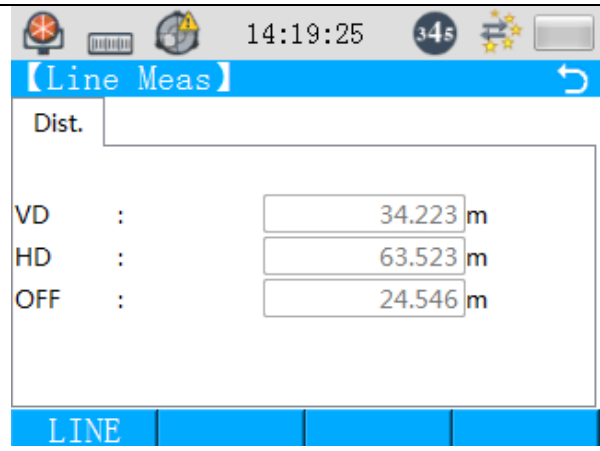
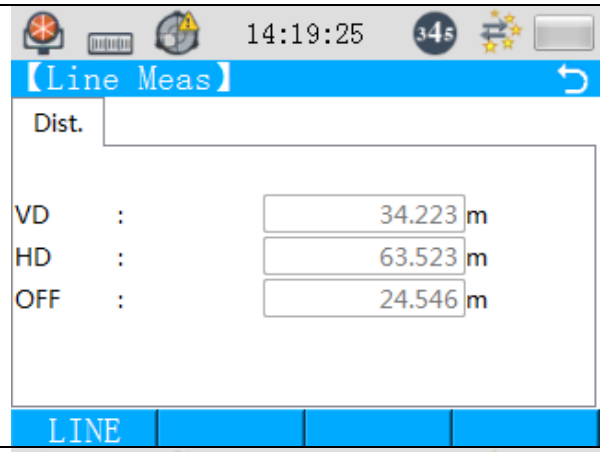
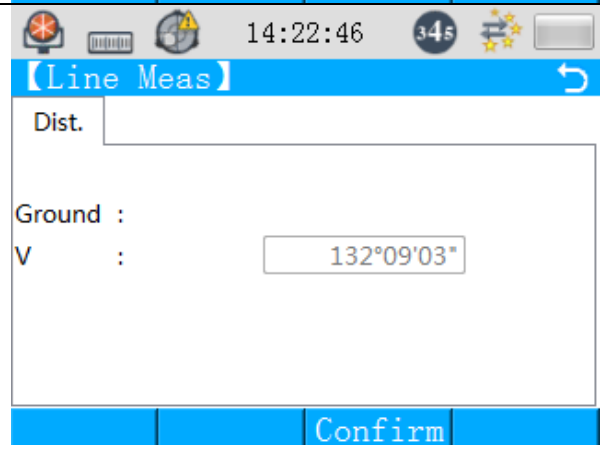
[Example: prism input]

Procedure	Display

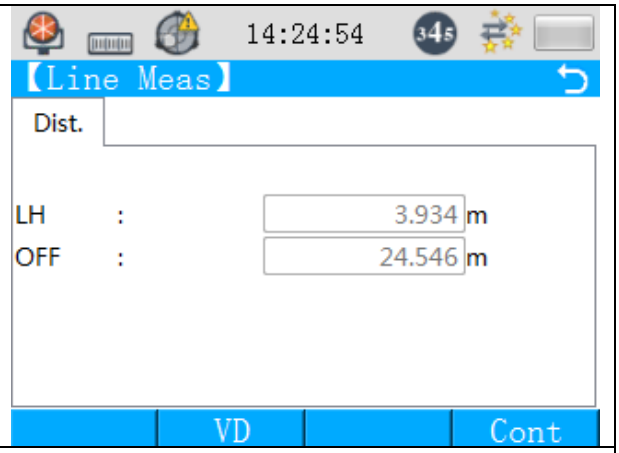
① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "⮌" to return to previous menu.	
② Press "Line Meas" or (8) to enter line measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌" to return to previous menu.	
③ Press "F4" or (4) to enter line measurement prism selection interface. Press "⮌" to return to previous menu.	

④ Press "F1" or (1) to have prism height. ⑤ Enter prism height.	
⑥ Press "F4" (Detemine) to enter line measurement interface. 。 ⑦ Sight prism A and press "F1" (Meas) to start distance measurement. Press "F2" (EDM) and you can enter EDM setting interface. ⑧ Horizontal distance is displayed.	 

⑨ Press “F4” (Set) to save horizontal distance.	
⑩ Sight prism B and press “F1” (Meas) to start distance measurement. (11) Horizontal distance is displayed.	 

(12) Press "F4" (Set) to save horizontal distance.	
(13) Sight point L on overhead line. The display will show measurement data of point L. VD: elevation difference of point L relative to A HD: horizontal distance between instrument station and point L Off: horizontal distance between point A and point L	
(14) Press "F1" (LINE). This function is intended to measure elevation of overhead line from the ground and the procedure is as follows: ● First sight the point on the overhead line before pressing "F3" (Confirm). ● When setting the corresponding ground point G, do not turn the horizontal tangent. (15) Turn vertical tangent and sight the ground point G.	

(16) Press "F3" (Confirm) and overhead line height LH (elevation) and horizontal distance (Off) will be displayed.



● Press "↩" to end measurement.

● Press "F2" (VD) to return to step (13).

● If the ground point is not clear, you can press "F4" (Cont) to determine another ground point G on the same plumb line.

6.10 Offset measurement mode

There are a total of 4 offset measurement modes:

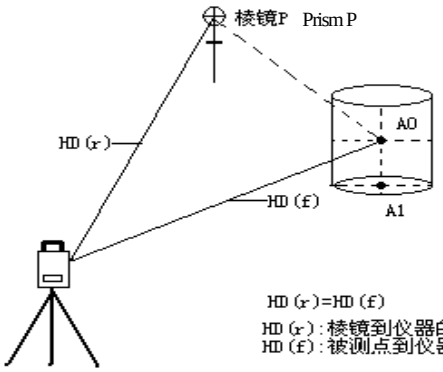
1. Angle offset measurement
2. Distance offset measurement
3. Plane offset measurement
4. Column offset measurement

6.10.1 Angle offset measurement mode

This mode is quite useful where it is difficult to erect the prism, for example, center of a tree. Under this mode, horizontal distance between instrument and point P (prism) shall be equal to horizontal distance between instrument and target point. With instrument height/prism height set, conduct offset measurement and you can get coordinates of the center of the observed object.

When measuring projection of A0 (coordinates of ground point A1), please set instrument height and prism height.

When measuring coordinates of A0, only instrument height is required (with prism height set to 0).



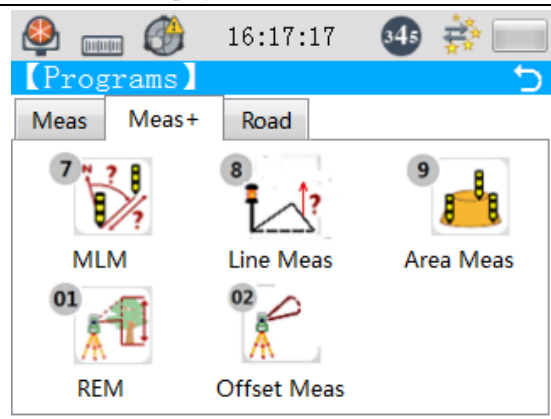
HD (r)=HD (f)
HD (r) : 棱镜到仪器的平距
HD (f) : 被测点到仪器的平距

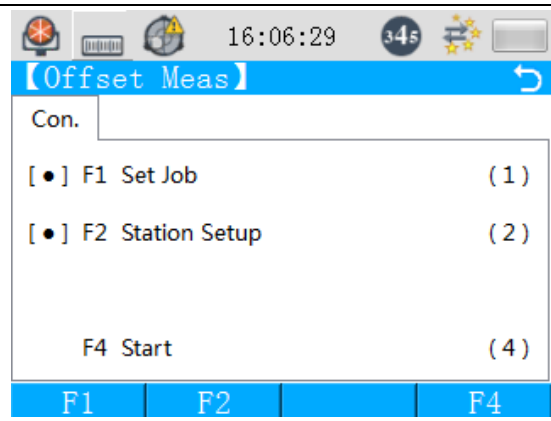
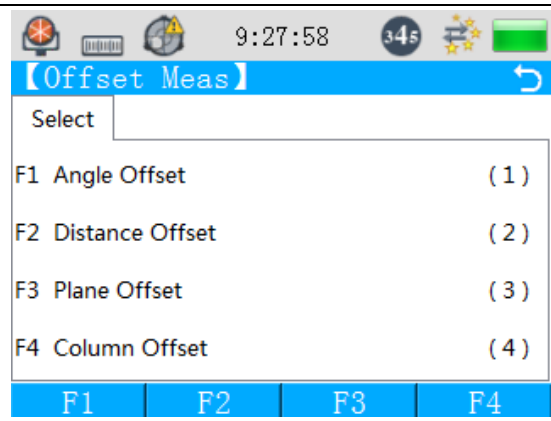
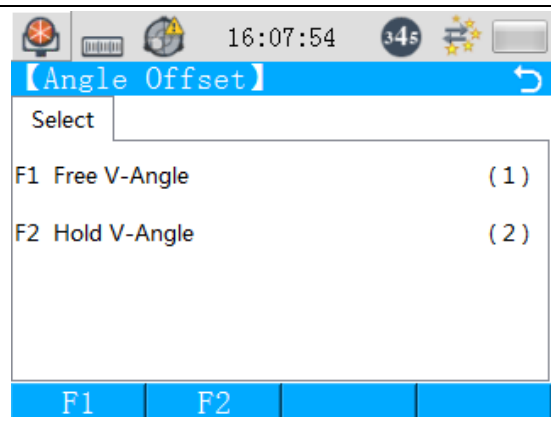
HD (r) = HD (f)
HD (r): horizontal distance from prism to instrument
HD (f): horizontal distance from measured point to instrument

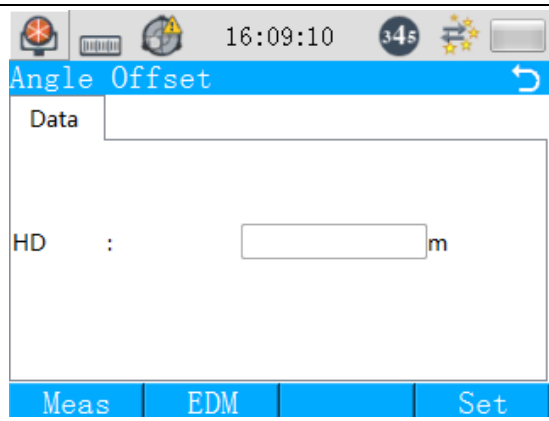
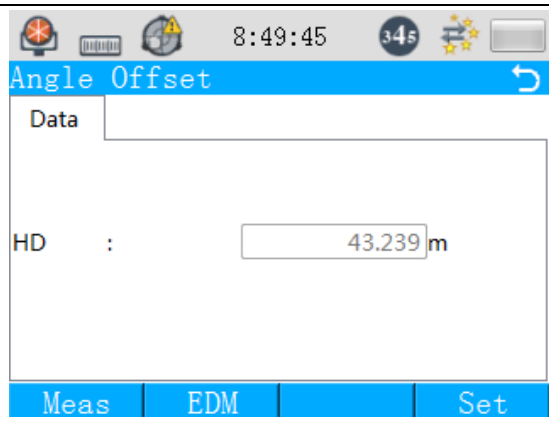
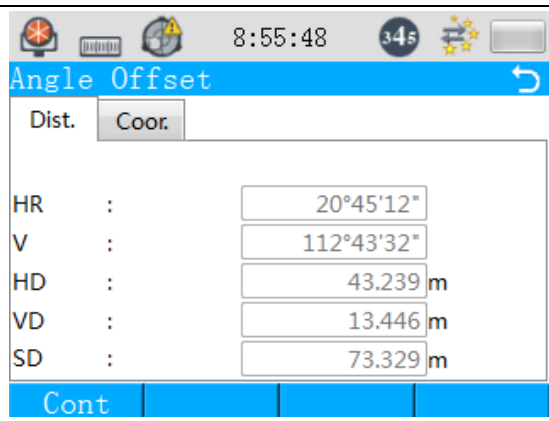
There are two ways to set vertical angle in angle offset measurement mode:

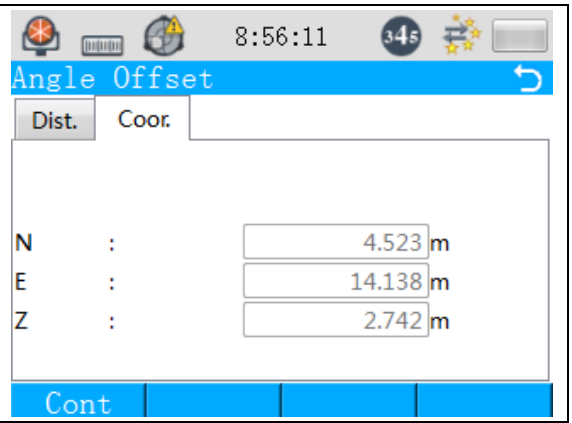
1. Free vertical angle: the vertical angle changes with movement of the telescope.
2. Hold vertical angle: the vertical angle is locked and will not change with movement of the telescope.

Hence, if the first way is adopted to sight A0, the vertical angle changes with movement of the telescope; so will the slope distance (SD) and elevation distance (VD). If the second way is adopted to sight A0, the vertical angle will be held at the prism position and will not change with movement of the telescope.

Procedure	Display
① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "⮌" to return to previous menu.	

② Press "Offset Meas" or (0) and (2) to enter offset measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌" to return to previous menu.	
③ Press "F4" or (4) to enter offset measurement selection interface. Press "⮌" to return to previous menu.	
④ Press "F1" or (1) to enter angle offset measurement selection interface. Press "⮌" to return to previous menu.	

⑤Press “F1” or (1) to enter free vertical angle offset measurement, or press “F2” or (2) to enter hold vertical angle offset measurement. (Users can choose the suitable vertical angle offset measurement as required.) Press “F2” (EDM) to enter EDM setting interface.	
⑥ Sight prism P and press “F1” (Prism) to conduct measurement. (If continuous measurement is adopted, “F4” (Set) shall be pressed when measurement is finished.)	
⑦ Sight target point A0 with horizontal clamp screw and tangent. Press “F4” (Set) to display elevation difference, horizontal distance and slope difference between instrument and A0 as well as coordinates of target point (N. E, Z).	

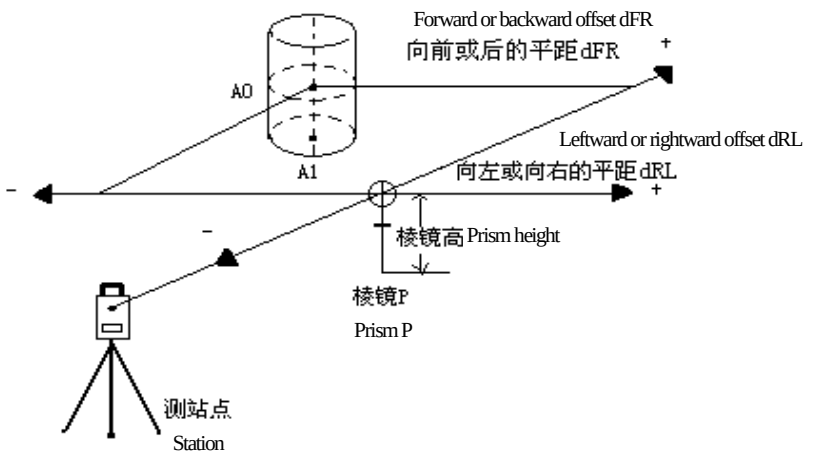
	
1) Press "⮌" and you can return to previous menu.	

Instrument height/prism height shall be set prior to offset measurement.

Refer to "6.1.2 Orientation setting" for setting of station coordinates.

6.10.2 Distance offset measurement mode

Enter forward/backward and leftward/rightward offsets of target point from the reflector and you can get position of this target.

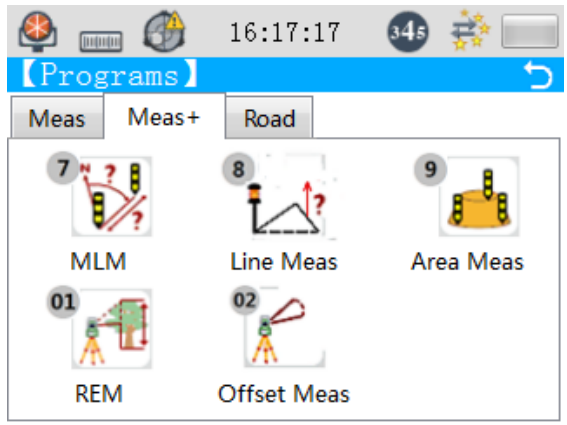
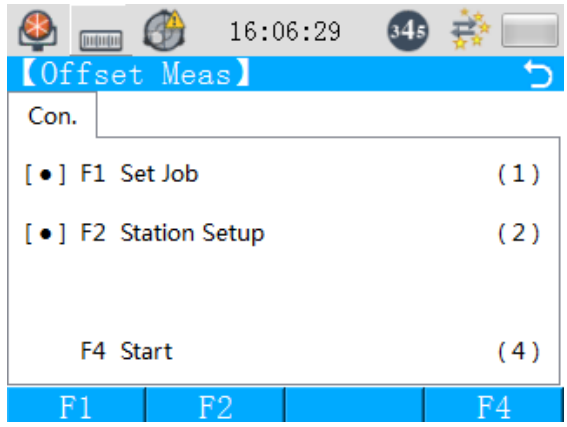
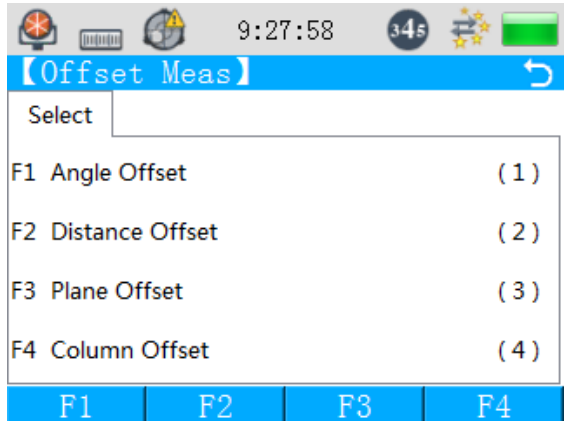


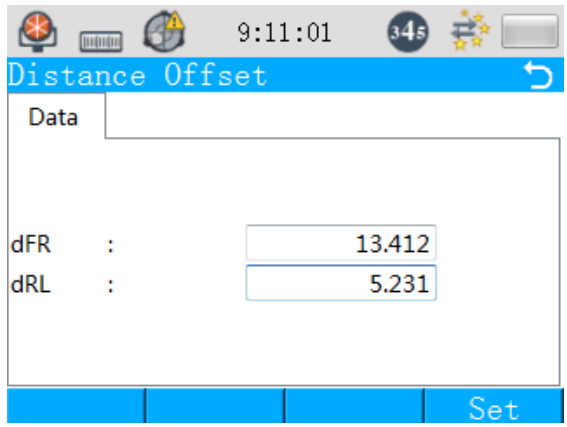
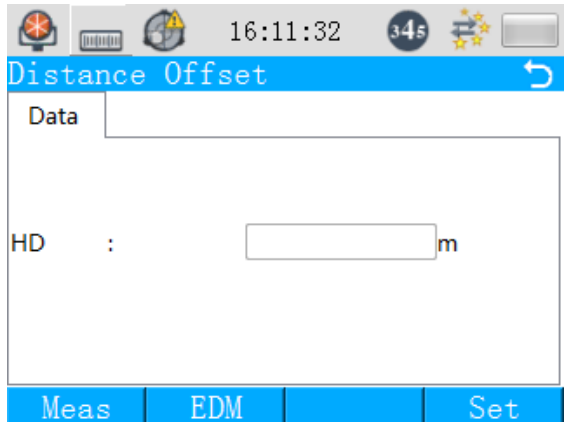
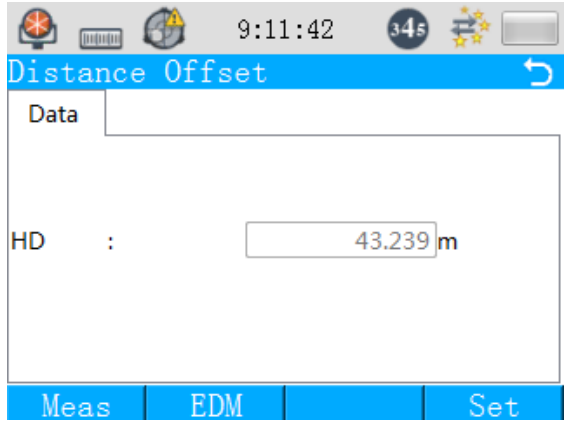
To measure coordinates of ground point A1, instrument height and prism height shall be set.

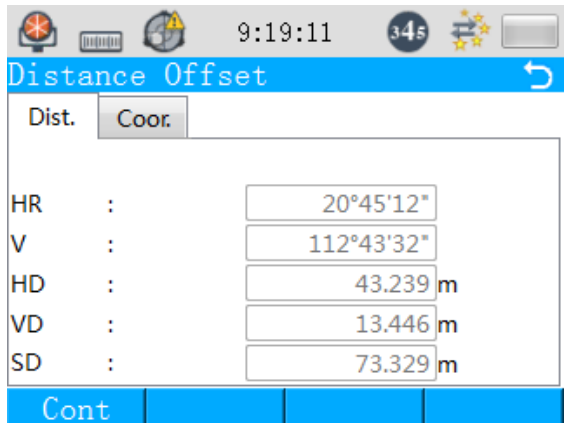
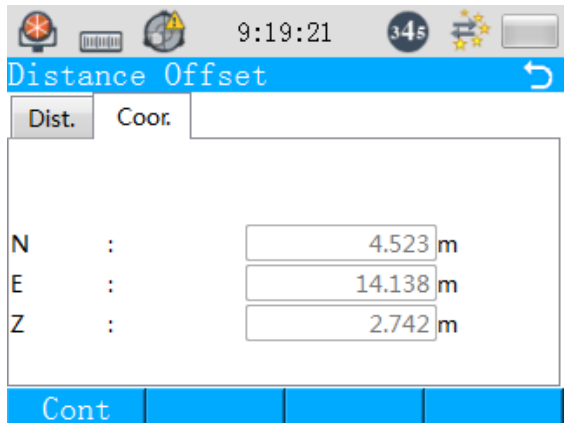
To measure coordinates of target point A0, only instrument height is required (with prism height set to 0).

Refer to "6.1.2 Orientation setting" for setting of station coordinates.

Procedure	Display

① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "↩" to return to previous menu.	
② Press "Offset Meas" or (0) and (2) to enter offset measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "↩" to return to previous menu.	
③ Press "F4" or (4) to enter offset measurement selection interface. Press "↩" to return to previous menu.	

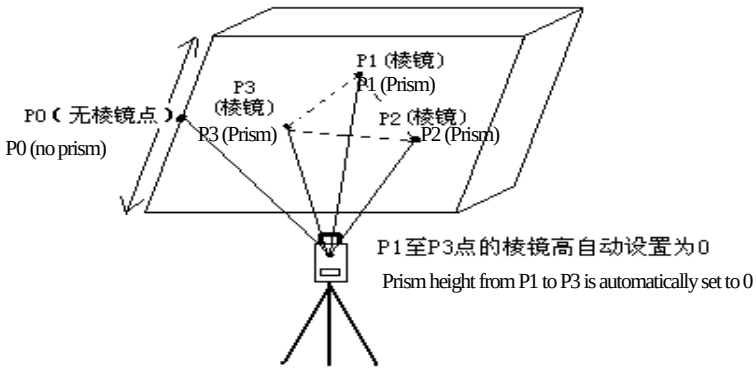
④ Press “F2” or “2” to enter distance offset measurement interface. ⑤ Enter horizontal and longitudinal parameters of offset.	
⑥ Press “F4” (Set) to enter prism point measurement interface. ⑦ Sight prism and press “F1” (Meas) to start measuring. (If continuous measurement is adopted, “F4” (Set) shall be pressed when measurement is finished.) When measurement is over, measurements after offset correction will be displayed.	 

⑧ Sight target point A0 with horizontal clamp screw and tangent. Press "F4" (Set) to display elevation difference, horizontal distance and slope difference between instrument and A0 as well as coordinates of target point (N. E, Z).	 

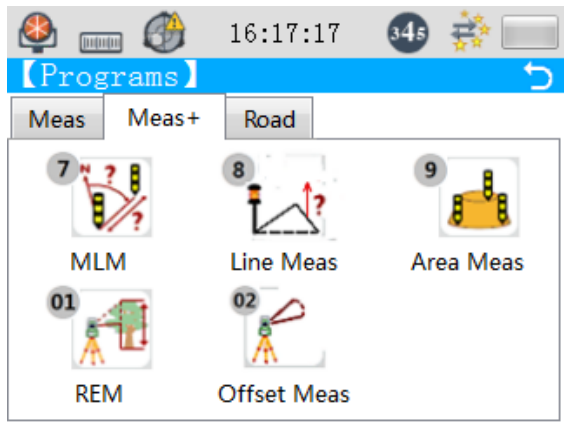
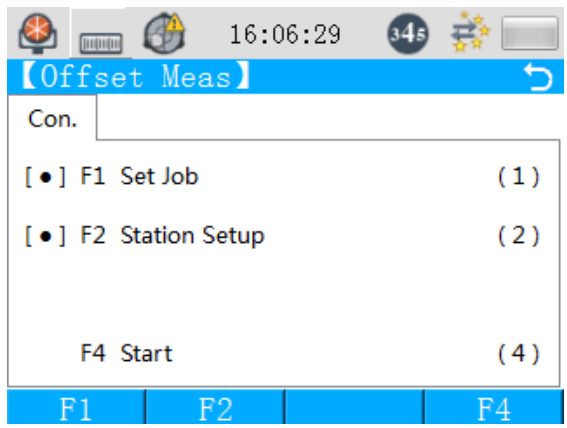
6.10.3 Plane offset measurement mode

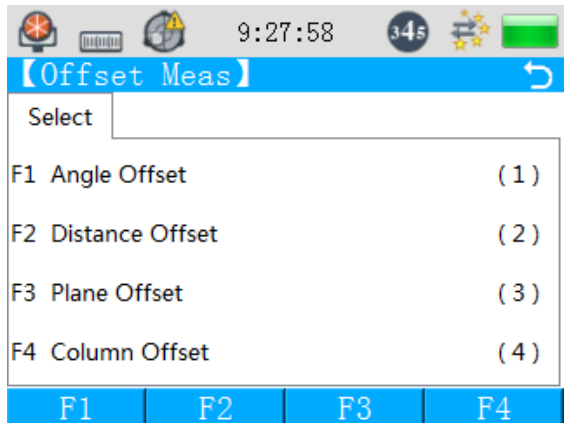
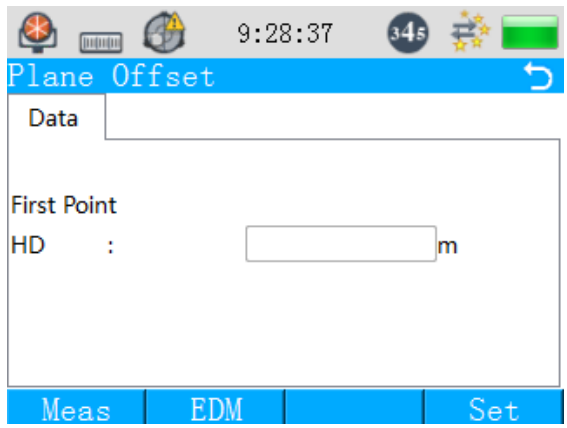
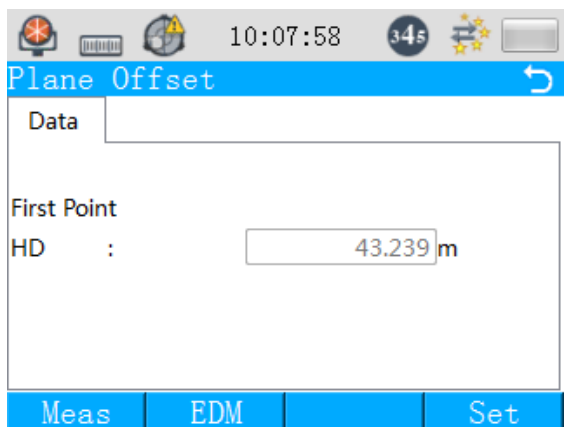
This function is intended to measure points that cannot be measured directly, for instance, distance or coordinates of a plane edge.

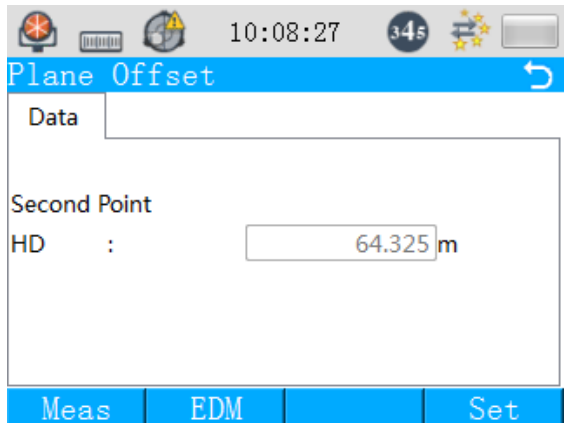
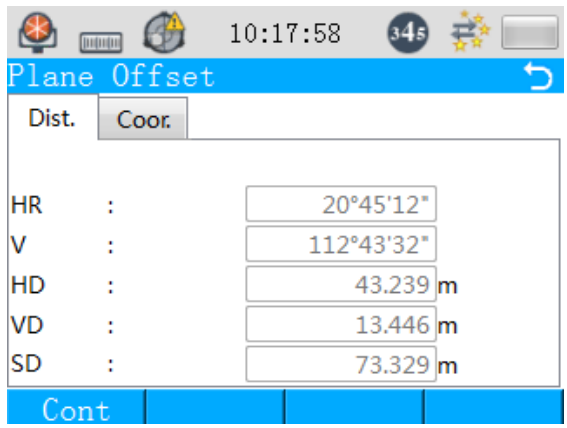
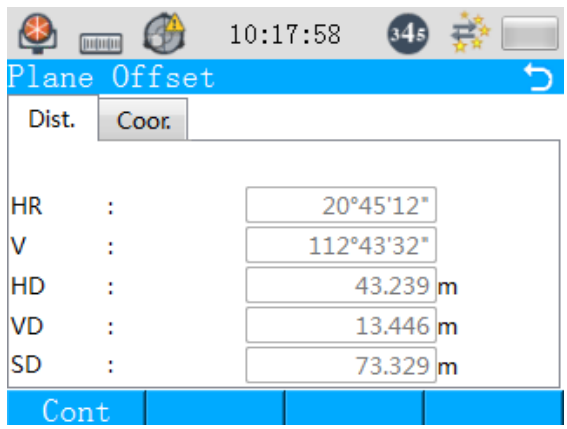
For application of this function, first measure any three points (P1, P2 and P3) to determine a reference plane (plane to be measured); then sight measure point P0 and the instrument will calculate and display distance and coordinates of the point of intersection of collimation axis and the plane.

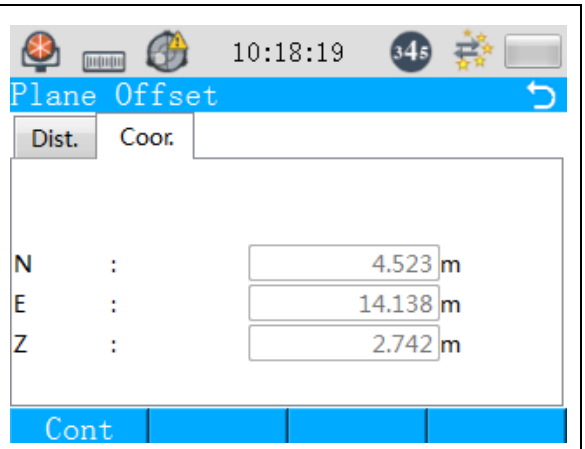


Refer to "6.1.2 Orientation setting" for setting of station coordinates.

Procedure	Display
① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "⮌" to return to previous menu.	
② Press "Offset Meas" or (0) and (2) to enter offset measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌" to return to previous menu.	

③ Press "F4" or (4) to enter offset measurement selection interface. Press "⮌" to return to previous menu.	
④ Press "F3" or (3) to enter plane offset measurement interface.	
⑤ Sight prism P1 and press "F1" (Meas) to start measuring. (If continuous measurement is adopted, "F4" (Set) shall be pressed when measurement is finished.)	

⑥ Sight P2 and P3 in the same way and measure point 2 and point 3.	
⑦ Press "F4" (Set) to calculate and display coordinates or distance of point of intersection of collimation axis and the plane.	
⑧ Sight target point A0 with horizontal clamp screw and tangent. Elevation difference, horizontal distance and slope difference between instrument and A0 as well as coordinates of target point (N. E, Z) will be displayed.	

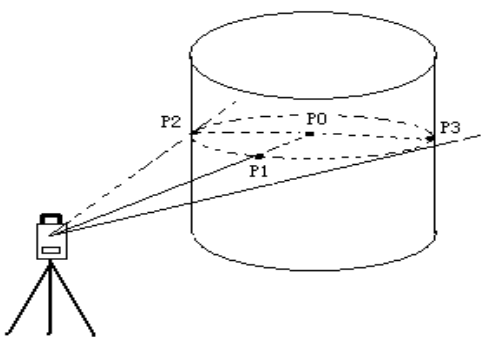
● If calculation of the three measure points cannot determine a plane, an error message will be displayed. In this case, conduct measurement again starting from the first point.

● When the collimation direction does not intersect the plane determined, an error message will be displayed.

6.10.4 Column offset measurement mode

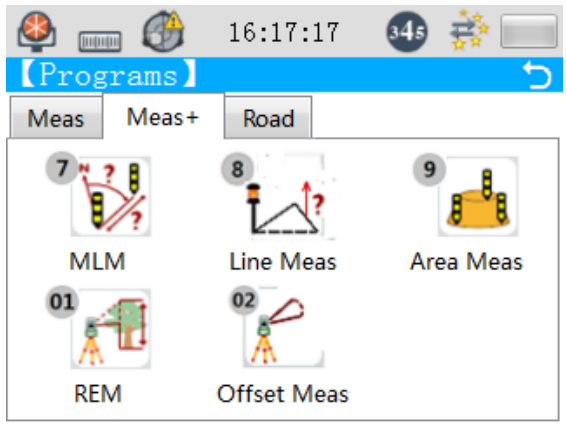
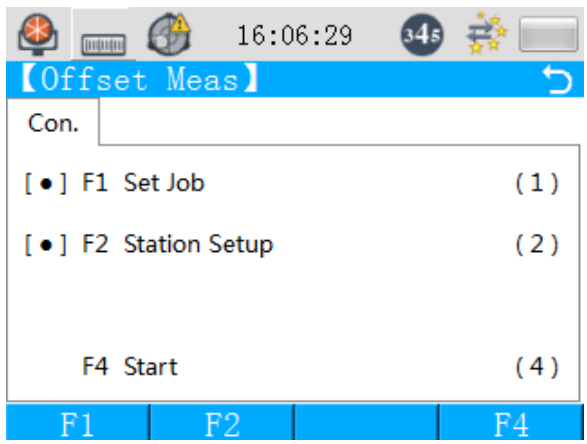
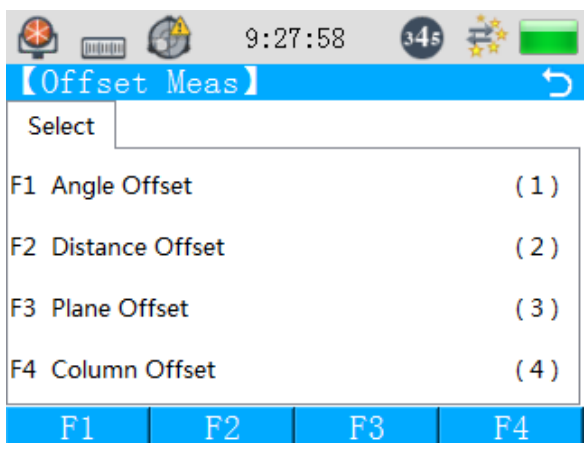
First, directly measure distance from instrument to P1 on the column surface. Then, respectively measure direction angles from instrument to P2 and P3 on the column surface. Distance, direction angle and coordinates of column center can then be calculated.

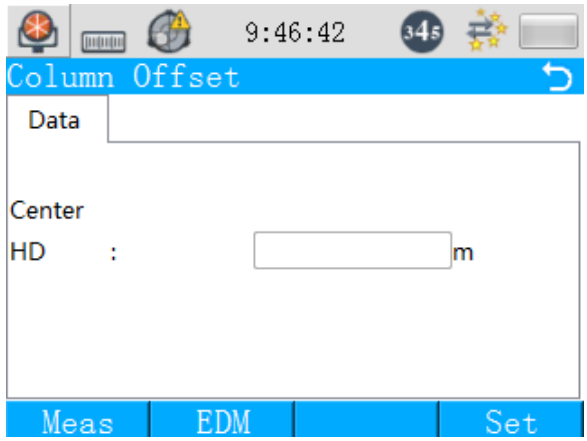
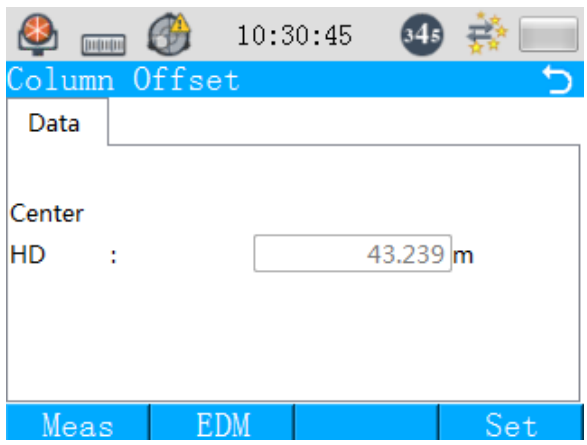
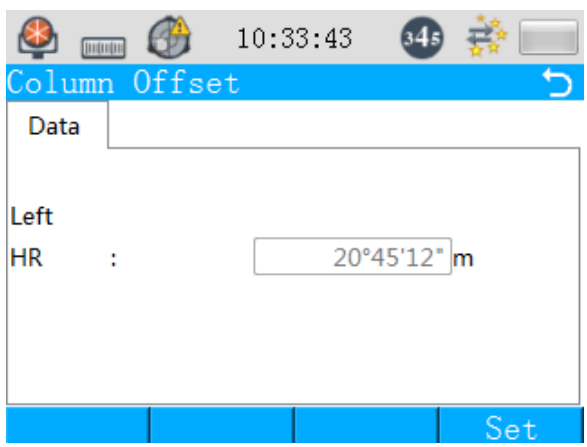
Direction angle of column center equals the average of direction angles of P2 and P3.



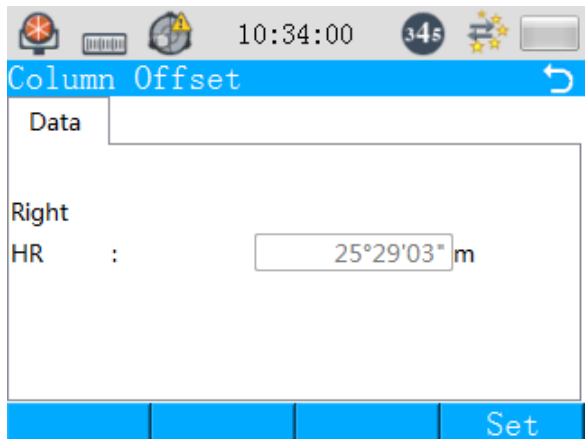
Refer to "6.1.2 Orientation setting" for setting of station coordinates.

Procedure	Display

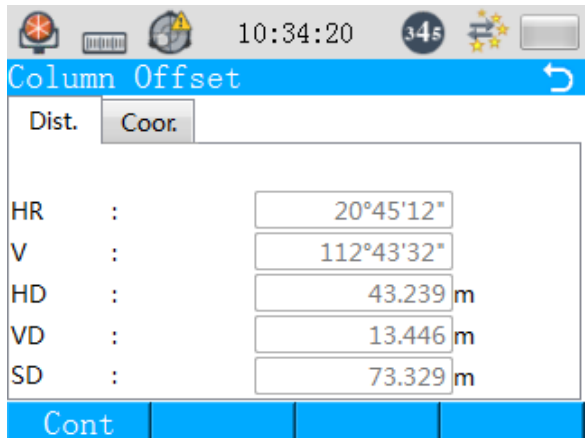
① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "⮌" to return to previous menu.	
② Press "Offset Meas" or (0) and (2) to enter offset measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌" to return to previous menu.	
③ Press "F4" or (4) to enter offset measurement selection interface. Press "⮌" to return to previous menu.	

