e-survey

ETS800 Series
Total Station

OPERATOR'S MANUAL

Thank you for selecting the ETS800 Electronic Total Station. For the best performance of the instrument, please read this operator's manual carefully and keep it in a convenient location for future reference. Some of the diagrams shown in this manual may be simplified for easier understanding.

The specifications and general appearance of the instrument may be altered at any time. And we will not inform you.

There is a guarantee card in the carrying case, and you should fill it and post it to our company.

CONTENTS

1.PRECAUTIONS FOR SAFE OPERATION

General

- Do not use the unit in areas exposed to high amounts of dust or ash, in areas where there is inadequate ventilation, or near combustible materials. An explosion could occur.
- Do not perform disassembly or rebuilding. Fire, electric shock or burns could result.
- Never look at the sun through the telescope. Loss of eyesight could result.
- Use solar filter for sun observation.
- Do not use the carrying case as a footstool. The case is slippery and unstable so a person could slip and fall off it.
- Do not wield or throw the plumb bob. A person could be injured if struck.
- Secure handle to main unit with locking screws. Failure to properly secure the handle could result in the unit falling off while being carried, causing injury.
- Tighten the adjustment tribrach clamp securely. Failure to properly secure the clamp could result in the tribrach falling off while being carried, causing injury.

Power supply

- Do not use voltage other than the specified power supply voltage. Fire or electrical shock could result.
- Do not use damaged power cords, plugs or loose outlets. Fire or electric shock could result.
- Do not use power cords other than those designated. Fire could result.
- Do not place articles such as clothing on the battery charger while charging batteries. Sparks could be induced, leading to fire.
- Use only the specified battery charger to recharge batteries.
- Do not heat or throw batteries into fire. An explosion could occur, resulting in injury.
- To prevent shorting of the battery in storage, apply insulating tape or equivalent to the terminals. Otherwise shorting could occur resulting in fire or burns.
- Do not use batteries or the battery charger if wet. Resultant shorting could lead to fire or burns.
- Do not use connect or disconnect power supply plugs with wet hands. Electric shock could result.
- Do not touch liquid leaking from batteries. Harmful chemicals could cause burns or blisters.

Tripod

- When mounting the instrument to the tripod, tighten the centering screw securely. Failure to tighten the screw properly could result in the instrument falling off the tripod, causing injury.
- Tighten securely the leg fixing screws of the tripod on which the instrument is mounted. Failure to tighten the screws could result in the tripod collapsing, causing injury.
- Keep hands and feet away from the tripod shoes when fixing the tripod in the ground. A hand or foot stab wound could result.
- Tighten the leg fixing screws securely before carrying the tripod. Failure to tighten the screws could lead to the tripod legs extending, causing injury.

2. PRECARTIONS

Precautions concerning water and dust resistance

- Do not put the instrument in the water. The instrument conforms to IPX4, so the normal rain can not damage to the instrument.
- Be sure to close the battery cover and correctly attach the connector caps to protect the SET from moisture and dust particles.
- Make sure that the inside of the carrying case and the instrument are dry before closing the case. If moisture is trapped inside the case, it may cause the instrument to rust.
- Never place the instrument directly on the ground. Sand or dust may cause damage to the screw holes or the centering screw on the base plate.

USING

- Mount the instrument on the wooden tripod, because the metal tripod will shake, and it will decrease the observing precision.
- The tribrach will affect the precision of the instrument, you should check the screw on it. It must be tighten in order to protect the instrument.
- Before your measurement, check all the settings and the parameter of the instrument carefully.
- Never carry the instrument on the tripod to another site.
- Turn the power off before removing the battery.

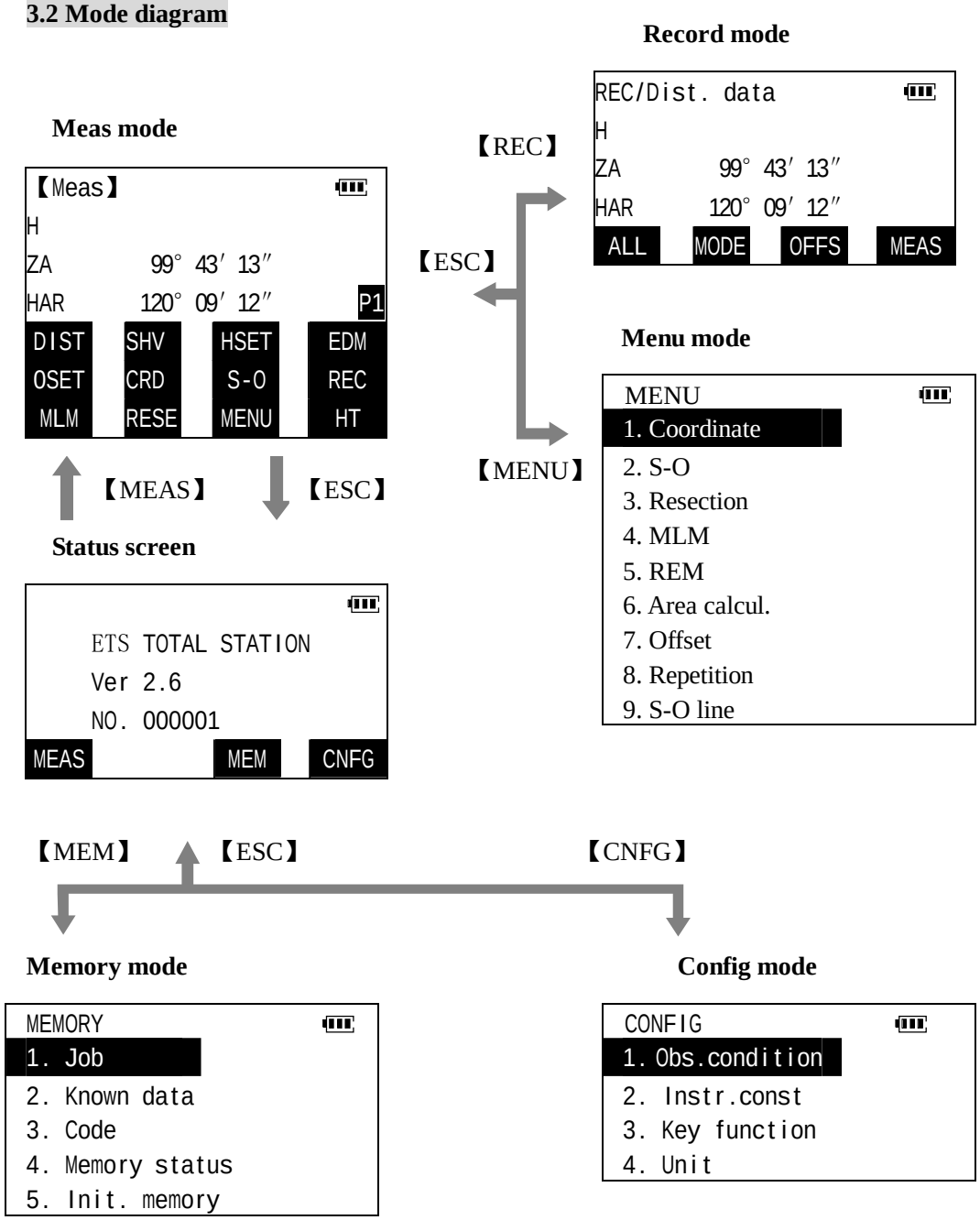
OTHER PRECATIONS

- If the instrument is moved from a warm place to an extremely cold place, internal parts may contract and make the keys difficult to operate. This is caused by cold air trapped inside the hermetically sealed casing. If the keys do not depress, open the battery cover to resume normal functionality. To prevent the keys from becoming stiff, remove the connector caps before moving the instrument to a cold place.
- Protect the instrument from heavy shocks or vibration.

3. NOMENCLATURE AND FUNCTION

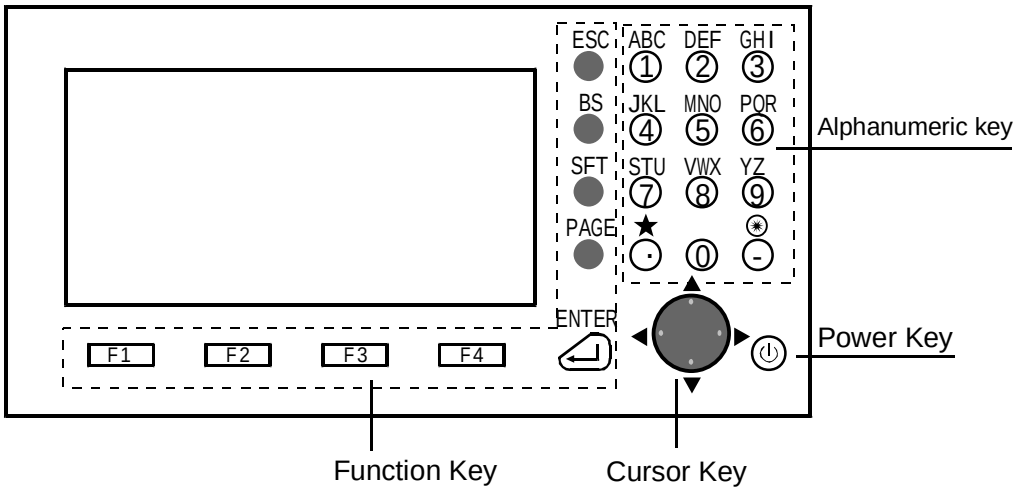
3.1 Parts of the instrument

3.2 Mode diagram



4. BASIC OPERATION

4. 1 Basic key operation



1. Power Key

Power on : press 【⏻】。

Power off : press 【⏻】, hold on 2 second.

2. Function key

【F1】～【F4】: Select the function matching the soft keys.

【ESC】: Cancel the input data or return to the previous screen.

【SFT】: Switch between upper and lower case.

【BS】: Delete a character on the left.

【PAGE】: Toggle between the display pages.

【↵】: Select the item/ Accept input value /Accept the option.

3. Keyboard shortcuts

【SFT】+【★】: Press【SFT】, and then press【★】,enter the star key mode.

【SFT】+【—】: Press【SFT】,and then press【—】, enter the EDM signal checking.

4. Cursor key

3 4 5 6 : Left, right, up and down cursor or select other option

5. Alphanumeric key

【0】～【9】: During numeric input, input number of the key. During alphabetic input, input the characters displayed above the key in the order they are listed.

【.】: Input a decimal point.

【-】: Input minus sign.

Example 1：Input file name“ETS”

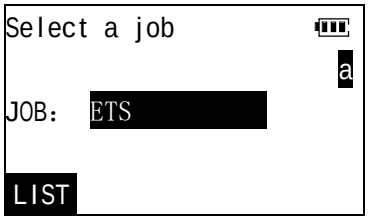
（1） Press【SFT】to come in the inputting letters mode, and there will display an letter “a” on the right of the screen.