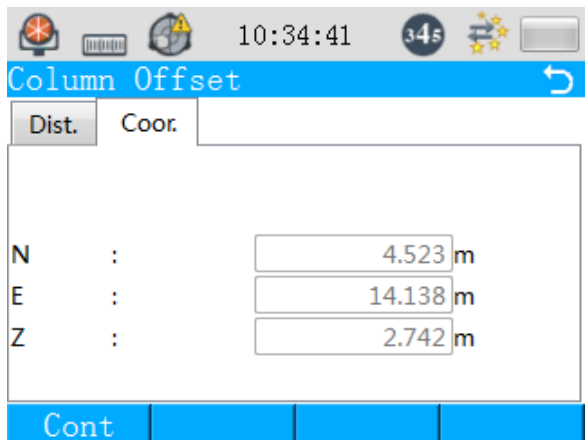
④ Press “F4” or (4) to enter column offset measurement interface.	
⑤ Sight center of column surface (P1) and press “F1” (Meas) to start measuring. (If continuous measurement is adopted, “F4” (Set) shall be pressed when measurement is finished.) When measurement is over, the display will give the prompt to start measurement of angle of point on left edge of column surface (P2).	
⑥ Sight point on left edge of column surface (P2) and press “F4” (Set). When measurement is over, the display will give the prompt to start measurement of angle of point on right edge of column surface (P3).	

⑦ Sight point on right edge of column surface (P3) and press "F4" (Set).



When measurement is finished, elevation difference, horizontal distance and slope distance between instrument and column center (P0) as well as coordinates of target point (N, E, Z) will be calculated and displayed on the screen.



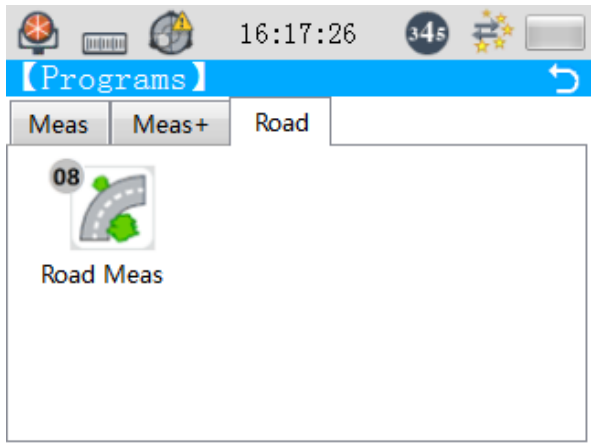
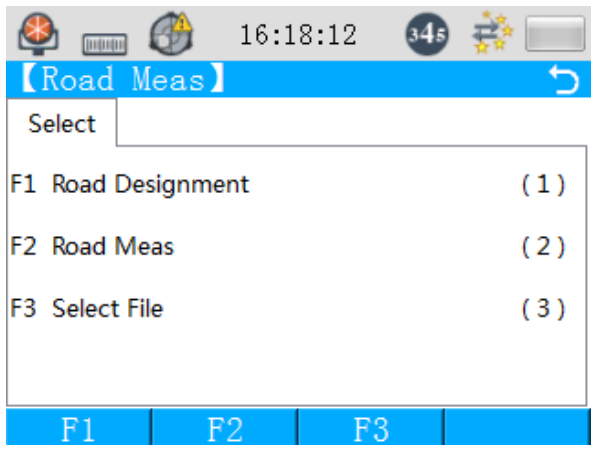


6.11 Road measurement mode

A road file must be selected before starting road measurement and the road file temp is the current road

file by default. See "6.11.3 Road file" for details.

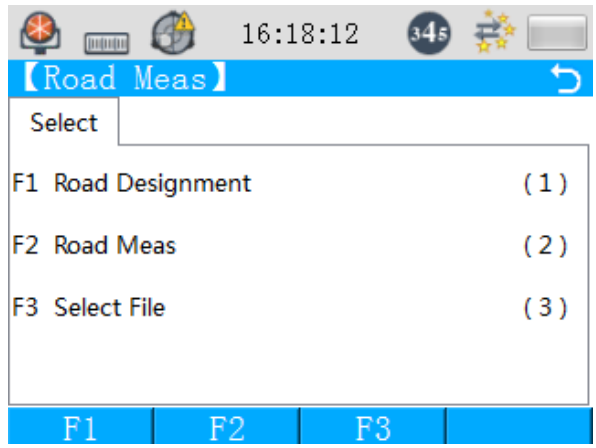
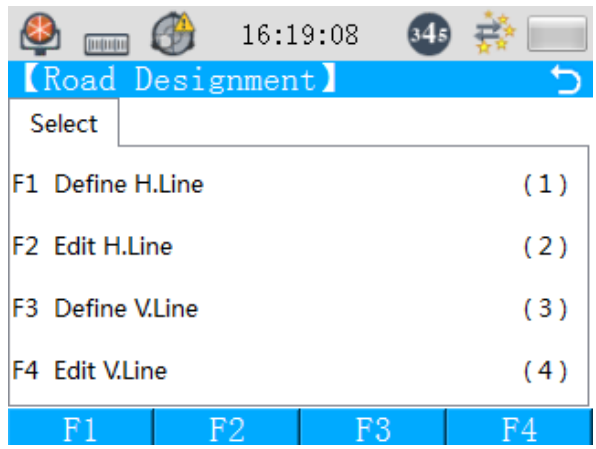
Enter road measurement menu, as follows:

Procedure	Display
① Under Programs mode, press "Road" to reveal page 3 of the Programs interface. Press "↩" to return to previous menu.	
② Press "Road Meas" or (0) and (8) to select road measurement. Press "↩" to return to previous menu.	

6.11.1 Road designment

Enter road designment menu, as follows:

Procedure	Display

① Under Programs mode, press "Road Meas" or (0) and (8) to select road measurement.	
② Press "F1" or (1) to enter road designment menu from road measurement menu.	

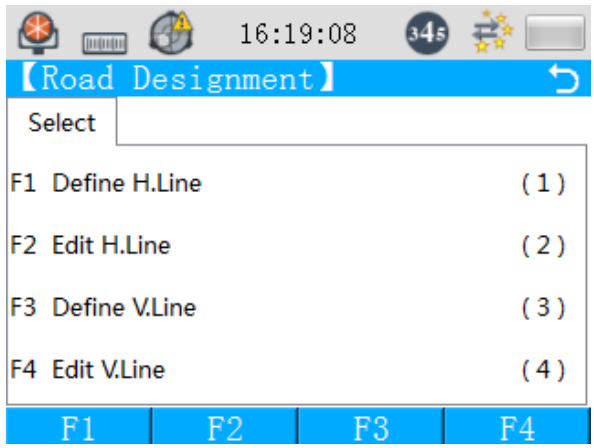
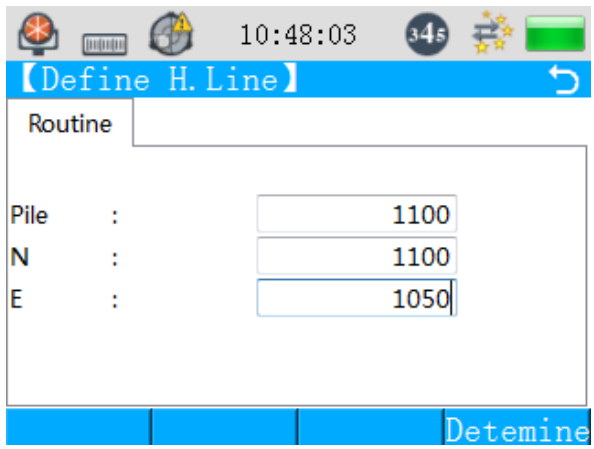
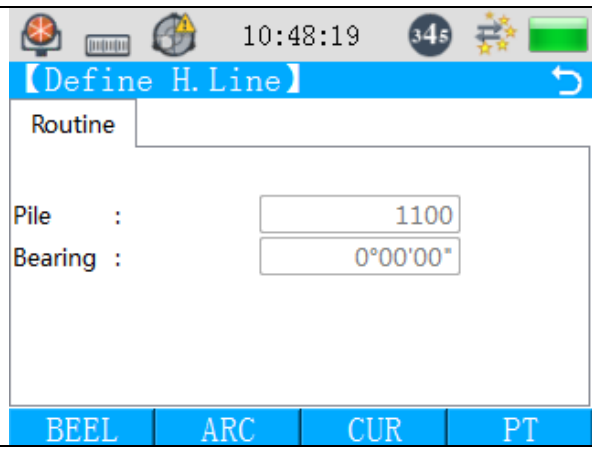
6.11.1.1 Define horizontal alignment (100 data at most)

Select [Define H. Line] from [Road designment] to define plane curve. See annex for the calculation of the alignment.

Horizontal alignment comprises the following elements: start point, beeline, arc and curve. The definition options will remind you to input details of the start point (pile number, N (north) and E (east) coordinates) and then enter the main line input process screen.

The start point consists of such elements as pile number and north and east coordinates. With detailed data of start point entered, press "F4" (Detemine) to enter main line input process screen:

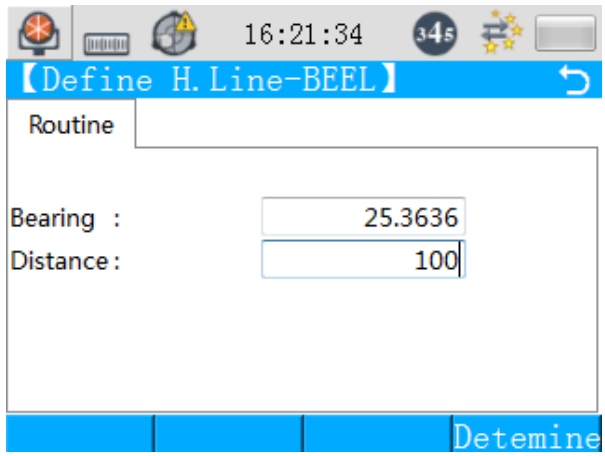
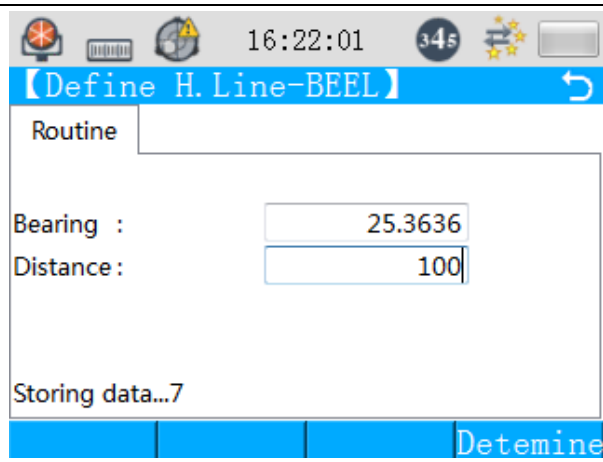
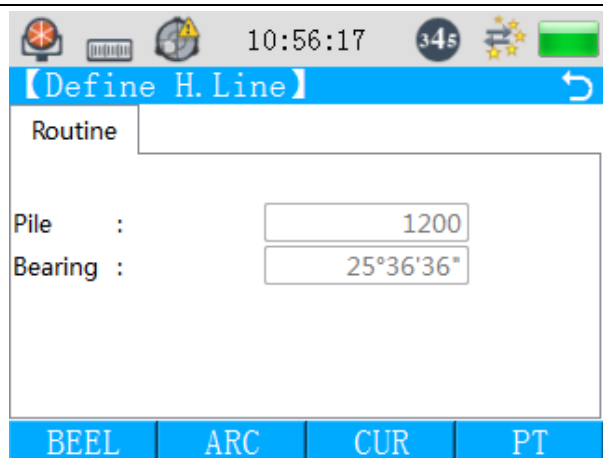
Procedure	Display

① Press "F1" or (1) to enter road designment menu from road measurement menu.	
② Press "F1" or (1) to enter horizontal alignment start point input interface from road designment menu. The start point consists of these elements: pile number and north and east coordinates.	
With detailed data of start point entered, press "F4" (Detemine) to enter main line input process screen: This screen displays the current pile number, tangent bearing at this pile number and function keys to create new line types.	

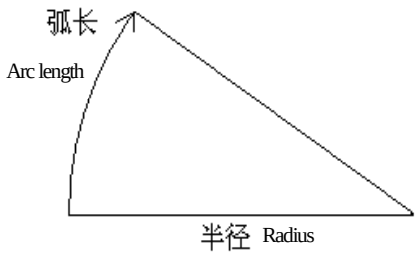
The horizontal alignment system provides four definition functions: beeline, arc, curve and point. Press one of the four function keys, enter details of the pile number and elements of alignment will be generated. Press "F4" (Detemine) and the system software will calculate the new pile number and bearing and return to the main alignment screen; then, you can define another line type. New alignment elements can only be added to end portion of the original alignment file.

Beeline

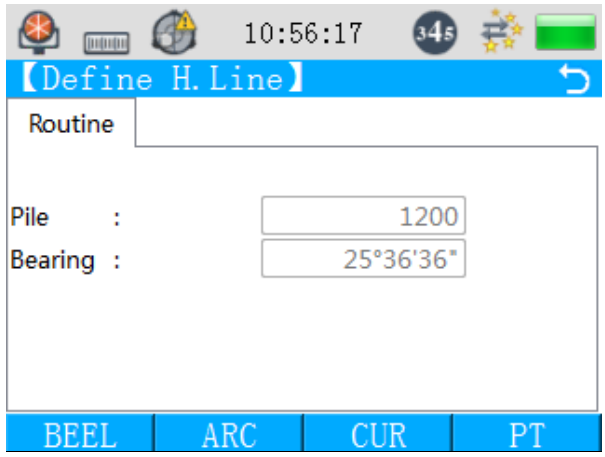
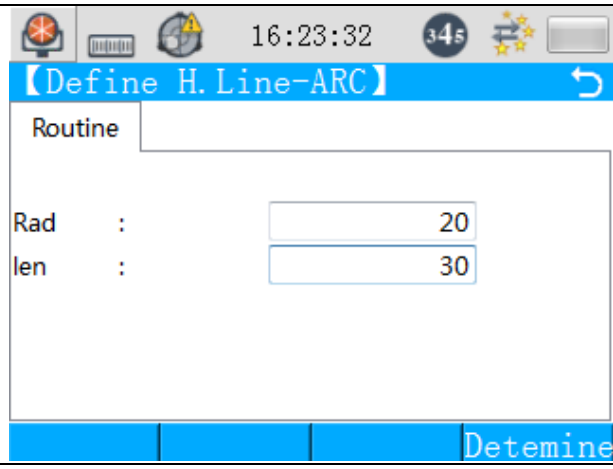
With start point or other line types defined, you can proceed to define beeline. Beeline comprises bearing and distance and the distance shall not be negative.

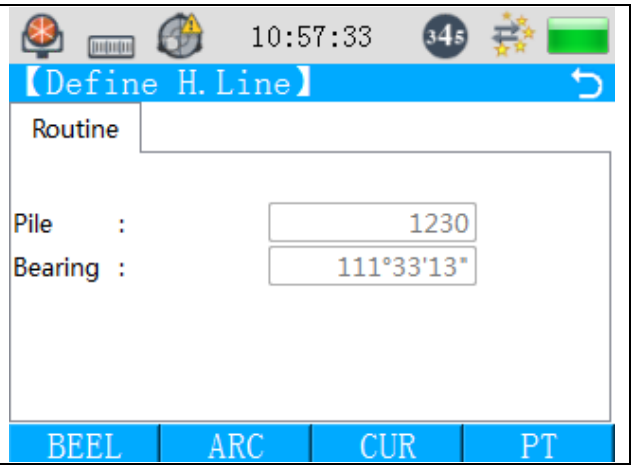
Procedure	Display
① Press "F1" (BEEL) to enter beeline definition screen from input process screen. ② Enter bearing and length of the beeline.	
② Press "F4" (Detemine) to save the alignment data.	
③ With the alignment data stored, it will show pile number at the end of beeline and bearing of the pile. •Then, you can define other arcs and curves. • If the beeline is in the middle of the route, bearing of the beeline will be calculated with aforesaid elements. To change the bearing, you can manually enter a new bearing.	

Arc

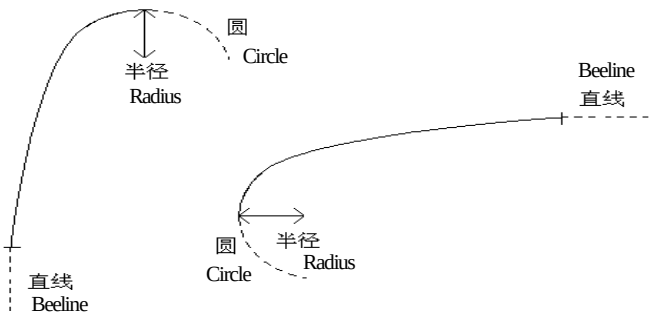


Press the button ARC in main line input process screen and you can define the arc which consists of radius and arc length. Radius is defined as moving direction along the arc. The radius is positive when it turns right and negative when it turns left. The arc length shall not be negative.

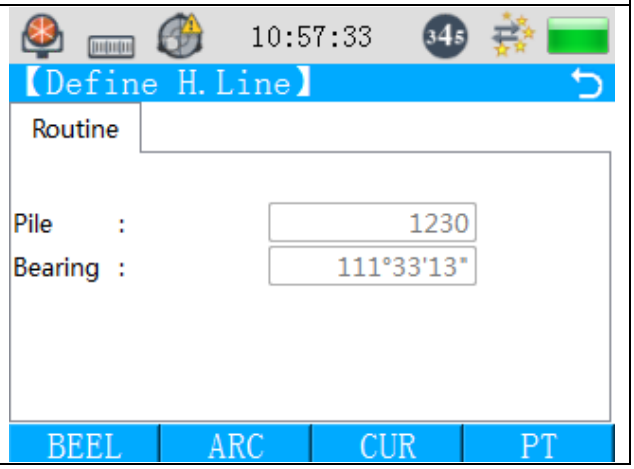
Procedure	Display
① Press "F2" (ARC) in input process screen and you can enter arc definition screen.	
② Enter radius and arc length. Press "F4" (Detemine) to save the data.	

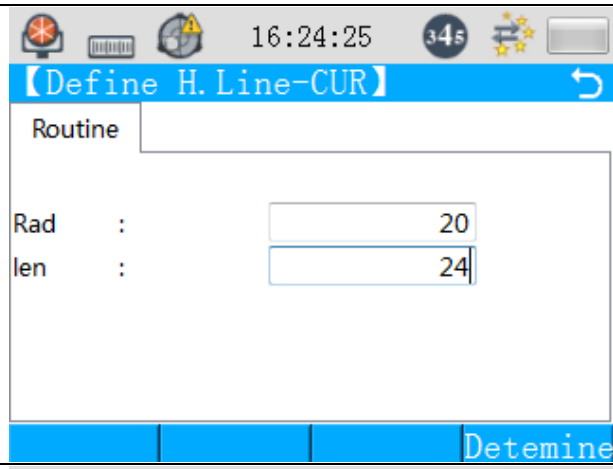
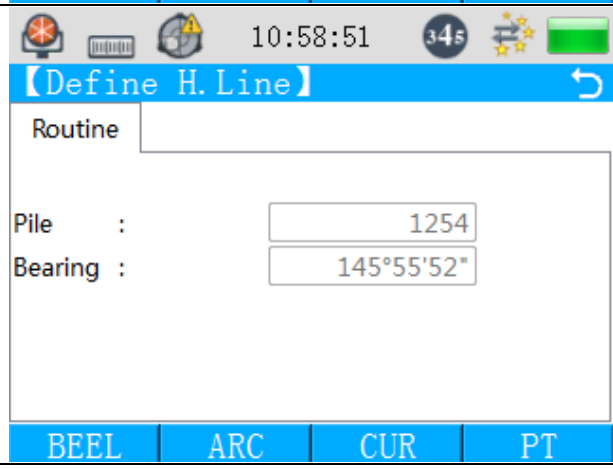
③ With the alignment data saved, it will return to the main input screen.	

Curve

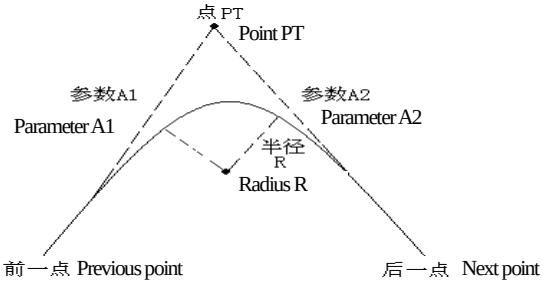


Press the button CUR in main line input process screen and you can define the curve which comprises the minimum radius and arc length. The definition of positive and negative radius is the same as the arc. Similarly, its arc length shall not be negative.

Procedure	Display
① Press "F3" (CUR) in input process screen and you can enter curve definition screen.	

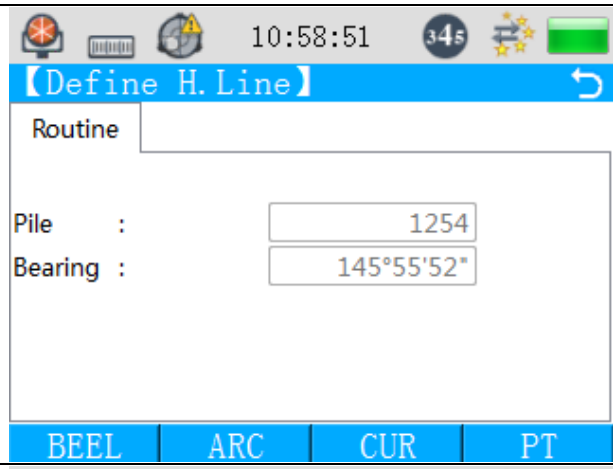
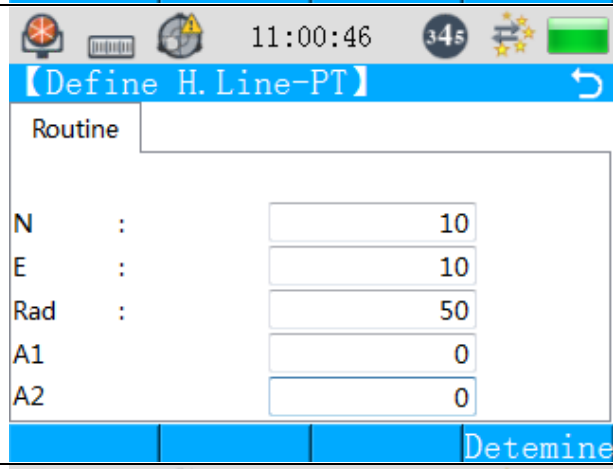
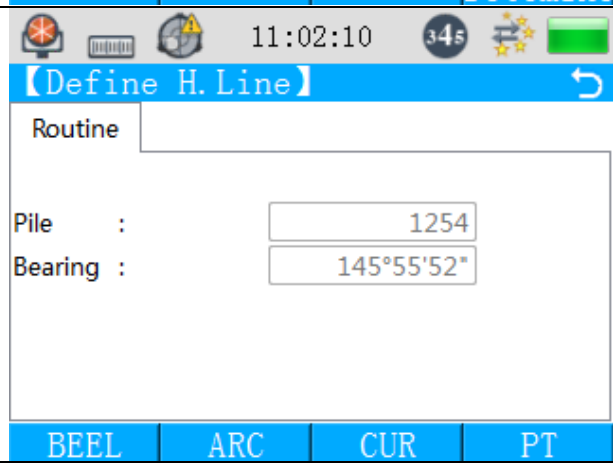
② Enter minimum radius and arc length of the curve.	
③ Press "F4" (Detemine) to save the data and return to main screen. If "⮌" is pressed, it will return to main input screen without saving the data.	

Point



Press the button PT in main line input process screen and you can define the point which comprises coordinates, radius as well as A1 and A2 parameters of the curve. The radius, A1 and A2 shall not be negative. If radius is entered, an arc of specified radius will be inserted between current point and next point. If parameters of the curve A1 and A2 are entered, a curve of specified length will be inserted between the beeline and the arc.

Procedure	Display

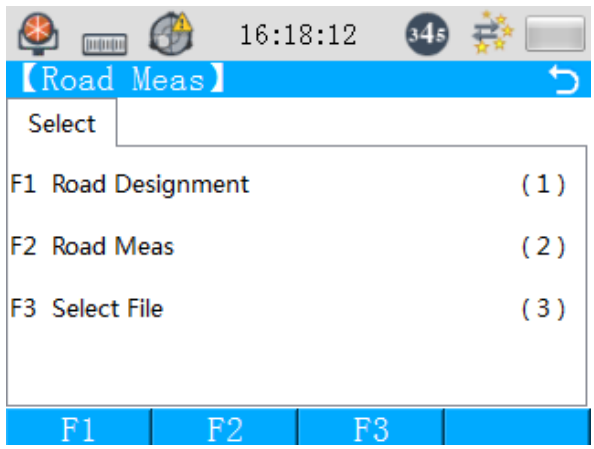
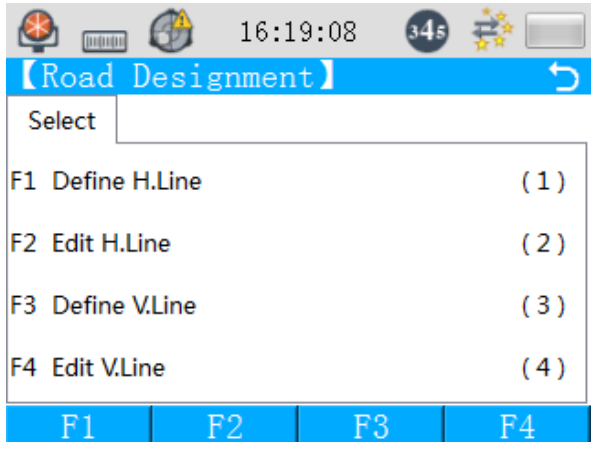
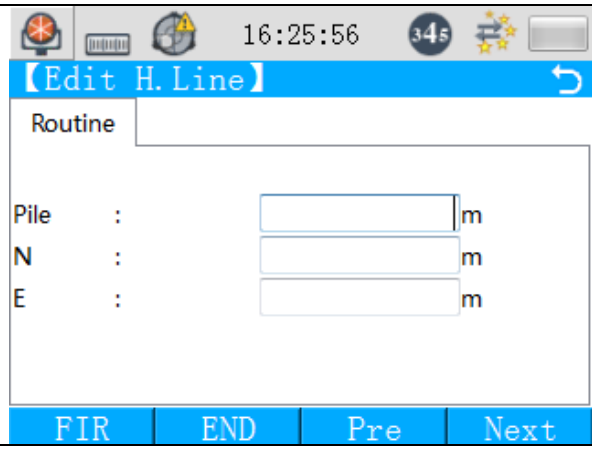
① Press "F4" (PT) in input process screen and you can enter point definition screen.	
② Enter N and E coordinates, radius, A1 and A2.	
③ Press "F4" (Detemine) to save the data and return to main screen. If "⮌" is pressed, it will return to main input screen without saving the data.	

[Note]: When A1 and A2 are entered based on L1 and L2 curve lengths, A1 and A2 shall be calculated with the following formulas:

$$A_1 = \sqrt{L_1 \cdot R} \qquad A_2 = \sqrt{L_2 \cdot R}$$

Alignment can only be modified with the alignment editing menu.

6.11.1.2 Edit horizontal alignment

Procedure	Display
① Under Programs mode, press "Road Meas" or (0) and (8) to select road measurement.	
② Press "F1" or (1) to enter road designment menu from road measurement menu.	
③ In road designment menu, press "F2" or (2).	

Horizontal alignment editing interface:

FIR: Press this button and the cursor will move to the beginning of the file.

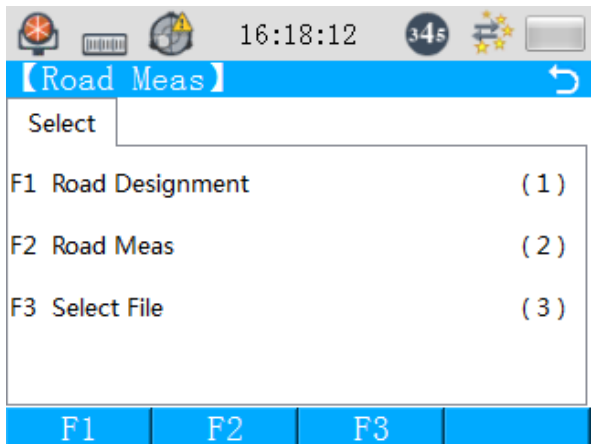
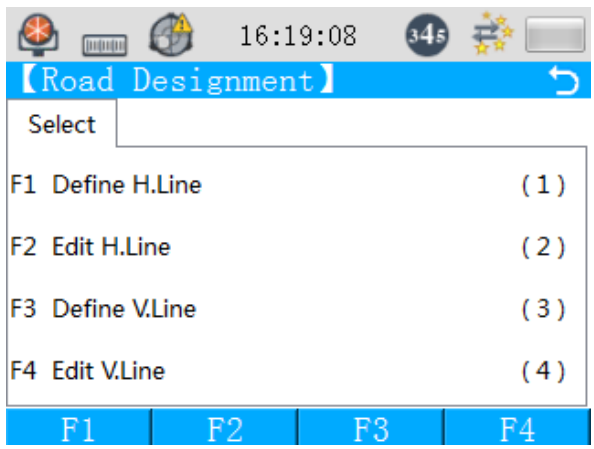
END: Press this button and the cursor will move to the end of the file.

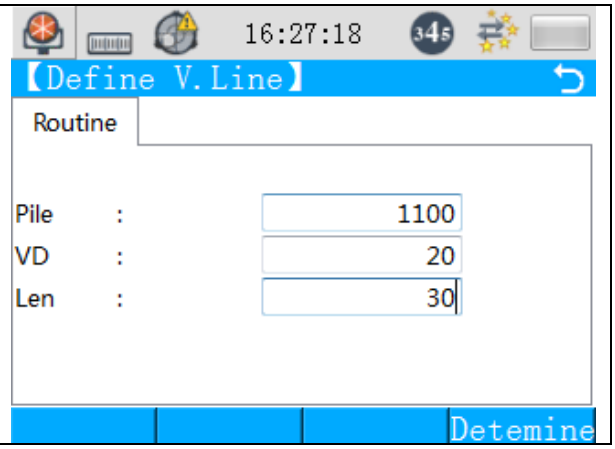
Pre: This button is used to display data of previous point. Press it to show data of previous point.

Next: This button is used to display data of next point. Press it to show data of next point.

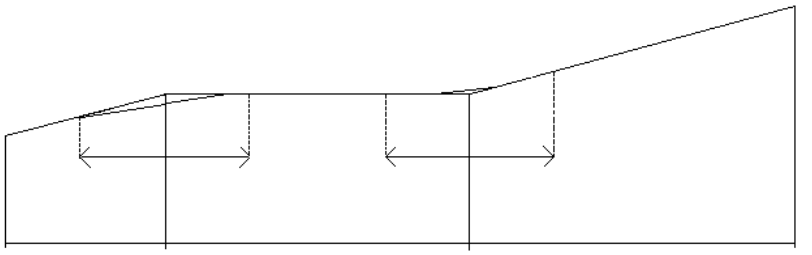
6.11.1.3 Define vertical alignment (100 data at most)

In road measurement menu, press "F1" or (1) ([Road Designment]) to enter road designment menu. In this menu, press "F3" or (3) ([Define V. Line]) to enter vertical alignment definition screen:

Procedure	Display
① Under Programs mode, press "Road Meas" or (0) and (8) to select road measurement.	
② Press "F1" or (1) to enter road designment menu from road measurement menu.	

③ In road designment menu, press "F3" or (3) to enter vertical alignment definition screen.	

Vertical alignment comprises a group of intersection points which comprise pile number, elevation and curve length. The curve lengths of start point and end point of vertical alignment must be zero.



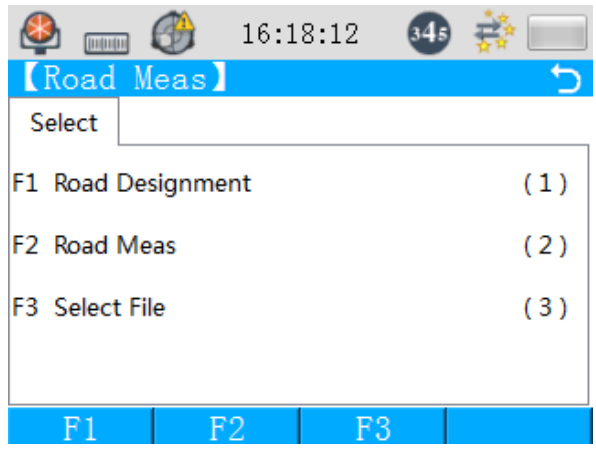
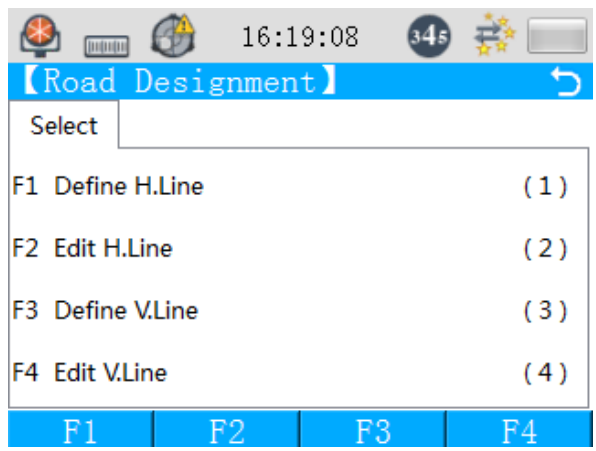
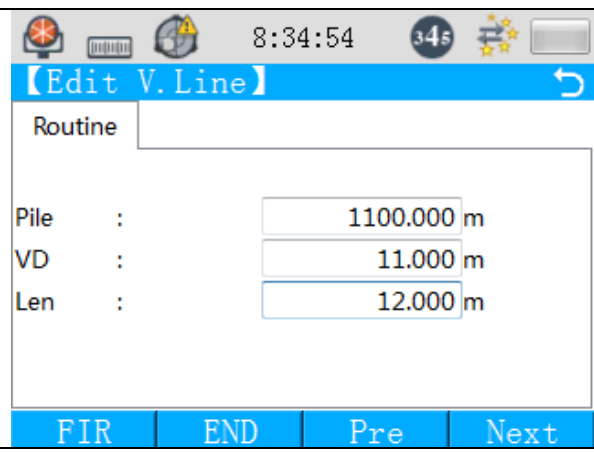
Pile number	1000	1300	1800	2300
Elevation	50	70	60	90
Length	0	300	300	0

The intersection points can be entered into the vertical alignment screen in any order. When data of a point is entered, press "F4" (Detemine) to save data of the point and enter input screen for the next point, or press "⮌" to withdraw from the vertical alignment screen without saving the data.

6.11.1.4 Edit vertical alignment

In road measurement menu, press "F1" or (1) ([Road Designment]) to enter road designment menu. Then press "F4" or (4) ([Edit V. Line]) to enter vertical alignment editing screen:

Procedure	Display

① Under Programs mode, press "Road Meas" or (0) and (8) to select road measurement.	
② Press "F1" or (1) to enter road designment menu from road measurement menu.	
③ Press "F4" or (4) in road designment menu to enter vertical alignment editing screen.	

The alignment data can be processed with this menu and the operations are the same as that for editing horizontal alignment data. See "6.11.1.2 Edit horizontal alignment".

6.11.2 Road layout

Select [Road Mea] from road measurement menu:

For the purpose of road layout, line type must be defined first. Method for definition of horizontal alignment: manually enter the data in [Road Designment] process. The definition of vertical horizontal data is optional, but it is mandatory if fill or cut is required. The method is the same as that for horizontal alignment.

Requirements for road layout data are as follows:

Offset:

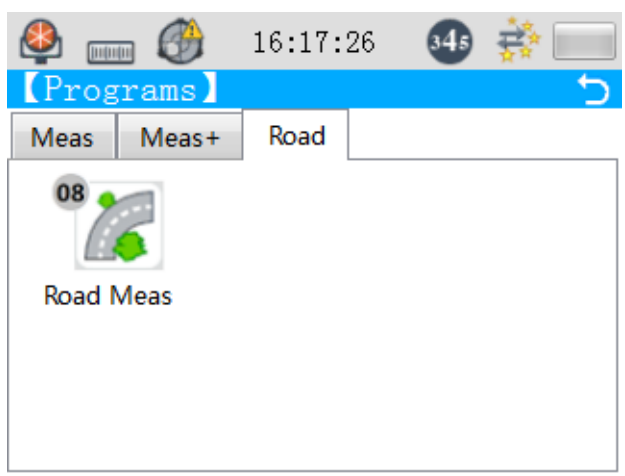
Left: horizontal distance between left pile and center line; right: horizontal distance between right pile and center line

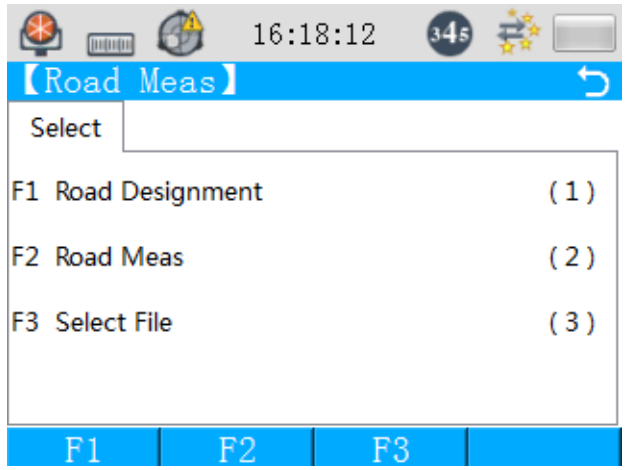
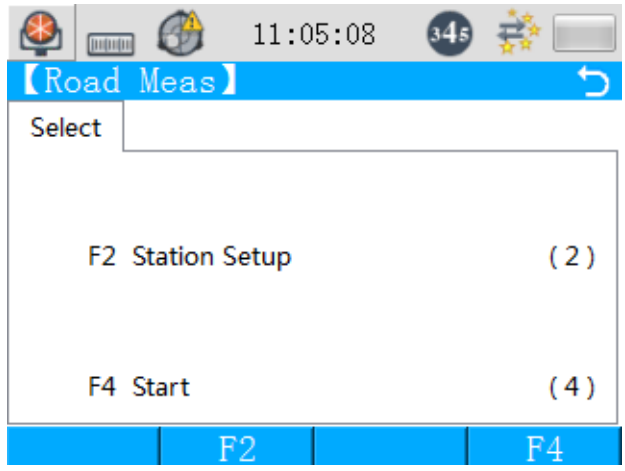
Elevation difference:

Left/right: elevation difference between left/right pile and center line point

6.11.2.1 Road layout menu

You can enter the road layout menu by following the procedure below:

Procedure	Display
① Under Programs mode, press "Road" to reveal page 3 of Programs interface. Press "⮌" to return to previous menu.	

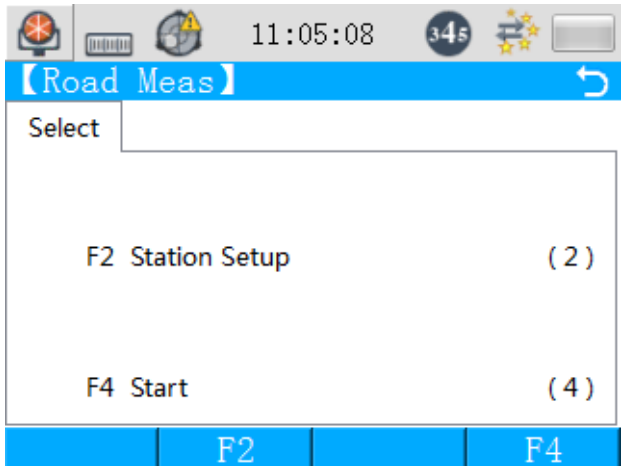
② Press “Road Meas” or (0) and (8) to select road measurement.	
③ In road measurement menu, press “F2” or (2) to enter road layout menu.	

6.11.2.2 Station setup for road layout

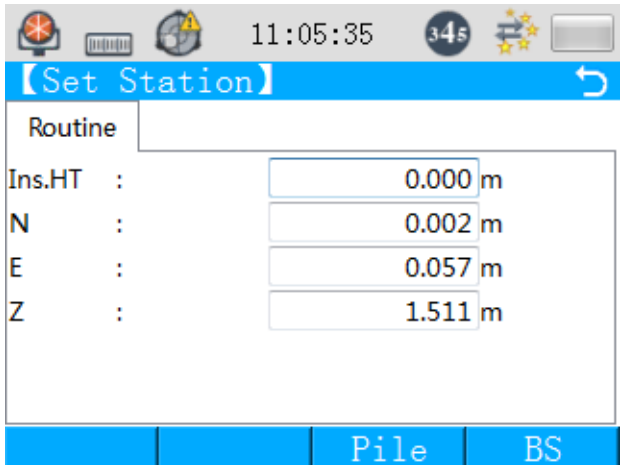
The station for road layout can be set by following the procedure below:

Procedure	Display

① In road measurement menu, press "F2" or (2) to enter road layout menu.



② To set station coordinates and azimuth, press "F2" or (2) to enter station setup interface.

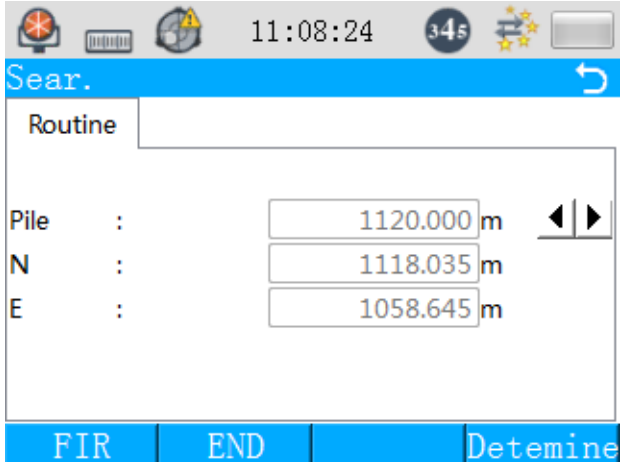


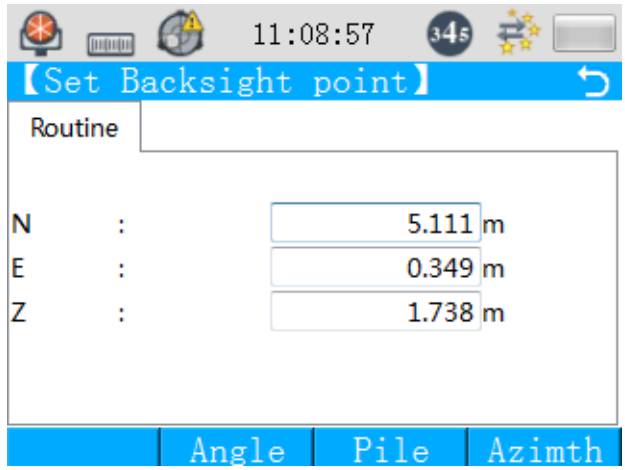
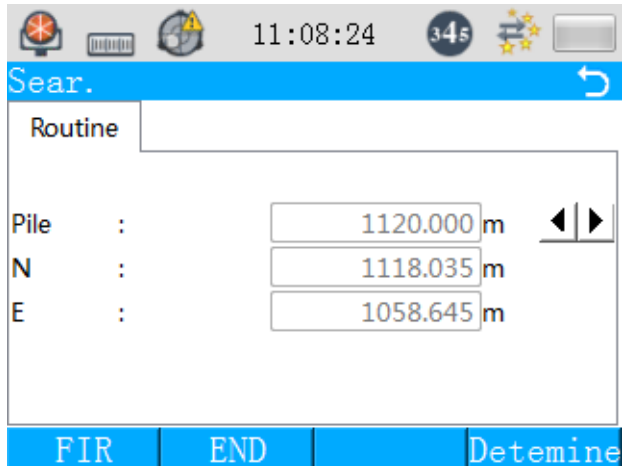
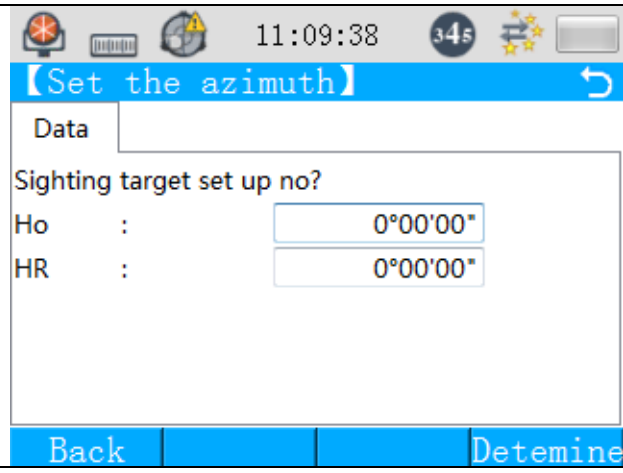
Press "F3" (Pile) to search for station coordinates based on pile number.

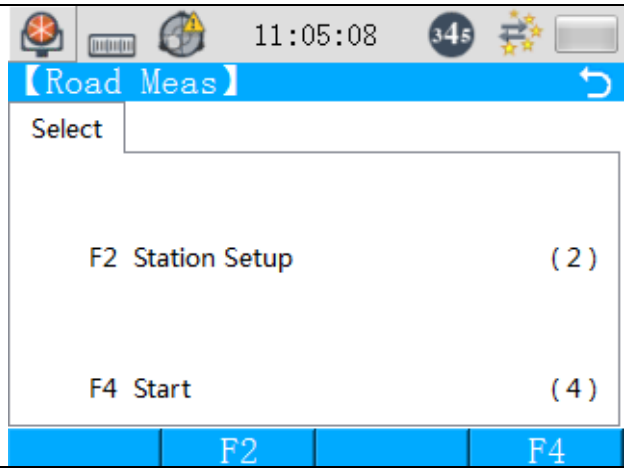
Press "F1" (FIR) to display data of the first pile.

Press "F2" (END) to display data of the last pile.

Press "F4" (Detemine) to set the pile as the station and return to station setup interface.

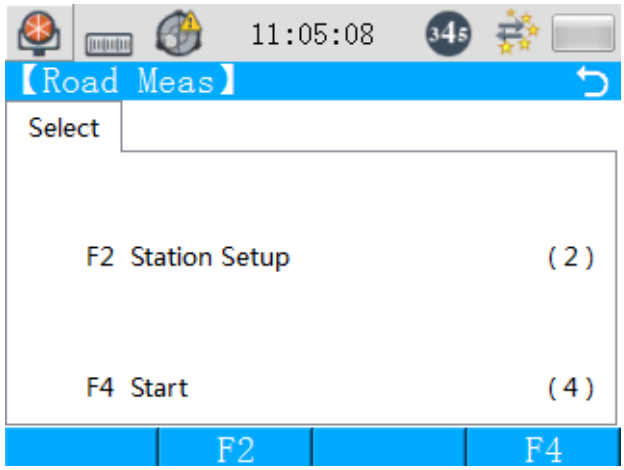


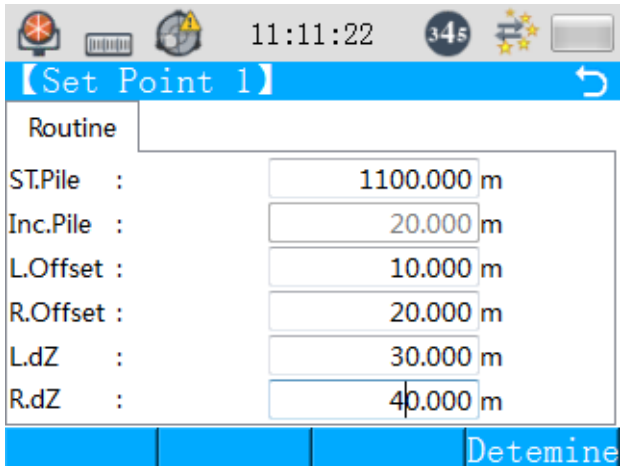
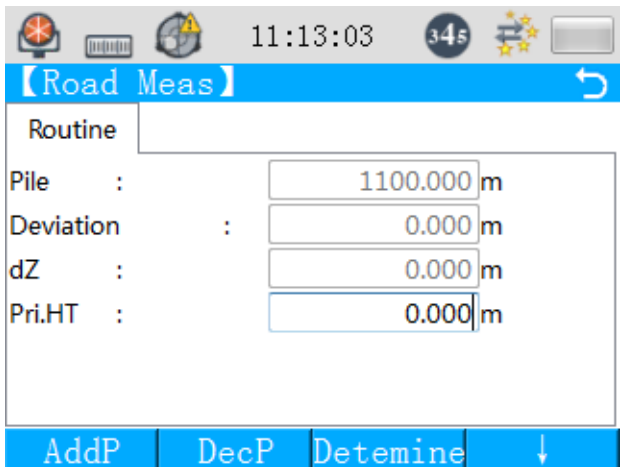
③ Press "F4" (BS) in station setup interface to enter backsight point setting interface. Press "F3" (Pile) to search for backsight point coordinates based on pile number. Press "F1" (FIR) to display data of the first pile. Press "F2" (END) to display data of the last pile. Press "F4" (Detemine) to set the pile as the station and return to backsight point setting interface.	 
④ Press "F4" (Azimth) in backsight point setting interface to enter azimuth setting interface. To set the azimuth, press "F4" (Detemine).	

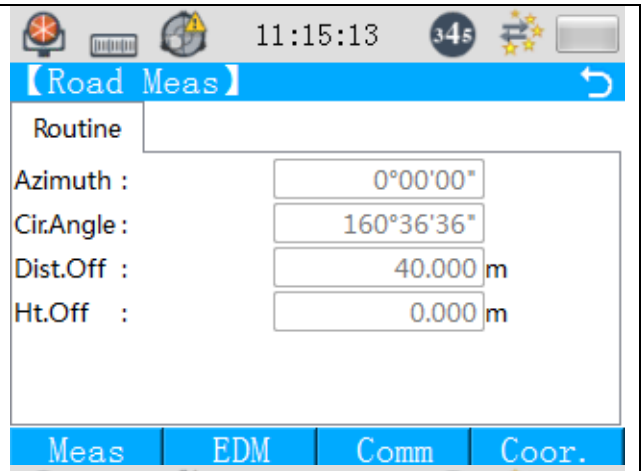
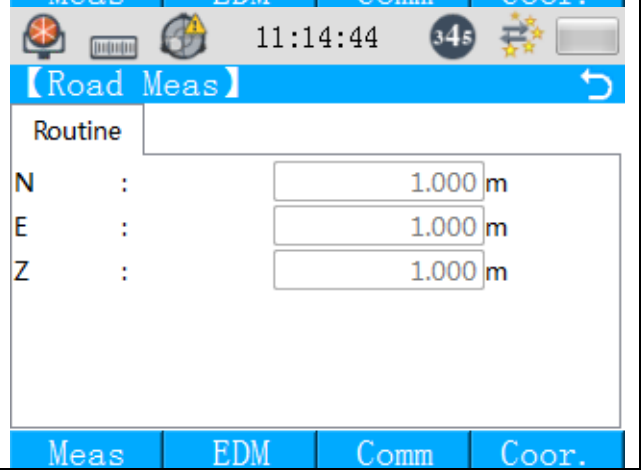
⑤ With azimuth set, press "F4" (Detemine) to return to road layout interface.	

6.11.2.3 Road curve layout

The station for road layout can be set by following the procedure below:

Procedure	Display
① In road measurement menu, press "F2" or (2) to enter road layout menu.	

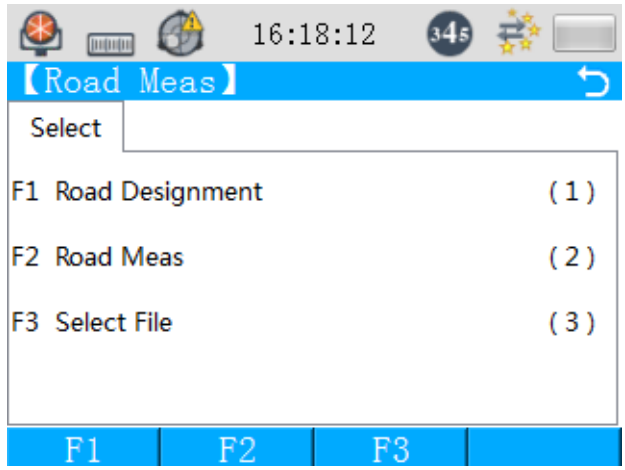
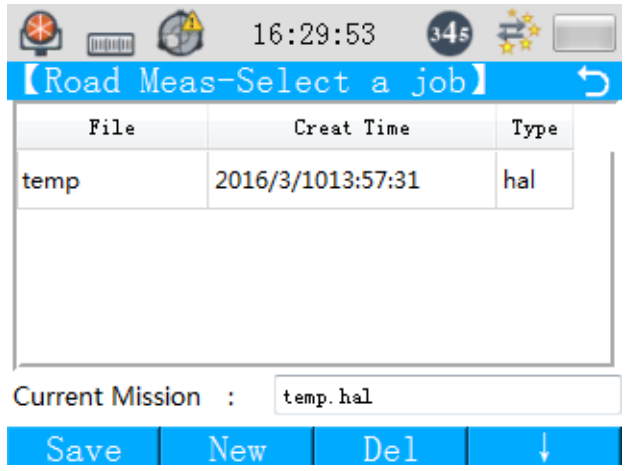
② In road layout menu, press "F4" or (4) to enter start point setting interface.	
③ Enter start point pile number and pile increment and then press "F4" (Detemine). Enter road layout setting interface. **Left offset ("F1" (LOff)):** button used for staking left side pile; **Right offset ("F1" (ROff)):** button used for staking right side pile; **Add pile ("F1" (AddP)):** button used to increase pile number (the increased value equals current pile number plus pile increment); **Decrease pile ("F2" (DecP)):** button used to decrease pile number (the decreased value equals current pile number minus pile increment) **Prism height:** prism height at the pile position	

④ With pile number, offset and height difference of layout point set, press "F3" (Detemine) to enter road layout interface. Press "F1" (Meas) to measure distance offset and height offset of layout point. Press "F2" (EDM) to select EDM setting. Press "F3" (Comm) to show distance offset and height offset of measuring point and layout point. Press "F4" (Coor.) to show coordinates of measuring point.	 

6.11.3 Road file

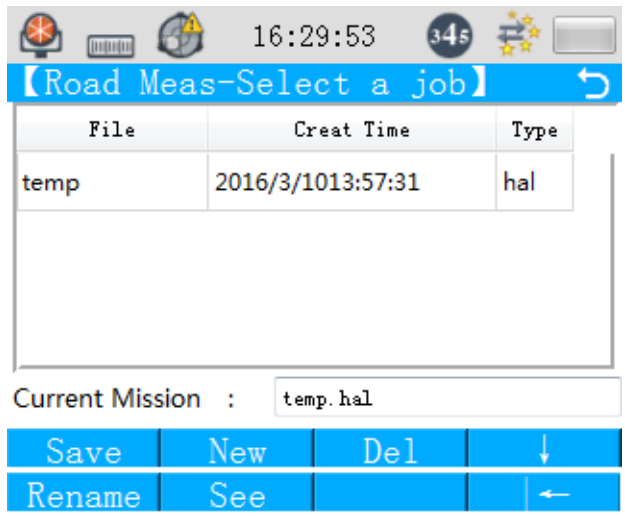
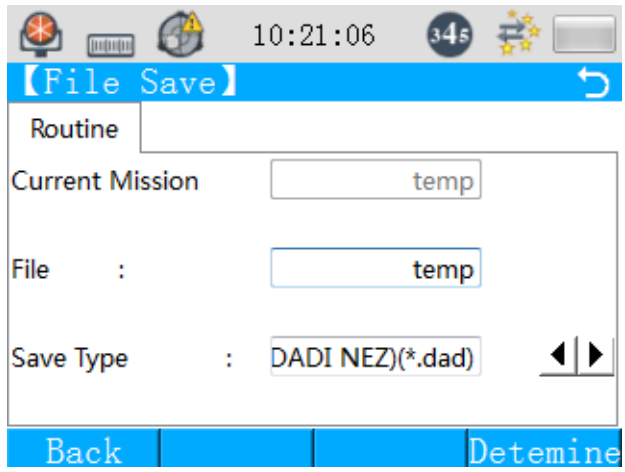
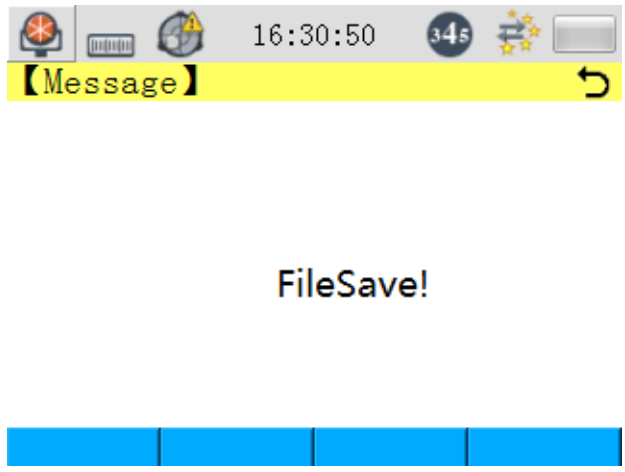
Enter road file interface, as follows:

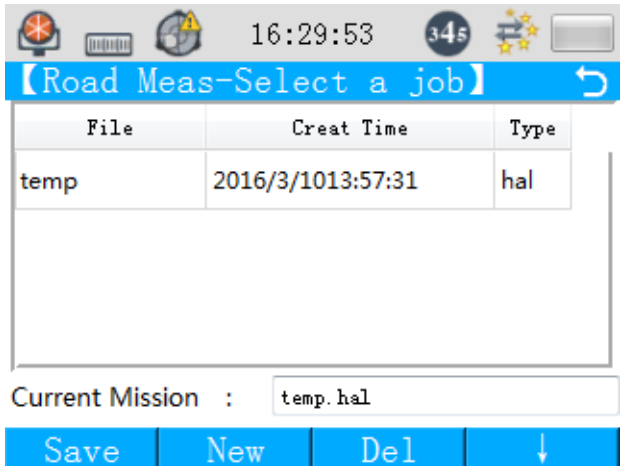
Procedure	Display

① Under Programs mode, press "Road Meas" or (0) and (8) to select road measurement. Press "↩" and you can return to previous menu.	
② Press "F3" or (3) in road measurement menu to enter road file interface and the status of each file will be displayed (file name, extension and creation date). Press "↩" and you can return to previous menu.	

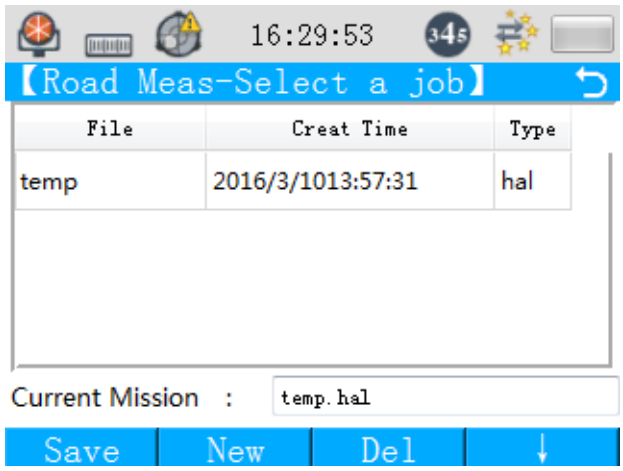
6.11.3.1 Save road file as

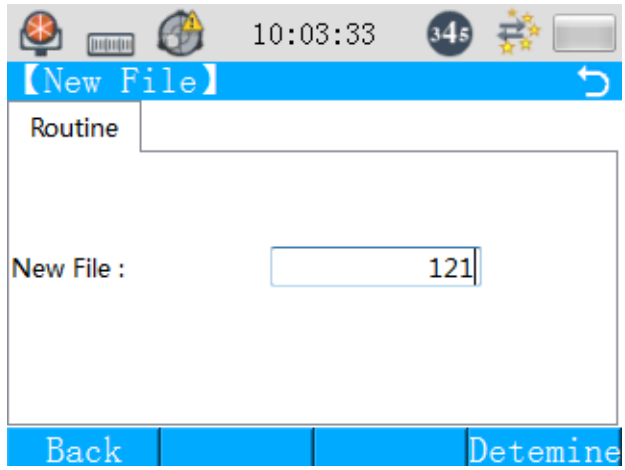
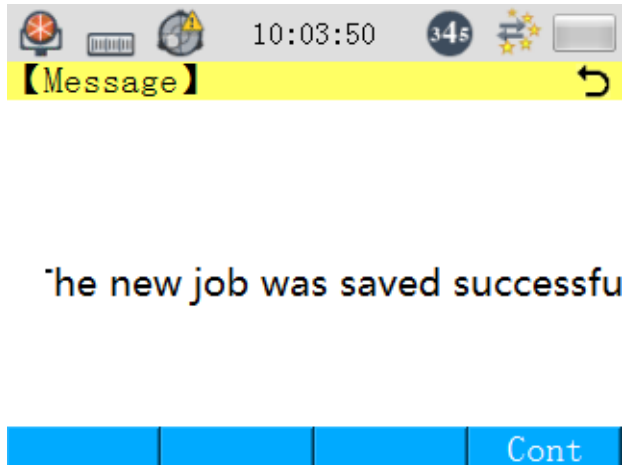
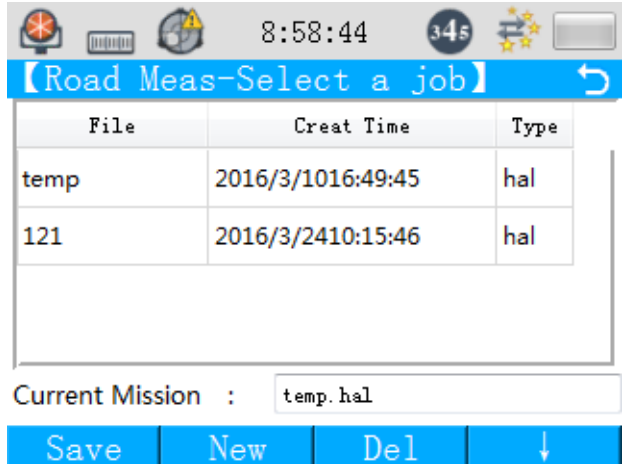
Procedure	Display

① In Road measurement menu, press "F3" or (3) to enter road file interface.	
② Select a file by clicking it and press "F1" (Save) to enter road file save interface. The current file name will be displayed. Enter the file name (7 characters at most) to be saved and select the save type.	
③ Press "F4" (Detemine) to save the file as the new file.	

	
The file is saved in the folder Mounted_Volume\fdp2\output.	

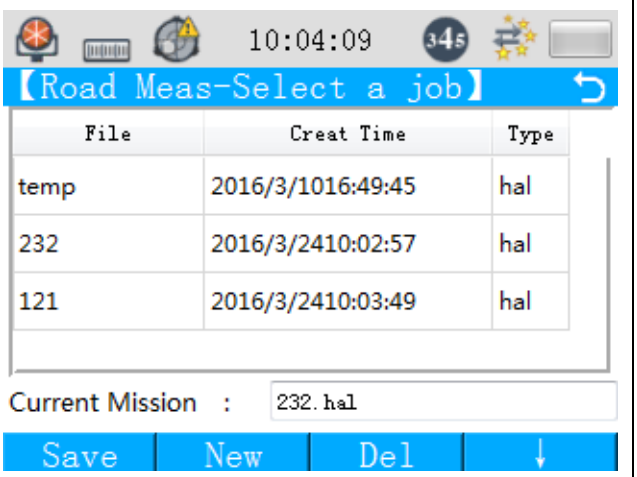
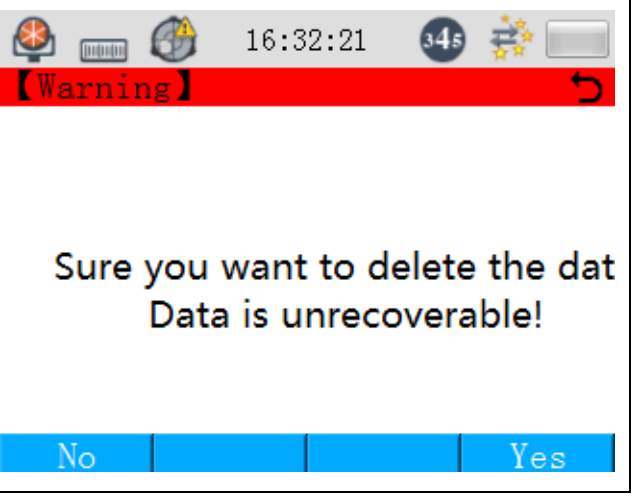
6.11.3.2 Create new road file

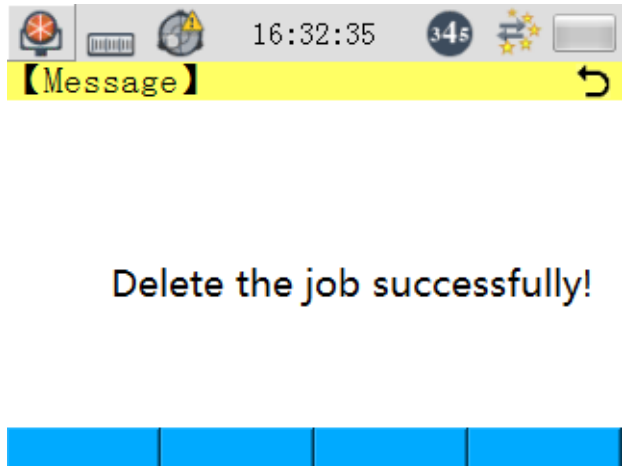
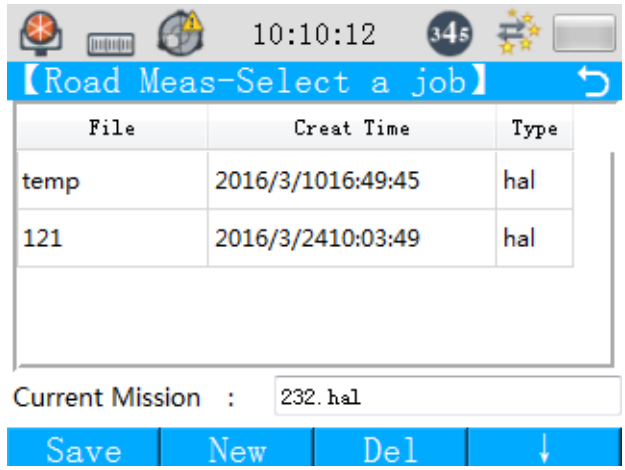
Procedure	Display
① In Road measurement menu, press “F3” or (3) to enter road file interface.	

② In road file interface, press "F2" (New) to enter new file interface. Enter name of the new file (7 characters at most).	
③ To save the new file, press "F4" (Detemine).	
④ Press "F4" (Cont) to return to road file interface.	

6.11.3.3 Delete road file

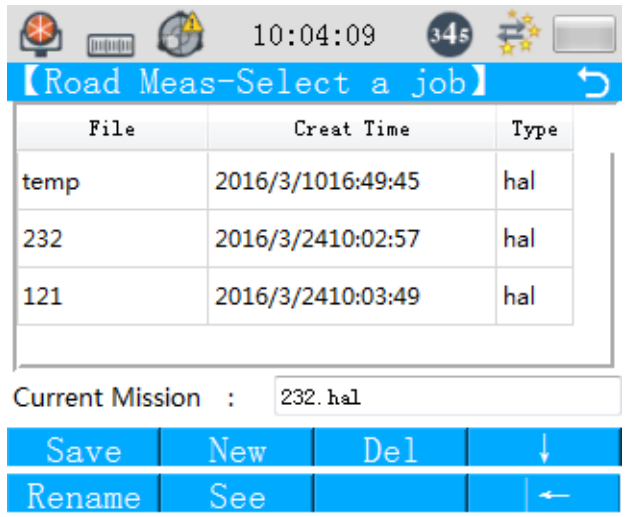
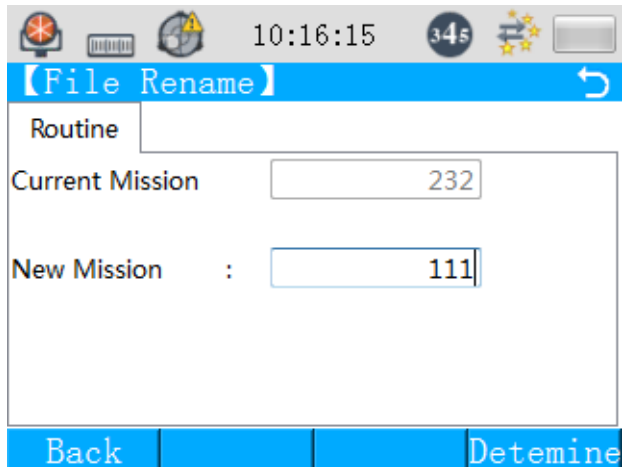
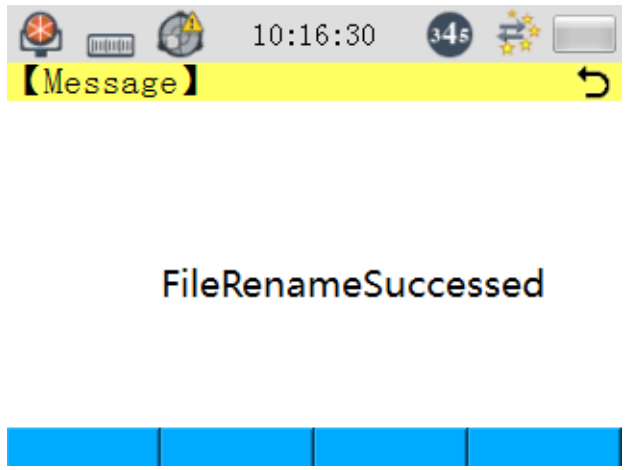
When the file is deleted, another road file shall be selected before conducting road measurement.

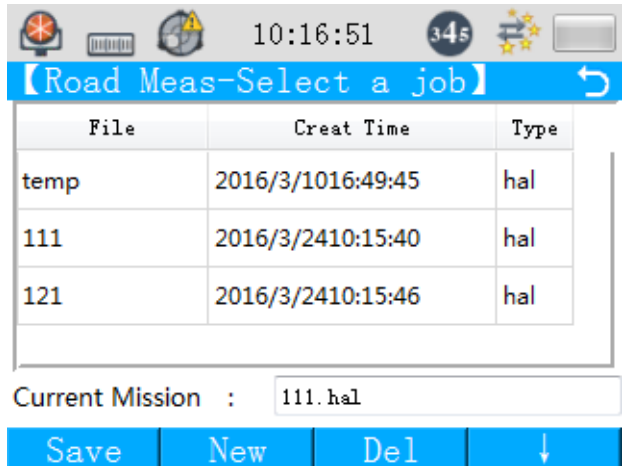
Procedure	Display
① In Road measurement menu, press "F3" or (3) to enter road file interface.	
② Select a file by clicking it and then press "F3" (Del) to enter road file deletion prompt interface.	

③ To delete the file, press "F4" (Yes). When the file is deleted, another road file shall be selected before conducting road measurement.	 

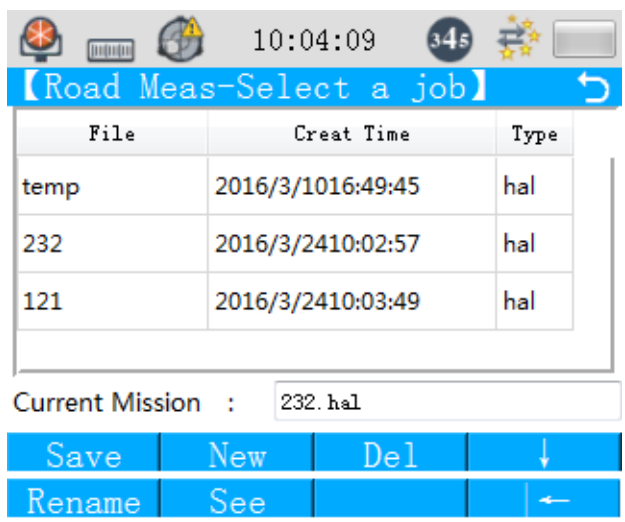
6.11.3.4 Rename road file

Procedure	Display

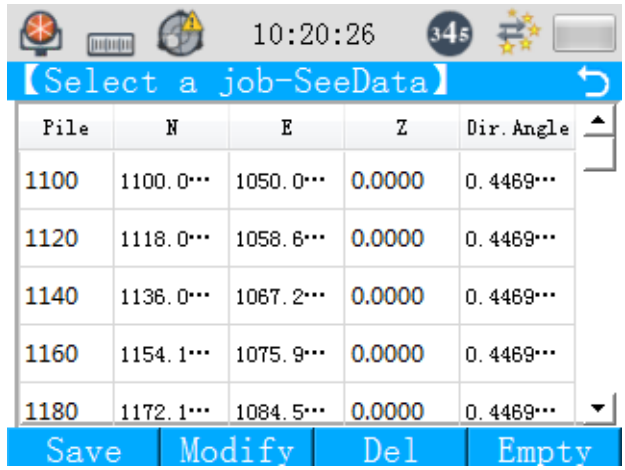
① In Road measurement menu, press "F3" or (3) to enter road file interface.	
② Select a file by clicking it and then press "F1" (Rename) to enter road file rename interface.	
③ Press "F4" (Yes) to confirm to rename the file.	

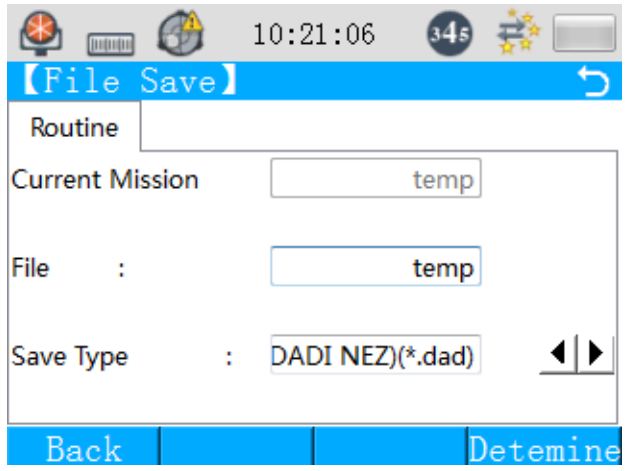
6.11.3.5 View road file

Procedure	Display
① In Road measurement menu, press “F3” or (3) to enter road file interface.	

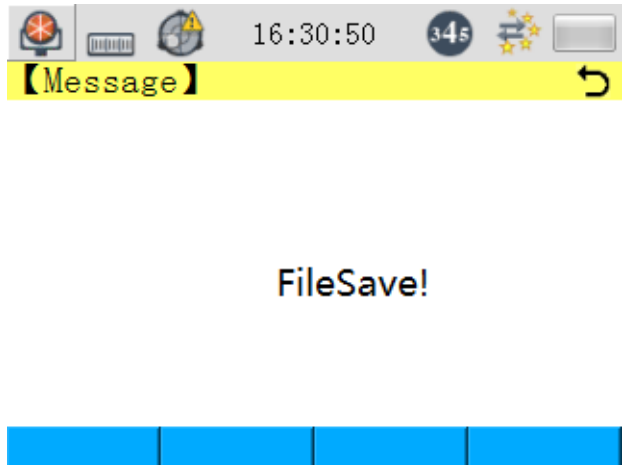
② Select a file by clicking it and then press “F2” (See) to enter road file viewing interface.



③ To save the file in road file viewing interface, press “F1” (Save).



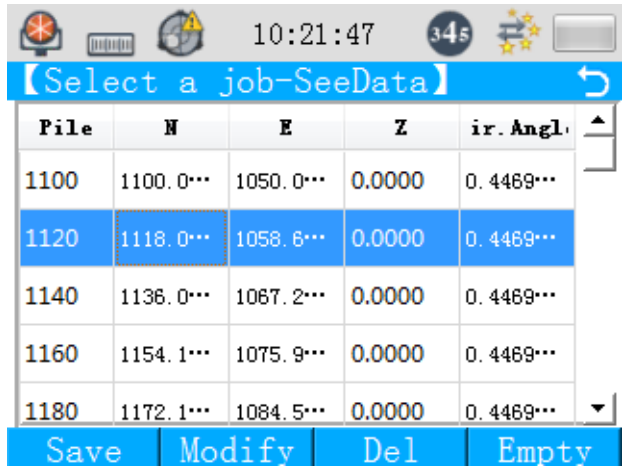
Press “F4” (Detemine) to confirm to save the file.

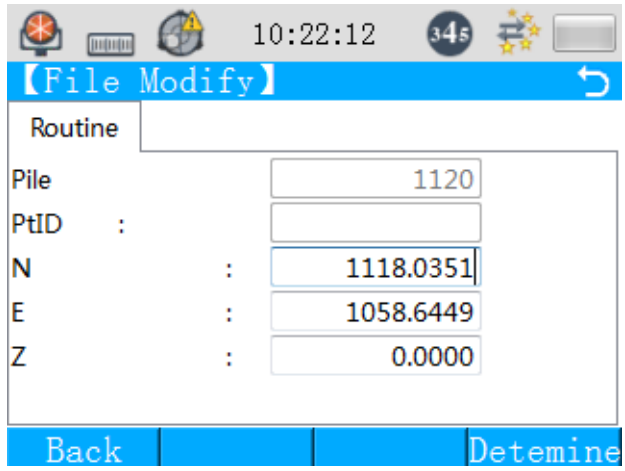


④ To modify the data in the road file viewing interface, first select a row data by clicking it.

Then, press "F2" (Modify) to modify the row data.

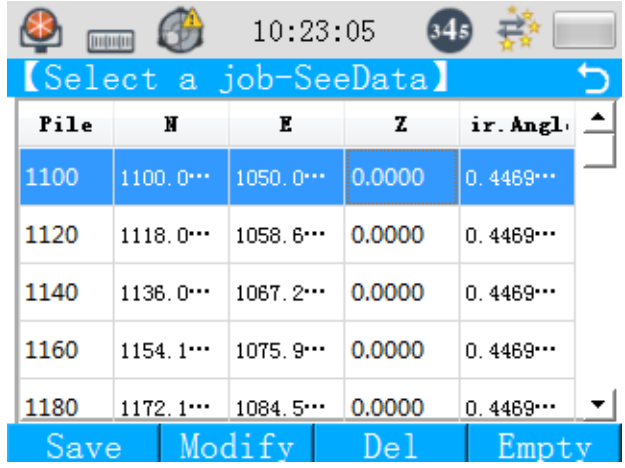
To save the modified data, press "F4" (Detemine).



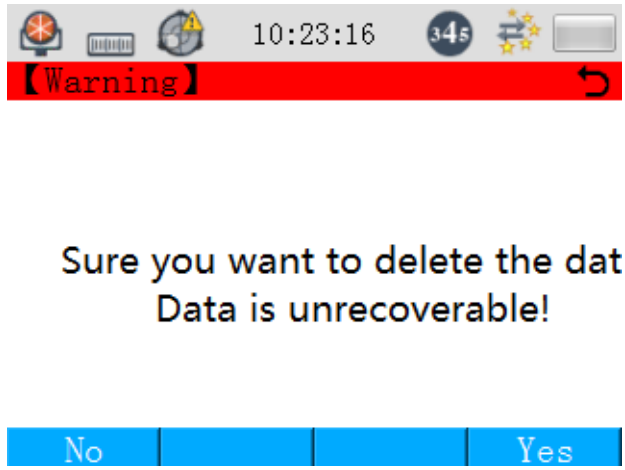


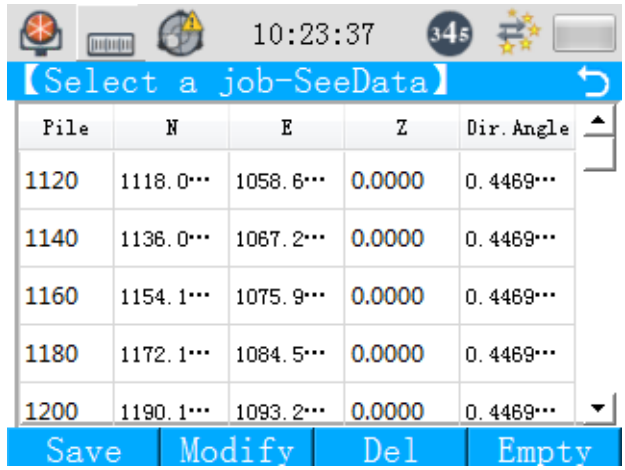
⑤ To delete the data in the road file viewing interface, first select the row data by clicking it.

Then, press "F3" (Del).

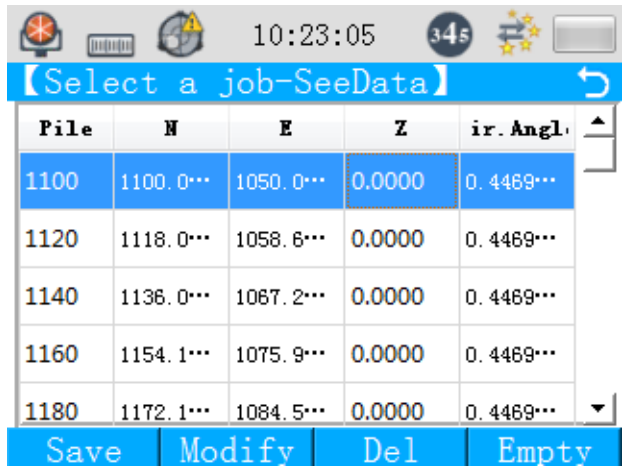


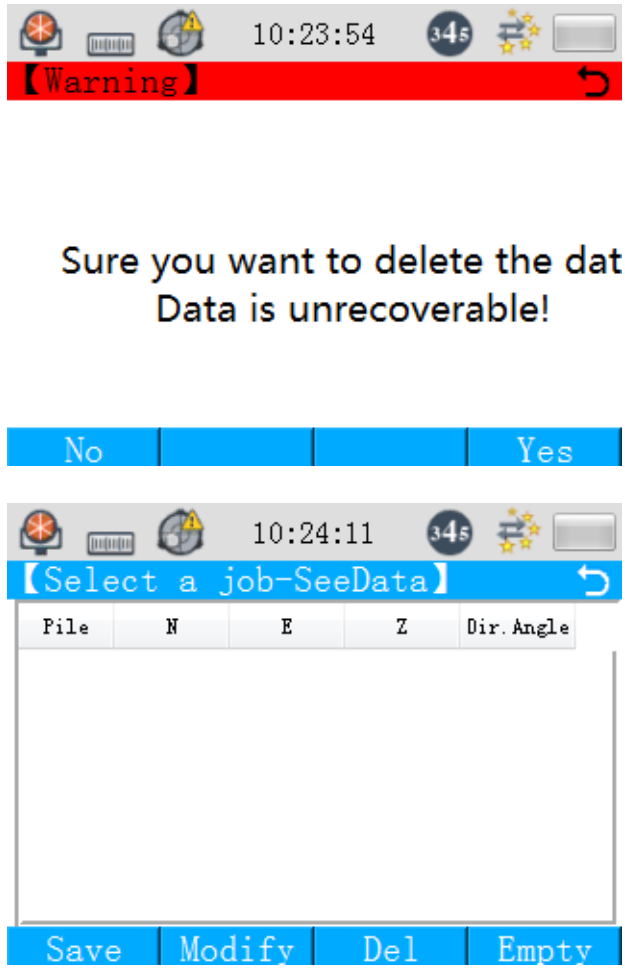
Press "F4" (Yes) to confirm to delete the data.