（2） Press 【5】once, and then input the “M”。

（3） Press【 4 】 to move the curser to the right , press 【7】 twice and input the letter“T”.

（4） Press 【 4 】 to move the curser to the right, press 【7】 once and input the letter “S”.

（5） Press 【↵】to confirm it.



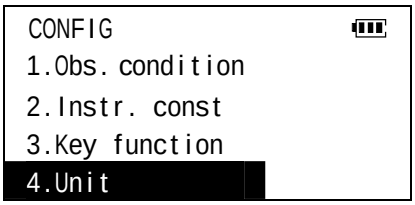
Example 2：Set the unit of air pressure as“mmHg”:

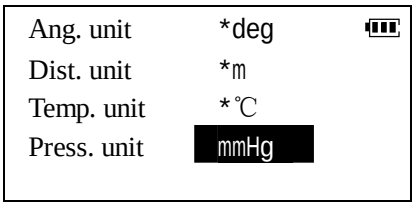
(1)In the config mode , Press 【5】/【6】to move the cursor to “4.Unit”. Press【↵】to confirm it.

(2) Press 【5】/【6】to move the cursor to“Pres. unit”

(3) Press 【3】/【4】to move the cursor and select the unit “mmHg”.

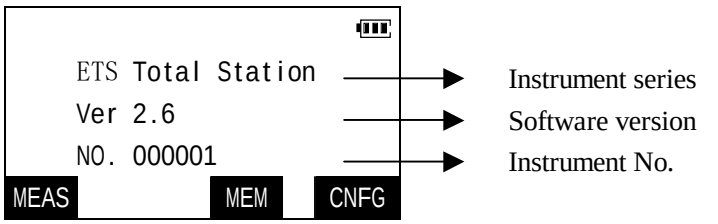
(4) Press【↵】to confirm it and then exit.



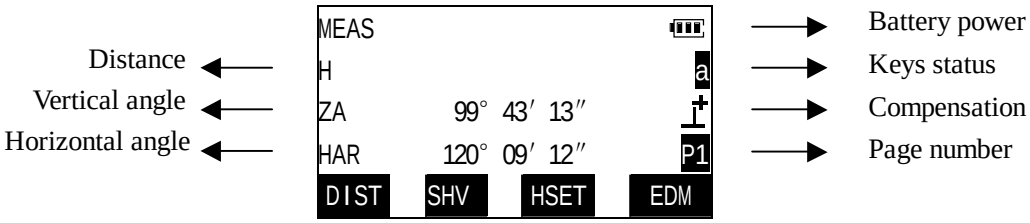


4.2 Display functions

Status screen



Meas mode screen



5．3 Display symbol

In the Meas mode , the symbol meaning：

- PC prism constant value
- ppm atmospheric correction factor
- S slope distance
- H horizontal distance
- V height difference
- ZA zenith angle
- VA vertical angle
- HAR horizontal angle right
- HAL horizontal angle left
- HAh hold on the horizontal angle

5. USING THE BATTERY

This instrument has the charger and battery of itself. The voltage of the battery is 7.2V. please charge it before measurement. Please read the operation manual carefully before you use it .

5.1 Charging procedure

（1） Connect the battery case with the charger.

（2） Plug the charger into the wall outlet. Mount the battery in the charger. Make sure the battery contact the charger well. When charging starts, the redlamp starts blinking.

（3） The lamp light turns to green when charging is finished.

（4） When charging finished, unplug the charger and then remove the battery.

5.2 Cautions

（1） When the instrument is working on , don't remove the battery.

（2） Before removing the battery, turn off the power to the instrument.

（3） When installing/removing the battery, make sure that moisture or dust particles do not come in contact with the inside of the instrument.

（4） Periodically wipe clean the pole with the cleaning cloth to keep them free of dirt.

（5） Please charge the battery at this temperature range 0℃~45℃.

（6） Before storing the battery, you should charge it full, and you should charge it every three months at least. If not doing so, the battery will discharge by itself, and the voltage will be very low. Life of the battery will be affected.

（7） The temperature and the humidity will affect the battery discharge speed. So we advice you store the battery in a dry room and the temperature range should be 0 ℃~20℃.

5.3 Charger operation manual

（1） Never use this charger with other batteries.

（2） This charger is a speedy set. it will finished the speed-charging in four hours.

（3） After speed-charging, the capability of the battery will attain 75%~80%. If you want to charge it full, you need 2~4 hours small current charging.

（4） When the charger is empty or in the small current charging, the green light will bright. In the speediness status the red light will bright, when it finished, it will turn into the small current status.

（5） The battery will not be damaged in the small current status, but you had better charge the battery not over twenty-four hours.

（6） If there is much electricity remains in the batteries, the charger may not come in the speediness status. It will charge it in the small current status. If you want to charge it speediness, you must put the batteries in the charger and then connect

the charger with the power supply.

5.4 Installing battery

1. Press the release button and hold the battery case toward the groove in the instrument.
2. Push the case until a click is heard.

5.5 Removing battery

1. Press the release button of the battery case and hold it on.
2. Pull the battery case toward you.
3. Remove it out.

5.6 Battery power display

There is a mark on the screen that can be used to check the status of the battery power.

If there is no power, the instrument will give an alarm every ten seconds, and it will display “Battery is low”. You should finish the measurement quickly, saving data and changing another battery. Or not it will power off after one minute.

6. SETTING UP THE INSTRUMENT

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

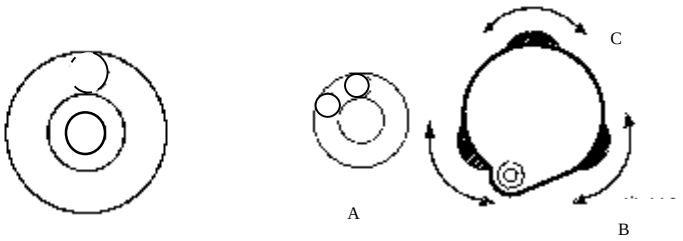
（1） Make sure the legs are spaced at equal intervals and the head is approximately level. Set the tripod so that the head is positioned over the surveying point. Make sure the tripod shoes are firmly fixed in the ground.

（2） Place the instrument on the tripod head. Supporting it with one hand, tighten the centering screw on the bottom of the unit to make sure it is secured to the tripod.

（3） Leveling the instrument with the circular level

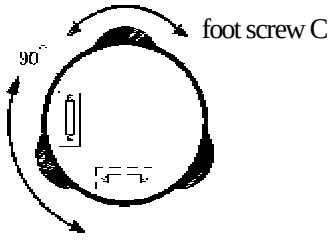
①rotate the foot screw s A、B, make the bubble to the vertical line of the foot screw center line.

②rotate the foot screw C, make the bubble in the center.



（4） Leveling the instrument with the plate level：

① loosen the horizontal clamp to turn the upper part of the instrument until the plate level is parallel to a line between leveling foot screws A and B. Center the air bubble using leveling foot screws A and B. the bubble moves towards a clockwise rotated leveling foot screw.



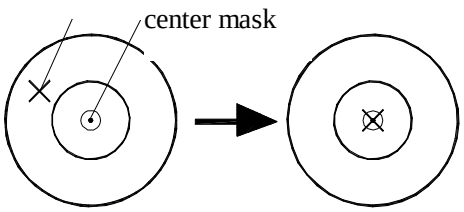
② turn the upper part of the instrument though 90° (100g). The plate level is now perpendicular to a line between leveling foot screws A and B. center the air bubble using leveling foot screw C.

（5） Centering the instrument with optical plummet：

Adjust the eyepiece of the optical plummet telescope to the user’s eyesight. Move the instrument by loosening adjusting screw. Coincide image of the point

on the ground with the center mark of the optical plummet telescope. Carefully move the instrument in order to make it steady.

Caution: don't rotate the instrument on the tripod, in order to decrease the excursion of the bubble.



（6） Leveling the instrument accurately

Follow the step 4, until you rotate the instrument and the bubble always in center. Tighten the centering screw.

7. FOCUSSING AND TARGET SIGHTING

CAUTION:

- **When sighting the target, strong light shining directly into the objective lens may cause the instrument to malfunction. Protect the objective lens from direct light by attaching the lens hood.**
- **Observe to the same point of the reticle when the telescope face is changed.**

（1） Focus on the reticle : look through the telescope eyepiece at a bright and featureless background. Turn the eyepiece screw clockwise, then counterclockwise little by little until just before the reticle image becomes focused. Using these procedures, frequent reticle refocusing is not necessary since your eye is focused at infinity.

（2） Sight the target: loosen the vertical and horizontal clamps, then use the peep sight to bring the target into the field of view. Tighten both clamps.

（3） Focus on the target : turn the telescope focusing ring to focus on the target. Turn the vertical and horizontal fine motion screws to align the target with the reticle. The last adjustment of each fine motion screw should be in the clockwise direction.

（4） Readjust the focus until there is no parallax: readjust the focus with the focusing ring until there is no parallax between the target image and the reticle.

8. POWER ON

（1） When the power is switched on, you will hear a buzzer. A self-check is run to make sure the instrument is operating normally. The instrument number and the software number will be displayed, and it will display “V angle set 0”.

（2） Rotate the telescope until you hear a buzzer, then the instrument come in the Meas mode.

Caution ：

- **If “out of range” is displayed, the instrument tilt sensor is indicating that the instrument is out of level. Level the instrument once again and the horizontal and vertical angles will be displayed.**
- **Due to vibration or strong wind, the angle display is unsteady. You should turn off the tilt angle compensation before measurement.**

9. FUNCTION IN THE STAR (★) KEY MODE

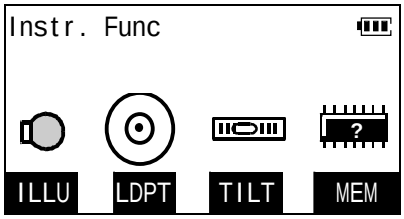
At any mode, pressing 【SFT】and 【★】can enter the star key mode. In this mode you can do this:

【F1】——on / off the light of the screen.

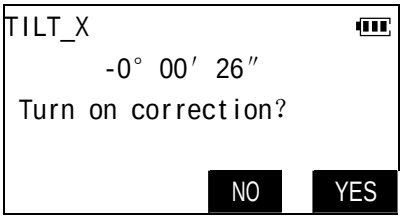
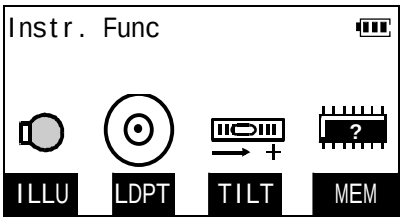
【F2】——power on / off the laser plummet.(only for the instrument with laser plummet)

【F3】——on / off tilt angle compensation.

【F4】——check the memory status.