⑥ To empty data in the road file viewing interface, press "F4" (Empty).

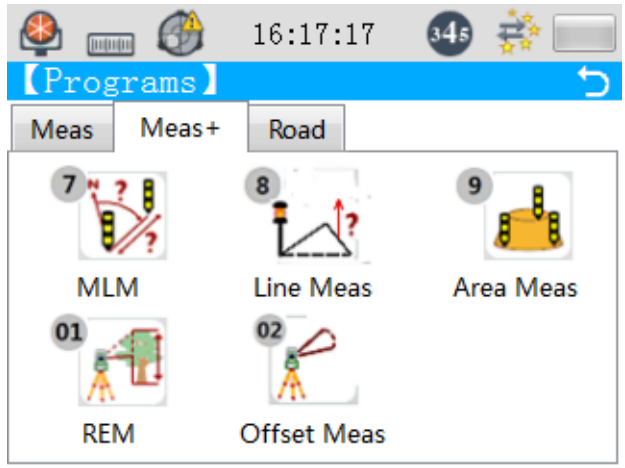
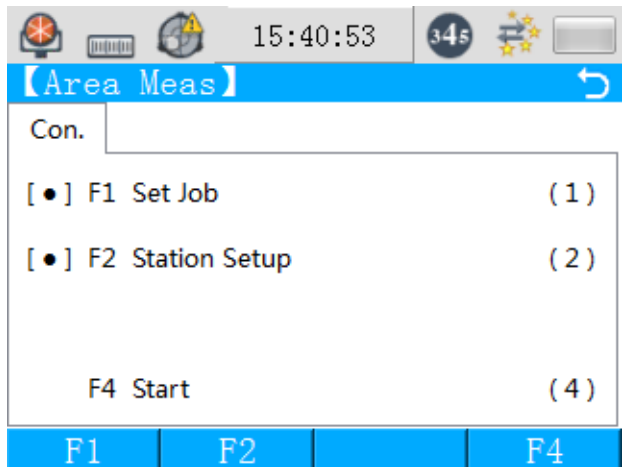
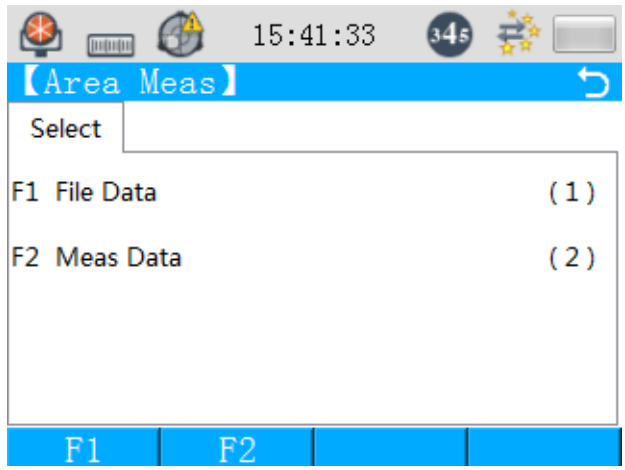


Press “F4” (Yes) to confirm to empty the data.	

6.12 Area measurement mode

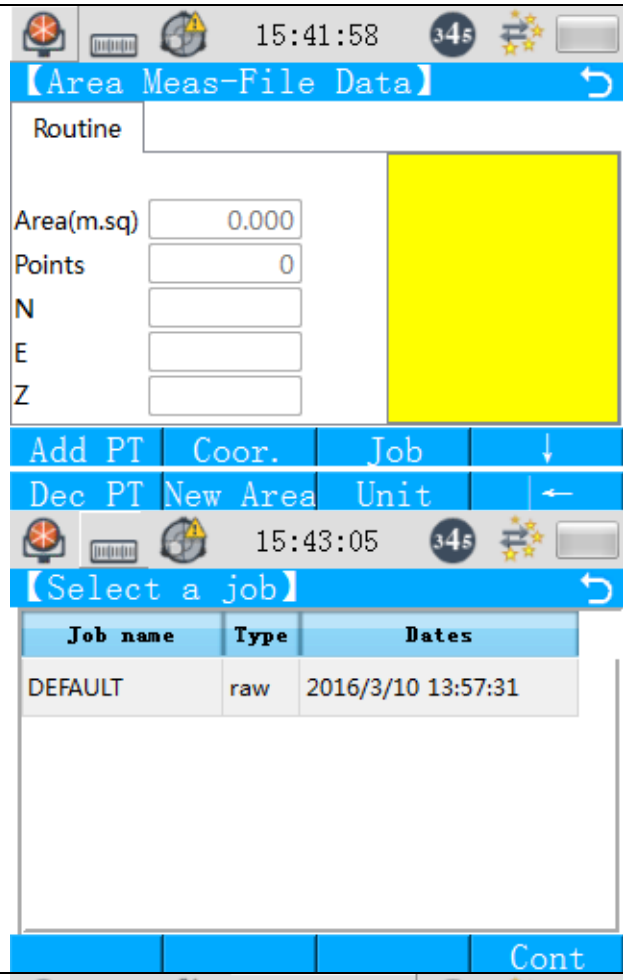
6.12.1 Calculate area with coordinate data file

Procedure	Display

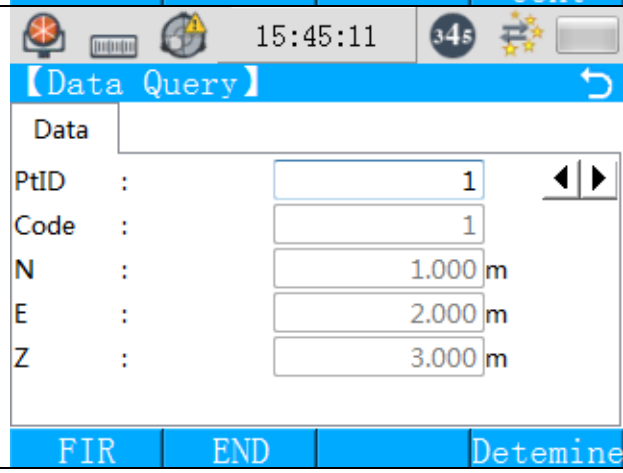
① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press "↩" to return to previous menu.	
② Press "Area Meas" or (9) to enter area measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "↩" to return to previous menu.	
③ Press "F4" or (4) to enter area measurement selection interface.	

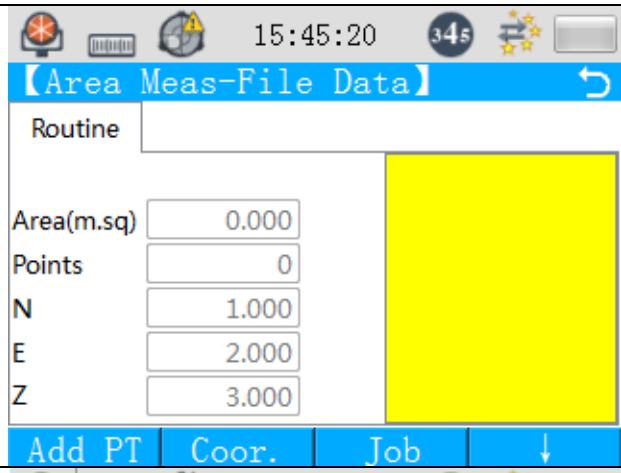
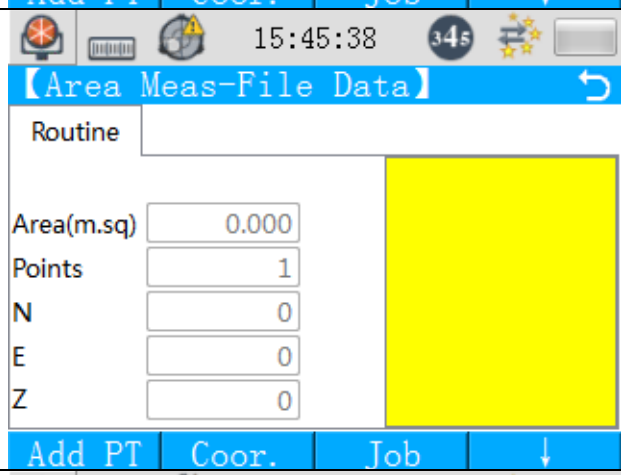
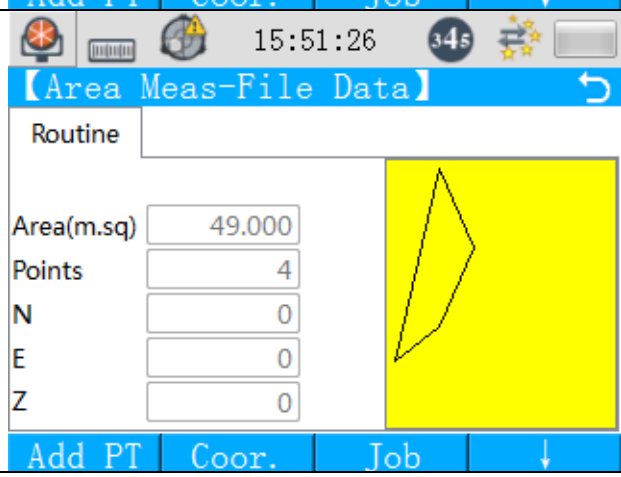
④ Press "F1" or (1) to enter the first point setting interface for area measurement.

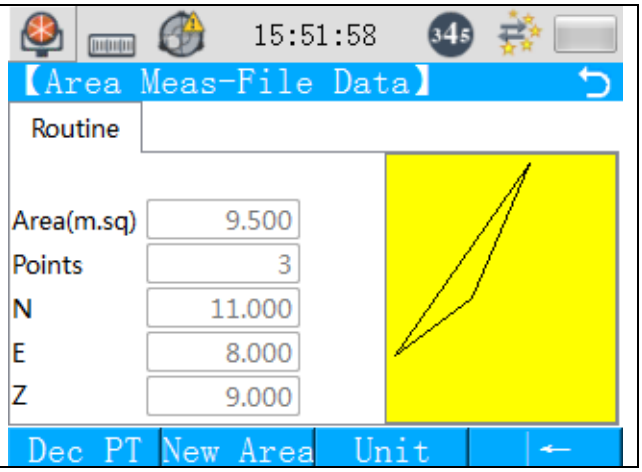
Press "F3" (Job) and you can select the job to which the coordinates belongs.



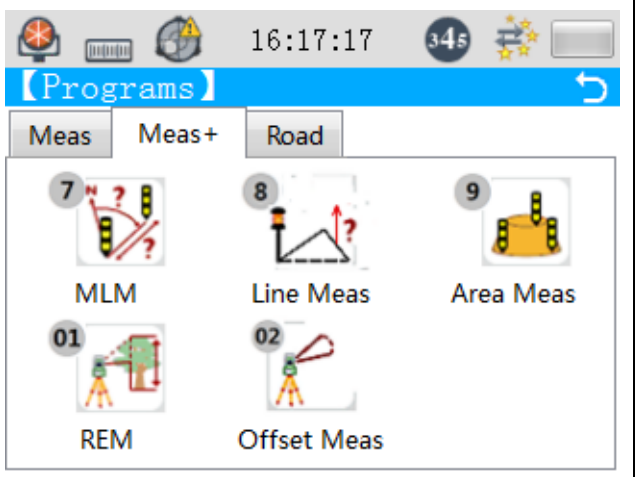
⑤ Press "F2" (Coor.) to search for the coordinates and press "F4" (Detemine) to select the coordinates.

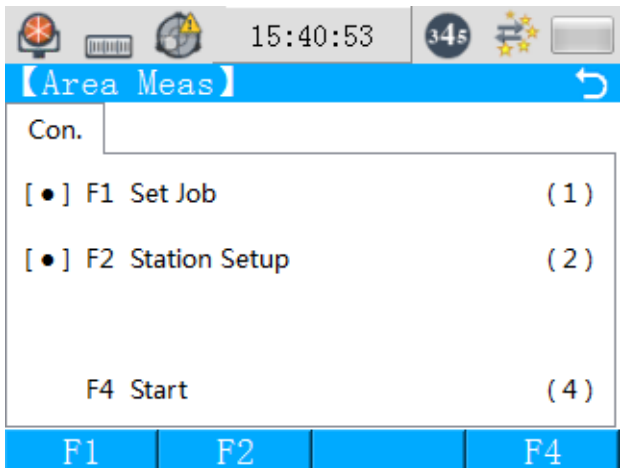
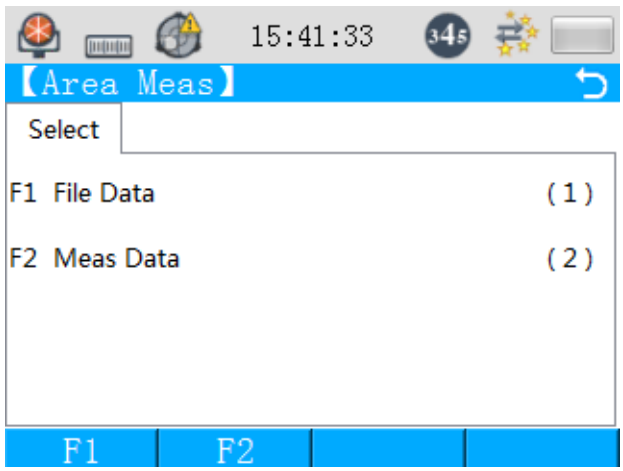
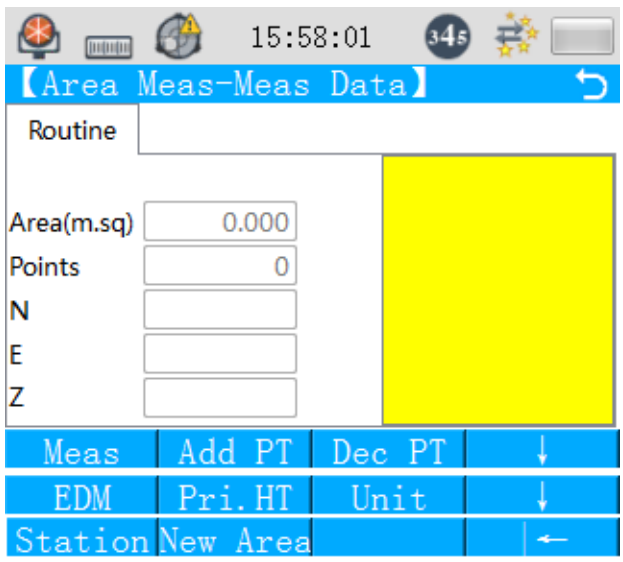


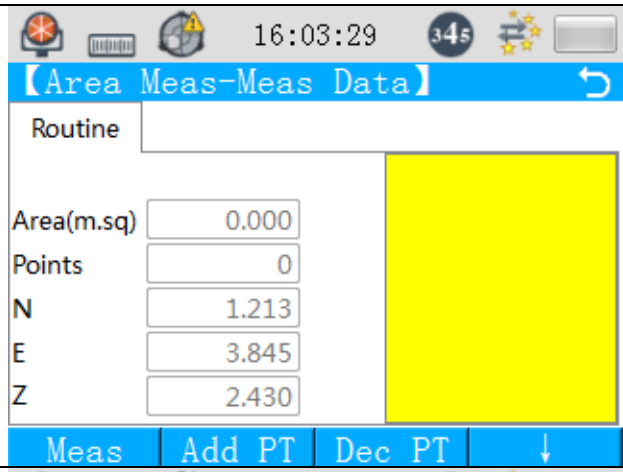
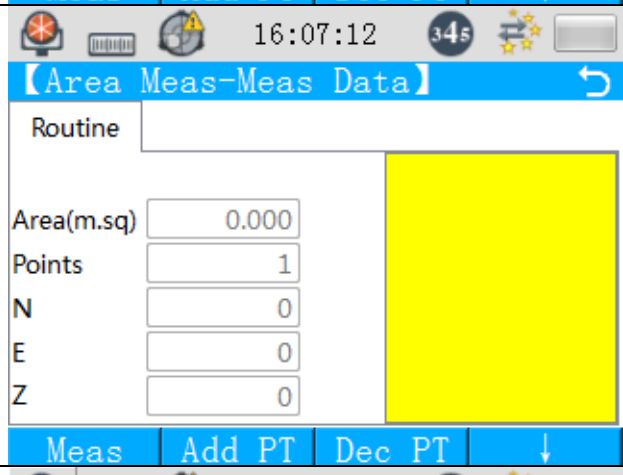
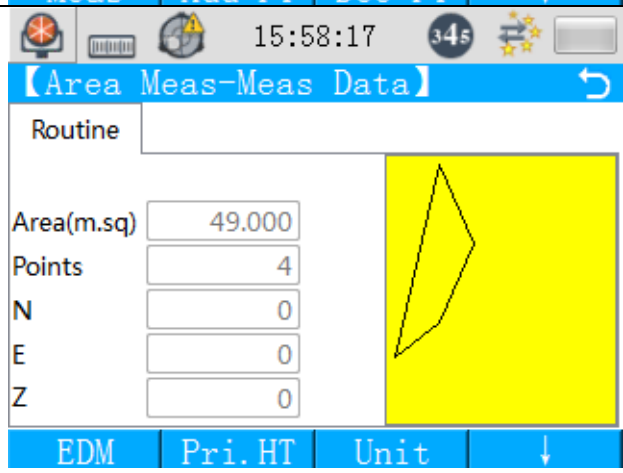
	
⑥ Press "F1" (Add PT) to add a point and continue to set coordinates of the second point.	
⑦ Repeat steps ⑤~⑥ to add more points. When the number of points is ≥3, the area of the graphic formed by all points will be automatically calculated. Example: Area of the graphic formed by the 4 points and the diagrammatic sketch are displayed.	

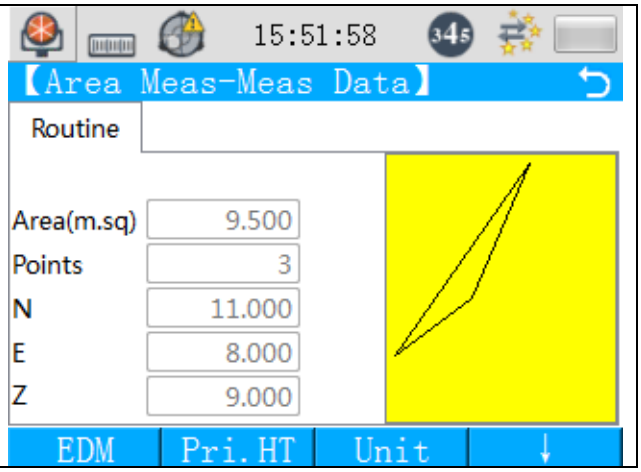
⑧ Press "F1" (Dec PT) to remove the last point and the area of the graphic formed by the three points will be automatically calculated and the diagrammatic sketch displayed.	

6.12.2 Calculate area with measurement data

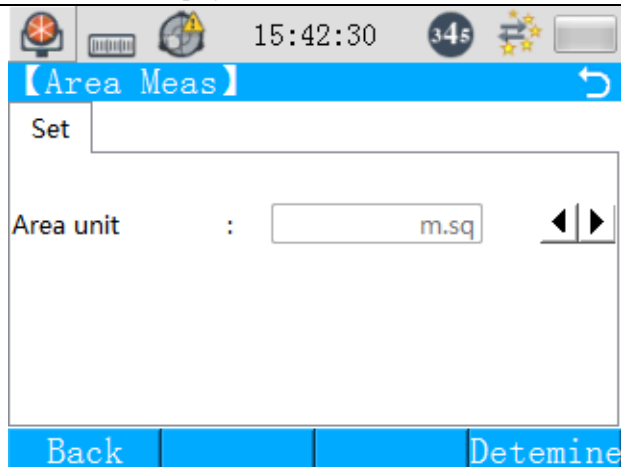
Procedure	Display
① Under Programs mode, press "Meas+" to reveal page 2 of Programs interface. Press " " to return to previous menu. ⮌	

② Press "Area Meas" or (9) to enter area measurement configuration interface. Press "F1" or (1) to enter job setting interface. Press "F2" or (2) to enter station setup interface. Press "⮌" to return to previous menu.	
③ Press "F4" or (4) to enter area measurement selection interface.	
④ Press "F1" or (1) to enter the first point setting interface for area measurement. Press "F1" (Station) to enter station setup interface. Press "F1" (EDM) to enter EDM setting interface.	

⑤ Press "F1" (Meas) to enter first point coordinate measurement interface.	
⑥ Press "F2" (Add PT) to add a point and enter the second point measurement interface.	
⑦ Repeat steps ⑤~⑥ to add more points. When the number of points is ≥3, the area of the graphic formed by all points will be automatically calculated. Example: Area of the graphic formed by the 4 points and the diagrammatic sketch are displayed.	

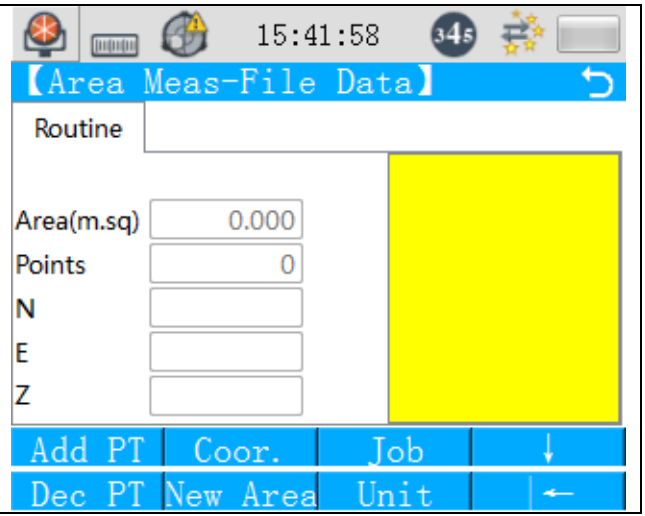
⑧ Press "F1" (Dec PT) to remove the last point and the area of the graphic formed by the three points will be automatically calculated and the diagrammatic sketch displayed.	

6.12.3 Conversion of display unit

Procedure	Display
① Press the button Unit to enter area measurement unit selection interface. Select a proper unit. For example, to choose "acre", change m.sq into acre. ② Press "F4" (Detemine) to save the modification and return to previous menu. Press "F1" (Back) to return to previous menu without saving the modification.	

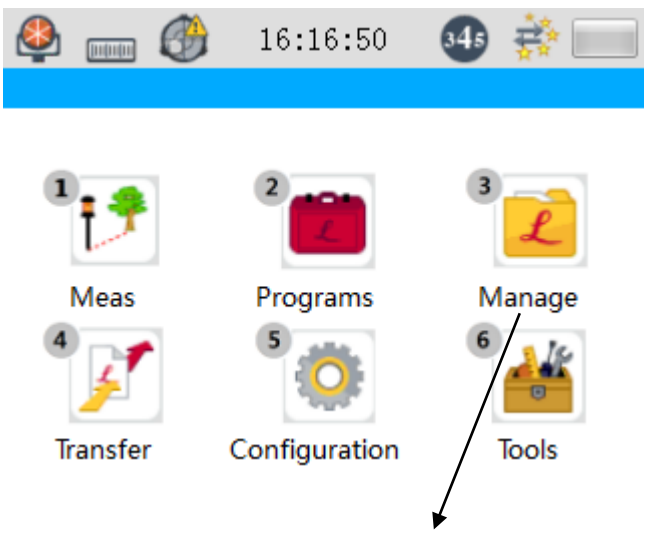
6.12.4 New area

Procedure	Display

① Press "F2" (New Area) to recalculate the area.	

7 Manage mode

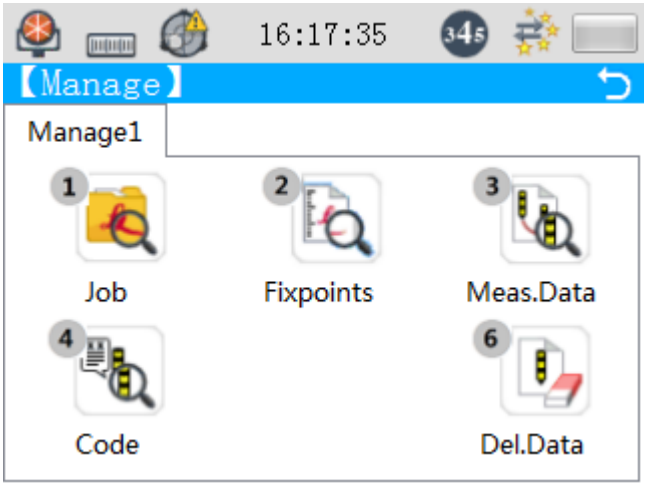
Press [3] or click the button "Manage".



Manage mode

This mode covers the following items:

1. Job
2. Fixpoints
3. Measurement data
4. Code
5. Memory initialization

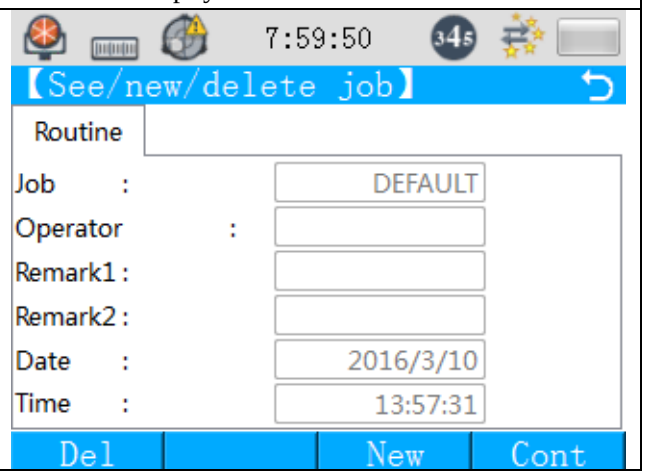


7.1 Job

This function can manage deletion, addition and creation of jobs.

The various measurement data, such as fixpoints and measuring points, are all stored in the selected job.

Definition of a job comprises the job name and operator.

Procedure	Display
① Under Manage mode, press "Job" or "1" to enter job setting interface. Press "⮌" to return to previous menu.	

Description of file formats in the memory is as follows:

******** .dat system file

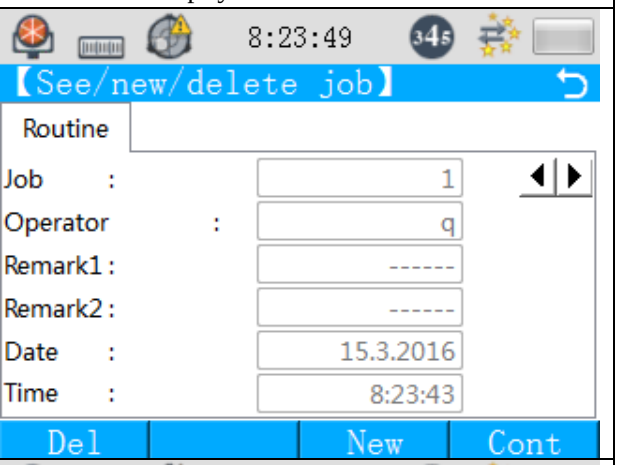
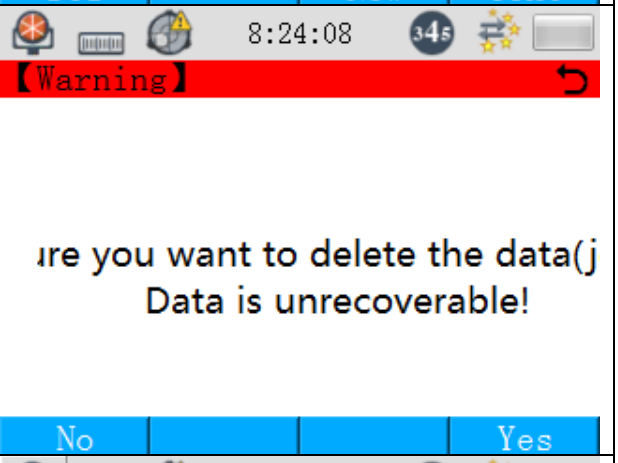
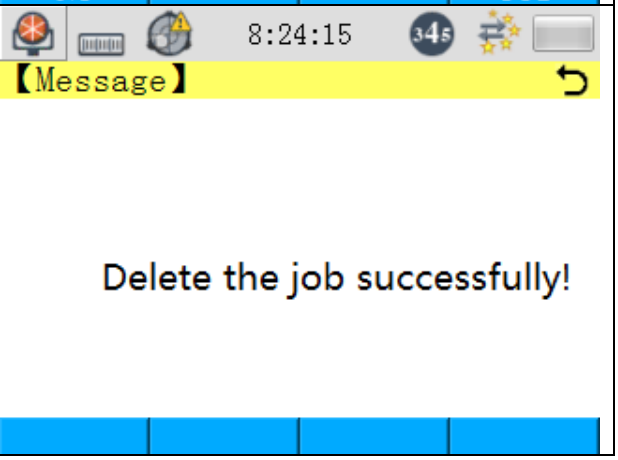
******** .RAW raw data file

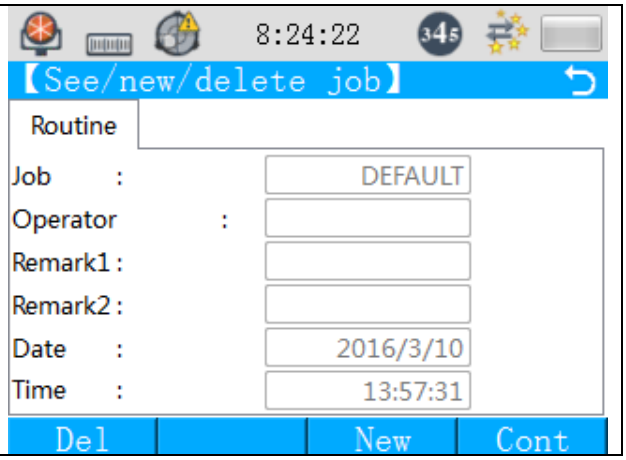
******** .HAL horizontal alignment data file

******** .VCL vertical alignment data file

7.1.1 Job deletion

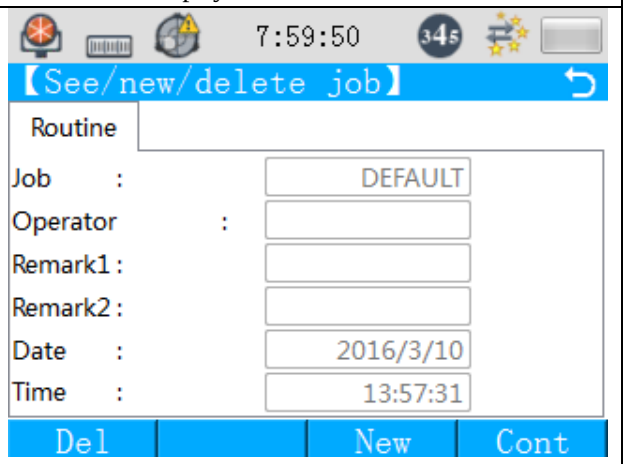
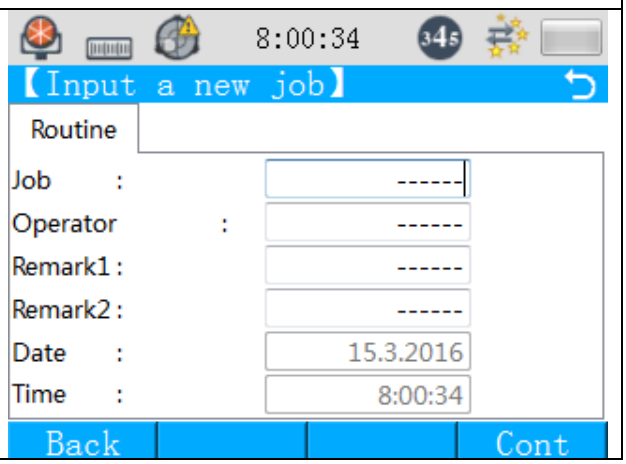
This function is used to delete jobs in the memory. A protected file cannot be deleted, unless the protection is eliminated. Only one file can be deleted at one time.

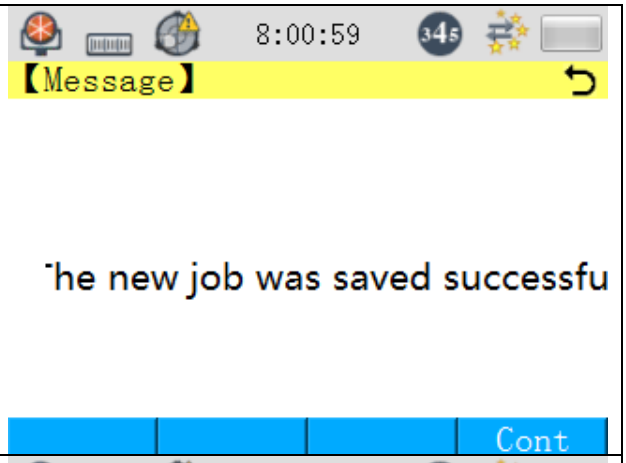
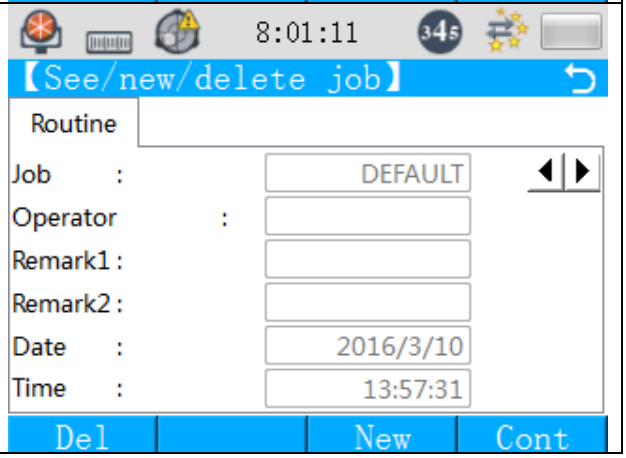
Procedure	Display
① Enter job setting interface. ② Press "◀ ▶" to select a job.	
③ Press "F1" (Del) to enter deletion interface.	
④ Press "F4" (Yes) to delete the job. Press "F1" (No) to return to previous menu without deleting it.	

7.1.2 New job

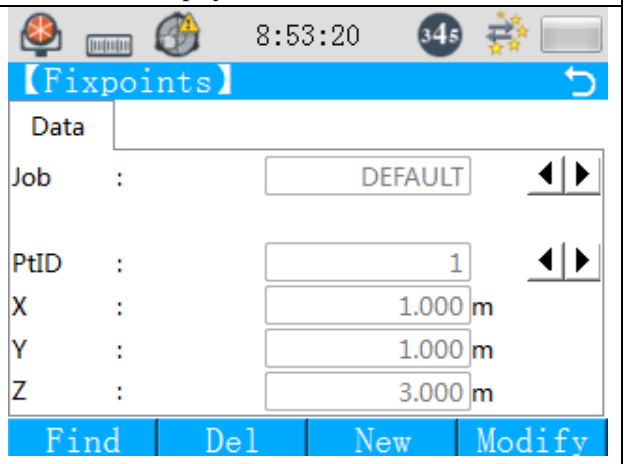
This function is used to create new job and only one job can be created at one time.

Procedure	Display
① Enter job setting interface.	
② Press "F4" (Cont) to enter job creation interface. It will display items to be entered (job name, operator, remark 1 and remark 2).	

③ With all items entered, press "F4"to generate a new job, or press "F1" (Back) to return to previous menu without saving it.	
④ Press "F4" (Cont) return.	

7.2 Fixpoints

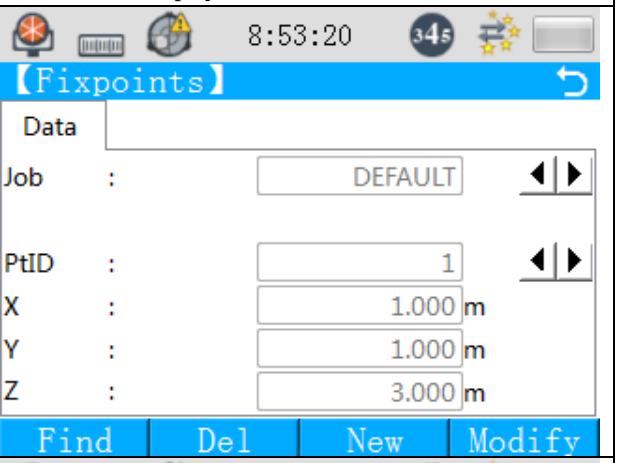
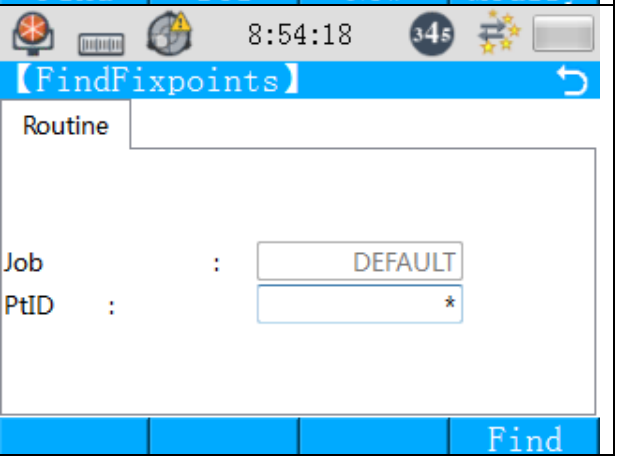
Search, editing, deletion and other operations of fixpoints of a job in the memory can be achieved with this function. Valid fixpoints comprises at least the point name and coordinates (X, Y) or height (Z).

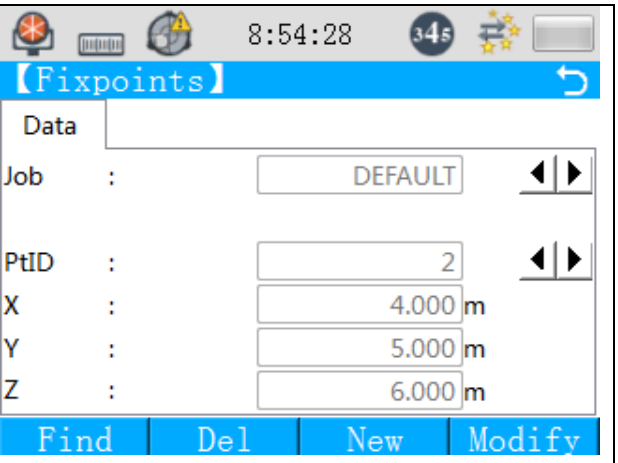
Procedure	Display
① Under Manage mode, press "Fixpoints" or "2" to enter fixpoint setting interface. Press "↩" and you can return to previous menu. ② Press the buttons "◀ ▶" following "Job" to select a job. If there are fixpoints in the job, press the buttons	

“◀▶”following “PtID” to check all fixpoints in the job one by one.	

7.2.1 Fixpoint query

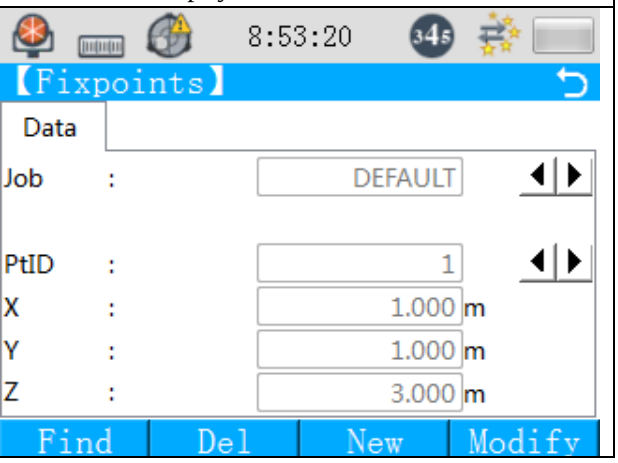
Enter the point name or wildcard “*” to find fixpoint(s) in the selected job.