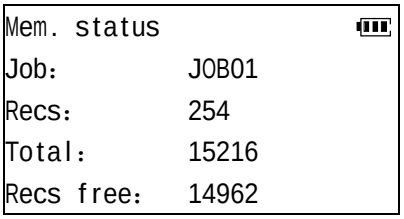
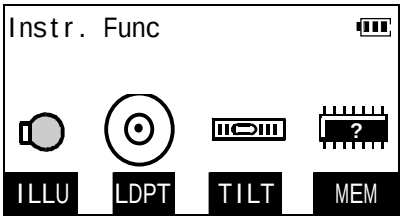
9.1 Tilt angle display and compensation

1. Press 【TILT】 to come in the screen of the tile angle display and compensation. Tilt angle value in X (sighting) direction is displayed on the screen. l If the value over 3′ , it will display "out of range".	【TILT】	
2. Press 【YES】to turn on correction and return to the star key mode screen. Then the instrument will compensate the tilt angle.	【YES】	

l Setting "Tilt crn" of "Obs.condition" in config mode can turn or off tilt angle correction also,and the setting remains even the power supply is cut off.

l The range of the compensator is: ±3′ .

9.2 Checking the memory quickly

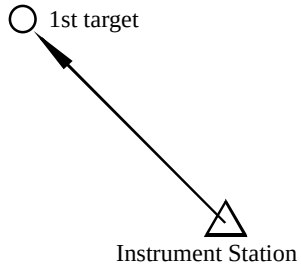
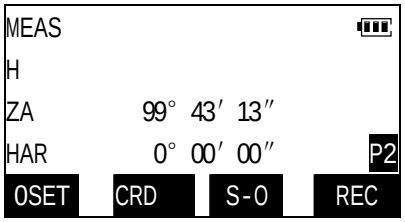
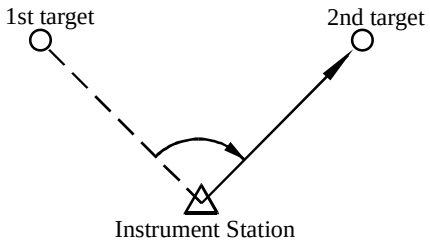
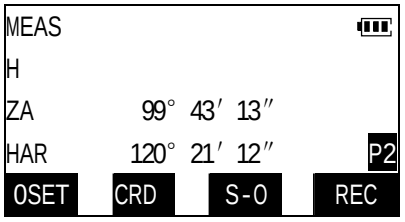
1. Press 【MEM】to display the status of memory. l Job：The current job. l Recs：the number of records in the current job. l Recs free：The number of the free record blocks can be used to store data in the memory. l Total record：Total record blocks in the memory.	【MEM】	
2. Press 【ESC】 to return to the star key mode screen.	【ESC】	

10. ANGLE MEASUREMENT

- About recording the data of the angle measurement, please see: "22.2 record the angle measurement data".

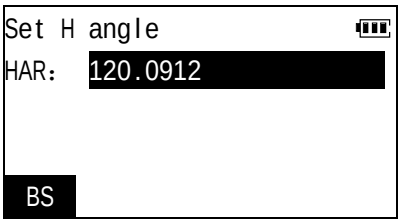
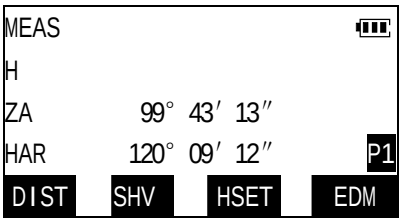
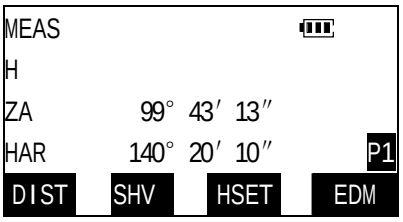
10.1 Measuring the horizontal angle between two points

Use the "0 SET" function to measure the included angle between two points. The horizontal angle can be set to 0 at any direction.

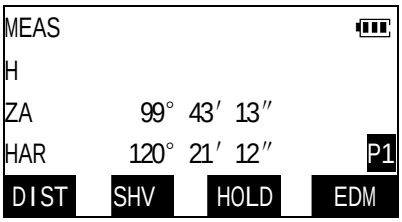
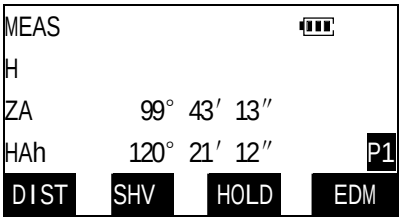
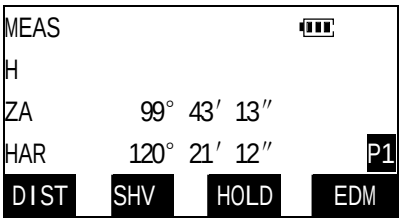
Operating	Keys	Display
1.Sight the first target as at right.		
2. Press 【0SET】 in the second page of the Meas mode screen, 【0SET】 will flash, so press it again. The horizontal angle at the first target becomes 0°.	【0SET】 【0SET】	
3.Sight the second target, the horizontal angle displayed is the angle of the two target points.		 

10.2 Setting the horizontal angle to a required value

1.You can reset the horizontal angle to a required value and use this value to find the horizontal angle of a new target.

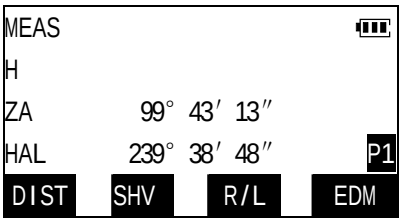
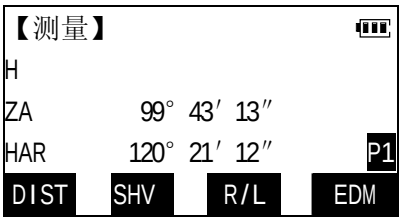
Operating	Keys	Display
1. Sight the first target and press 【HSET】in the second page of the Meas mode.	【HSET】	
2. Enter the horizontal angle value you wish to set, then press 【↵】.	【↵】	
3.Sight the second target. The horizontal angle from the second target to the value set as the horizontal angle is displayed.		
❙ Calculating the azimuth ： Press 【BS】.See “12.2 Azimuth angle setting”		

2.Pressing 【HOLD】performs the same function as above.
Before this operation, you should define the horizontal hold function【HOLD】in the Meas mode. See “22.3.1 defining softkeys”.

Operating	Keys	Display
1.Turn the instrument by the horizontal clamp and horizontal fine motion screw until the horizontal angle is displayed as the required value.		
2.:Press【HOLD】,【HOLD】will flash, press it again,and the horizontal angle display is hold.	【HOLD】 【HOLD】	
3.Sight the target, and then press【HOLD】to set the target angle to the required value.	【HOLD】	

10.3 Selecting the direction of horizontal angle（HAL/HAR）

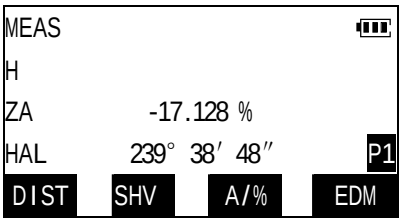
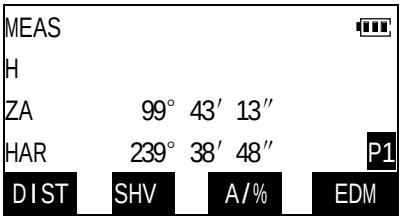
You can select horizontal angle displayed by right angle (HAR) or left angle(HAL). Before doing this, you should define the 【R/L】keys in the Meas mode. See "22.3.1 defining softkeys".

Operating	Keys	Display
1.Press 【R/L】, the horizontal angle will be changed from HAR to HAL.	【R/L】	
2.Press 【R/L】again，and it will be changed back to HAR.	【R/L】	
■ The relation of HAL and HAR：HAL=360°-HAR		

10.4 ％ Slope

ETS-800 can display the % slope of vertical angle.

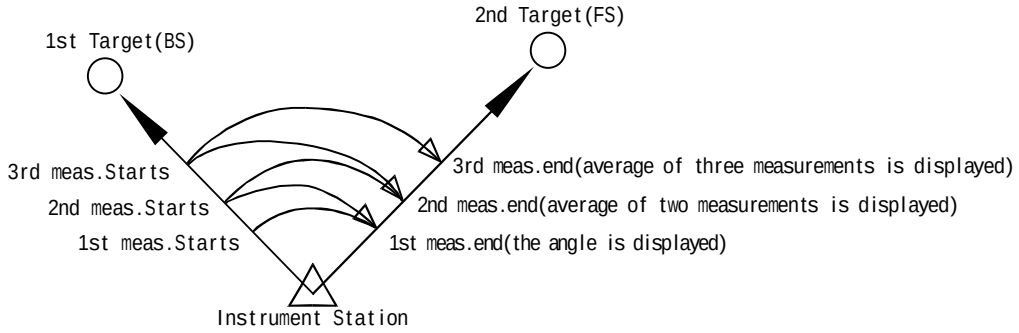
Before this operation, you should define the【A/%】 in the Meas mode. See "22.3.1 defining softkeys".

Operating	Keys	Display
1.Press【A/%】, the % slope of the vertical angle will be display on ZA line.	【A/%】	
2. Press 【A/%】once again，come back to display the normal vertical angle.	【A/%】	

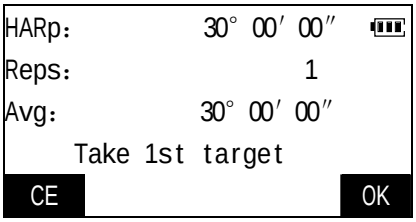
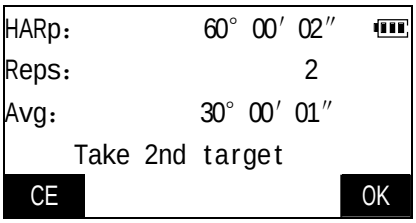
- The range of % slope can be displayed： ±300％
- When the vertical angle setting "horizontal 0"，"ZA" will display "VA"。

10.5 Horizontal angle repetition

To find the horizontal angle with greater precision, perform repetition measurement.



Operating	Keys	Display
1. In the third page of the Meas mode , press【MENU】,then select “8.Repetition”.	【MENU】 【5】 【6】	MENU 5.REM 6.Area Calcul. 7.Offset 8.Repetition
2.Press【↵】, begin with the angle repetition measurement . Sight the first target and press 【OK】.	【↵】 【OK】	HARp: 0° 00′ 00″ Reps: 0 Avg: 0° 00′ 00″ Take 1st target CE OK
3.Sight the second target and press【OK】.	【OK】	HARp: 30° 00′ 00″ Reps: 1 Avg: 30° 00′ 00″ Take 2nd target CE OK

Operating	Keys	Display
4. Sight the target point 1 again, and press【OK】.	【OK】	
5. Sight the target point 2 again, press【OK】 The added value of the horizontal angle is displayed on the first line "HARp" and the average value of the horizontal angle is displayed on the third line "AVG".	【OK】	
6. Repeat the step 4 to 5, and continue the measurement.		
7. When the measurement is completed, press【ESC】.	【ESC】	

- Pressing 【REP】in the Meas mode performs the same function. Please see "22.3.1 defining softkeys".
- Press 【CE】to cancel last measurement and redo it.
- The maximum number of angle measurements that can be made is 10.

10.6 Outputting angle measurement data

1. Connect the ETS-800 to a computer.
2. Define【SEND】in the Meas mode（Please see "22.3.1 defining softkeys"），and set the communication baud rate（Please see "22.2 instrument configuration"）.
3. Sight the target point.
4. Press 【Send】to output the observed data to the computer.

11. DISTANCE MEASUREMENT

11.1 EDM Settings

Complete the following EDM settings before the distance measurement：

- Atmospheric correction factor
- Prism constant correction value
- Distance measurement mode

1. Atmospheric correction factor

To perform higher accuracy measurements, it is necessary to find the atmospheric correction factor from even more accurate temperature and pressure measurements and perform an atmospheric correction.

ETS measures the distance with a beam of light, but the velocity of this light varies according to the index of refraction of light in the atmosphere. This index of refraction of light varies according to the temperature and pressure. In the normal conditions, with constant pressure, a temperature change of 1℃, or with constant temperature, a pressure change of 3.6hPa，an index change of 1ppm . This means the distance measurements will be changed 1mm for one kilometer. So in order to precisely determine the atmospheric correction factor, the average air pressure and temperature along the measurement beam route must be taken. Take care when calculating the correction factor in mountainous terrain as the difference in height will result in differences in atmospheric conditions between two points.

- The instrument is designed so that the correction factor is 0 ppm at an air pressure of 1013 hPa and a temperature of 15℃.
- The atmospheric correction factor(ppm) can be calculated using the following formula and stored in the instrument's memory.

$$ppm = 278.96 - \frac{0.2904 \times pressure\ (hPa)}{1+0.003661 \times temperature\ (^{\circ}C)}$$

- If the weather correction is not required , set the ppm value to 0.
- The ppm data can also be entered directly.

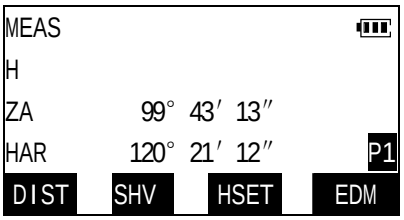
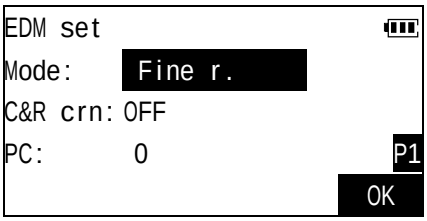
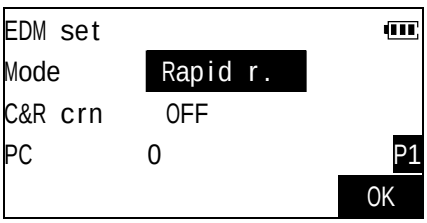
2. Prism constant correction value

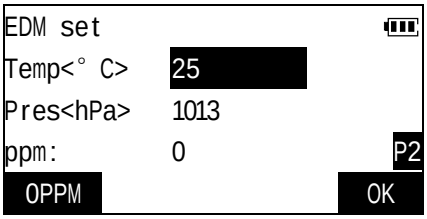
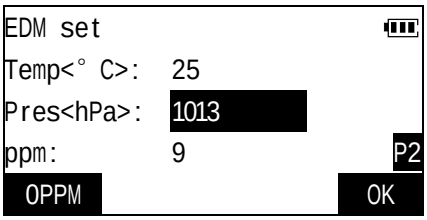
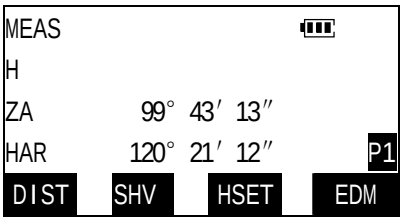
Reflective prisms each have their prism constant(PC). Before measurement, you must set the prism constant correction value of the prism you are using. This instrument's prism constant correction value has been set to "0" by default.

3. Distance measurement mode

the mode can be following:

- Fine Single measurement (Fine s.)
- Fine Repeat measurement(Fine r.)
- Fine Average measurement(Fine AVG)
- Rapid Single measurement(Rapid s.)
- Rapid Repeat measurement(Rapid r.)
- Tracking measurement(Tracking)

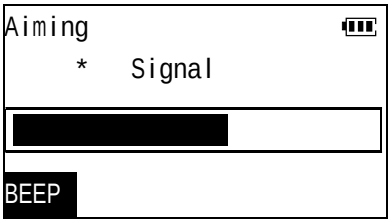
Operating	Keys	Display
1. The first page of the Meas mode.		
2. Press 【EDM】to come in EDM setting screen .	【EDM】	
3. Press 【3】/【4】to change the distance measurement mode to Rapid Repeat measurement mode.	【3】 【4】	

Operating	Keys	Display
4. Press 【5】【6】 or press 【PAGE】 directly to come to the temperature line of the second page, and input the temperature 25 °C.	【5】 【6】	
5. Press 【5】/【6】 to move cursor to the air pressure line, the ppm data is calculated automatically and displayed on "ppm" line.	【5】 【6】	
6. Press 【OK】to confirm the input and return to the first page of Meas mode.	【OK】	

- When ppm value entered directly, temperature and pressure values will be cleared.
- 【0PPM】:Atmospheric correction factor returns to 0 and temperature and pressure are set to the default values.
- C&R crn：Earth curvature and refraction correction. The value can be select from OFF,0.14,0.20 . It should be taken care when measuring a long horizontal distance and height difference .Default value is OFF.

11.2 Returned signal checking

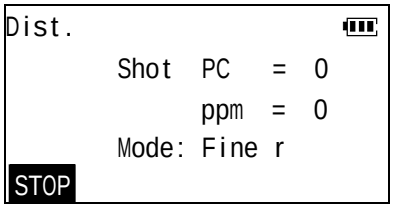
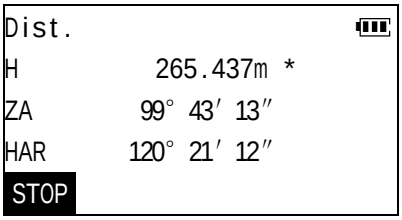
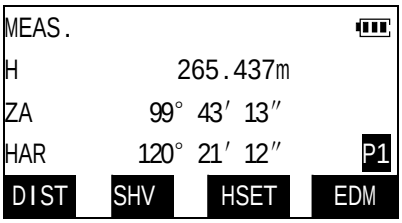
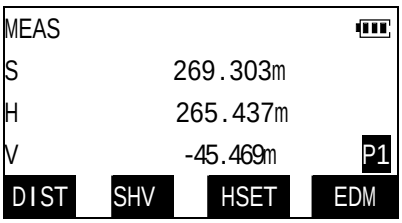
- Check to make sure that sufficient reflected light is returned by the reflective prism sighted by the telescope. This function is particularly useful when perform long distance measurements.
- Note: In short distance measurement, even though the center of the reflective prism and the reticle are slightly misaligned, "*" will be also displayed, but in fact, accurate measurement is impossible. Therefore make sure that the target is sighted correctly.
- This Checking can be performed at any time unless in the star key mode.

Operating	Keys	Display
1. Press【SFT】and then press【-】to come in returned signal checking. The intensity of the returned signal is displayed by a gauge. - The more black part displayed, the greater the quantity of reflected light. - if "*" is displayed, only enough light for the measurement is returned. - When "*" is not displayed, accurately re-sight the target. - When light is returned, the buzzer will sound. Pressing 【BEEP】can close or open the buzzer.	【SFT】 【-】	
2. Press【ESC】to finish signal checking and return to previous mode.	【ESC】	

11.3 Distance and angle measurement

An angle can be measured at the same time as the distance.

- About record distance and angle data please see "21.1 Recording distance measurement data"

Operating	Keys	Display
1. Sight the target. - If the target can not be easily sighted, the function of returned signal checking maybe a help.		
2. In the first page of the Meas mode, press【DIST】to start distance measurement. When measurement starts, EDM information(distance mode, prism constant correction value, atmospheric correction factor) is displayed and "Shot" flashes.	【DIST】	
3. A short beep sounds, and the measured distance data(H),vertical angle(ZA),and horizontal angle(HAR) are displayed. Press 【 STOP 】 to quit distance measurement and return to the Meas mode.	【STOP】	
4.New measurement results will be displayed in the Meas mode.		
5.Press 【 SHV 】 ,slope distance "S",horizontal distance "H" and height difference "V" are both displayed at same time.	【SHV】	

- If the single measurement mode is selected, measurements automatically stops after a single measurement.

During fine average measurement, the distance data is displayed as H_1, H_2,…to H_9. When the designated number of measurements has been completed, the average value of the distance is displayed in the H line.

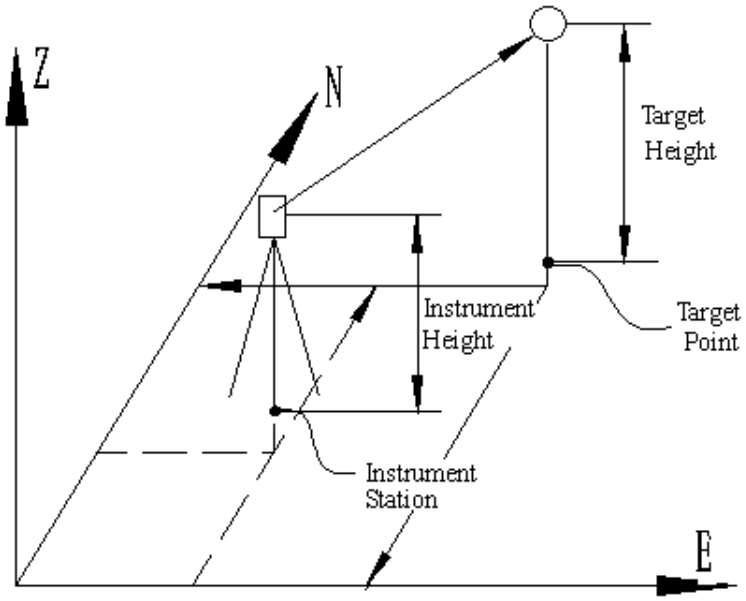
11.4 Outputting distance measurement data

1. Connect ETS-800 to computer or peripheral equipment.
2. Define【SEND】in the Meas mode（Please see "22.3.1 defining softkeys"），and set the communication baud rate（Please see "22.2 instrument configuration"）.
3. Sight the target point.
4. Press 【Send】to output the distance data to computer or peripheral equipment.