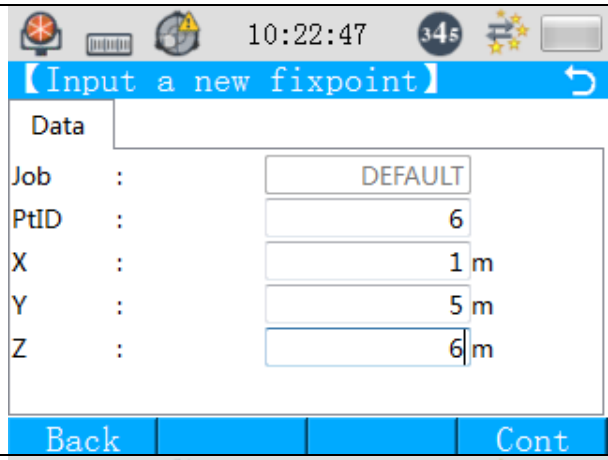
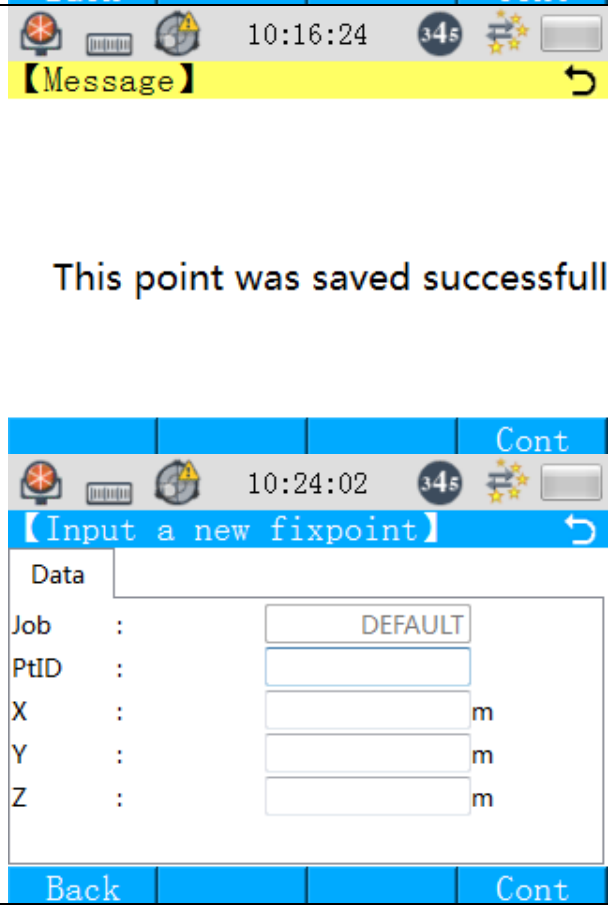
Procedure	Display
① Enter the fixpoint setting interface. Press the buttons “◀▶” following “Job” to select a job.	
② Press “F1” (Find) to enter fixpoint query interface.	

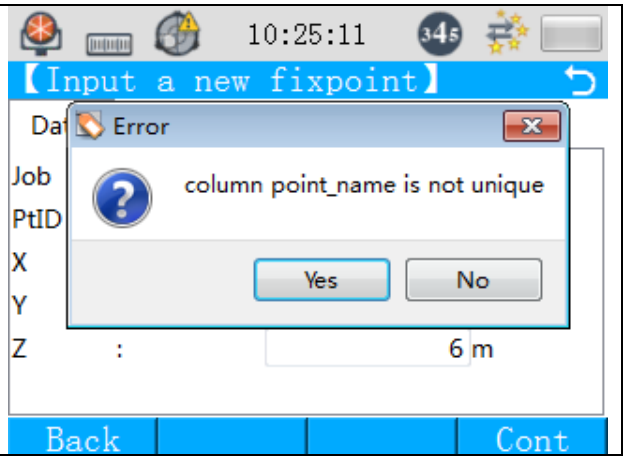
③ Enter the fixpoint name or the wildcard "*" and press "F4" (Find). ④ The search results will be displayed. If you are searching for a certain fixpoint, coordinates of the point will be displayed. If wildcard "*" is entered, you can view all fixpoints one by one with the buttons "◀▶".	

7.2.2 New fixpoint

This function allows the creation of new fixpoints in a job.

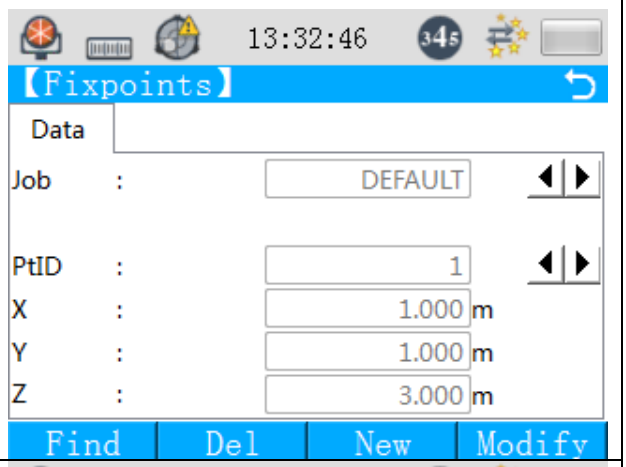
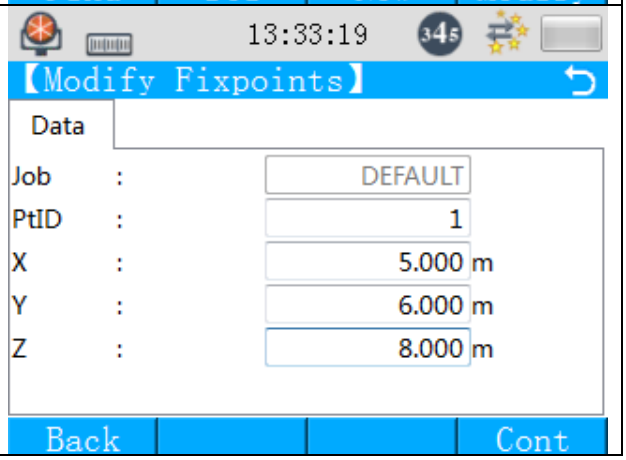
Procedure	Display
① Enter the fixpoint setting interface. Press the buttons "◀▶" following "Job" to select a job.	

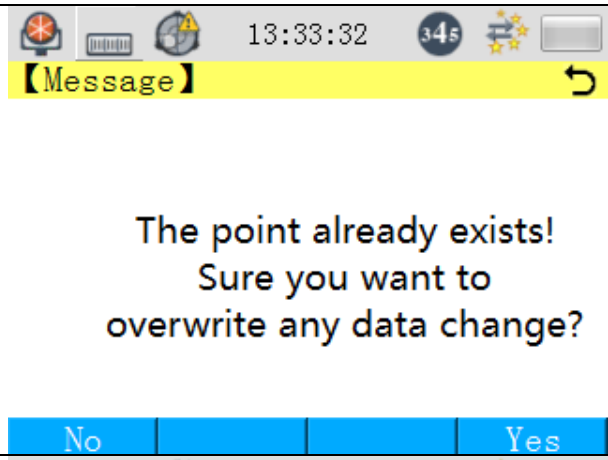
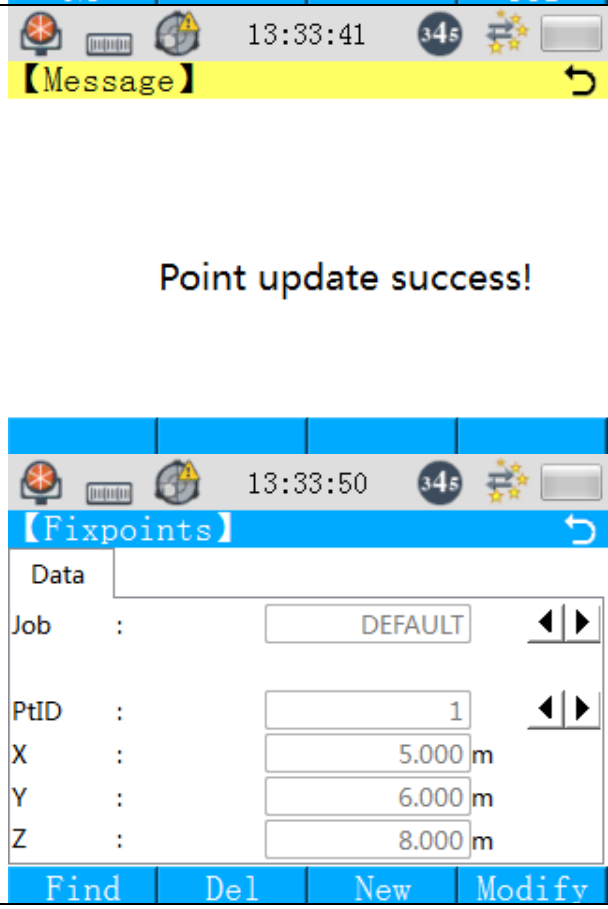
② Press “F3” (New) to enter new fixpoint interface. To return to previous menu, press “F1” (Back).	
③ Enter point name and coordinates of the new fixpoint and then press “F4” (Cont) to complete the addition of the new fixpoint and save it behind existing fixpoints in the job. ④ Press “F4” (Cont) to enter new fixpoint interface.	

⑤ If there is already a fixpoint of the entered name, a prompt box will pop up. Please enter a new point name and save it.	

7.2.3 Fixpoint modification

This function allows editing of fixpoints in a job.

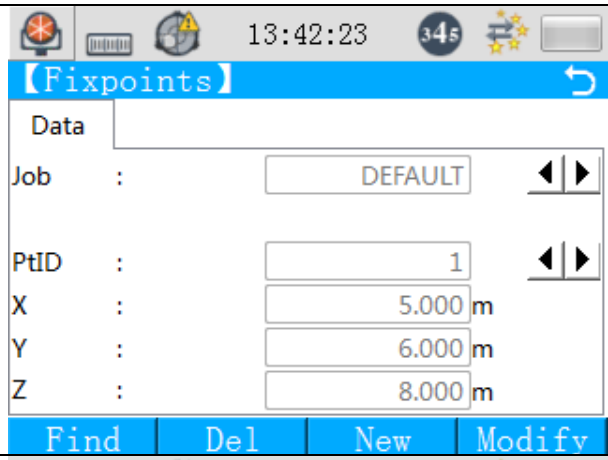
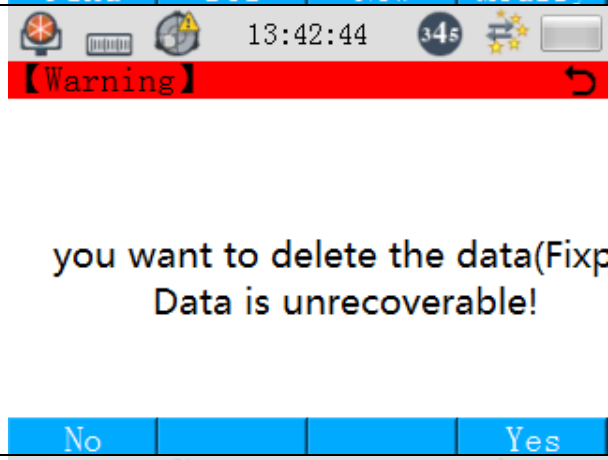
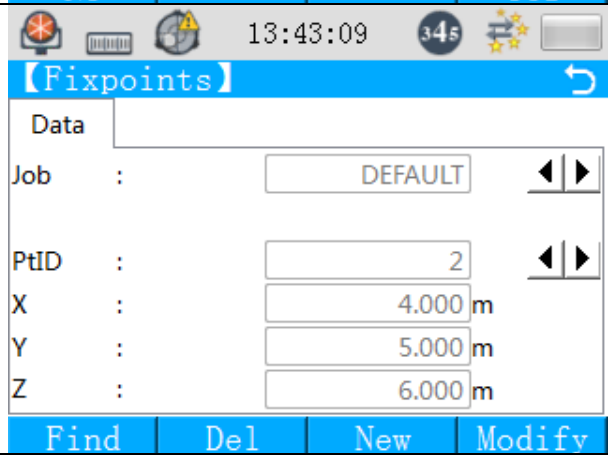
Procedure	Display
① Enter the fixpoint setting interface. Press the buttons "◀▶" following "Job" to select a job. Press the buttons "◀▶" following "PtID" to select the fixpoint to be modified.	
② Press "F4" (Modify) to enter fixpoint modification interface. To return to previous menu, press "F1" (Back).	

③ Enter the fixpoint name and coordinates. Then, press "F4" (Cont) to modify the fixpoint. Press "F1" (No) to return to previous menu without modifying it.	
④ Press"F4" (Yes) to confirm to modify the fixpoint.	

7.2.4 Fixpoint deletion

This function allows the deletion of fixpoints in a job.

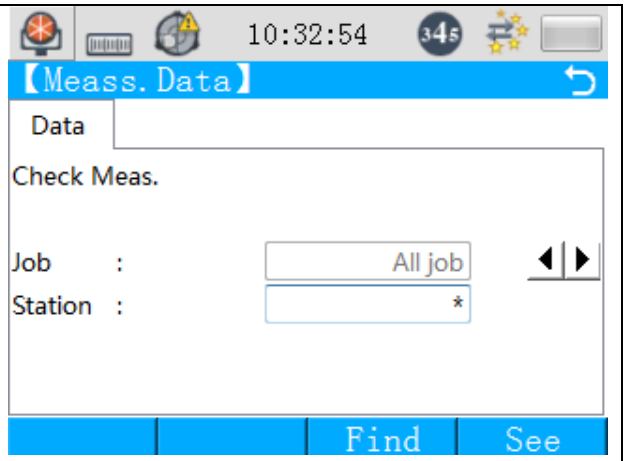
Procedure	Display

① Enter the fixpoint setting interface. Press the buttons " ◀ ▶ " following "Job" to select a job. Press the button " ◀ ▶ " following "PtID" to choose the fixpoint to be deleted.	
② Press "F2" (Del) to enter fixpoint deletion interface.	
③ Press "F4" (Yes) to confirm to delete the fixpoint and return to previous menu. Or press "F1" (No) to return to previous menu without deleting the fixpoint.	

7.3 Meas. Data

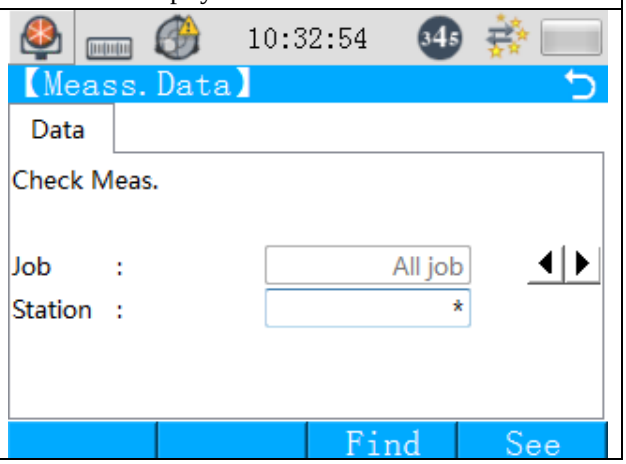
The measurement data in the memory can be searched and displayed.

Procedure	Display

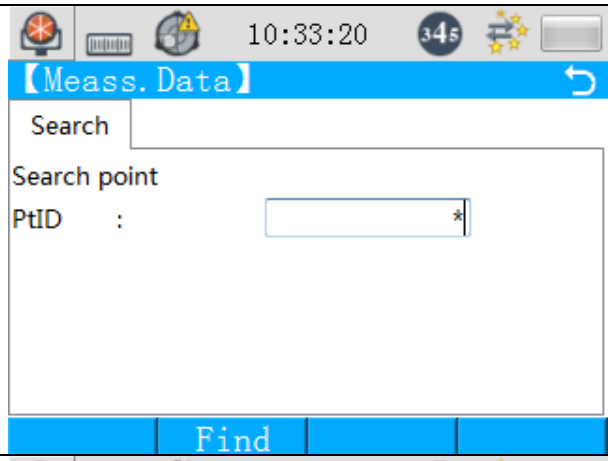
① Under Manage mode, press "Meas. Data" or "3" to enter measuring point setting interface. Press "⮌" and you can return to previous menu. Press the buttons "◀▶" following "Job" to select a job. Enter the station name in the field following "Station".	

7.3.1 Measuring point query

This function allows search for specific measuring points in a job.

Procedure	Display
① Enter measuring point setting interface. All query conditions are station based. Hence, the station name entered here can either be a specific one or a wildcard "*". The system default is wildcard "*", namely, all stations. ※1)	

② Press “F3” (Find) to enter measuring point query interface. The station name entered here can either be a specific one or a wildcard “*”. The system default is wildcard “*”, namely, all stations.



③ Display search results.

Press “F2” to search for measuring point(s) in a job.

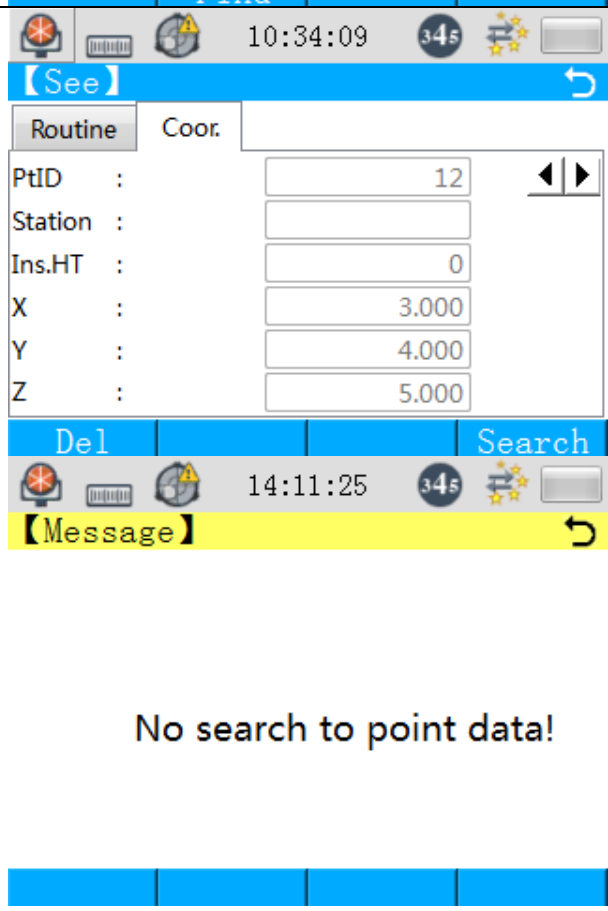
A:

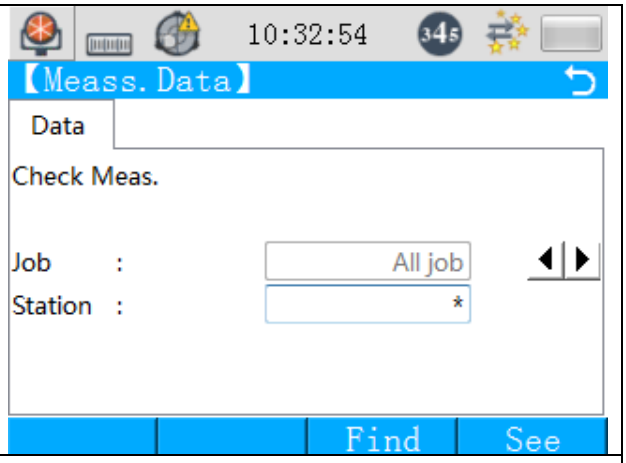
If points consistent with the query conditions are found, they will be displayed on the screen in the order of storage in the memory. Press “◀ ▶” to view the points one by one.

B:

If no point consistent with the query conditions is found, a prompt will pop up and then it will automatically return to measuring point viewing interface.

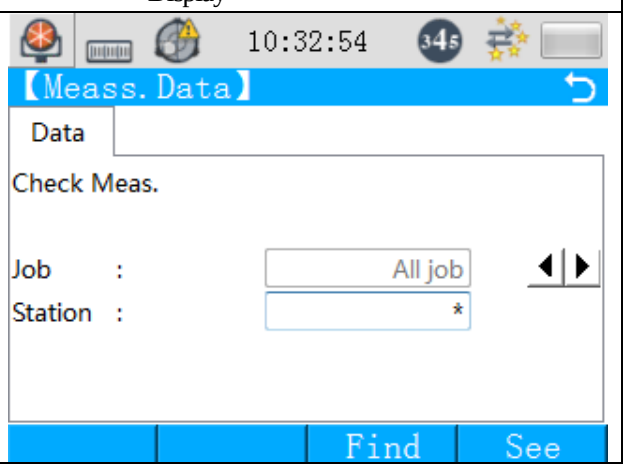
④ Press “F4” (Search) to measuring point query interface.



	
※1) Since the station name and point name can both be either specific or a wildcard "*", the search results of the various combinations will be explained here. All search results are based on the selected job name: Station name (specific) + point name (specific): the search results show all measurement data named after this point name on the specific station. Station name (*) + point name (specific): the search results show all measurement data named after this point name on all stations of the job. Station name (specific) + point name (*): the search results show all measuring points on the specific station. Station name (*) + point name (*): the search results show all measurement data in the job.	

7.3.2 Measuring point viewing

This function allows searching for measuring points in a job.

Procedure	Display
① Enter measuring point setting interface. All query conditions are station based. Hence, the station name entered here can either be a specific one or a wildcard "*". The system default is wildcard "*", namely, all stations. ※1)	

② Press "F4" (See) to view the search results.

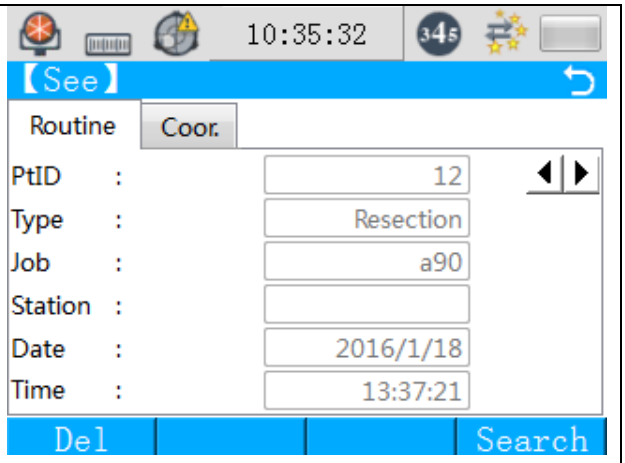
A:

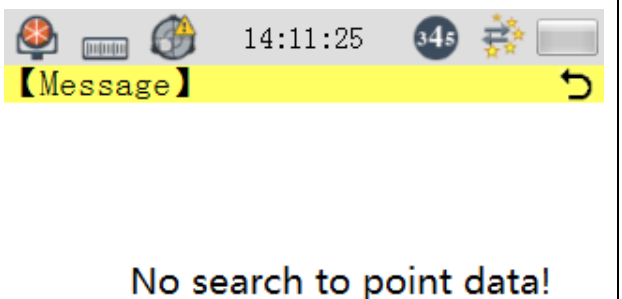
If points consistent with the query conditions are found, they will be displayed on the screen in the order of storage in the memory. Press "◀|▶" to view the points one by one.

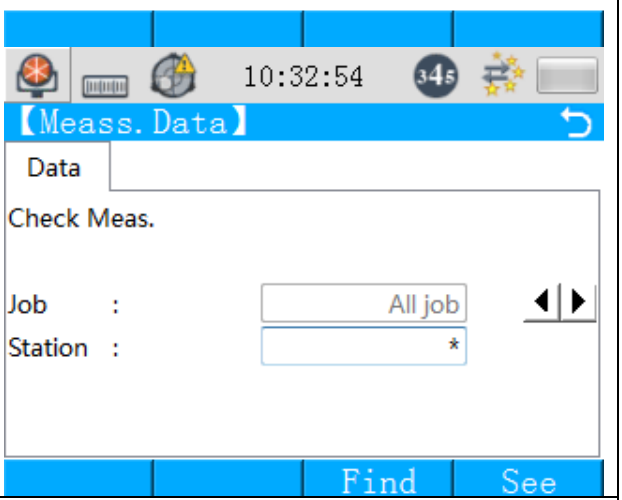
B:

If no point consistent with the query conditions is found, a prompt will pop up and then it will automatically return to measuring point viewing interface.

③ Press "F4" (Search) to measuring point query interface.



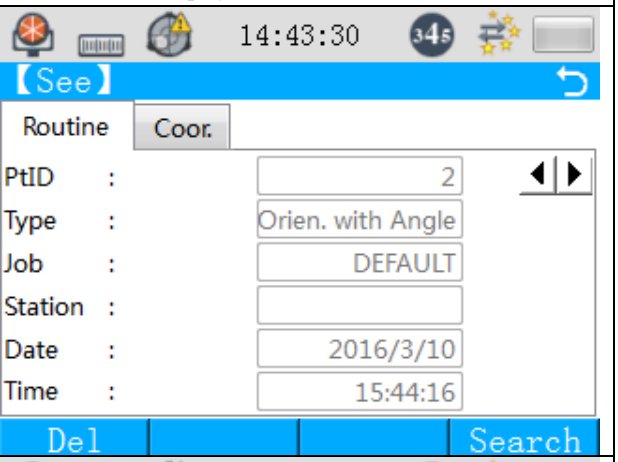
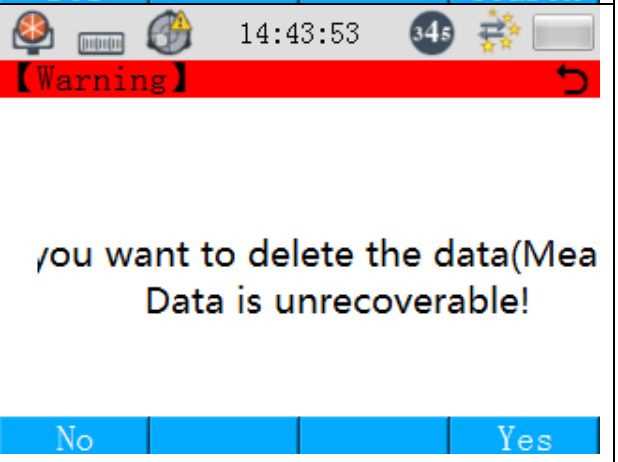
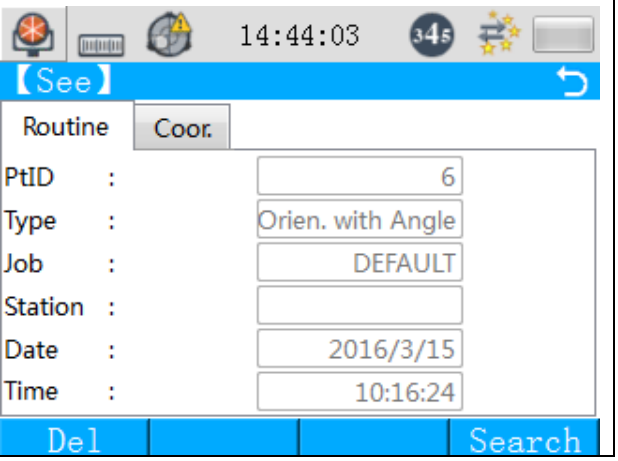




※1) Since the station name can be either specific or a wildcard "*", the search results of all combinations will be explained here. All search results are based on the selected job name:
Station name (specific) + point name (*): the search results show all measuring points on the specific station.
Station name (*) + point name (*): the search results show all measurement data in the job.

7.3.3 Measuring point deletion

This function allows deletion of measuring points in a job.

Procedure	Display
① Find data of the measuring point to be deleted and press "F1" (Del).	
② Press "F4" (Yes) to delete the measuring point, or press "F1" (No) to return to previous menu without deleting it.	 

7.4 Code

Creation, search and deletion of codes in the encoding library can be realized here.

Codes in the encoding library can be manually entered.

Each code can have a description and at most 8 attributes each of less than 16 characters.

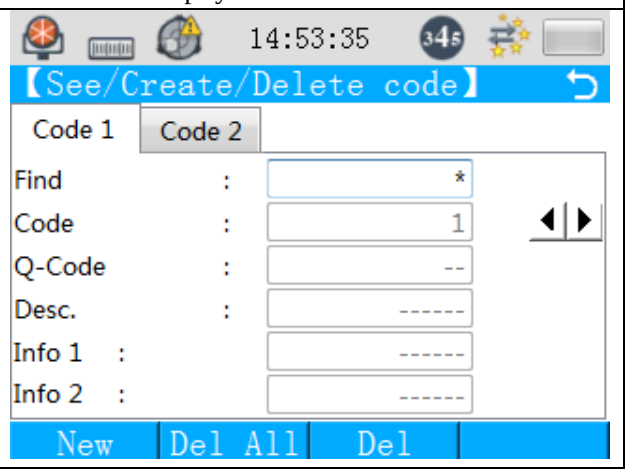
Code: name

Description: additional comment

Info1: editable, containing more content information

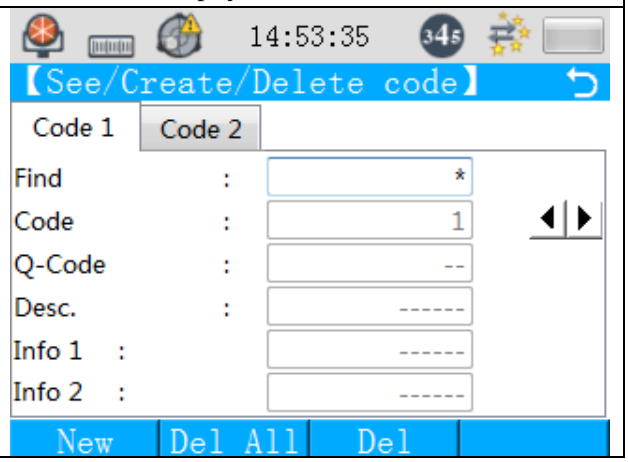
……

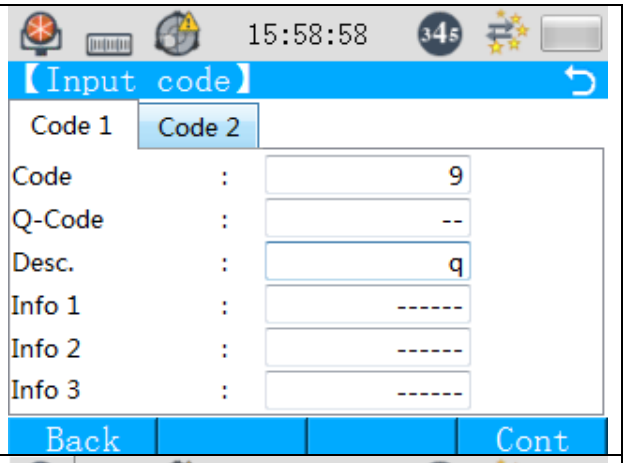
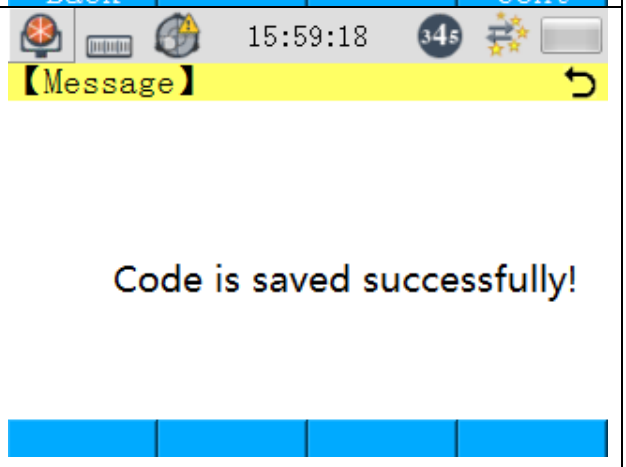
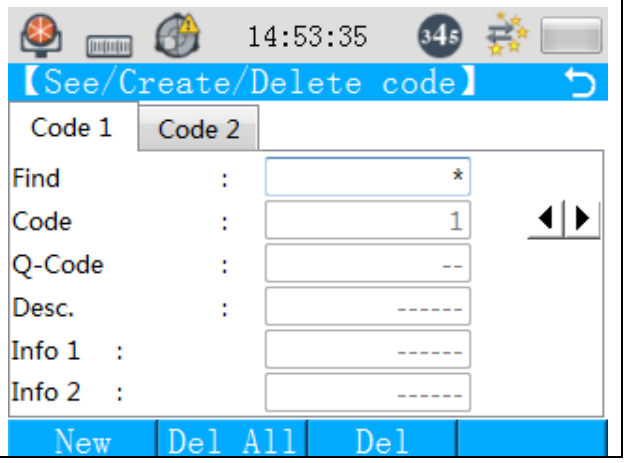
Info8: other information line

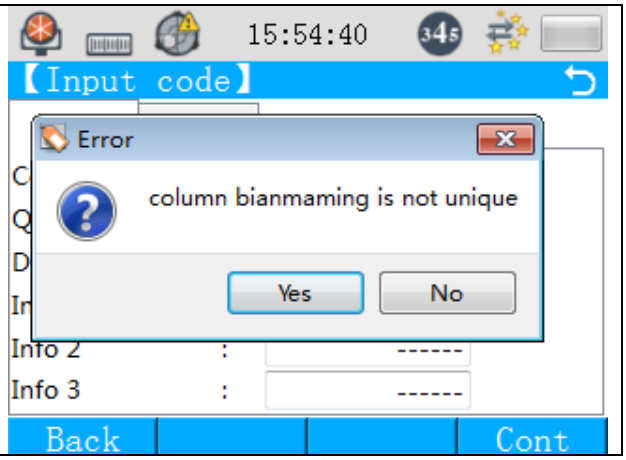
Procedure	Display
① Under Manage mode, press "Code" or "4" to enter code setting interface. Press "⮌" and you can return to previous menu. Press the buttons "◀▶" following "Code" to select a code.	

7.4.1 New code

This function allows the creation of new codes.

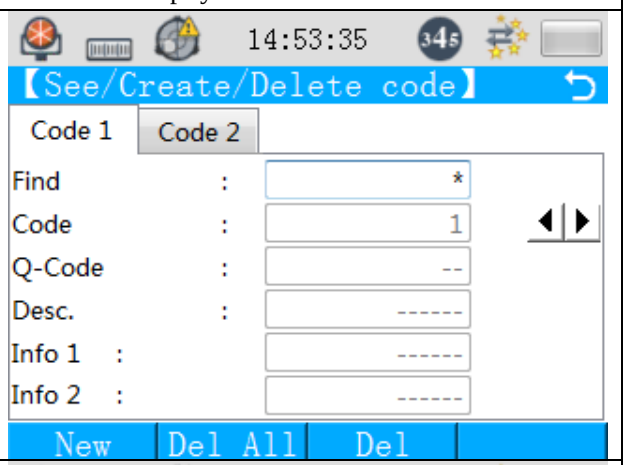
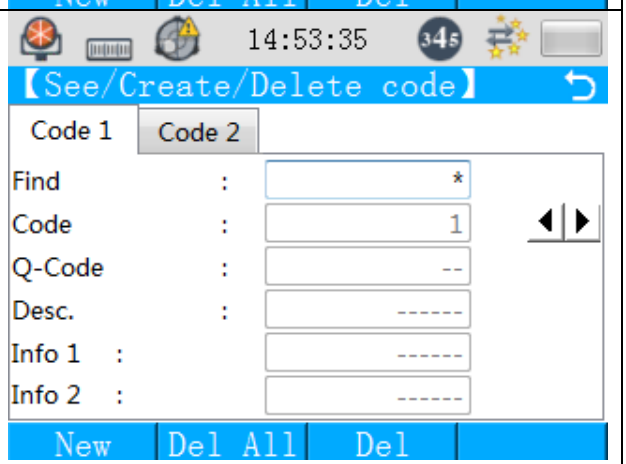
Procedure	Display
① Enter code setting interface.	

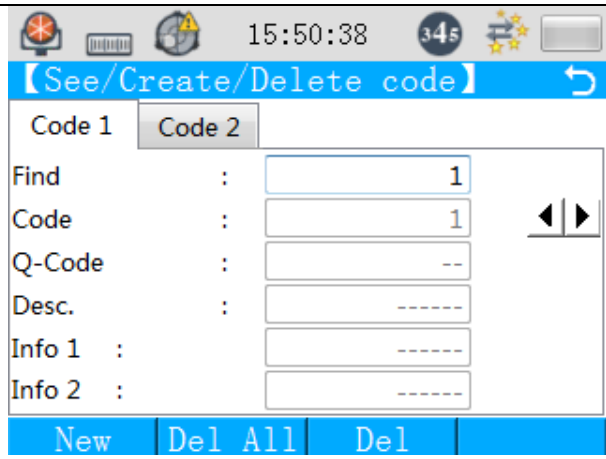
② Press "F1" (New) to enter new code creation interface. Enter code, description and other information.	
③ Press "F4" (Cont) to save the new code.	 

④ If there is an existing code with the name entered, the prompt will pop up. Please enter a new code name and then save it.	

7.4.2 Code query

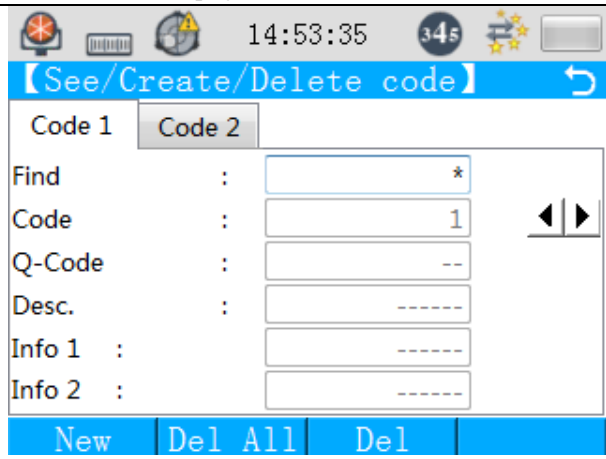
This function allows searching for codes.

Procedure	Display
① Enter code setting interface.	
② A: You can search for the code by directly pressing "◀▶" and the codes in the file will be displayed one by one. B: Enter the name (or wildcard "*") of the code you are looking for into the field of "Code" and press "OK".	

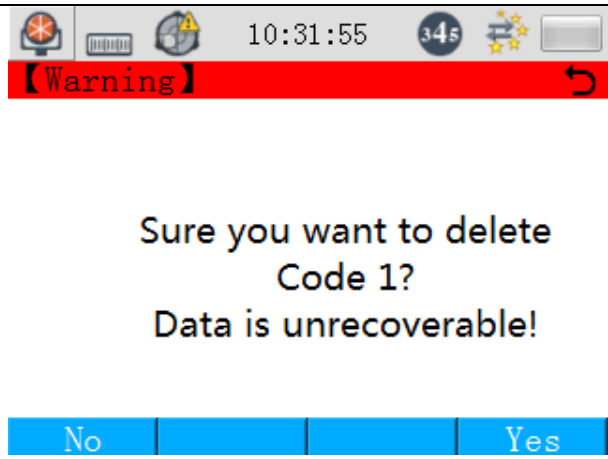
③ A: The query results will be displayed under the code entry. B: If wildcard "*" is entered, press "◀▶" to see all codes in the file one by one. C: If there is no such code in the file, the code entry will be empty. Please enter the correct code you want to find.	

7.4.3 Code deletion

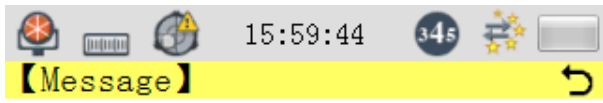
This function allows deletion of codes.

Procedure	Display
① Enter code setting interface. A: Directly press "◀▶" view codes in the file one by one to find the code to be deleted. B: Enter the name of the code to be deleted into the field following "Find" and press "OK".	

② When the code to be deleted is found, press "F3" (Del) to delete the specific code.

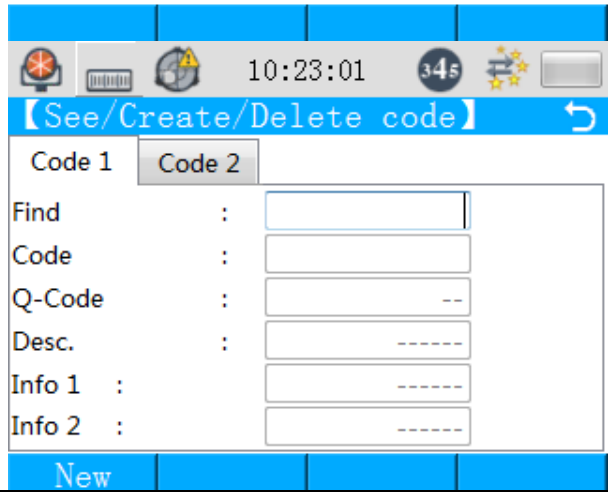


③ Press "F4" (Yes) to delete the code; press "F1" (No) to return to previous menu without deleting the code.

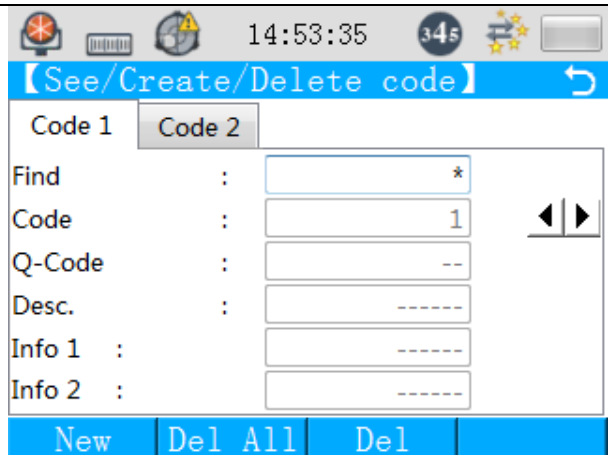


④ It will return to code setting interface when the specified code is deleted.

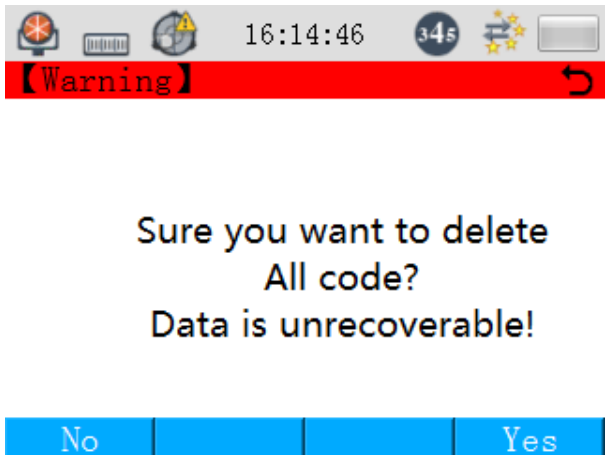
Delete code success!