12. COORDINATE MEASUREMENT

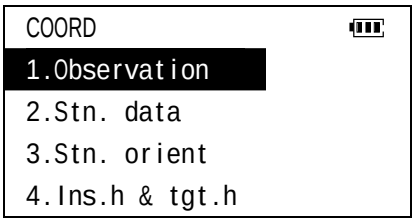
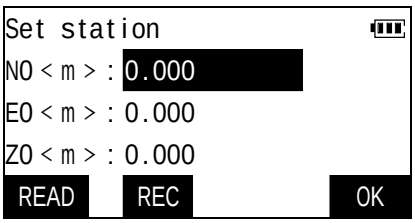
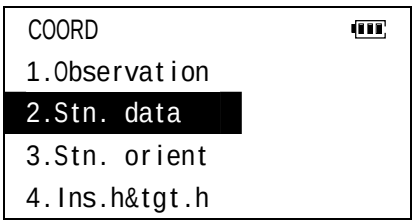
By performing coordinate measurements it is possible to find the 3-dimensional coordinates of the target based on instrument station coordinates, instrument height, target height, and azimuth angles of the backsight point which are entered in advance.

- EDM setting should be done before coordinate measurement.（Please see "11.1 EDM settings"）.



12.1 Inputting instrument station coordinate

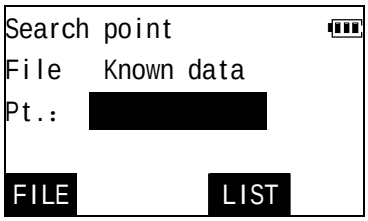
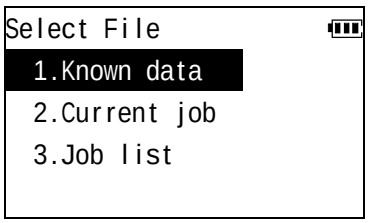
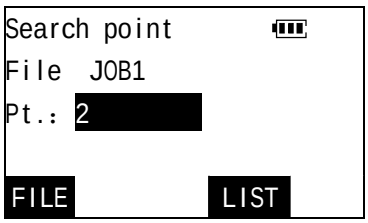
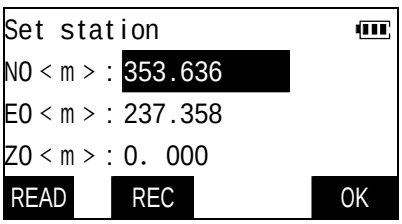
12.1.1 Inputting instrument station coordinate from keyboard

Operating	Keys	Display
1. In the second page of Meas mode , press 【CRD】 to display coordinate measurement menu. l Selecting "1.Coordinate" in menu mode can perform the same function.	【CRD】	
2. Select "2.Stn.data" and press【◄┘】 to come in the screen of station setting. Input the station coordinates. l When you wish to read in the registered coordinate data in the memory , press【READ】. l When【REC】is pressed, instrument station data is stored in the current JOB. Please see "21.3 Recording coordinate measurement data".	【5】 【6】 【◄┘】	
3. Press 【OK】to confirm the station coordinate and return .	【OK】	

12.1.2 Reading in registered coordinate data

The coordinate data registered in the memory in advance can be recalled by pressing 【READ】when inputting coordinates.

Known point data, coordinate data in the current job and coordinate data in any job file can be read in.

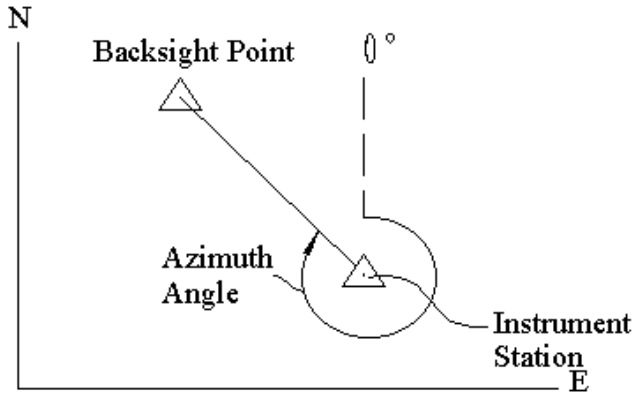
Operating	Keys	Display
1.In the screen of setting station , press 【READ】 to display the screen of finding coordinate data. The file from which coordinate data will be read in is displayed on the second line. This file can be changed by pressing 【FILE】.	【FILE】	
2. Press 【FILE】 to select another file. Press【5】/【6】to move the cursor to the required position, press 【↵】. Example: Select the "Current job".	【5】 【6】 【↵】	
3. Input the point number you want to search and press 【↵】. You can also press【LIST】to list all data in the file and select the required point.	【↵】	
4.When the point is found, the coordinate of the point will be displayed . Press 【OK】to set the data as the instrument station coordinate and return .	【↵】	

In the data list:

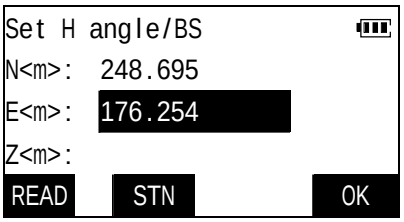
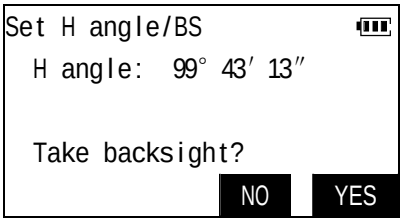
- Press 【▲】/【▼】to move the cursor up and down from line to line.
- Press 【SFT】and then Press 【▲】/【▼】to move the cursor from page to page.
- Press 【TOP】 to move the cursor to the list's beginning, press 【LAST】 to move the cursor to the list's end.
- Press 【SRCH】to input the point name and search it.

12.2 Azimuth angle setting

The azimuth angle of the backsight point can be set by inputting the angle directly or by calculating from coordinates of the back sight point and the instrument station.

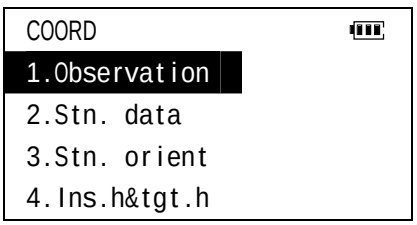
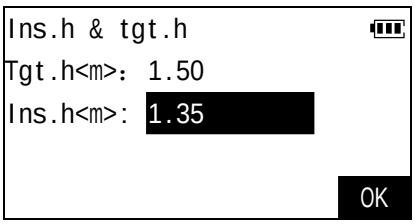


Operating	Keys	Display
1. Select "3.Stn.orient" in <COORD> menu, and press【↵】to come in the azimuth angle setting.	【↵】	COORD 1.Observation 2.Stn. data 3.Stn. orient 4.Ins.h&tgt.h
2.Input the azimuth angle directly and sight the backsight point, press 【↵】 to complete the orientation of the instrument station and return. please see "11.2set the horizontal as the needed direction" Press【BS】to set azimuth angle by calculating from coordinates.	【BS】	Set H angle HAR: BS

Operating	Keys	Display
3. Input the coordinates of the backsight point and press 【OK】. l When you wish to read in and set coordinate data from memory, press【READ】.（Please see "12.1.2 Reading in registered coordinate data"）. l Press 【 STN 】 to input the coordinates of the instrument station .See " 12.1 Inputting instrument station coordinate"	【OK】	
4. Calculated azimuth angle is displayed . Sight the backsight point and press 【YES】 to complete setting and return to <COORD> menu.	【YES】	

12.3 Inputting the height of instrument and prism

if you wish to measure the Z coordinate of target， the height of the prism and the instrument must be entered.

Operating	Keys	Display
1. Select "4.Ins.h&tgt.h" in <COORD> menu, and press【↵】to come in the screen of inputting the prism height and instrument height. In the third page of the Meas mode, press 【HT】to perform the same function.	【5】 【6】 【↵】	
2.Input the height of the prism and the instrument, press 【OK】confirm the data and return to <COORD> menu.	【OK】	

12.4 3-D COORDINATE MEASUREMENT

The coordinate values of the target can be found by measuring the target based on the settings of the instrument station and backsight azimuth angle.

The coordinate values of the target are calculated using the following formula.

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

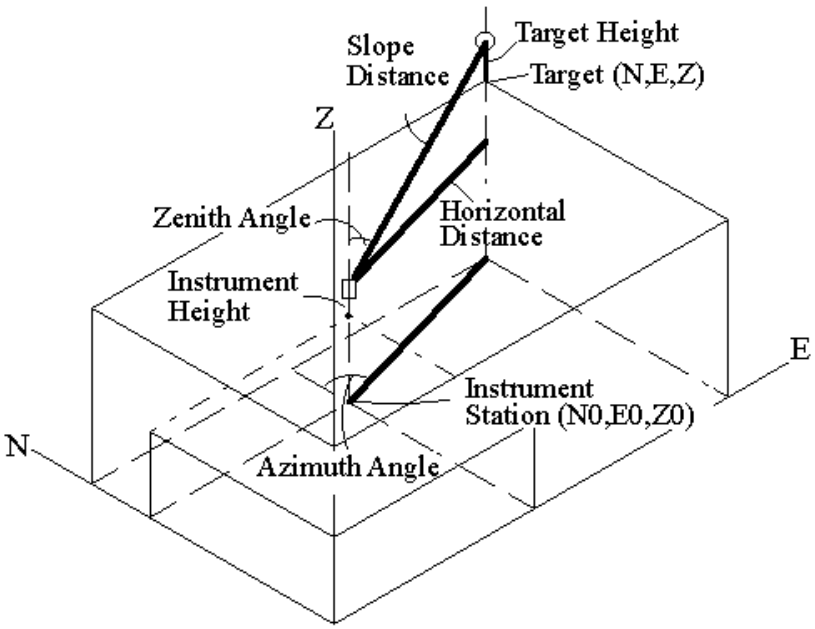
$$E1=E0+S\times\sin Z\times\sin Az$$

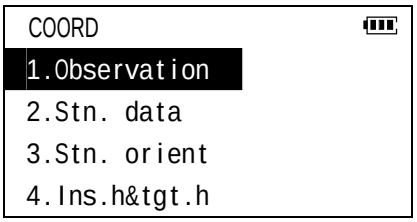
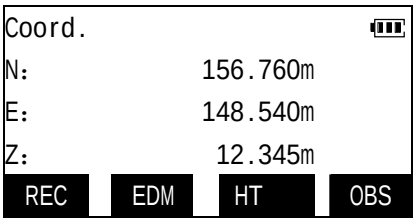
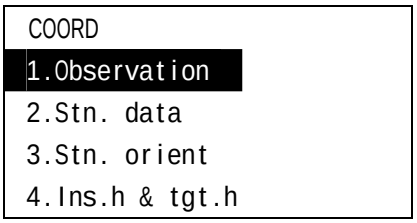
$$Z1=Z0+S\times\cos Z+ih-fh$$

N0：Station N coordinate　S：Slope distance　ih：Instrument height

E0：Station E coordinate　Z：Zenith angle　fh：Target height

Z0：Station Z coordinate　Az：Direction angle



Operating	Keys	Display
1. Sight the prism at the target point, In <COORD> menu, select "1.Observation" and press 【↵】 to start measurement.	【↵】	
2. The coordinate value of the target is displayed. Press【STOP】to quit measurement. l When the height of the next target is different, reenter the target height before beginning the observation.（Please see "12.3 Inputting the height of instrument and prism"）。 l Pressing 【REC】can record measurement results.（Please see "21.3 Recording coordinate measurement data"） l Press 【EDM】to change the settings of EDM. (Please see "11.1 EDM Settings").		
2. Sight the next target and press【OBS】to start next measurement. Continue until all targets have been measured.	【OBS】	
3. Press【ESC】to finish the coordinate measurement , return to <COORD> menu.	【ESC】	

13. SETTING-OUT MEASUREMENT

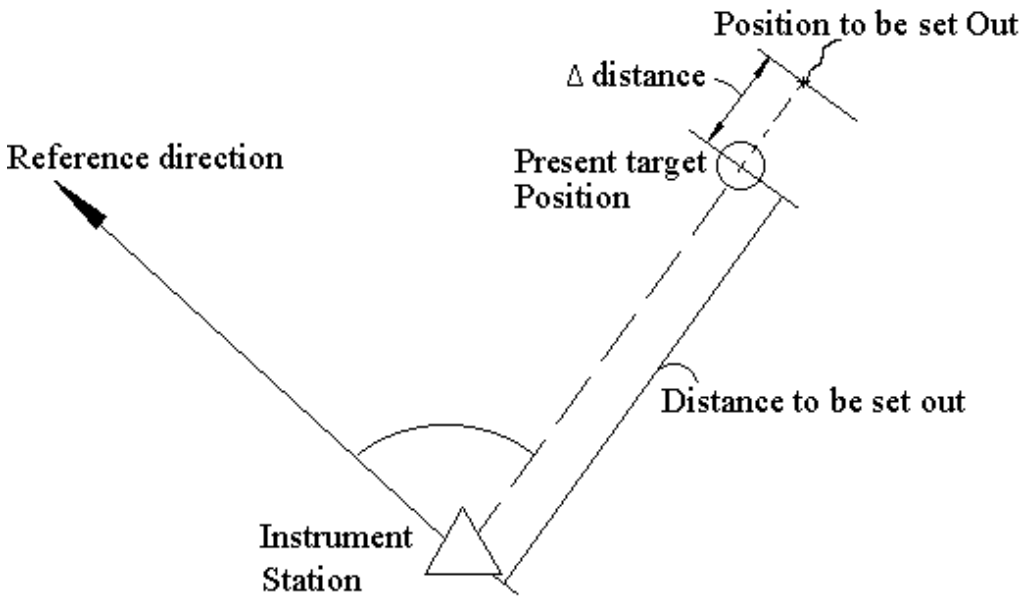
Setting-out measurement is used to set out the required point. The difference between the previously input data to the instrument (the setting-out data) and the measured value can be displayed by measuring the horizontal angle, distance or coordinates of the sighted point.

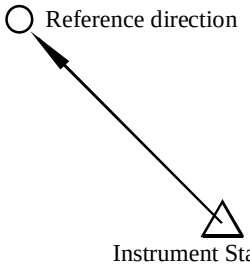
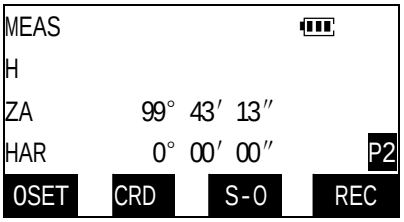
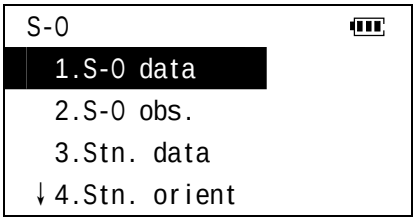
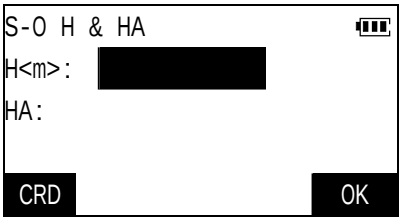
Display data=measured data-setting-out data

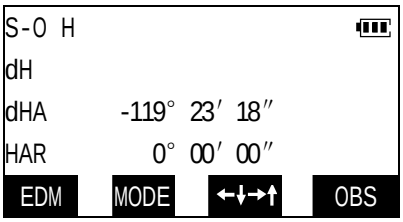
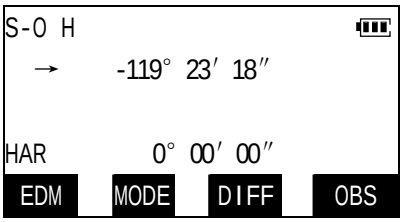
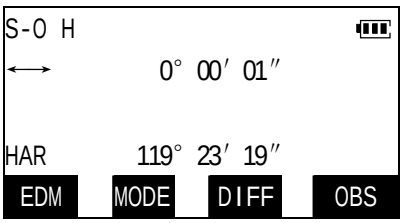
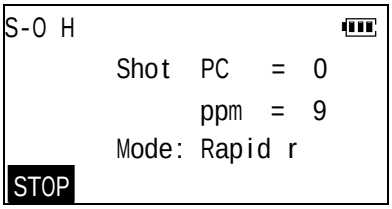
- The setting-out measurement should be performed in Face 1.

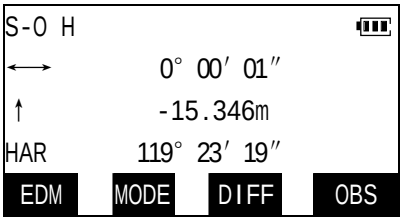
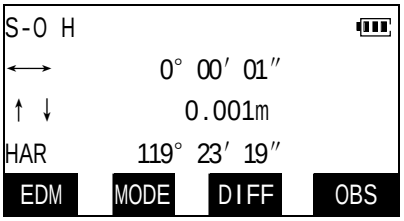
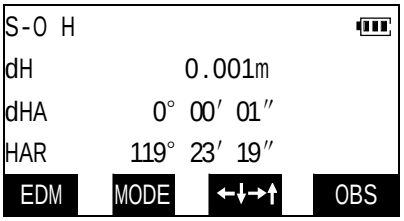
13.1 Distance setting-out measurement

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



Operating	Keys	Display
1. Sight the reference direction.		
2. In the second page of the Meas mode , press 【0SET】. when it flash press it again and set horizontal angle to 0.	【0SET】	
3. In the second page of the Meas mode, press 【S-O】 to come in the setting-out measurement menu. I In the menu mode, selecting "2.S-O" perform the same function.	【S-0】	
4. Select "1.S-O data" and press【◄┘】 to come in the screen of inputting setting-out data. Input the following items: (1) H: horizontal distance from the instrument station to the point to be set out. (2) HA: included angle between the direction of the reference and the point to be set out .	【◄┘】	

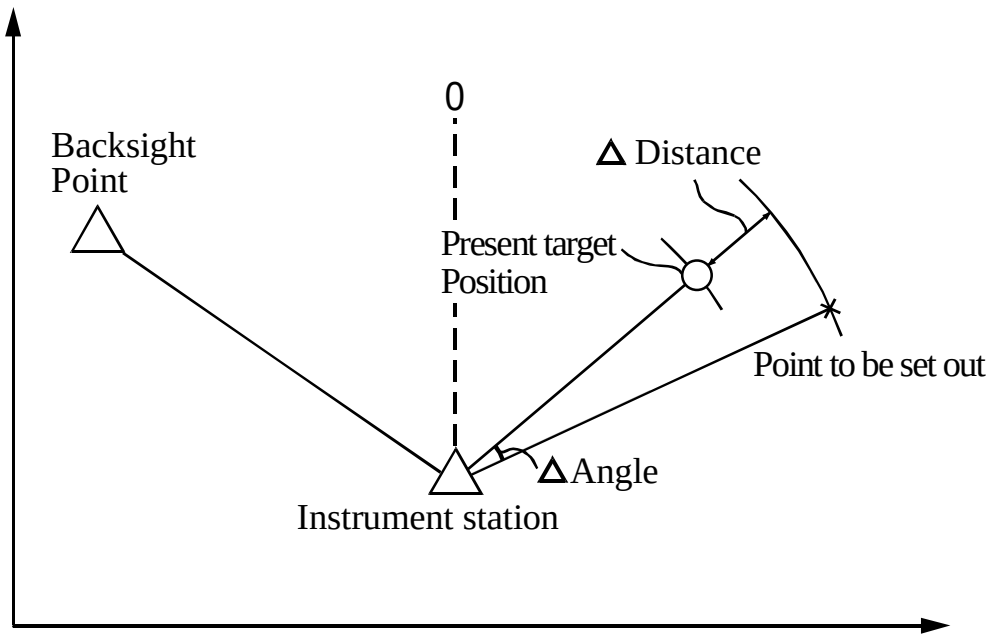
Operation	Keys	Display
5. Press 【OK】 to come in the setting-out observation screen. dH: horizontal distance difference. dHA: horizontal angle difference	【OK】	
6. Press 【←↓→↑】 to come in the setting-out leading screen. The horizontal angle difference between the target and the point to be set out is displayed on the second line ,and the arrow displays which direction the target should be moved. l Arrow meanings ←: Looking from the station , move the prism to the left. →: Looking from the station, move the prism to the right. l To return to the setting-out observation , press 【DIFF】.	【←↓→↑】	
7.Rotate the top of the instrument until 0° displayed on the second line. When the horizontal angle difference is within ±30″, ←→ will be displayed.		
8.Place the prism on the sight line.		
9.Press 【 OBS 】 to start distance measurement.	【OBS】	

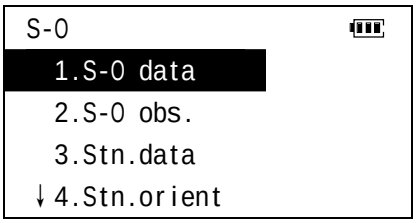
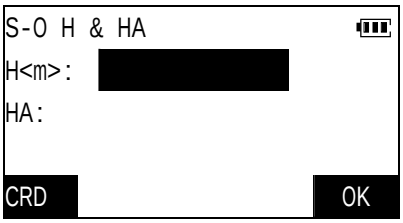
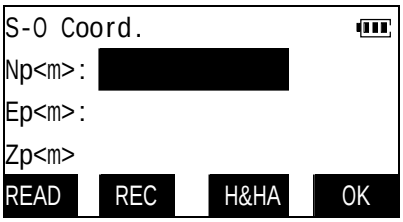
Operating	Keys	Display
10.When the distance measurement completed, the horizontal distance difference between the target and the point to be set out is displayed on the third line. and the arrow displays which direction the target should be moved. l The means of the arrow: ↓: Move the prism forward ↑: Move the prism away l To change EDM settings, Press 【EDM】. Please see "12.1setting the distance Meas"		
11.Move the prism forward and backward until the horizontal distance difference is 0m. When the horizontal distance difference is within ± 1cm, ↑ ↓ will be displayed. l When repeat measurement mode or tracking measurement mode is selected, without any key press, the setting-out result will be displayed continuously while sighting the prism .		
12. Press 【DIFF】 to display the setting-out result. Press 【ESC】 to return to <S-O> menu.	【DIFF】	
l Press 【MODE】to change setting-out measurement mode,the mode will be toggled between setting-out distance and setting-out coordinate. l When repeat measurement mode or tracking measurement mode is selected, press 【STOP】to stop measurement.		