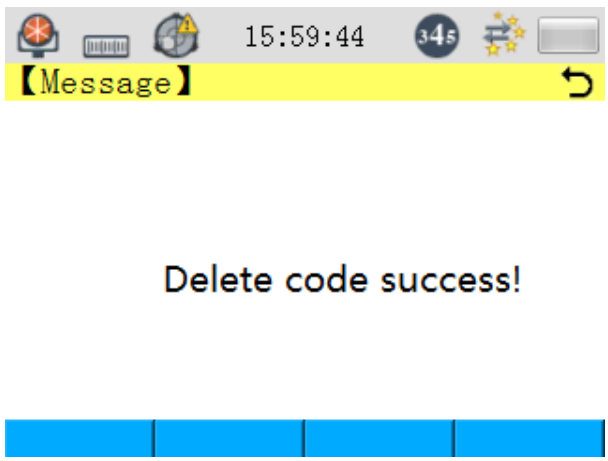
⑤ Enter code setting interface.



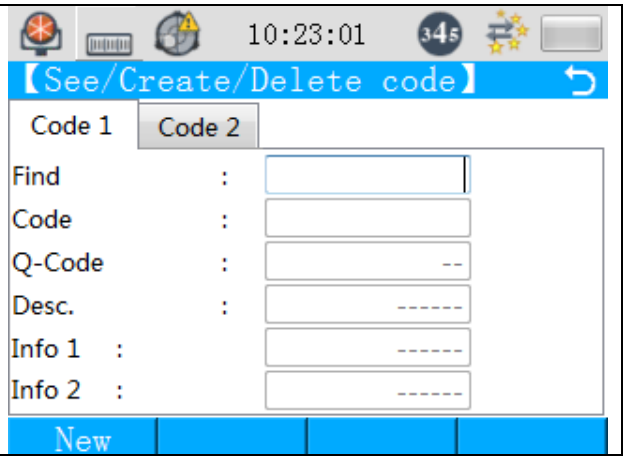
⑥ Press "F2" (Del All) to delete all codes.



⑦ Press "F4" (Yes) to delete all codes; press "F1" (No) to return to previous menu without deleting the codes.

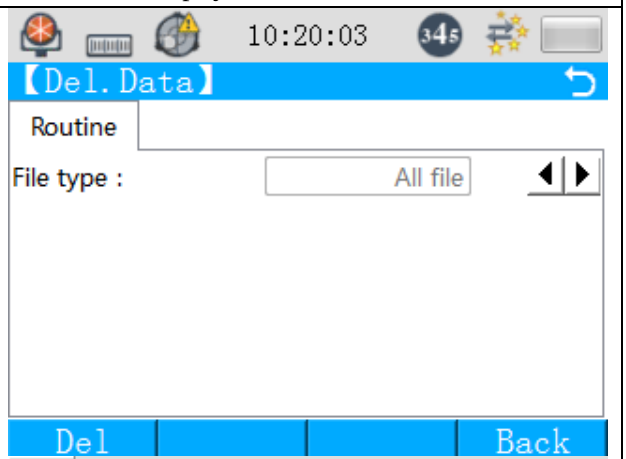
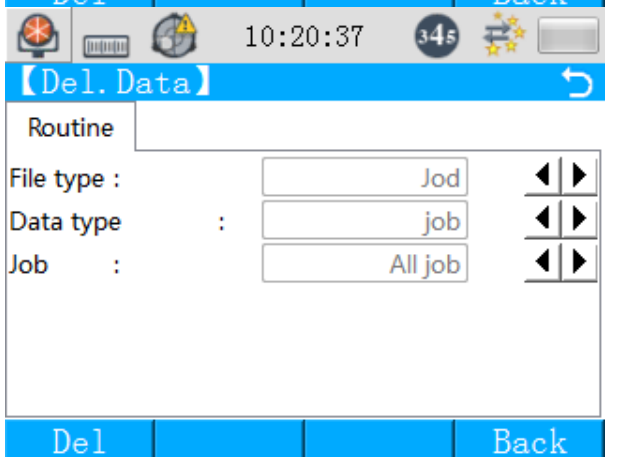


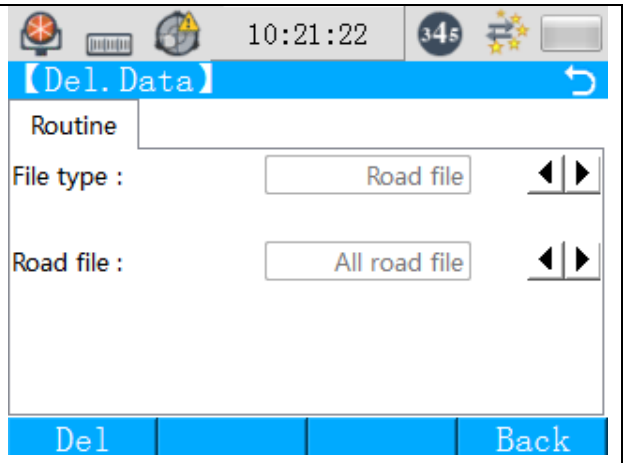
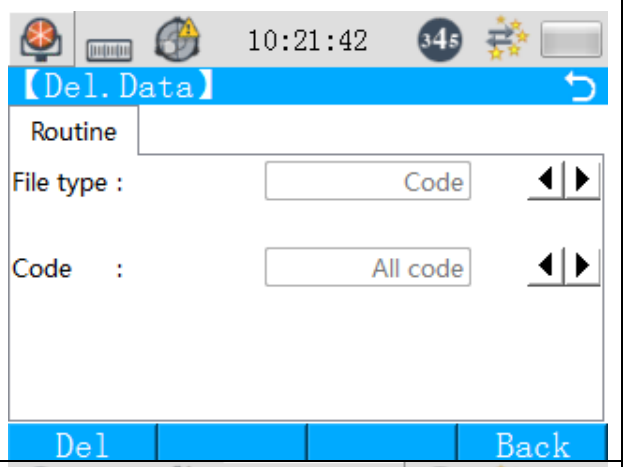
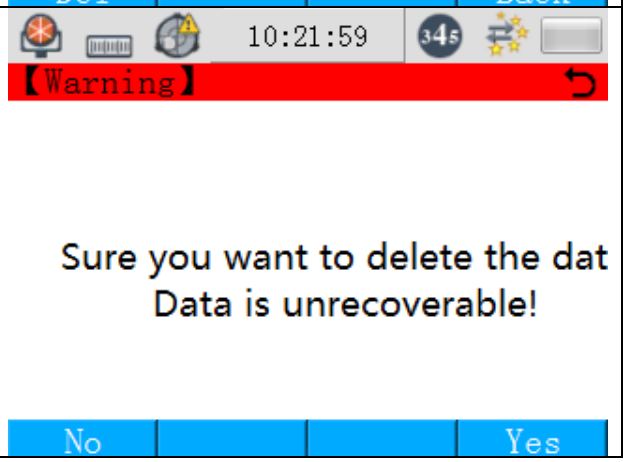
⑧ It will return to code setting interface when all codes are deleted.

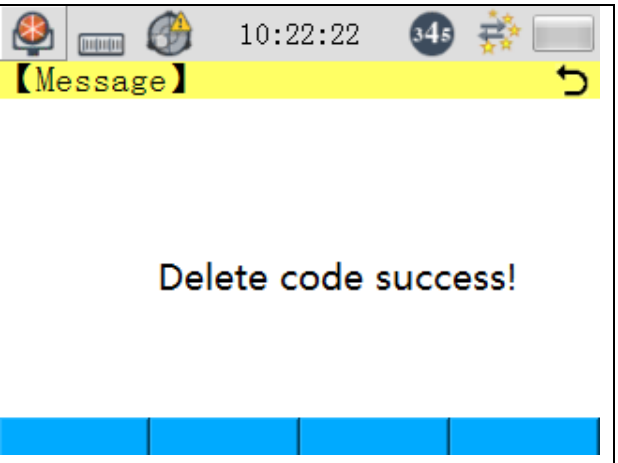
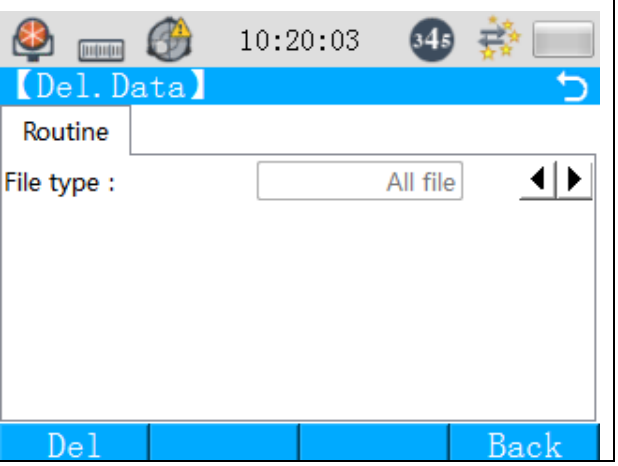
	

7.5 Memory initialization

A single data field or all data in the memory can be deleted with this function.

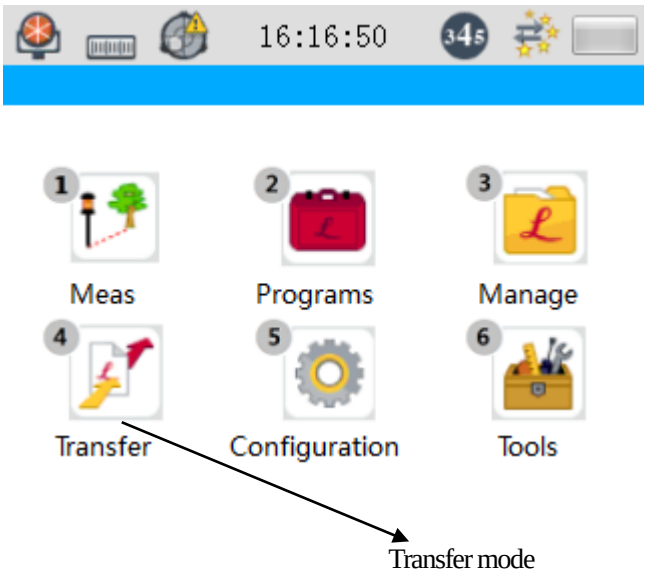
Procedure	Display
① Under Manage mode, press "Del. Data" or "6" to enter memory initialization setting interface. Press "↩" and you can return to previous menu. Press buttons" ◀ ▶ " following "File type" to select the file type. File types include: all files, job, road file and code. A: Job includes: all jobs and single job. B: Road file includes: all road files and single road file.	 

C: Code includes: all codes and single code.	 
② With the file selected, press "F1" (Del).	

③ Press "F4" (Yes) to delete the file; press "F1" (No) to return to previous menu without deleting it.	
④ It will return to memory initialization interface after data deletion.	

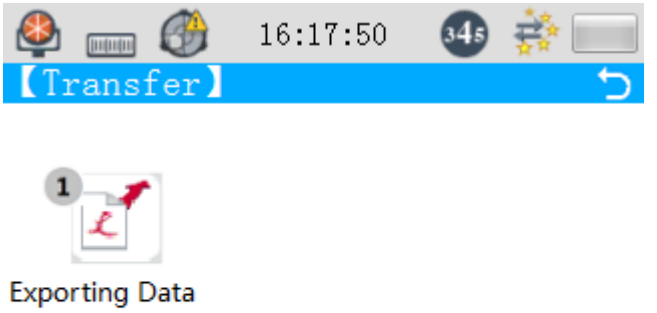
8 Transfer mode

Press [4] or click the button "Transfer".



This mode covers the following item:

1. Exporting data



8.1 Export data

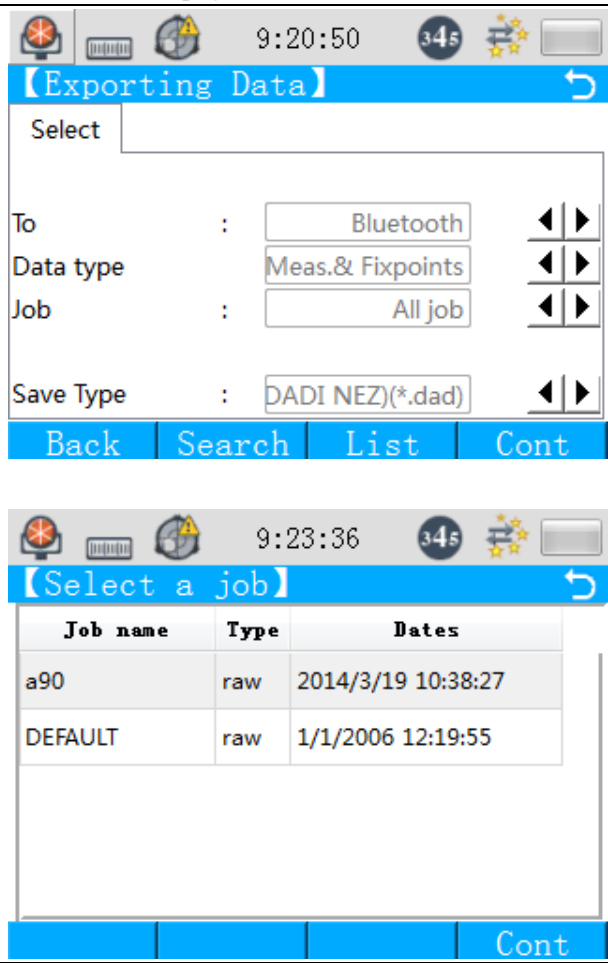
Data can be exported in two ways with this function.

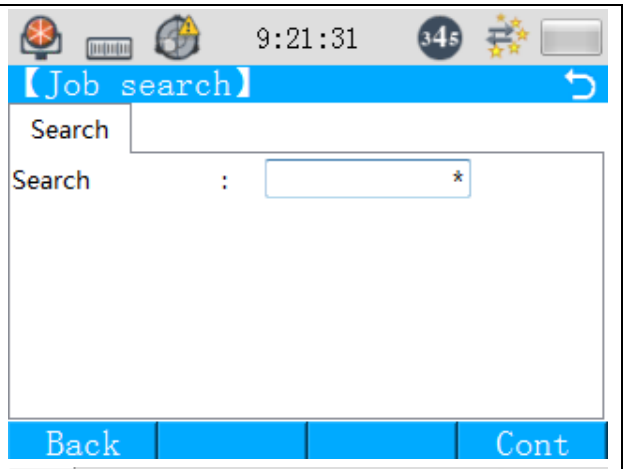
1. Bluetooth: Data in the instrument memory can be transferred to a receiver (such as PC with a Bluetooth receiver, etc.) via Bluetooth. Data transferred in this way do not undergo check. Bluetooth PIN: 1234. Bluetooth must be activated before exporting the data. See "9.6 Interface" for details.

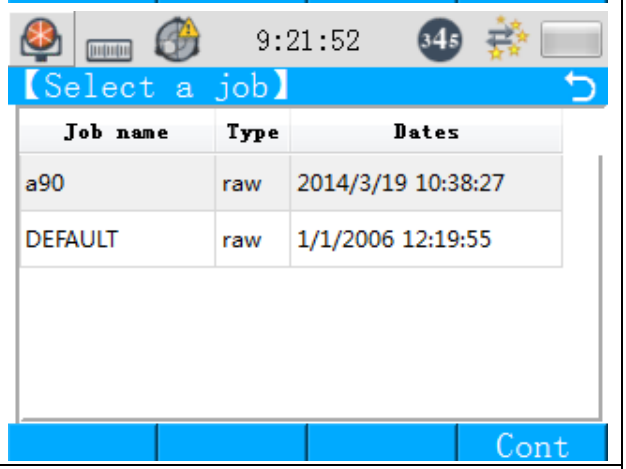
2. File: Save the file in the folder Mounted_Volume\fdp2\output.

2.1 Via USB connection: First, the computer must install Active Sync of the version higher than 4.0 and double click it. USB device (USB Download Firmware) connection driver shall also be installed (start the total station, connect the computer to the total station with USB cable, then the driver installation prompt will pop up; find the folder and install it). Afterwards, connect USB device connection cable to the total station. Ensure that the computer has already the connection driver installed. When the total station starts and enters the system, the computer can access files in the total station.

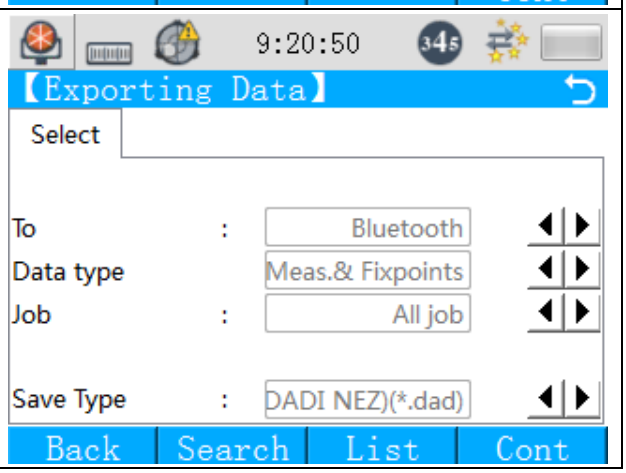
2.2 Via SD card connection: Turn off the total station, insert the SD card into the SD card slot and then turn on the total station. When it enters the system, you can access files in the total station and copy them to the SD card.

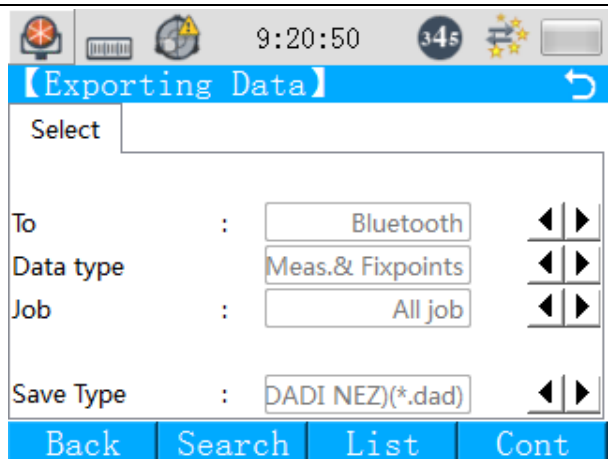
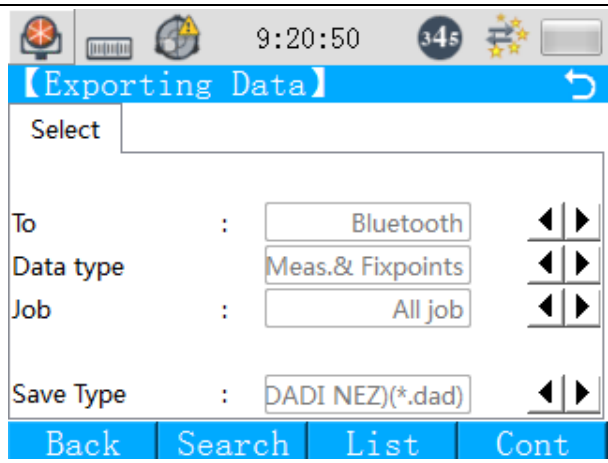
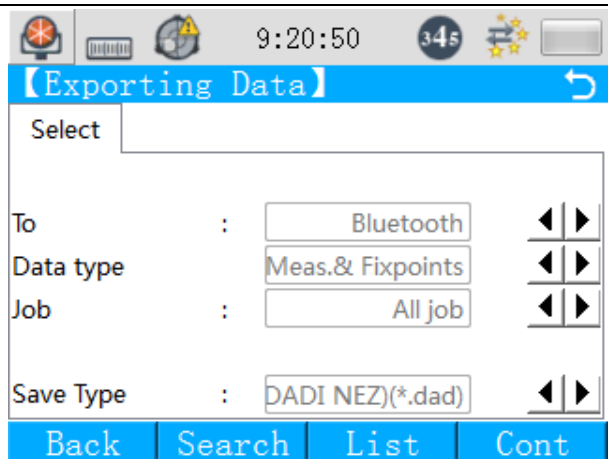
Procedure	Display
① Under transfer mode, click the button "Exporting Data" or press "1" to enter data export setting interface. Press " ⮌ " to return to previous menu. Press "F1" (Back) to return to previous menu. Press "F3" (List) to list the jobs. Press "F4" to select a job. Press "F2" (Search) to search for job(s).	

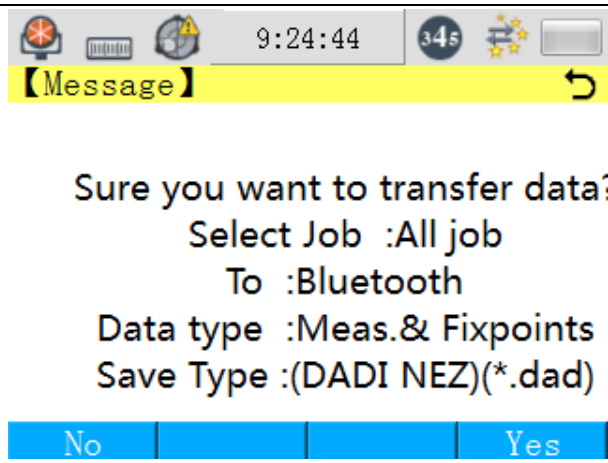
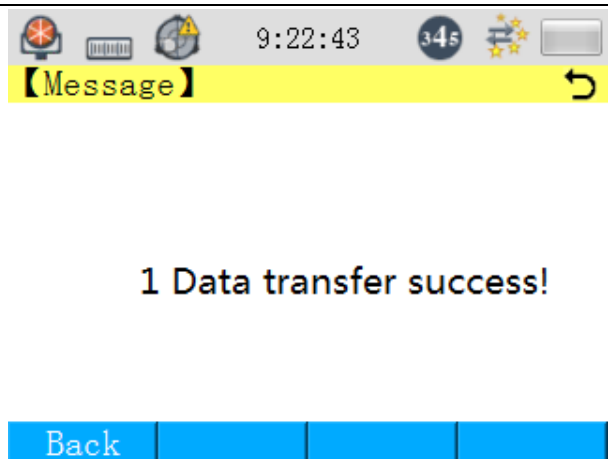
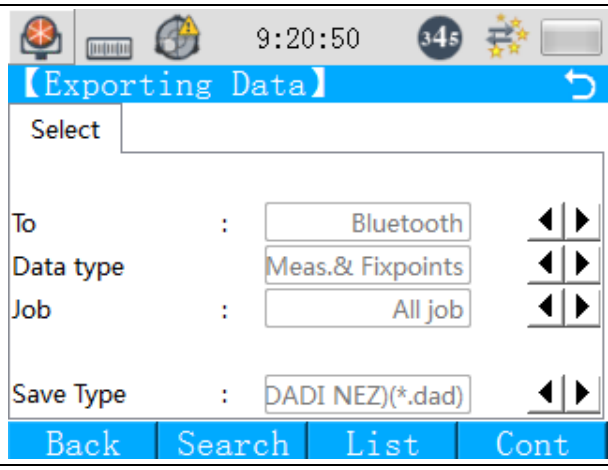




② Press buttons "◀ ▶" following "To" to select the place to save the data. The options include Bluetooth and File.

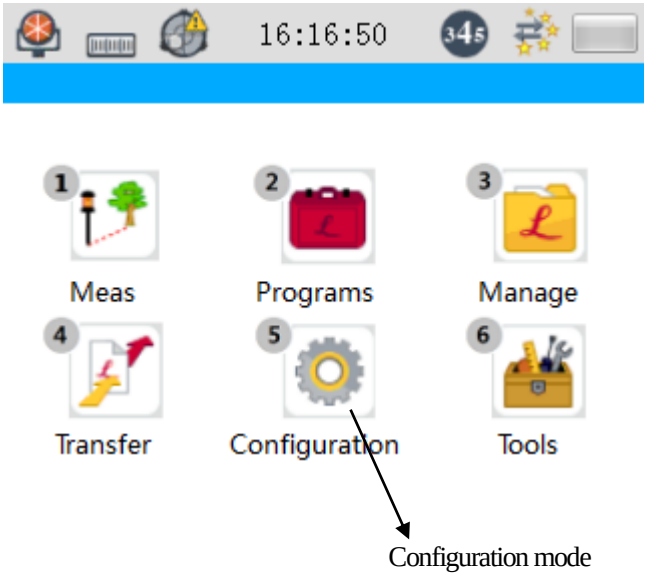


③ Press buttons "◀ ▶" following "Data type" to select output data type. The options include: Meas.Data, Fixpoints and Meas.&Fixpoints.	
④ Press buttons "◀ ▶" following "Job" to select the job(s). The options include single job and all jobs. You can press "F2" (Search) to search for the job file(s) or press "F3" (List) to invoke the job file(s).	
⑤ Press buttons "◀ ▶" following "Save Type" to select the storage type. The options include: (DADI NEZ)(*.dad), (DADI ENZ)(*.dad), (South)(*.dat), (SCS)(*.dat)", (SV300)(*.svf) and (Topcom)(*.pts)	

⑥ Press "F4" (Cont) to confirm the options and prepare for exporting the data.	
⑦ Press "F4" (Yes) to transfer the file(s); press "F1" (No) to return to previous menu without transferring the file(s).	
⑧ Press "F1" (Back) to return to previous menu.	

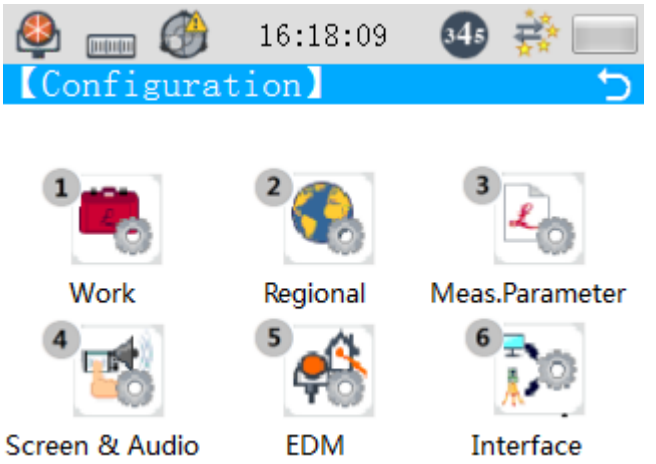
9 Configuration mode

Press [5] or click the button "Configuration".



This mode covers the following items:

1. Work
2. Regional
3. Meas.Parameter
4. Screen & Audio
5. EDM
6. Interface



Menu	Item	Content
Work	USER key 1	Select function of the USER key, including: Laser Line, Laser Point, Regional, VD, Home and Meas.
	USER key 2	Select function of the USER key, including: Laser Line, Laser Point, Regional, VD, Home and Meas.

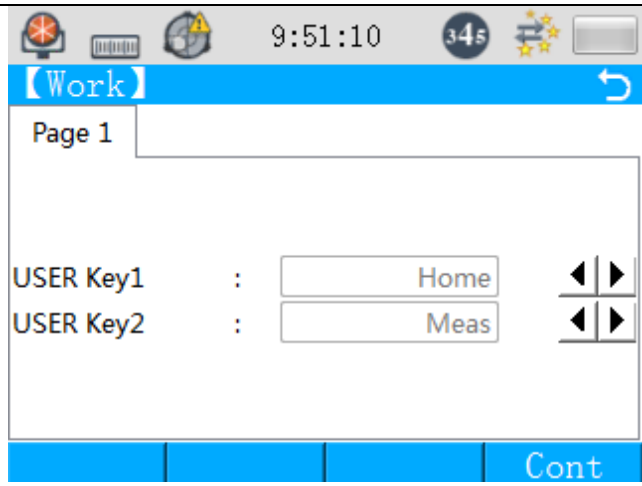
Regional	Vertical angle	Select vertical angle zero reading: either zenith or horizontal direction.
	Angular unit	Select angular unit, including degree-minute-second (360 °), gon (400 Gon), mil (6400 Mil) and degree (360 °).
	Distance unit	Select distance unit, either meter or foot.
	Date format	Select date display format, including:
Meas.Parameter	Air pressure	Air pressure can be entered.
	Temperature	Temperature can be entered.
	PPM	PPM can be entered or it can also be calculated with the air pressure and temperature entered.
	Prism constant	Prism constant can be entered.
	Reflector constant	Reflector constant can be entered.
	Data storage	To choose to or not to store the data
	Measurement storage	To choose to or not to store measurement information
Screen & Audio	Beep	Set beep to OFF or ON during setting of the audio mode.
EDM	Measurement mode	Select the measurement mode, including S.Meas, P.Meas and NP.Meas.
	Laser type	Select the laser type, including fine measurement and tracking.
	Number of measurements	Number of measurements can be entered.
Interface	Bluetooth communication	Set Bluetooth communication to ON or OFF.

9.1 Work

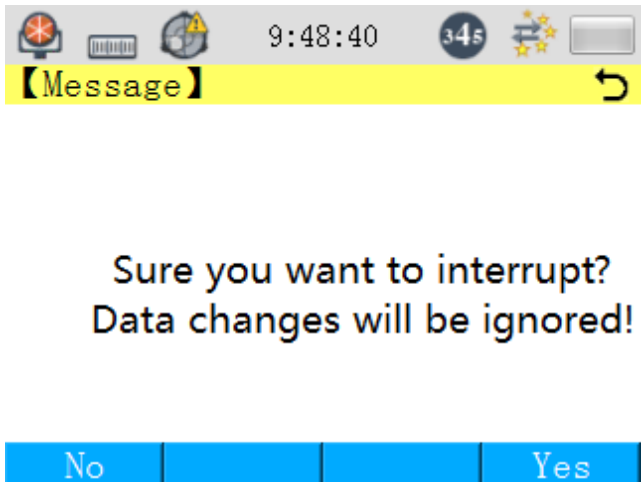
This function allows general work configuration and configuration of USER key 1 and 2.

Procedure	Display

① Under Configuration mode, press the button "Work" or "1" to enter general work configuration interface.

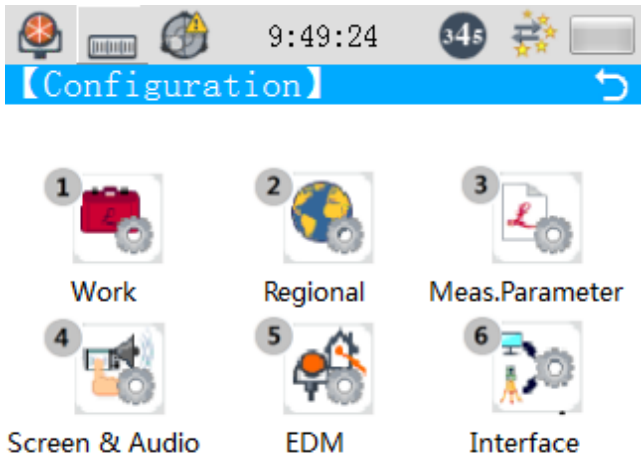


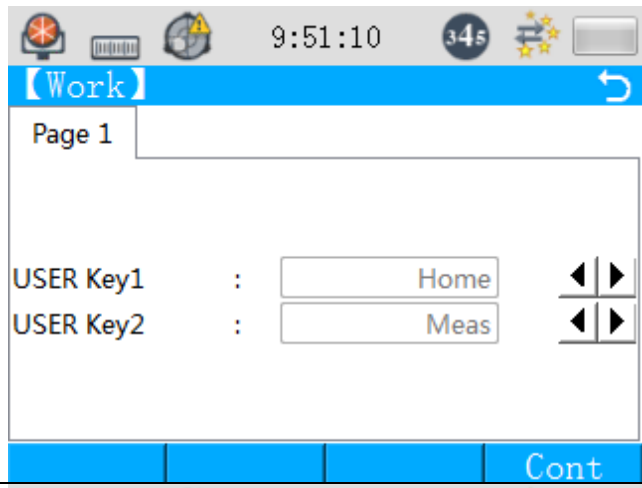
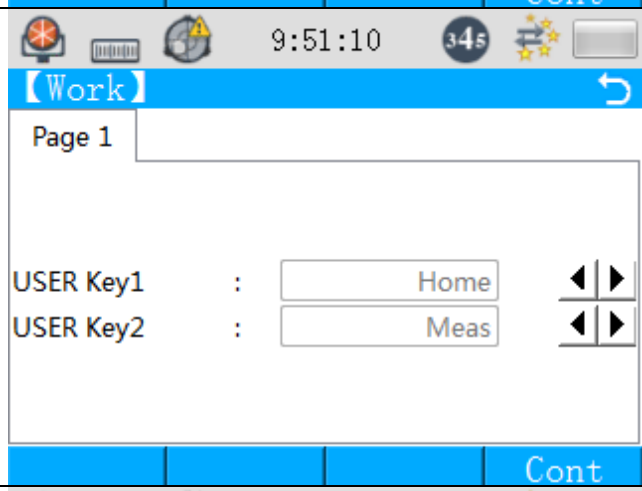
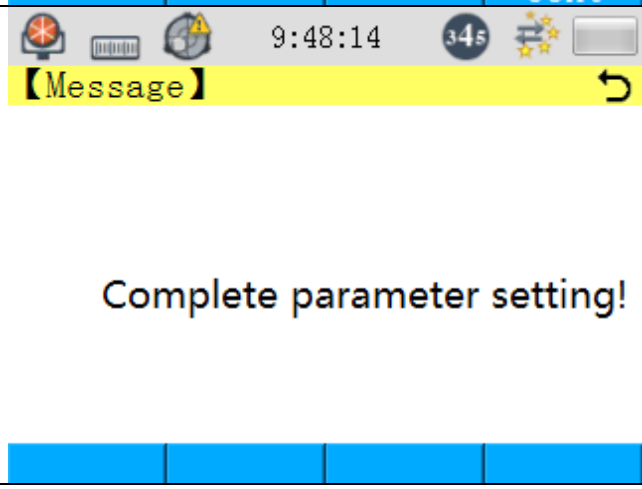
Press "↩" to return without saving the configuration.

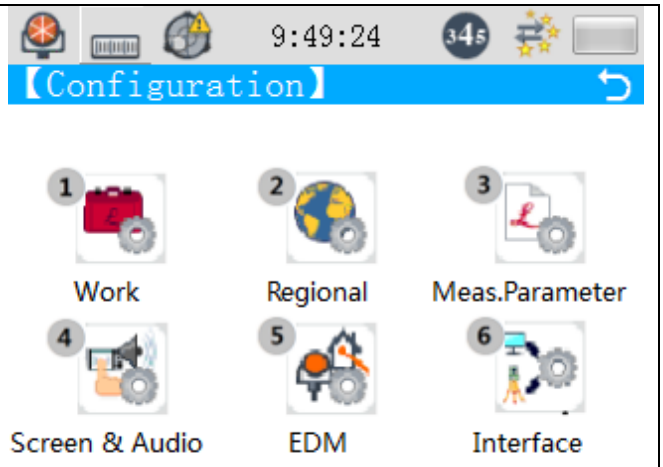


Press "F4" (Yes) to save the configuration and return to previous menu.

Press "F1" (No) to return to general work configuration interface without saving the configuration.

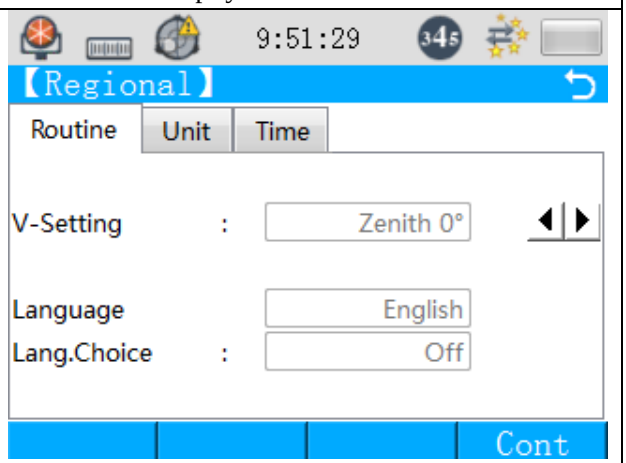


② In general work configuration interface, function of USER key 1 can be configured with the buttons " ◀ ▶ " behind "USER Key1" and the options include: Laser Line, Laser Point, Regional, VD, Home and Meas.	
② Press the buttons " ◀ ▶ " behind "USER Key2" to configure the function of USER key 2 and the options include: Laser Line, Laser Point, Regional, VD, Home and Meas.	
④ Press "F4" (Cont) to save the configuration and return to previous menu.	

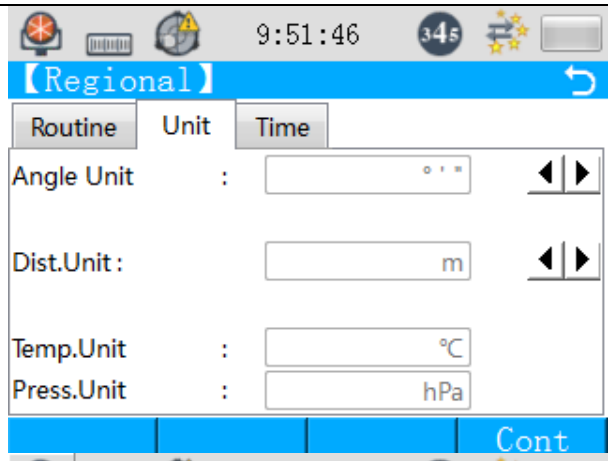
	

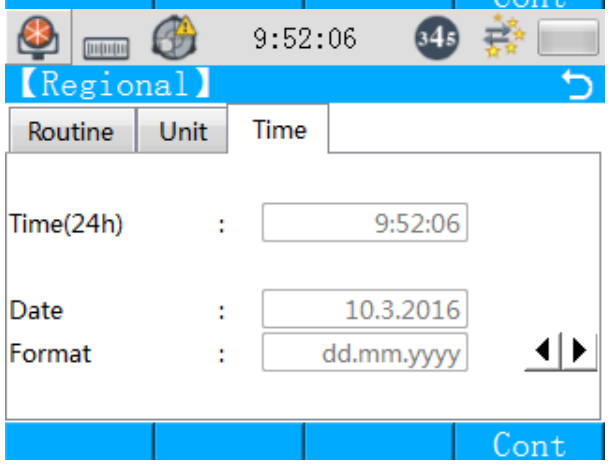
9.2 Regional

This function allows regional configuration, including the configuration of vertical angle, angular unit, distance unit and date format.

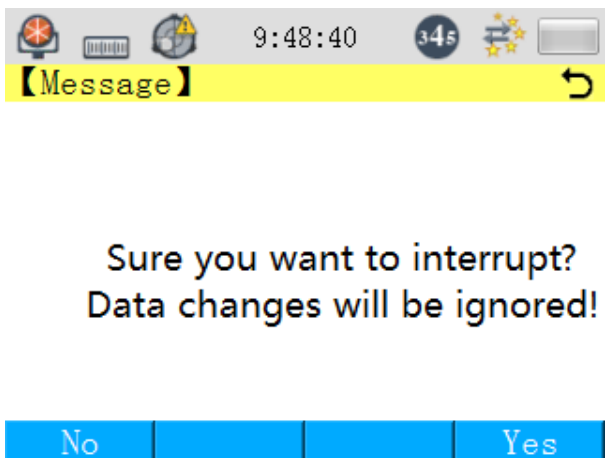
Procedure	Display
① Under Configuration mode, press the button "Regional" or "2" to enter regional configuration interface.	

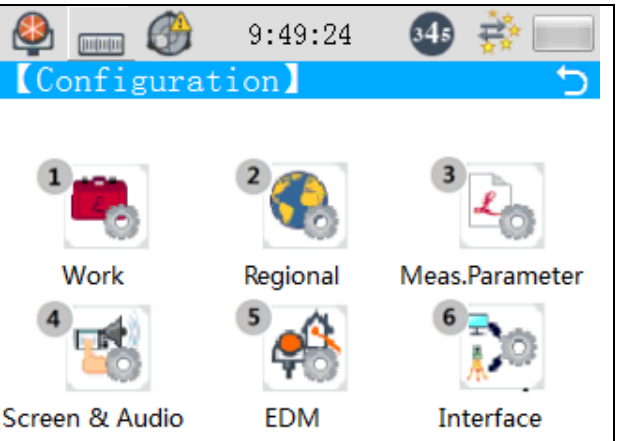
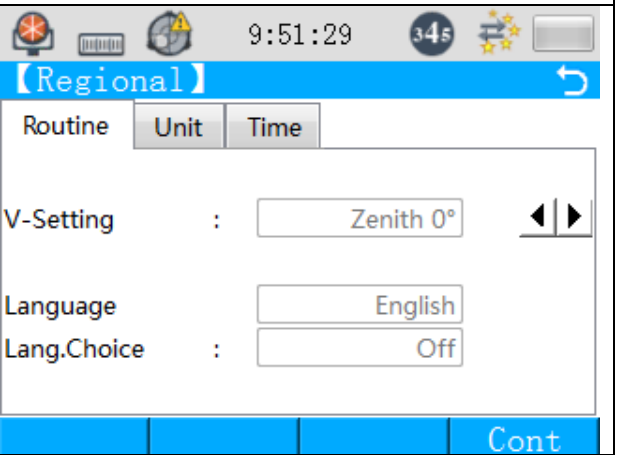
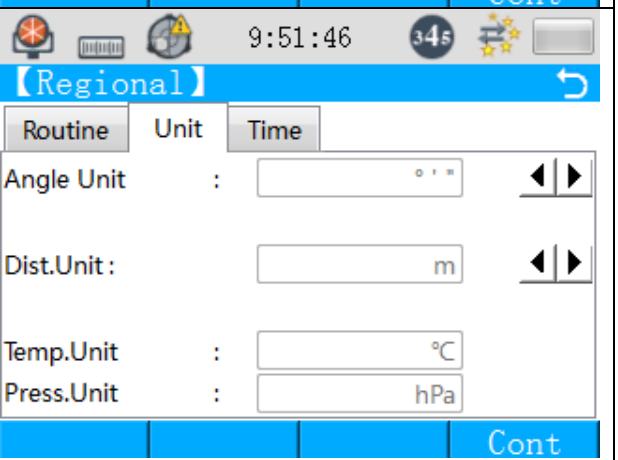
Press "⮌" to return without saving the configuration.

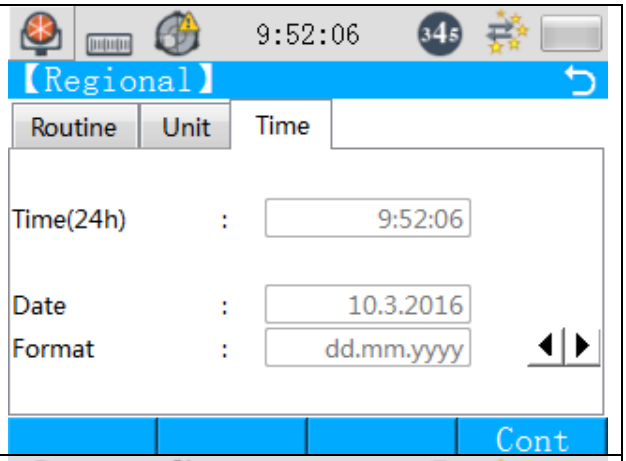
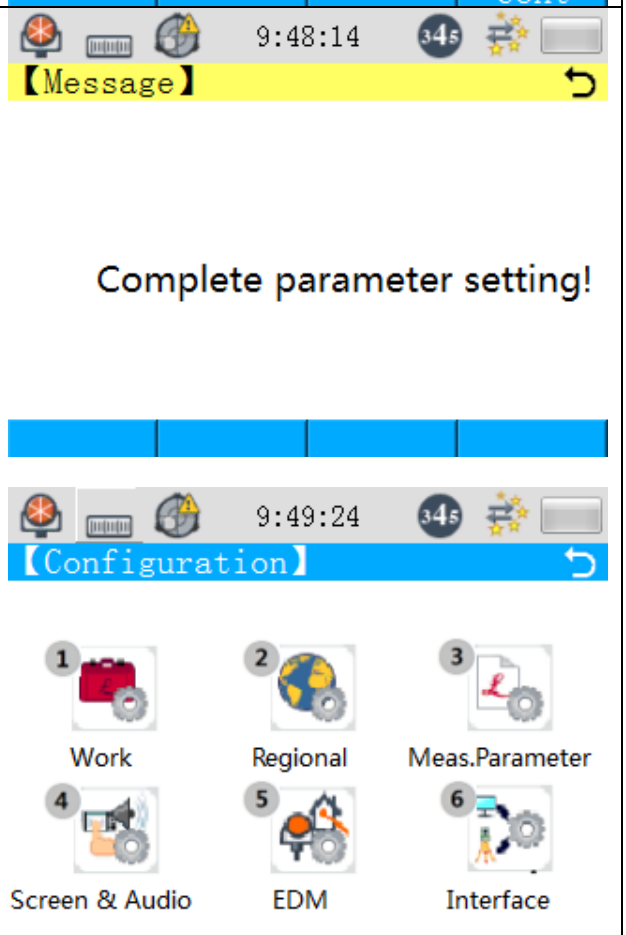




Press "F4" (Yes) to save the configuration and return to previous menu.
Press "F1" (No) to return to regional configuration interface without saving the configuration.

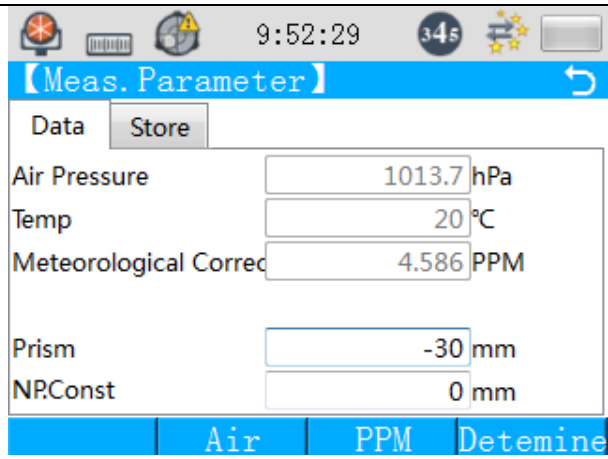
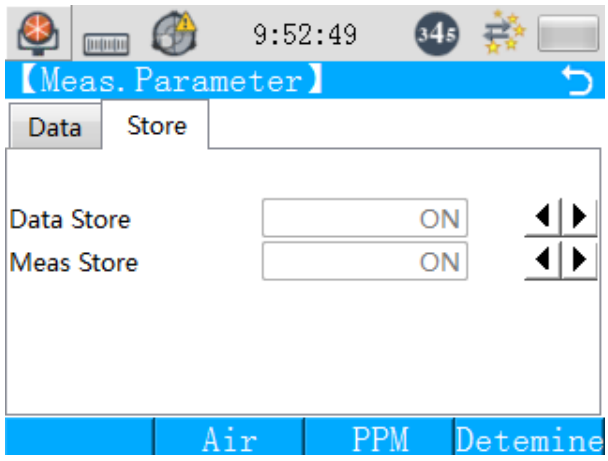
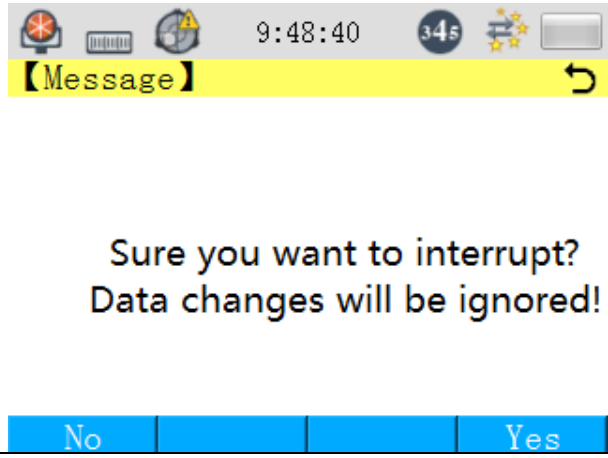


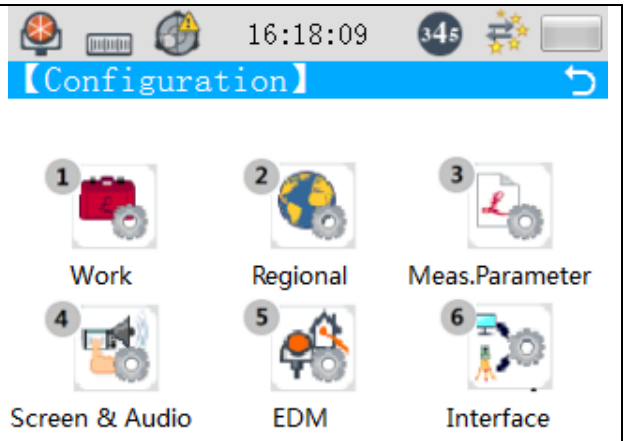
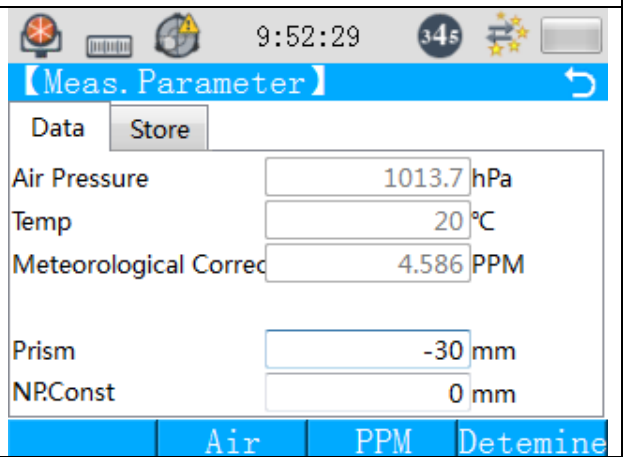
	
② In regional configuration interface, press the buttons "◀ ▶" behind "V-Setting" to configure vertical angle zero reading and the options include Zenith 0 °and Horizon 0 °.	
③ Press the buttons "◀ ▶" behind "Angle Unit" to configure the angular unit and the options include: ° ' " (360 °), gon (400 Gon), mil (6400 Mil) and °(360 °). Press the buttons "◀ ▶" behind "Dist.Unit" to configure the distance unit and the options include m and ft.	

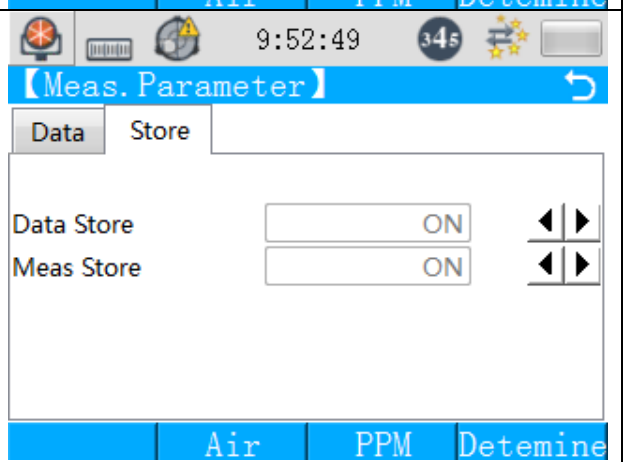
④ Press the buttons "◀ ▶" behind "Format" to configure the date format and the options include: dd.mm.yyyy, mm.dd.yyyy and yyyy.mm.dd.	
⑤ Press "F4" (Cont) to save the configuration and return to previous menu.	

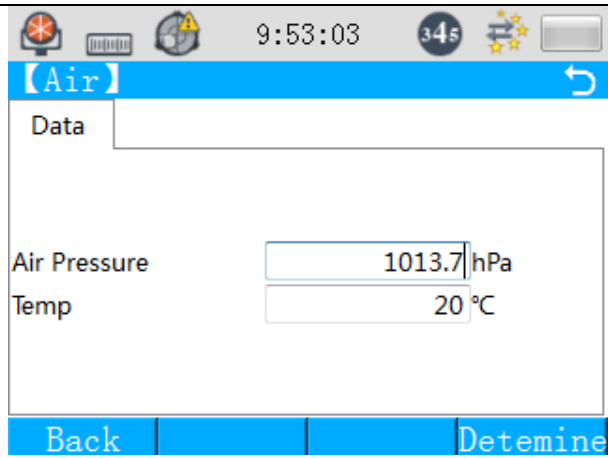
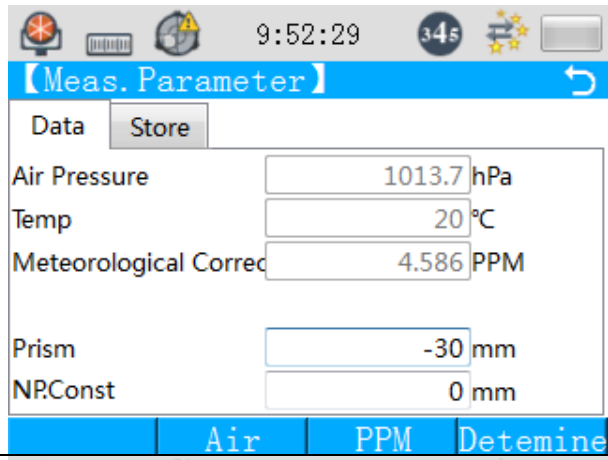
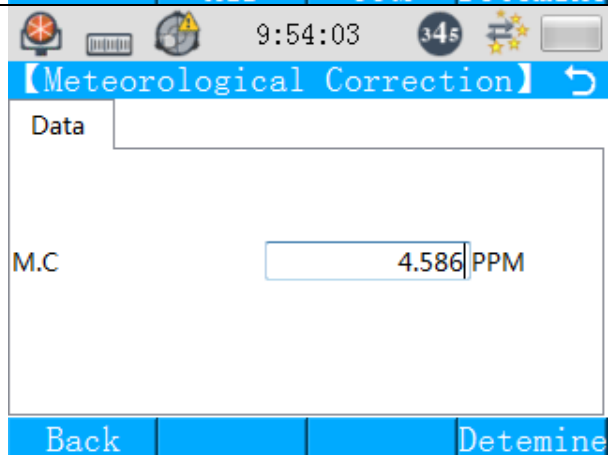
9.3 Meas.Parameter

This function allows configuration of measurement parameters, including air pressure, temperature, PPM, prism constant, reflector constant, data storage and measurement storage.

Procedure	Display
① Under Configuration mode, press the button "Meas.Parameter" or "3" to enter measurement parameter configuration interface.	
Press "⮌" to return without saving the entered data and configuration.	
Press "F4" (Yes) to save the entered data and configuration and return to previous menu; Press "F1" (No) to return to measurement parameter configuration interface without saving the entered data and configuration.	

<table>
<tr><td></td><td> 
</td></tr>
<tr><td>② In measurement parameter configuration interface, the prism constant can be entered in the field of “Prism”.
Enter the reflector constant into the field of “NP. Const”.</td><td> 
</td></tr>
<tr><td>③ Press the buttons “◀▶” behind “Data Store” to choose to or not to store the data and the options include: ON and OFF.

Press the buttons “◀▶” behind “Meas Store” to choose to or not to store measurement data and the options include: ON and OFF.</td><td> 
</td></tr>
</table>

④ Press "F2" (Air) to configure air pressure and temperature. Enter air temperature into the field of "Air Pressure". Enter temperature into the field of "Temp". Press "F4" (Detemine) to save the air pressure and temperature, calculate PPM and then return to measurement parameter configuration menu; Press "F1" (Back) to return to measurement parameter configuration interface without saving air pressure and temperature.	 
⑤ Press "F3" (PPM) to configure PPM. Enter PPM into the field of "M.C". Press "F4" (Detemine) to save the PPM and return to measurement parameter configuration menu; Press "F1" (Back) to return to measurement parameter configuration interface without saving the PPM.	

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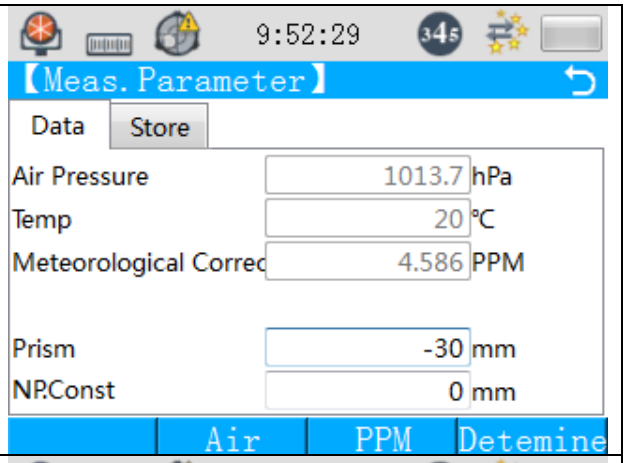
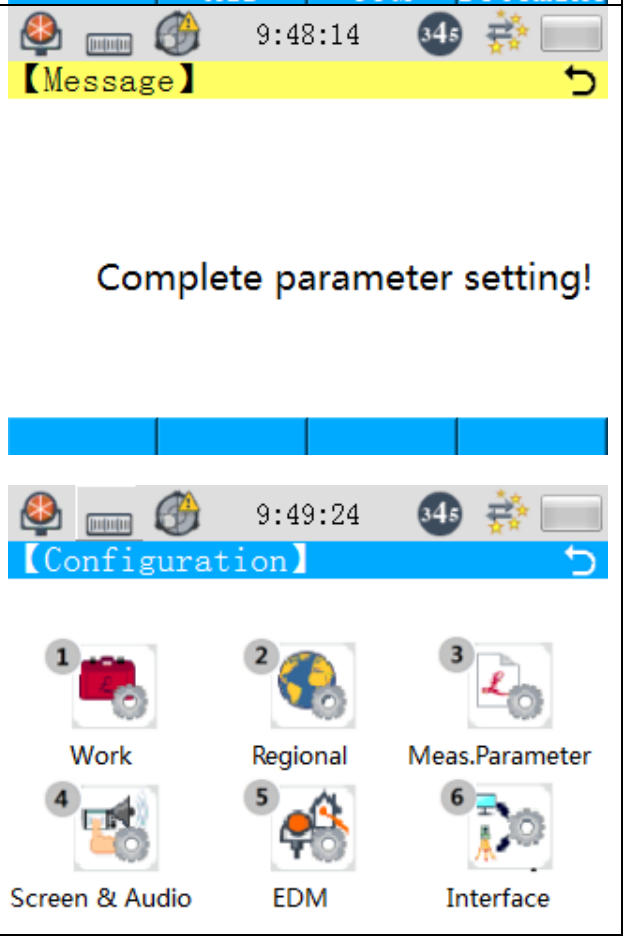
<td> 
</td>
</tr>
<tr>
<td>⑥ Press “F4” (Detemine) to save the configuration and return to previous menu.</td>
<td> 
</td>
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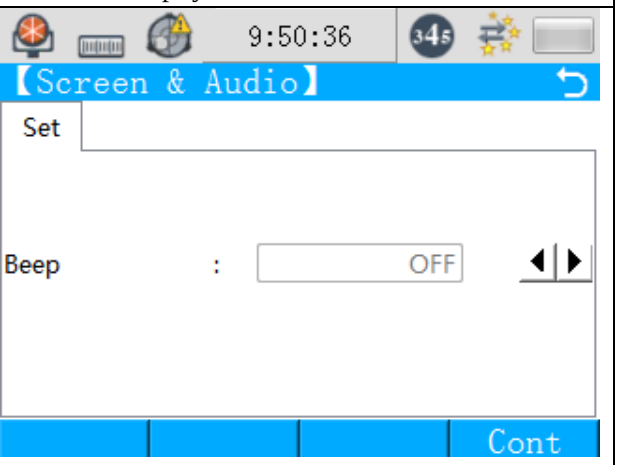
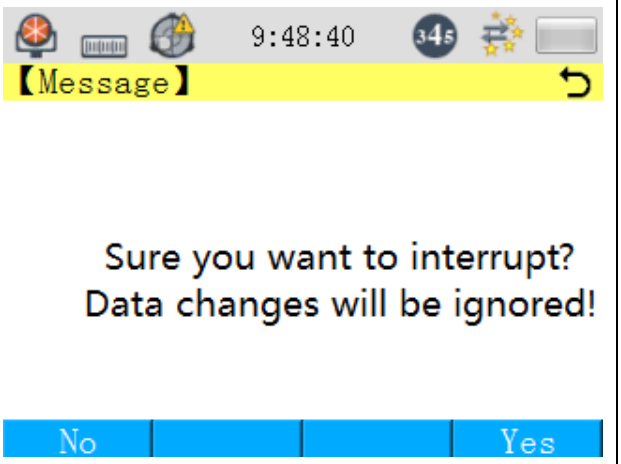
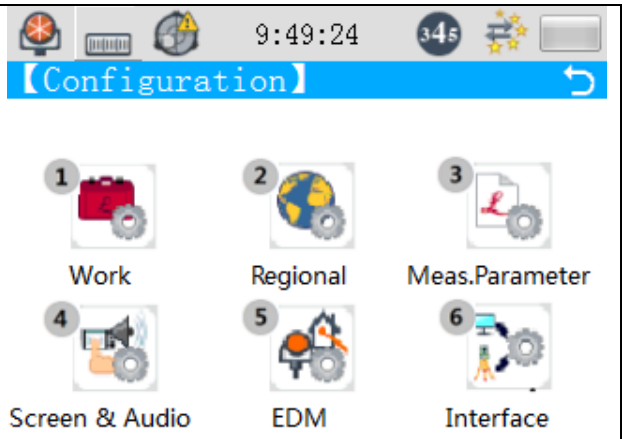
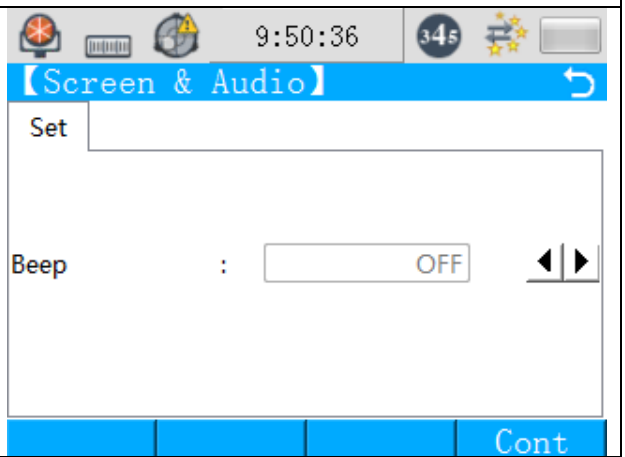
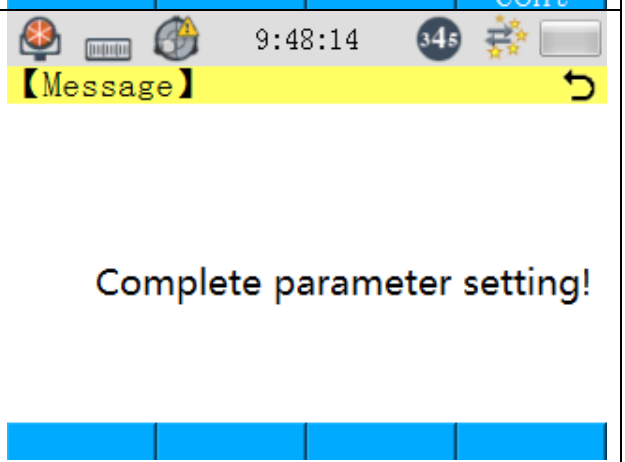
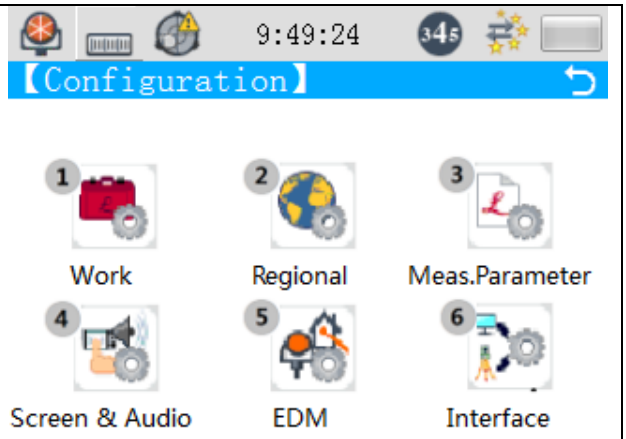
</table>

9.4 Screen & Audio

This function allows configuration of the screen and audio and set beep to ON or OFF under audio mode.

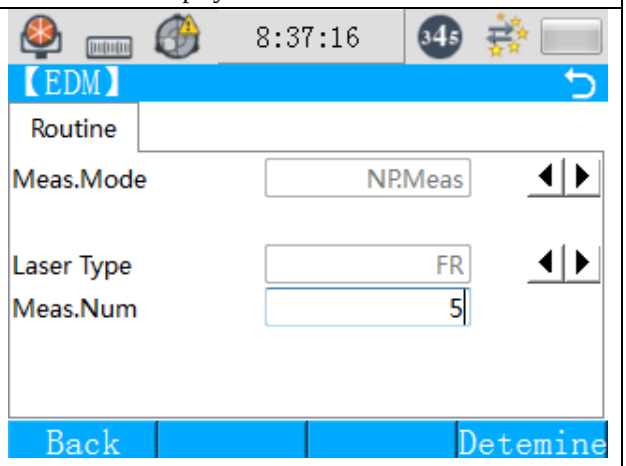
Procedure	Display
① Under Configuration mode, press the button "Screen & Audio" or "4" to enter screen and audio configuration interface.	
Press "⮌" to return without saving the configuration.	
Press "F4" (Yes) to save the configuration and return to previous menu. Press "F1" (No) to return to Screen &Audio configuration interface without saving the configuration.	

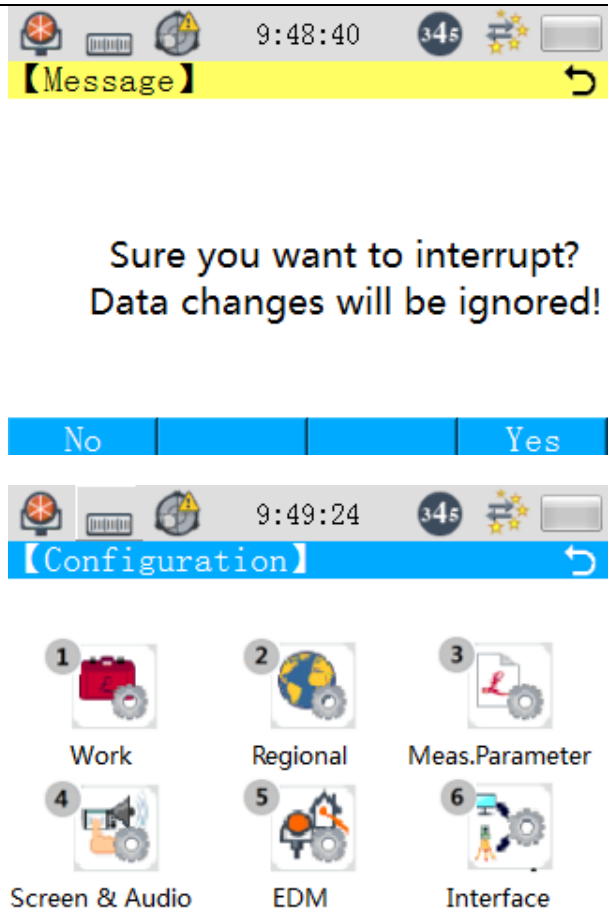
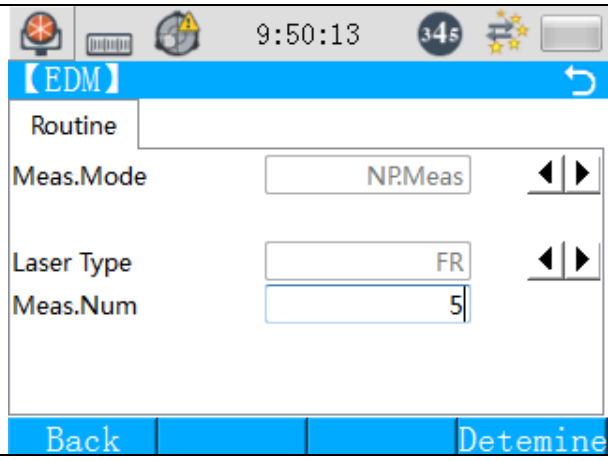
	
② In screen and audio configuration interface, press the buttons " ◀ ▶ " behind "Beep" to set it to ON or OFF under audio mode. To save the modification, press "F4" (Cont).	
③ Press "F4" (Cont) to save the configuration and return to previous menu.	

9.5 EDM

This function allows configuration of EDM, including measurement mode, laser type and number of measurements.

Procedure	Display
① Under Configuration mode, press the button "EDM" or "5" to enter EDM configuration interface. Press "↩" to return without saving the configuration. Press "F1" (Back) to return without saving the configuration. Press "F4" (Yes) to save the configuration and return to	

<table>
<tr>
<td>previous menu.
Press “F1” (No) to return to EDM configuration interface without saving the configuration.</td>
<td> 
</td>
</tr>
<tr>
<td>② In EDM configuration interface, press the buttons “ ◀|▶ ” behind “Meas.Mode” to configure the measurement mode and the options include: S.Meas, P.Meas and NP.Meas.</td>
<td> 
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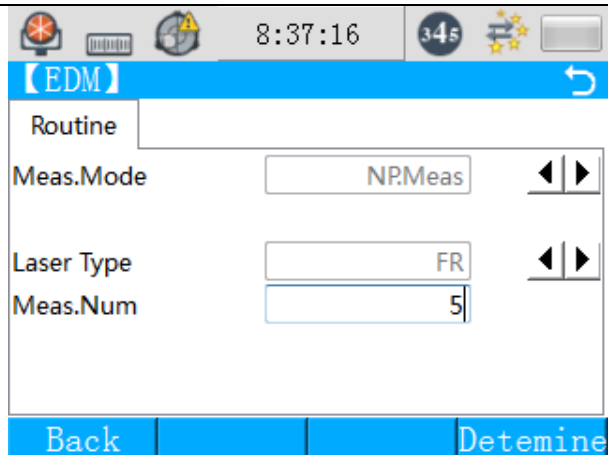
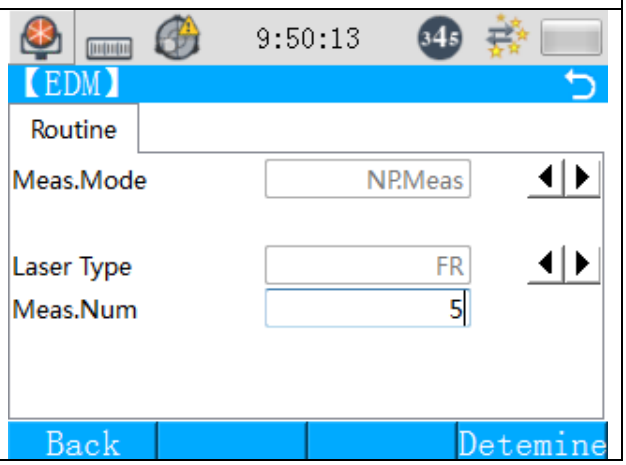
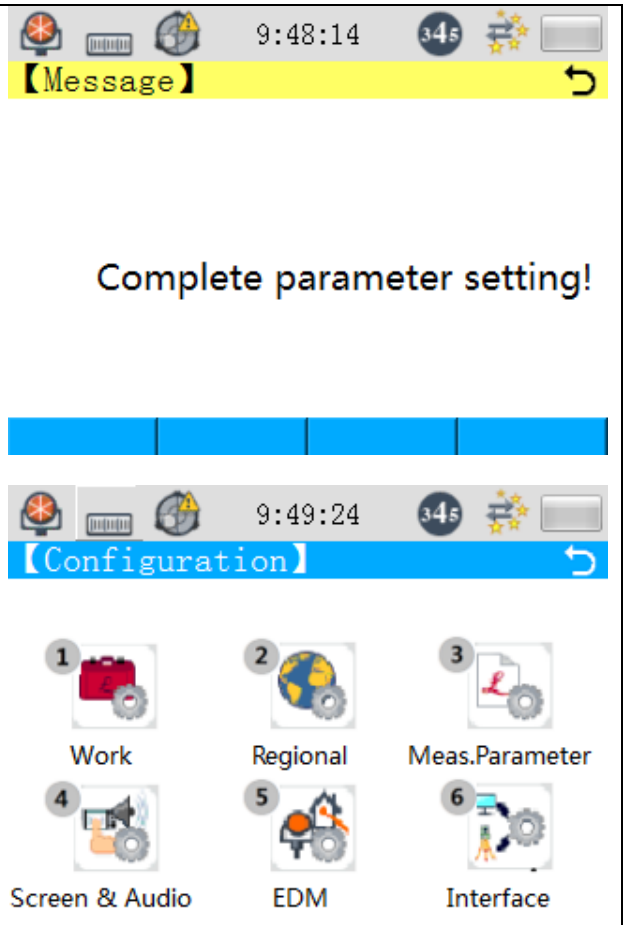
</table>

③ Press the buttons "◀ ▶" behind "Laser Type" to configure the laser type and the options include: TR and FR. ☆ FR mode: fine measurement, the normal distance measurement mode. Measuring time: approx. 2s Minimum display distance: 1mm ☆ TR mode: tracking; measuring time of this mode is shorter than that of fine measurement mode and it is mainly use for layout measurement. It is quite useful in tracking moving targets and engineering layout. Measuring time: approx. 0.8s Minimum display distance: 1mm	
④ Enter the number of measurement in the field of "Meas.Num".	

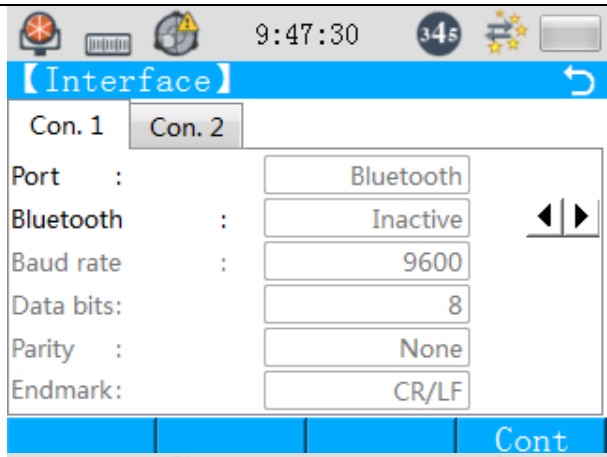
⑤ Press "F4" (Detemine) to save the configuration and return to previous menu.	

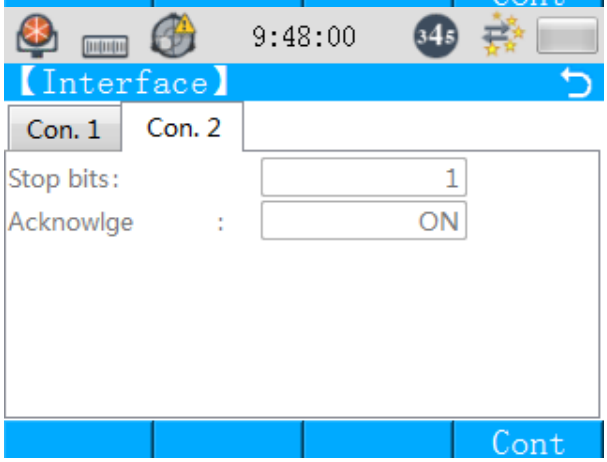
9.6 Interface

This function allows communication interface configuration and whether to activate the Bluetooth or not.

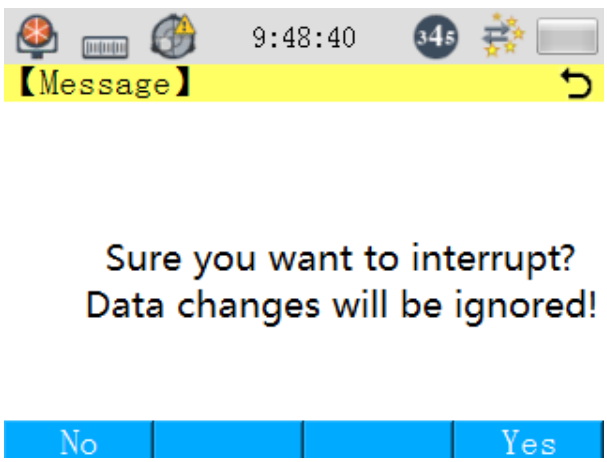
Procedure	Display

① Under Configuration mode, press the button "Interface" or "6" to enter interface configuration interface.



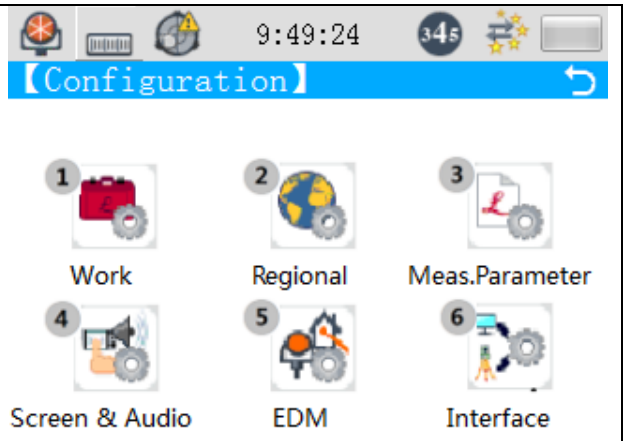
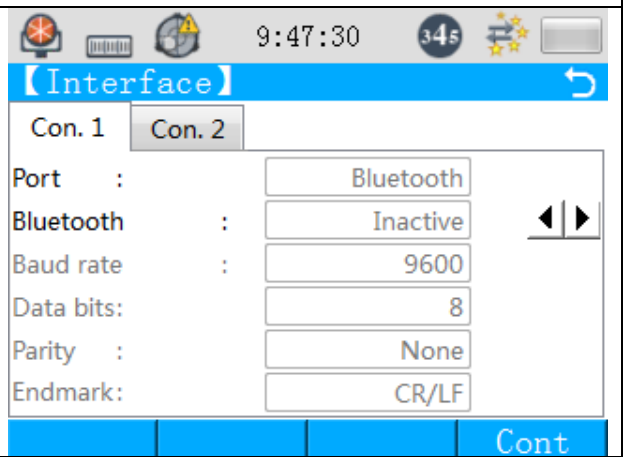
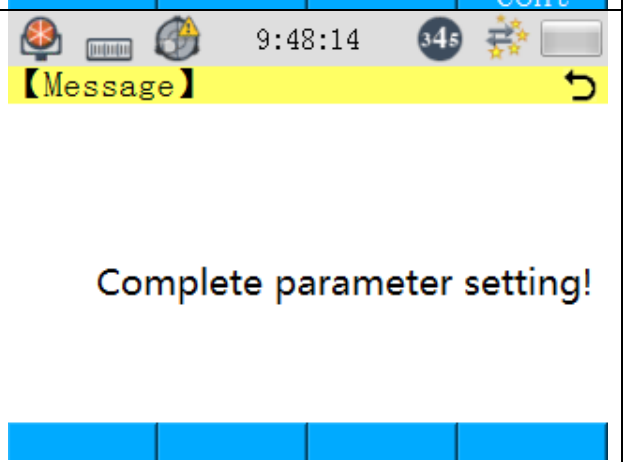


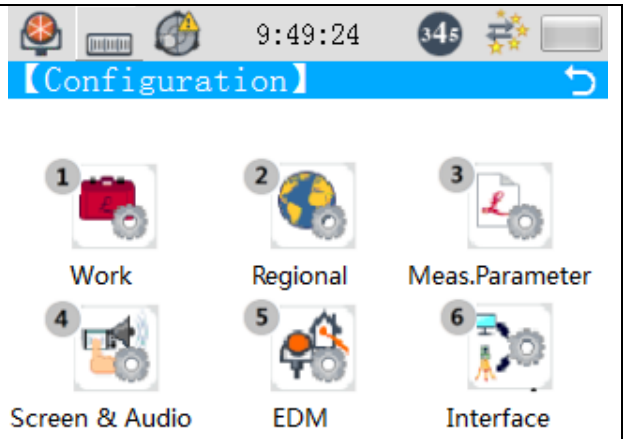
Press "↩" to return without saving the configuration.



Press "F4" (Yes) to save the configuration and return to previous menu.

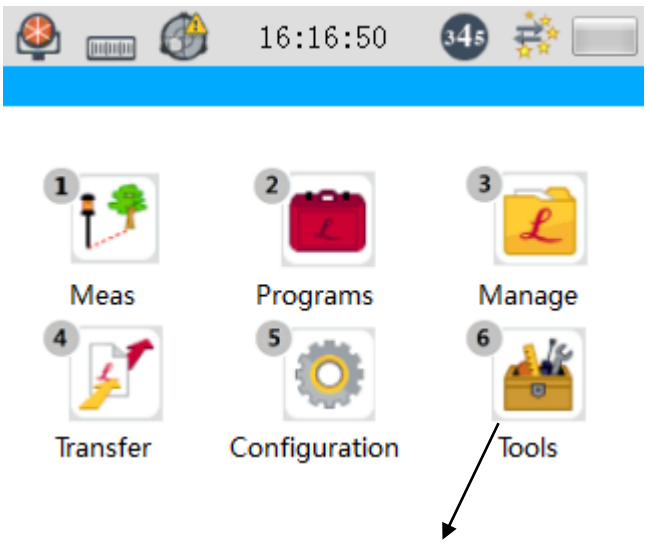
Press "F1" (No) to return to

interface configuration interface without saving the configuration.	
② In interface configuration interface, press the buttons "◀▶" behind "Bluetooth" to configure the Bluetooth and the options include: Active and Inactive.	
③ Press "F4" (Cont) to save the configuration and return to previous menu.	

10 Tools mode

Press [6] or click the button “Tools”.

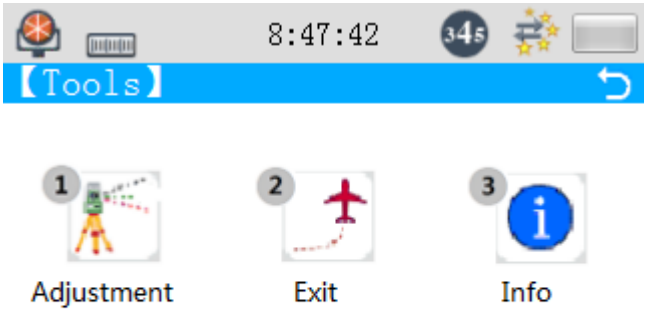


Tools 模式

Tools mode

This mode covers the following items:

1. Adjustment
2. Exit
3. Info

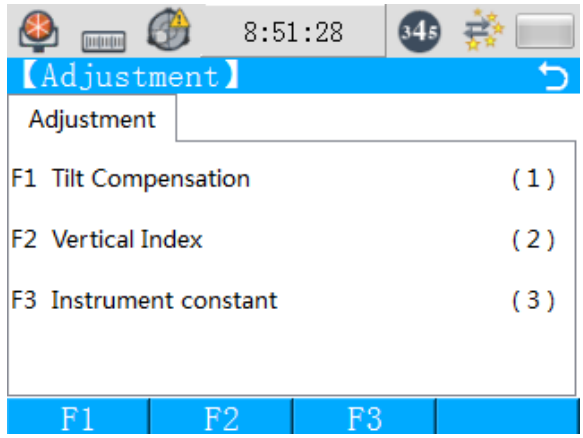


10.1 Adjustment

The compensator can automatically measure the angle between the instrument and the horizontal plane and compensate vertical angle measured by the instrument, to make the results more accurate. Therefore, the compensator shall be frequently inspected and adjusted.