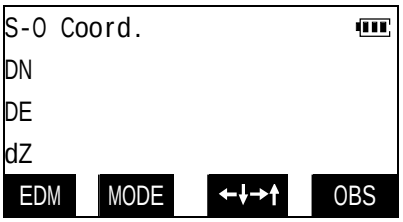
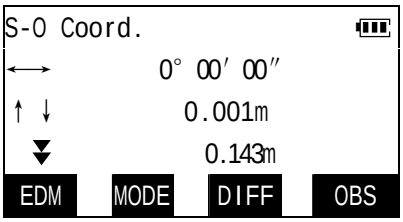
13.2 Coordinates Setting-out Measurement

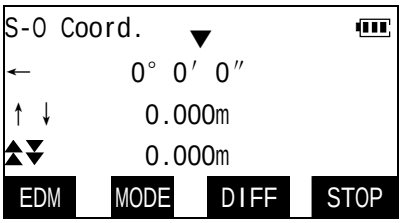
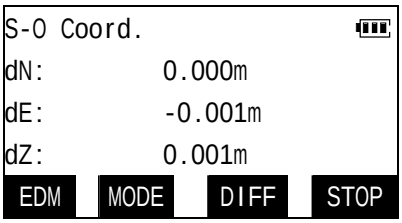
Setting-out coordinates measurement is used to set out the point whose coordinates is known. After inputting the coordinates for the point to be set out, the instrument calculates the setting-out horizontal angle and horizontal distance and store them in the memory. By selecting the horizontal angle and then the horizontal distance setting-out functions, the required coordinate location can be set out.

- To find the Z coordinate , you had better attach the prism to a pole etc. with the same target height.



Operating	Keys	Display
1. In the third page of the Meas mode, press 【S-O】to come in <S-O> menu. l Selecting "2.S-O" in the menu mode perform the same function. 2. Select "3.Stn.data"to input the instrument station data. Select "4.Stn. orient" to set the azimuth angle. Select "5.Ins.h&tgt.h" to input the instrument height and the prism height.（Please see "12.1inputting instrument station coordinate", "12.2 Azimuth angle setting", "12.3 inputting the height of instrument and prism"）,	【S-O】	
3. Select "1.S-O data" and press 【↵】 to come in the setting-out data screen.	【↵】	
4. Press【CRD】.<S-O Coord.> is displayed. Input the coordinates of the setting-out point. l When 【READ】 is pressed, registered coordinates can be recalled and used as setting-out coordinates.（Please see "12.1.2 Reading in registered coordinate data"） l Press【H&HA】to come in the distance setting-out mode. l Press 【REC】 to record the input coordinate data.	【CRD】	

Operating	Keys	Display
5.After the coordinates entered, press [OK]. The distance and the horizontal angel of the point to be set out are calculated and displayed on the screen. l When the the prism height has been changed. Press 【HT】to reenter the prism height before the measurement.(Please see "12.3 inputting the height of instrument and prism")	【OK】	
6.Press 【OK】to come in the screen of the setting-out observation.	【OK】	
7.Press 【←↓→↑】 to come in the setting-out leading screen. Following step 7 to 10 in "12.2 Distance setting-out measurement", complete the plane coordinates setting-out. Then observe the difference height between the target and the required point which displayed on the fourth line. l Means of arrow: ▲: move the prism upward ▼: move the prism downward	【←↓→↑】	

8.Move the prism upward and downward until the value displayed on the fourth line is 0m. When the height difference approach 0m，two arrows will be displayed. When all the values displayed on the screen are 0,then the setting-out point is just located at the bottom of the pole that the prism attached to.		
9. Press 【DIFF】to display the setting-out result. Press 【ESC】to return to <S-O> menu..	【DIFF】	

Reference: Distance correction in the coordinates setting-out measurement.

ETS-800 can carry out the distance correction of Average Elevation and Projection by setting a scale factor .

The correction is performed using the following formula:

（1）The distance on the projection plane:

HDg = HD×scale factor

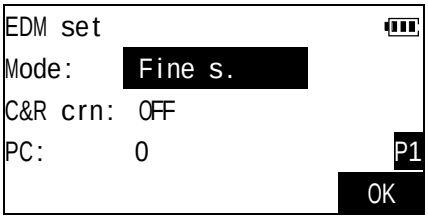
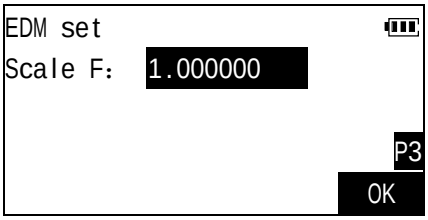
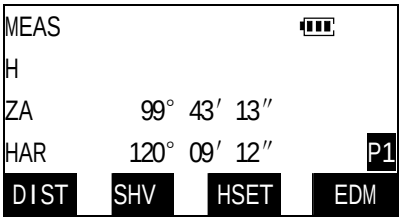
HDg：The distance on the projection plane.

HD： The distance on the ground.

（2）The distance on the ground:

HD = HDg/ scale factor

- Note: When the scale factor is set, it will affect all functions relate to coordinate measuring.
- Scale factor input range: 0.98-1.02. Default value is 1.000000(This means no correction is carried out.)

Operating	Keys	Display
1. Press 【EDM】 in the first page of the Meas mode.	【EDM】	
2. Press 【3】/【4】or press 【PAGE】 directly to move the cursor to the scale factor line.	【5】 【6】	
3. Input the scale factor，press 【OK】 and return to the Meas mode.	【OK】	

14. OFFSET MEASUREMENT

Offset measurements are performed in order to find a point where a target cannot be installed directly or to find the distance and angle to a point which cannot be sighted.

It is possible to find the distance and angle to a point you wish to measure by installing the target at a location a little distance from the target point and measuring the distance and angle from the surveying point to the offset point.

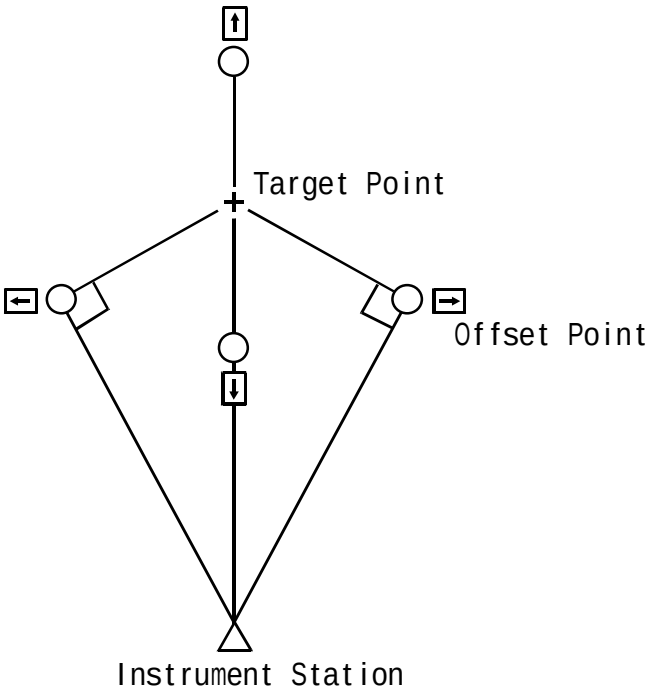
There are two measuring methods: distance offset and angle offset.

Before this measurement , the softkey 【OFS】 must be allocated in the Meas mode according to "22.3.1defining softkeys".

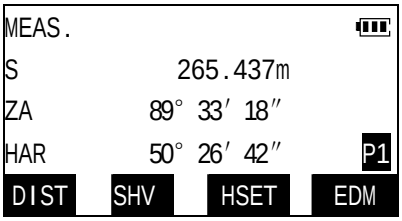
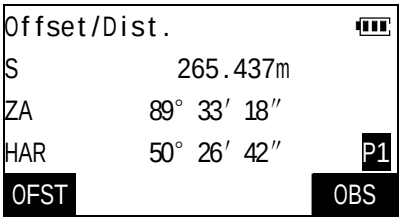
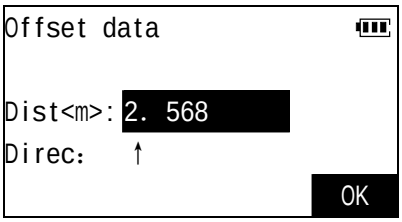
In the menu mode, selecting "7.Offset" can perform the offset measurement also.

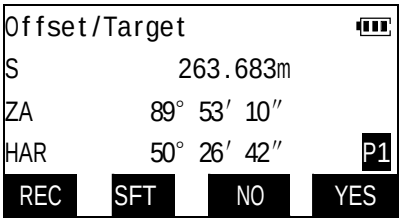
14.1 Distance Offset Measurement

Finding it by entering the horizontal distance from the target point to the offset point.



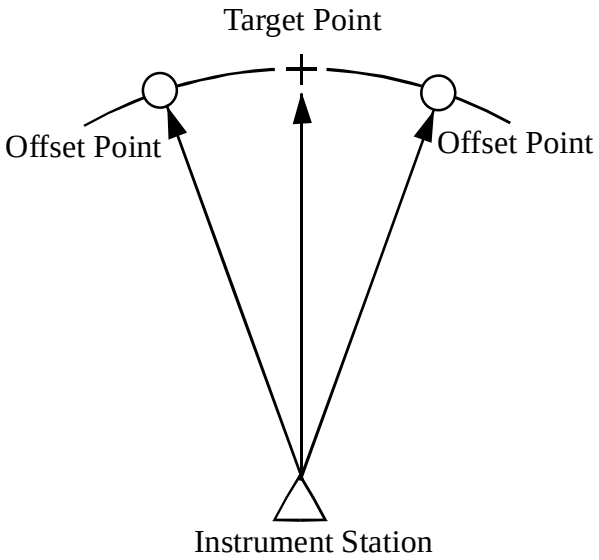
l when the offset point is positioned to the left or right of the target point, make sure the angle formed by lines connecting the offset point to the target point and to the instrument station is almost 90°. When the offset point is positioned in front of or behind the target point, install the offset point on a line linking the instrument station with the target point.