10.1.1 Compensator adjustment

For specific operations, please contact local dealers.

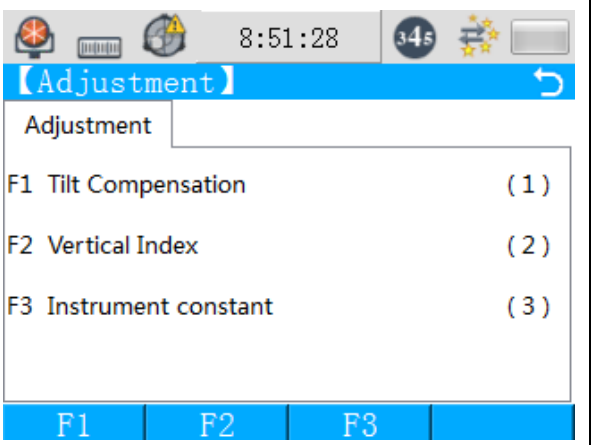
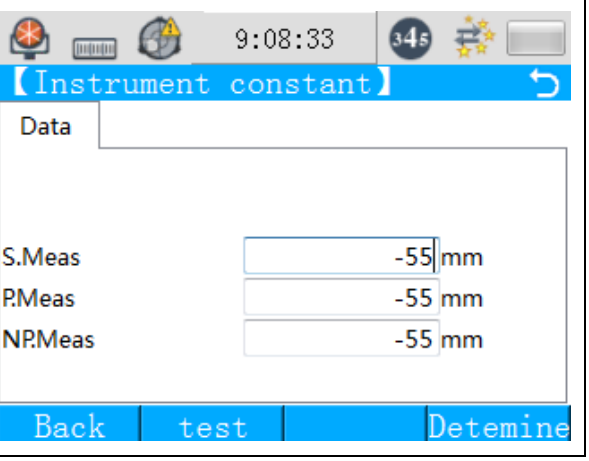
Procedure	Display
① Under Tools mode, press the button "Adjustment" or "1" to enter adjustment setting interface.	
② Press "F1" or (1) to enter compensator adjustment interface. For specific operations, please contact local dealers.	

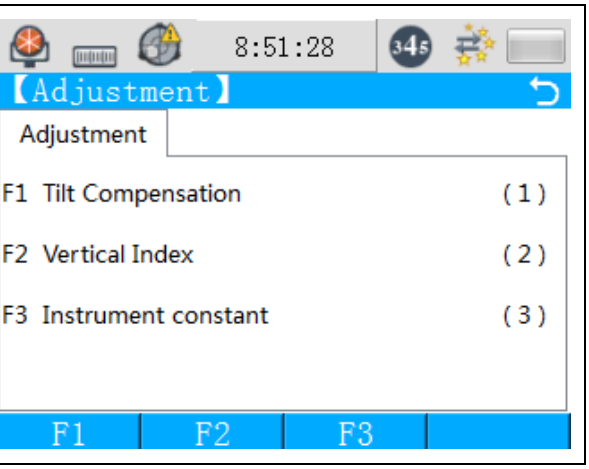
10.1.2 Index error

For specific operations, see "11.6 Index error of vertical circle (angle i) and vertical circle index zero setting".

10.1.3 Instrument constant

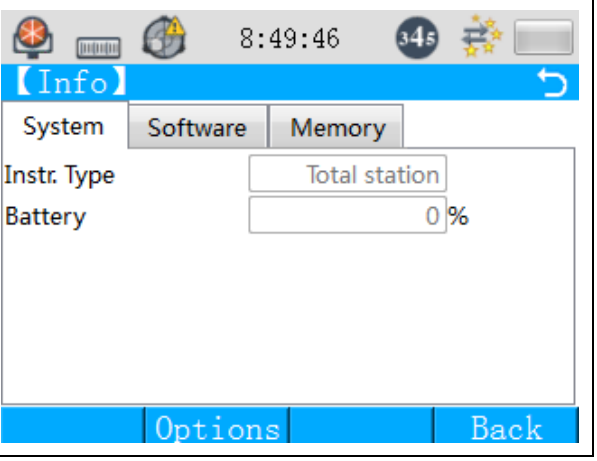
Instrument constant can be configured with this function, including that for "prism distance measurement", "Reflector distance measurement" and "non-prism distance measurement".

Procedure	Display
① In adjustment setting interface, press "F3" or (3) to enter instrument constant setting interface.	
② Enter the constant for "prism distance measurement", "Reflector distance measurement" and "non-prism distance measurement".	

③ Press "F4" (Detemine) to save the settings and return to previous menu; or press "F1" (Back) to cancel the operation and return to previous menu.	

10.2 Info

This function allows display of system information, including instrument type, battery level, operating system, language, version number, job information, number of measurements and fixpoints in a job, road file quantity, code quantity and options.

Procedure	Display
① Under Tools mode, press "Info" or "3" to enter system information interface. Press "F4" (Back) to return to previous menu.	

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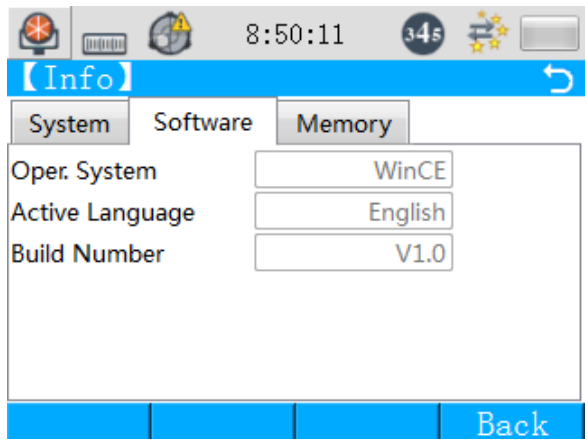
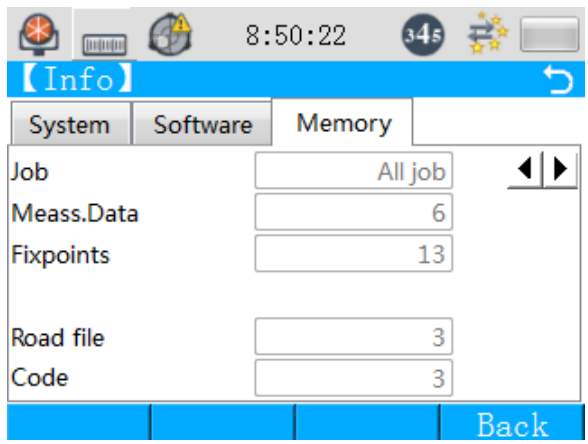
<td> 


</td>
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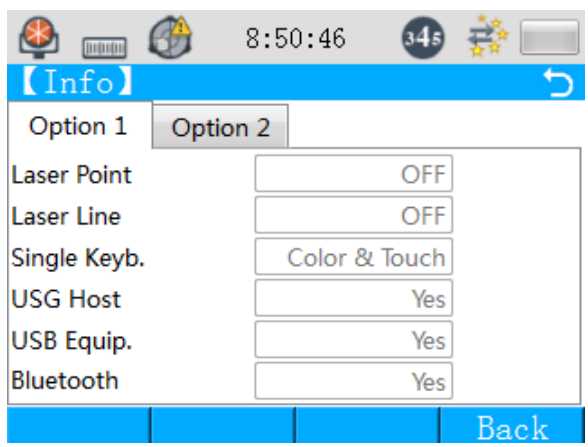
<tr>
<td>② In the page of “system”, press “F2” (Options) to enter options interface.
Press “F4” (Back) to return to previous menu.</td>
<td> 
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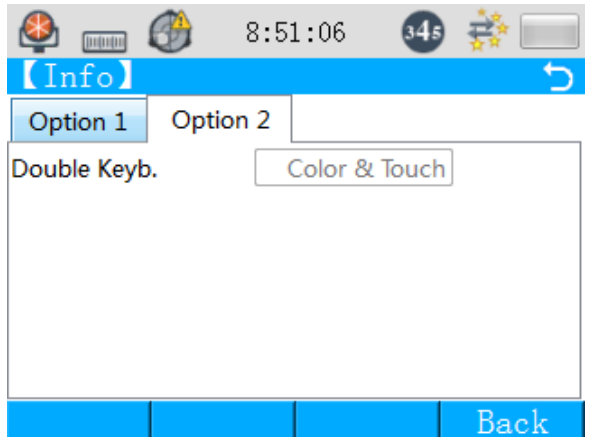
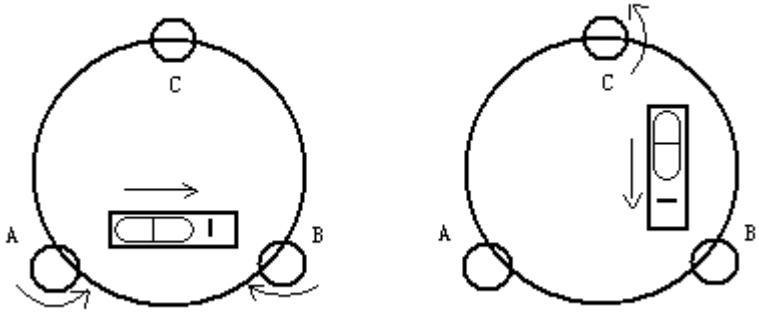


11 Inspection and calibration

本仪器在出厂时均经过严密的检验与校正，符合质量要求。但仪器经过长途运输或环境变化，其内部结构会受到一些影响。因此，新购买本仪器以及到测区后在作业之前均应对仪器进行本节的各项检验与校正，以确保作业成果精度。

The instrument is carefully inspected and calibrated in the factory and conforms to quality requirements. However, the internal structure may be affected due to long-distance transport or environmental changes. Hence, newly purchased instrument and instrument prior to operation in the survey region shall undergo the various inspection and calibration items specified in this chapter, to ensure accuracy of the measurement results.

11.1 Level tube



- Inspection:

  See 4.2 “Level the instrument with level tube in a fine manner” of this document for the method.

• Calibration:

1. During inspection, if bubble in the level tube is not on the center, first adjust it with the foot screws parallel with the level tube to make the bubble move toward the center for half of the offset; for the rest half, turn the adjusting screw (on the right of the level tube) of the level tube with the adjusting pin to set the bubble to the center.

2. Rotate the instrument for 180 °to check whether the bubble is centered. If not, repeat step 1 until it is centered.

3. Rotate the instrument for 90 °and adjust the bubble to the center with the third foot screw.

• Repeat the inspection and calibration procedure until the bubble is centered whichever direction the alidade is turned to.

11.2 Circular vial

• Inspection:

If bubble of circular vial is in the center after correct inspection and calibration of the level tubes, no calibration is required.

• Calibration

If the bubble is not centered, it shall be set to the center by adjusting the adjusting screws below the bubble with adjusting pin or Allen wrench. For calibration, first loosen the adjusting screw (1 or 2) on the opposite of the offset direction and then tighten other adjusting screws in the near the bubble to center the bubble. When centering the bubble, the tightening force applied to the three adjusting screws shall be uniform.

11.3 Telescope reticle

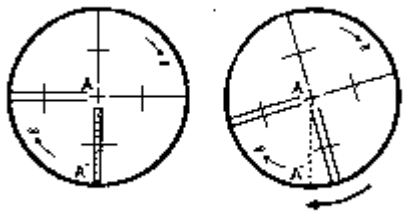
• Inspection:

1. With the instrument leveled, select a target point A on the sight line of the telescope, sight A with graticule on the reticle and then fix the horizontal and vertical clamp screws.

2. Turn vertical tangent of the telescope to move point A to edge of the field of view (point A').

3. If point A moves along the vertical line of the graticule, namely, point A' is within the vertical line, no calibration is required if the graticule does not slant.

As shown in the following figure, if point A' is not on the center of the vertical line, namely, the graticule tilts, calibration of the reticle is required.



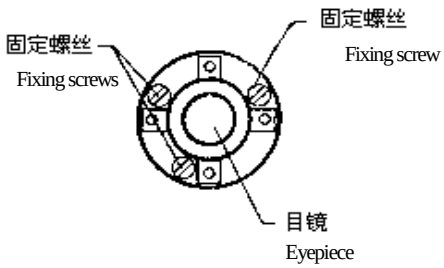
• Calibration

1. First remove the reticle base cover between telescope eyepiece and focusing knob and the four screws retaining the reticle base will be exposed (see the figure attached).

2. Evenly unscrew the four screws with a screwdriver and turn the reticle base around the collimation axis to make point A' on the vertical line.

3. Evenly tighten the four screws and check the calibration results with the method stated above.

4. Reinstall the cover.



11.4 Perpendicularity of collimation axis and horizontal axis (2C)

• Inspection:

1. Set a target A far away at the same height of the instrument, finely level the instrument and switch on the power.

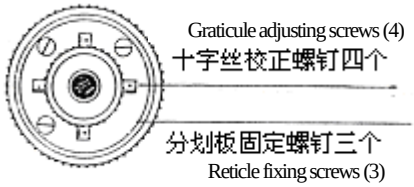
2.With circle left, sight target A with the telescope and read the horizontal angle.

(e.g.: horizontal angle L = 10°13′10″)

3. Releasing vertical and horizontal clamp screws to adjust the telescope and then turn the alidade circle right to sight the same point A and read the horizontal angle. Horizontal and vertical clamp screws shall be tightened prior to sighting.

(e.g.: horizontal angle L = 190°13′40″)

4. 2 C＝L－ (R±180 °) ＝－30″≥±20″ and calibration is required.



• Calibration

1. Adjust the horizontal angle reading to the correct value with C offset by adjusting horizontal tangent:

R+C=190°13′40″−15″=190°13′25″.

2. Remove the reticle base cover between telescope eyepiece and focusing knob and adjust the two horizontal graticule adjusting screws on the reticle. First loosen the screw on one side and then tighten the one on the other side. Move the reticle to sight target A with the graticule.

3. Repeat the inspection and calibration procedure until it conforms to the requirement of |2C| <20″.

4. Reinstall the cover.

11.5 Vertical circle index zero automatic compensation

• Inspection:

1. With the instrument installed and leveled, make direction of the telescope consistent with the line formed by instrument center and any of the foot screws X and tighten the horizontal clamp screw.

2. Turn on the instrument, set vertical circle index to zero, tighten vertical clamp screw and the instrument will display vertical angle of current telescope direction.

3. Turn the foot screw X for 10mm circumference along one direction and the vertical angle displayed will change along until it disappears and the "out" message pops up, indicating the instrument vertical axis tilts for over 3' and has exceeded design range of vertical circle compensator. When the foot screw is turned in the opposite direction to restore it, the instrument will display the vertical angle again. Repeat the test at the critical position to see the change which indicates the vertical circle compensator works normally.

• Calibration

The instrument shall be sent to the factory for repair when any fault with the compensator is found.

11.6 Index error of vertical circle (angle i) and vertical circle index zero setting

Conduct this test after items of 11.3 and 11.5 are carried out.

• Inspection:

1. With the instrument erected, leveled and turned on, sight any clear target A with the telescope and get the vertical angle circle left reading L.

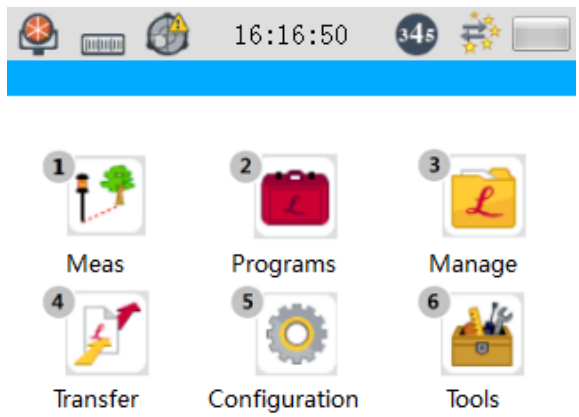
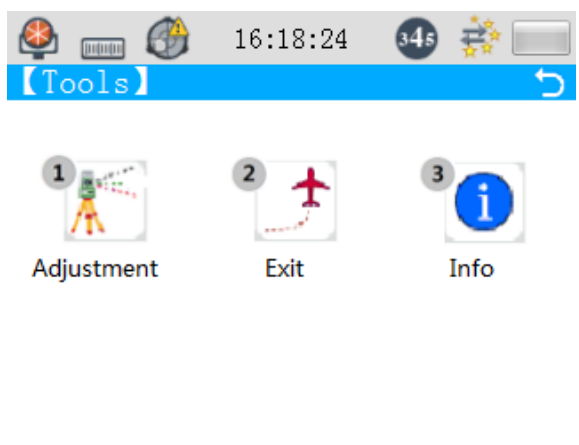
2. Turn the telescope and sight A again to get the vertical angle circle right reading R.

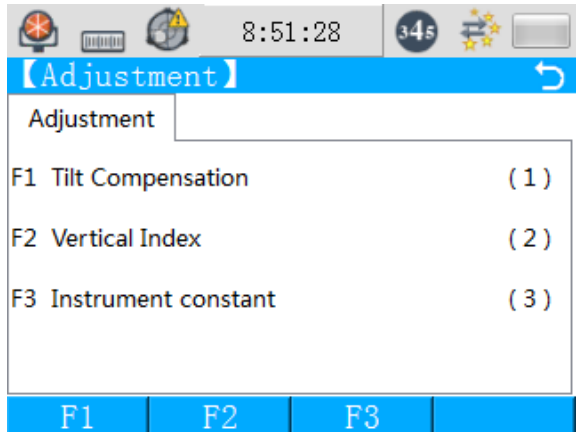
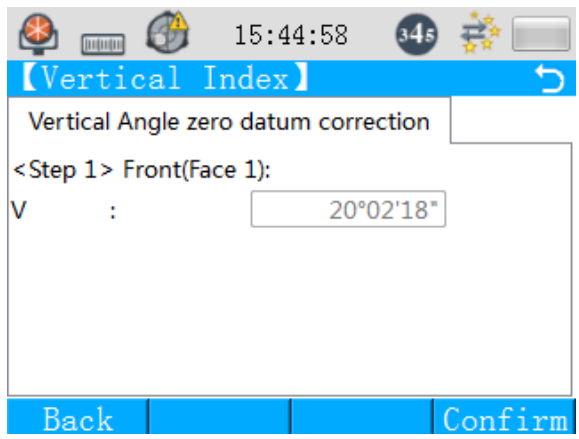
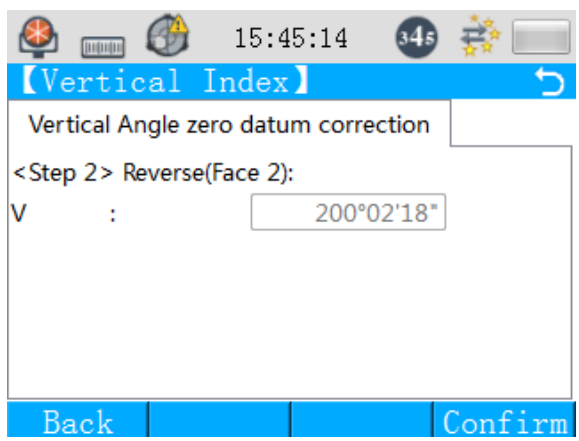
i = （L＋R－180°）/ 2 或 （L＋R－540°）/ 2。

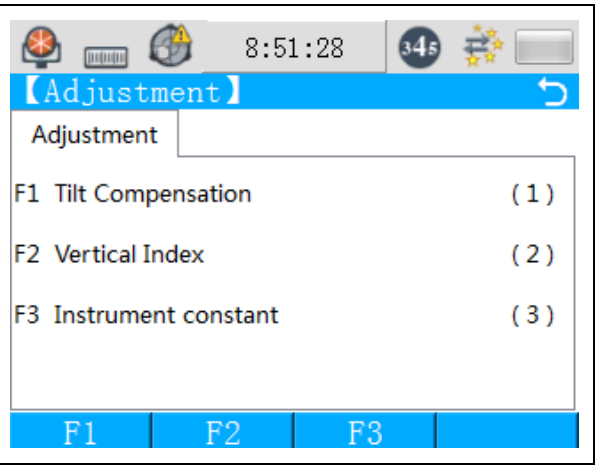
3. If vertical angle zenith is 0°, i=(L+R−360°)/2; if vertical angle horizontal is 0°, i=(L+R−180°)/2 or (L+R−540°)/2.

4. If |i| ≥10″, vertical circle index zero shall be reset.

• Calibration

Procedure	Display
① With instrument leveled, press POWER to turn on the instrument.	
② Press the button “Tools” or “6” to enter Tools mode.	

③ Press the button "Adjustment" or "1" to enter adjustment setting interface.	
④ Press "F2" or "2" to enter index error setting interface. ⑤ Accurately sight the target at normal position (circle left) of the telescope and press "F4" (Confirm) to proceed with next step.	
⑥ Turn the telescope and accurately sight the same target with telescope inverted (circle right). Press "F4" (Confirm) to finish setting and it will automatically return to adjustment menu.	



Notes: 1. Repeat the inspection procedure to measure the index error (angle i) again. If the index error still cannot meet the requirement, it shall be checked whether the three calibration (index zero setting) steps are properly conducted and whether the target is properly sighted. Please reset it as required.

2. The instrument shall be sent to the factory for repair if the requirements are not met after repeated inspection and calibration.

● The vertical angles displayed during zero setting are values not compensated or corrected and can only serve as reference in the setting process. They shall not be used for other applications.

11.7 Optical plummet

• Inspection:

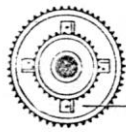
1. Set the instrument onto the tripod, draw a cross on a white paper and place it on the ground right below the instrument.

2. Properly adjust focusing distance of the optical plummet and move the white paper to set the cross to the center of the sight field.

3. Turn the foot screw to make center mark of the plummet coincide with intersection of the cross.

4. Turn the alidade. Observe overlap ratio of center mark of the plummet with intersection of the cross for every turn of 90 °.

5. If center mark of the optical plummet coincides with intersection of the cross while turning the alidade, no calibration is required. Otherwise, it shall be calibrated in the following way.



对中器校正螺丝(四个)

Plummet adjusting screws (4)

• Calibration

1. Remove the adjusting screw cover between optical plummet eyepiece and focusing knob.

2. Retain the white paper with a cross and mark drop point of plummet center mark on the paper for each turn of 90 °of the instrument, point A, B, C and D, as shown in the figure.

3. Draw two lines connecting diagonal points AC and BD and intersection point of the two lines is O.

4. Adjust the four adjusting screws of the plummet with the adjusting pin to make center mark of the plummet coincide with point O.

5. Repeat inspection step 4 to check whether it meets the requirements after calibration.

6. Reinstall the cover.

11.8 Instrument constant (K)

Instrument constant is inspected before it leaves factory and the instrument is adjusted to set K to 0. The instrument constant rarely changes, but we suggested checking it once or twice every year. This inspection shall be conducted on a standard base line or in the way described below.

• Inspection:

1. Select a flat field and erect and level the instrument at point A. carefully mark point A, B and C on the same line with an equal space of 50m and accurately install and align the reflector prism.

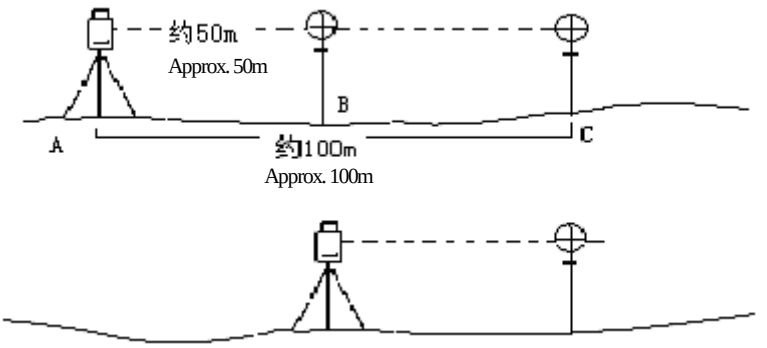
2. With temperature and air pressure entered into the instrument, accurately measure the horizontal distances AB and AC.

3. Erect and accurately align the instrument at point B and accurately measure the horizontal distance BC.

4. Then you can get the instrument constant:

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

K shall be approximately 0. If $|K|>6mm$, strict inspection shall be conducted in a standard base line site and calibration shall be conducted based on the test value.



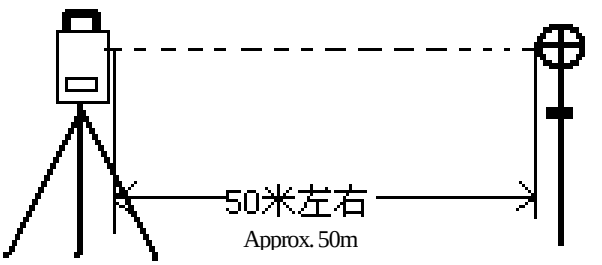
• Calibration

It has been verified through strict tests that changes have occurred when the instrument constant is not approximately 0. If the user must calibrate it, the instrument addition constant shall be set to the composite constant K.

● Vertical line of the instrument shall be used for orientation, to make points A, B and C strictly on the same line. There shall be a solid and clear alignment mark on the ground at point B.

● Whether prism center at point B coincide with instrument center is an important factor affecting measurement accuracy. Hence, it would be preferred to use a tripod or a universal base at point B. if three-leg type prism connector and base are adopted, the tripod and base shall remain still when exchanging them and only exchange the parts of the prism and the instrument above the base, to reduce coincidence error.

11.9 Parallelism of collimation axis and emission electric-optical axis



• Inspection:

1. Erect a reflector prism at 50m from the instrument.
2. Accurately sight the reflector prism center with the telescope.
3. Switch on the power and enter routine measurement mode. Press “Meas” to conduct distance

measurement. Turn horizontal tangent left and right and vertical tangent up and down for electric sighting. Find the center of the emission electric-optical axis for distance measurement based on the left and right flashing points and up and down flashing points indicating smooth optical path for distance measurement.

4. Check whether graticule center of the telescope coincides with center of emission electric-optical axis. If so, it is qualified.

• Calibration

If telescope graticule center deviates hugely from center of emission electric-optical axis, it shall be sent to the professional repair department for calibration.

11.10 Base foot screw

If the foot screw is found loose, it can be tightened by adjusting the 2 adjusting screws on eth base. Tighten the screws with proper torque.

11.11 Assemblies for reflector prism

1. Reflector prism connector

It shall be checked whether the level tubes and optical plummet on the base connector are correct. See 11.1 and 11.7 for the inspection methods.

2. Centering rod perpendicularity

As shown in the figure in 11.7, draw a "+" at point C and insert lower tip of centering rod into the point. Do not move it throughout the inspection. The two feet e and f shall be respectively at point E and F on the cross. Adjust the length of e and f to set bubble of centering rod circular level to the center.

Erect the leveling instrument at point A not far from the cross. Sight point C with center of graticule. Retain horizontal clamp screw with foot point and tilt the telescope upward to make point D on upper part of centering rod near the horizontal line. Withdraw and extend only foot e of the centering rod to move point D left and right to sight center of the graticule. At this time, points C and D shall be both on centerline of the graticule.

Erect the instrument on point B another point on the graticule in the same way. At this time, only withdraw and extend foot f to make point D on the centering rod coincide with point C on the graticule centerline.

After calibration at point A and B, the centering rod is already perpendicular. If bubble of the circular level on the rod is not at the center, adjust the three adjusting screws below the circular level to center the bubble.

Conduct inspection and calibration again until the centering rod is perpendicular in both directions and the bubble is centered.

12 Technical parameters

		Wince total station
Distance measurement		
Maximum distance (under good weather conditions)	Single prism	2.5 Km
	Three prisms	5.0 Km
	Non-prism	400m or 600m (optional)
Numeric display		Maximum: 99999999.999 m minimum: 1mm
Accuracy		Non-prism: 5+3ppm; prism: 3+2ppm
Unit		m/ft (optional)
Measuring time		Fine measurement: 2s each time; tracking: 0.8s
Number of measurements		1~99 measurements can be taken
Meteorological correction		It will automatically correct it with parameters entered
Atmospheric refraction and earth curvature correction		It will automatically correct it with parameters entered; K=0.14
Prism constant correction		It will automatically correct it with parameters entered
Angle measurement		
Measurement mode		Absolute code
Grating disc diameter (horizontal, vertical)		79mm
Minimum display reading		1″
Detection method		Vertical disc: diameter

	Horizontal disc: diameter
Accuracy	2″
Telescope	
Imaging	Positive image
Barrel length	170mm
Effective aperture of objective lens	48mm
Magnifying ratio	30×
Field angle	1 °30′
Resolution	3.5″
Minimum focusing distance	1.5m
Automatic vertical compensator	
System	Single- or double-axis liquid electronic sensing and compensation
Operating range	±3′
Accuracy	±3″
Level	
Level tube	20″/2mm, 30″/2mm
Circular vial	8′/2mm
Optical plummet	
Imaging	Positive image
Magnifying ratio	3×
Focusing range	0.5m～∝
Field angle	5°
Display	
Type	Double-side, diagram form
Data transmission	
Interface	RS—232C
Bluetooth	
Onboard battery	
Power	Rechargeable mh-ni battery, rechargeable lithium battery

\Voltage	Lithium battery: DC7.6V; mh-ni battery: DC7.2V
Continuous working hours	7h
Size and weight	
Overall dimensions	174×207×383mm
Weight	6.8 kg

13 Accessories

- Packing box 1 pcs
- Main machine 1 set
- Standby onboard battery 1 set
- Charger 1 set
- Plumb 1 pcs (laser plummet has no plumb)
- Adjusting pin 2 pcs
- Soft brush 1 pcs
- Screwdriver 1 pcs
- Allen wrench 2 pcs
- Lint 1 pcs
- Drying agent 1 bag
- Certificate of quality 1 pcs
- Instrument operation manual 1 copy
- USB data line 1 pcs
- Driver disk 1 set

14 [Annex] Road alignment element calculation

The alignment elements in road alignment layout program include beeline, arc and curve.

Notes:

1) Road alignment data are directly manually entered;

2) Road alignment data are management based on pile number;

3) Though [Layout store] is set to ON, the layout data can neither be printed or stored;

4) A job name corresponds with a road data alignment and multiple alignments can be created by creating several job names.

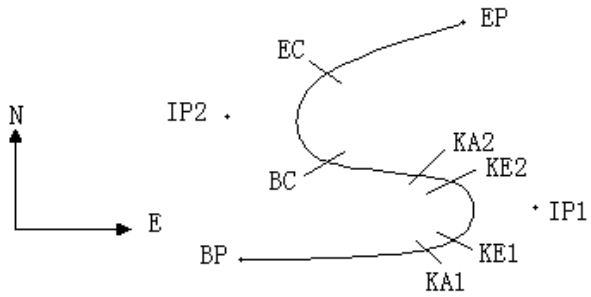
1. Road alignment elements

They are manually entered into the Wince total station.

The way to enter the alignment elements is described below.

Alignment element	Parameters
Beeline	Azimuth, distance
Curve	Radius, curve length
Arc	Radius, arc length
Point	N and E coordinates, radius, A1 and A2

Note: When data is loaded from the computer or the items are entered by selecting the point name, calculation of the parameters is not required.



PT name	North (N)	East (E)	Radius (R)	Curve A1	Curve A2
BP	1100.000	1050.000			
IP1	1300.000	1750.000	100.000	80.000	80.000
IP2	1750.000	1400.000	200.000	0.000	0.000
EP	2000.000	1800.000			

For example:

Under Programs menu, select [Road Designment] and then [Define H. Line] to define road horizontal alignment. Enter the data in the following way:

Pile	0
N	1100.000
E	1050.000

Press [Detemine]; then press [PT] and enter the data as follows:

N	1300.000
E	1750.000
R	100.000
A1	80.000
A2	80.000

Enter the following data in the way described above:

N	1750.000
E	1400.000
R	200.000
A1	0.000
A2	0.000

N	2000.000

E	1800.000
R	0.000
A1	0.000
A2	0.000

The format of the above data to be transferred from the instrument to the computer is as follows:

START 0.000，1050.000，1100.000 CRLF

PT 1750.000，1300.000，100.000，80.000，80.000 CRLF

PT 1400.000，1750.000，200.000，0.000，0.000 CRLF

PT 1800.000，1800.000，2000.000 CRLF

2. Calculation of road alignment elements

(1) Calculation of curve length

$$L_{1.2}=\frac{A_{1.2}^2}{R}$$

L_{12}: curve length

A_{12}: curve parameter

R: radius

$$L_1=\frac{A_1^2}{R}=\frac{80^2}{100}=64\text{ m} \qquad L_2=\frac{A_2^2}{R}=\frac{80^2}{100}=64\text{ m}$$

(2) Calculation of steering angle

$$\tau=\frac{L^2}{2A^2}$$

$$\tau_1=\frac{64^2}{2\cdot 80^2}=0.32\text{ rad} \quad \Rightarrow \quad \text{deg} \quad \Rightarrow \quad 0.32\frac{180}{\pi}=18°20'06''$$

$$\therefore \quad \tau_1=-\tau_2$$

(3) Calculation of curve point coordinates

$$N=A\cdot\sqrt{2\tau}\ (1-\frac{\tau^2}{10}+\frac{\tau^4}{216}-\frac{\tau^6}{9360}....)$$

$$E=A\cdot\sqrt{2\tau}\ (\frac{\tau}{3}-\frac{\tau^3}{42}+\frac{\tau^5}{1320}-\frac{\tau^7}{7560}....)$$

$$N = 80 \cdot \sqrt{2 \cdot 0.32}\ (1 - \frac{(0.32)^2}{10} + \frac{(0.32)^4}{216} - \frac{(0.32)^6}{9360} ....)$$

$$= 64(1 - \frac{0.01024}{10} + \frac{0.0\,1\,0\,4\,8\,5\,7\,6}{2\,1\,6} - \frac{0.0\,0\,1\,0\,7\,3\,4\,4\,1}{9\,3\,6\,0})$$

$$= 64(1 - 0.0\,1\,0\,2\,4 + 0.0\,0\,0\,0\,4\,8\,5\,7\,6 - 0.0\,0\,0\,0\,0\,1\,1\,4\,4\,1)$$

$$= \mathbf{64 * 0.98981}$$

$$= 63.348$$

Similarly, the value of E is:

$$E = 80 \cdot \sqrt{2 \cdot 0.32}\ (\frac{0.32}{3} - \frac{(0.32)^3}{42} + \frac{(0.32)^5}{1320} - \frac{(0.32)^7}{7560} ....)$$

$$= 64(0.1\,0\,6\,6\,6\,6\,6 - 0.0\,0\,7\,8\,0\,1\,9\,0\,0\,0\,0\,0\,2\,5)$$

This example shows a symmetric curve. N1=N2, E1=E2

(4) Calculation of rise ΔR

$$\Delta R = E - R(1 - \cos\tau)$$

$$\Delta R = 6.777 - 100(1 - \cos 18°20'06'')$$

$$= 1.700$$

For a symmetric curve, $\Delta R_1 = \Delta R_2$.

(5) Calculation of transition point coordinates

$N_m = N - R\sin\tau$ =63.348-100sin18° 20′ 06″ =31.891

For a symmetric curve, $N_{m1} = N_{m2}$.

(6) Calculation of tangent length

$$D_1 = R\tan(\frac{LA}{2}) + \Delta R_2 \cos ec(LA) - \Delta R_1 \cot(LA) + N_{m1}$$

$$LA = +111°55'47'', \qquad \cos ec = \frac{1}{\sin}\ , \qquad \cot = \frac{1}{\tan}$$

$$D_1 = 100 * \tan(111°55'47''/2) + 1.7(1/\sin 111°55'47'')$$

$$-1.7(1/\tan 111°55'47'') + 31.891$$

$$= 148.06015 + 1.8326 + 0.6844 + 31.891$$

$$= 182.468$$

$$D_1 = D_2$$

(7) Calculation of coordinates of KA1

$$N_{KA1} = N_{IP1} - D_1 \cdot \cos\alpha_1$$

$$E_{KA1} = E_{IP1} - D_1 \cdot \sin\alpha_1$$

Azimuth from BP to IP1 $\Rightarrow$ $\alpha_1 = 74°03'16.6''$

N_{KA1} = 1300 –182.468 * cos 74°03′16.6″=1249.872 m

E_{KA1} = 1750 –182.468 * sin 74°03′16.6″=1574.553 m

(8) Calculation of curve length

$L = R(LA - \tau_1 + \tau_2)$

=R(111°55′47″-2 * 18°20′06″)

=100(75°15′35″ $\frac{\pi}{180^\circ}$)

=131.353 m

(9) Calculation of coordinates of KA2

$N_{KA2} = N_{IP1} - D_2 \cdot \cos\alpha_2$

$E_{KA2} = E_{IP1} - D_2 \cdot \sin\alpha_2$

Azimuth from IP1 to IP2 $\Rightarrow$ $\alpha_2 = 322°07'30.1''$

N_{KA2} = 1300 –(-182.468) * cos 322°07′30.1″= 1444.032 m

E_{KA2} = 1750 –(-182.468) * sin 322°07′30.1″= 1637.976 m

(10) Calculation of curve length feature point coordinates BC and EC

Curve length $CL = R \cdot IA$

IA= 95°52′11″

So,

CL=200 * 95°52′11″* $\frac{\pi}{180^\circ}$ =334.648 m

Tangent length

$TL = R \cdot \tan(\frac{IA}{2}) = 200 * \tan(95°52'11''/2)$ =221.615 m

Calculation of coordinates of each point is as follows:

$N_{BC} = N_{IP2} - TL \cdot \cos\alpha_2$

$E_{BC} = E_{IP2} - TL \cdot \sin\alpha_2$

$N_{EC} = N_{IP2} - TL \cdot \cos\alpha_3$

$E_{EC} = E_{IP2} - TL \cdot \sin\alpha_3$

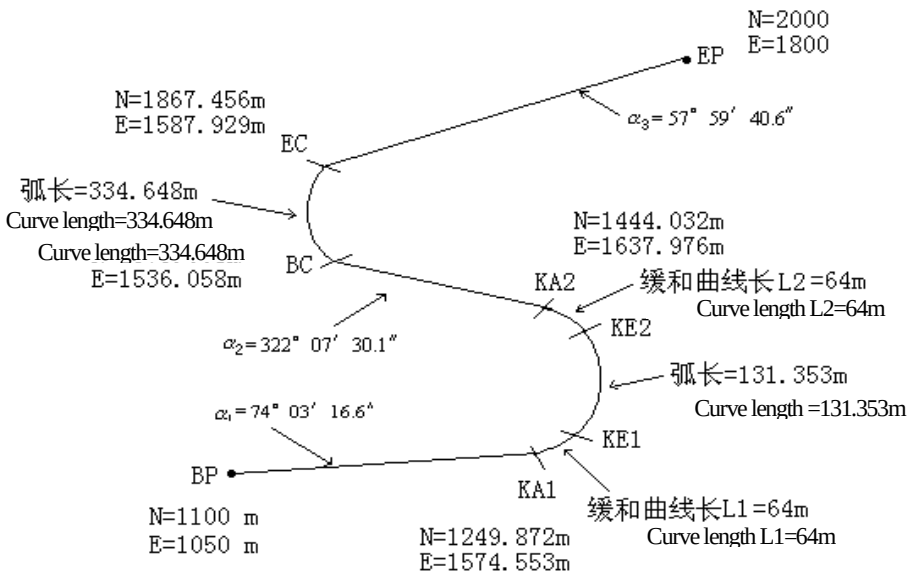
Where:

α_2 (Azimuth from IP1 to IP2) = 322°07′30.1″

α_3 (Azimuth from IP2 to EP) = 57°59′40.6″

$$N_{BC} = 1750 - 221.615 * \cos 322°07'30.1'' = 1575.068 \text{ m}$$
$$E_{BC} = 1400 - 221.615 * \sin 322°07'30.1'' = 1536.058 \text{ m}$$
$$N_{EC} = 1750 - (-221.615) * \cos 57°59'40.6'' = 1867.456 \text{ m}$$
$$E_{EC} = 1400 - (-221.615) * \sin 57°59'40.6'' = 1587.929 \text{ m}$$

The diagram showing the calculation results is as follows:



Calculate coordinates and distances in the way described below:

1) Calculation of beeline length

Beeline

$$\text{BP KA1} = \sqrt{(1249.872-1100.000)^2 + (1574.553-1050)^2} = 545.543 \text{ m}$$

$$\text{Beeline KA2 BC} = \sqrt{(1575.068-1444.032)^2 + (1536.058-1637.976)^2} = 166.005 \text{ m}$$

Beeline

$$\text{EC EP} = \sqrt{(2000-1867.456)^2 + (1800-1587.929)^2} = 250.084 \text{ m}$$

Start point coordinates (BP)

N 1100.000 m

E 1050.000 m

Beeline between BP and KA1

Azimuth 74°03′16.6″

Distance 545.543 m

Curve between KA1 and KE1

Radius -100 m ("-" indicates the curve turns left toward the direction of the terminal)

Length 64 m

Curve between KE1 and KE2

Radius -100 m ("-" indicates the curve turns left toward the direction of the terminal)

Length 131.354 m

Curve between KE2 and KA2

Radius -100 m ("-" indicates the curve turns left toward the direction of the terminal)

Length 64 m

Beeline between KA2 and B

Azimuth 322°07′30.1″

Distance 166.004 m

Curve between BC and EC

Radius 200 m (no symbol before it indicates the curve turns right toward the direction of the terminal)

Length 334.648 m

Beeline between EC and EP

Azimuth 57°59′40.6″

Distance 250.084 m