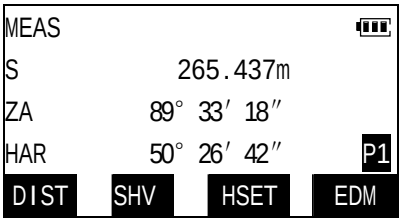
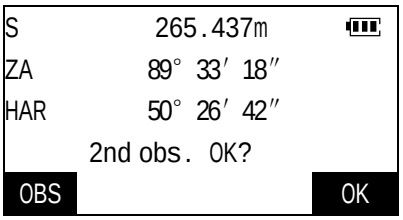
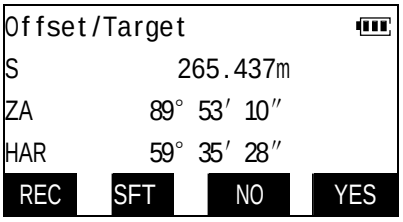
Operating	Keys	Display
1. Set the offset point close to the target point and measure the distance between them, then set up a prism on the offset point. Sight the offset point and press【DIST】in the first page of the Meas mode to measure it.(Please see "11.3 Distance and angle measurement")		
2.Press 【OFS】to come in the offset measurement menu.	【OFS】	
3.Select "1.Offset/Dist." to come in the distance offset screen. The measurement results of the offset point are displayed. Press【OBS】to re-observe the offset point.	【↵】	
4.Press 【OFST】.Input the follow items: (1)Input the horizontal distance from the target point to the offset point and press【↵】. (2) Press【3】/【4】to select the direction of offset point. ↓: Closer than the target point. ↑: Beyond the target point. →: On the right of the target point. ←: On the left of the target point.	【OFST】	

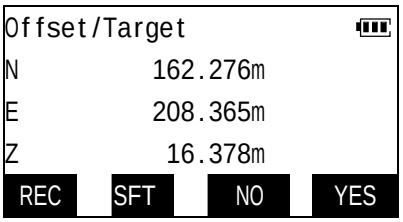
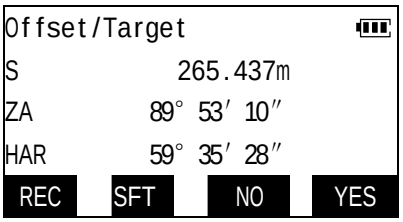
5.Press 【OK】. The distance and angle of the target point are calculated and displayed. l Press 【 REC 】 to record the result.(Please see "21.1 Recording distance measurement data"). l Press 【SFT】to switch the screen display from distance values to coordinates values. l Press 【NO】to return to display the previous distance and angle. l Press 【YES】to return to <Offset> menu.	【OK】	

14.2 Angle Offset Measurement

Sighting the direction of the target point to find it from the included angle. Install offset points for the target point on the right and left sides of and as close as possible to the target point and measure the distance to the offset points and the horizontal angle of the target point.



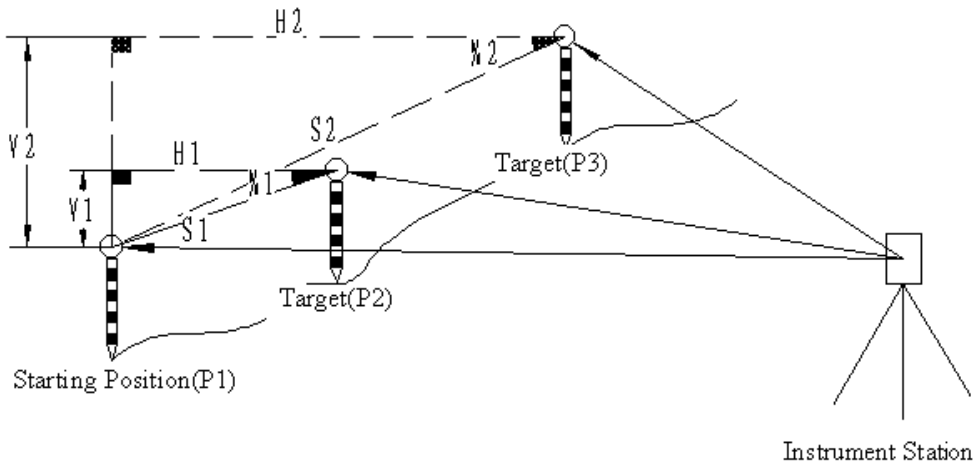
Operating	Keys	Display
1.Set the offset points close to the target point , making sure the distance from the instrument station to the target point and the height of the offset points and the target point are the same, then use the offset points as the target. Set the offset point and press 【DIST】in the first page of the Meas mode to begin measurement.(Please see "11.3 Distance and angle measurement")	【DIST】	
2.Press 【OFS】to come in the offset measurement menu screen.	【OFS】	
3.Select "2.Offset/Angle" to come in the angle offset screen. The measurement results of the offset point are displayed. l Press【OBS】to re-observe the offset point.	【5】 【6】 【↵】	
4.Press 【OK】. The distance and angle of the target point are displayed. l Press 【REC】to record the results. (Please see "21.1 Recording distance measurement data") l Press 【SFT】to switch the screen display from distance values to coordinates values. l Press 【NO】to return to the previous distance and angle. l Press 【YES】to return to <Offset> menu.	【OK】	

Operating	Keys	Display
5. Press 【SFT】, and the coordinate of the target point will be displayed. l Select "3.Stn.data" in <Offset> menu to confirm the data of the instrument station.	【SFT】	
6. Press 【SFT】to display the distance and angle of the target point again.	【SFT】	

15. MISSING LINE MEASUREMENT

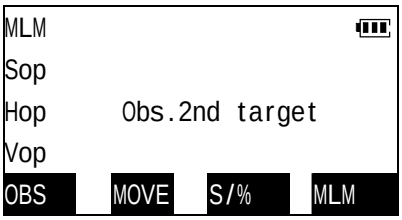
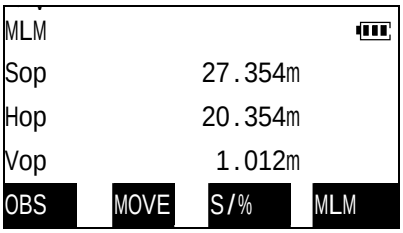
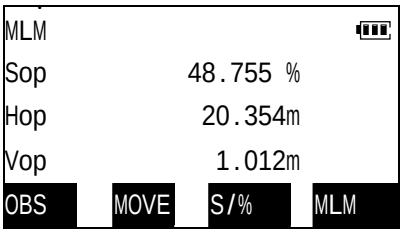
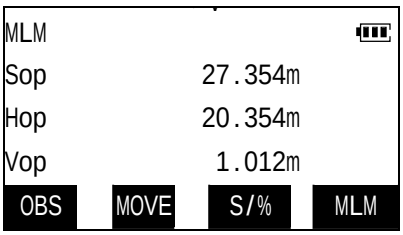
Missing line measurement(MLM) is used to measure the slope distance, horizontal distance, and horizontal angle to a target from the target which is the reference（starting point） without moving the instrument.

- It is possible to change the last measured point to the next starting position.
- When measuring the height difference of two or more points, attach the prism to a pole etc. and make all the targets at the same height.
- Measurement result can be displayed as the gradient between two points.



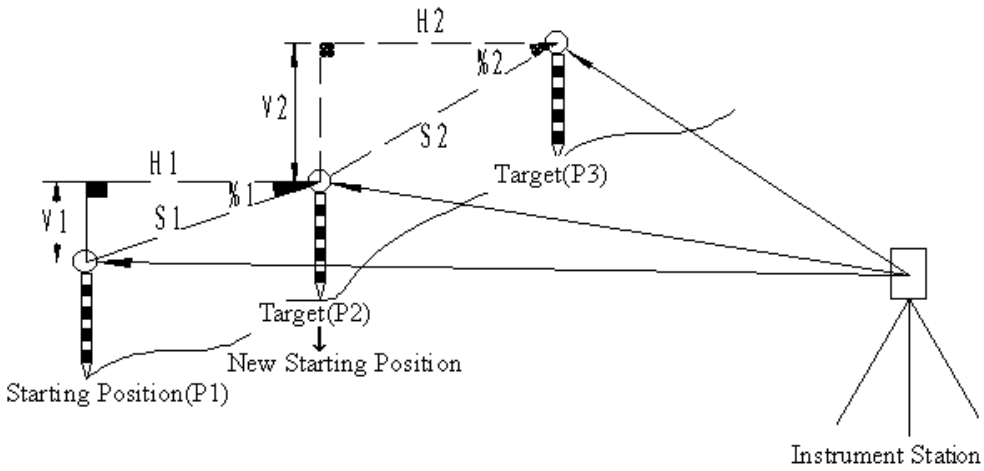
15.1 Measuring the distance between 2 or more points

Operating	Keys	Display
1. Sight the target of the starting position, and press【DIST】 in the first page of Meas mode to begin measurement. The measured values are displayed. Press 【STOP】to stop measurement.	【DIST】	MEAS S 10.567m ZA 70° 11′ 57″ HAR 135° 31′ 27″ P1 DIST SHV HSET EDM

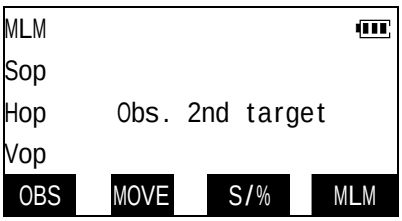
Operating	Keys	Display
2. Press【MLM】 in the third page of the Meas mode to come in the missing line measurement. l Select "4.MLM"in the menu mode to perform the same function.	【MLM】	
3.Sight the second target and press 【MLM】 to begin observation. When observation finished , the following values are displayed : Sop: Slope distance of the starting position and 2nd target point . Hop: Horizontal distance of the starting position and 2nd target point. Vop: Height difference of the starting position and 2nd target point.	【MLM】	
4.Press 【S/%】.The distance between two points is displayed as the gradient between two points. Press 【S/%】again to return to display the slope distance.	【S/%】	
5.Sight the next target point and press 【MLM】to observe it. Slope distance, horizontal distance and height difference between multiple points and the starting point can be measured this way. l Sight the starting point and press 【OBS】to re-observe it. l When 【MOVE】 is pressed, the last target measured becomes the new starting position to perform MLM of the next target.		

15.2 Changing the starting point

it is possible to change the last measured point to the next starting position.

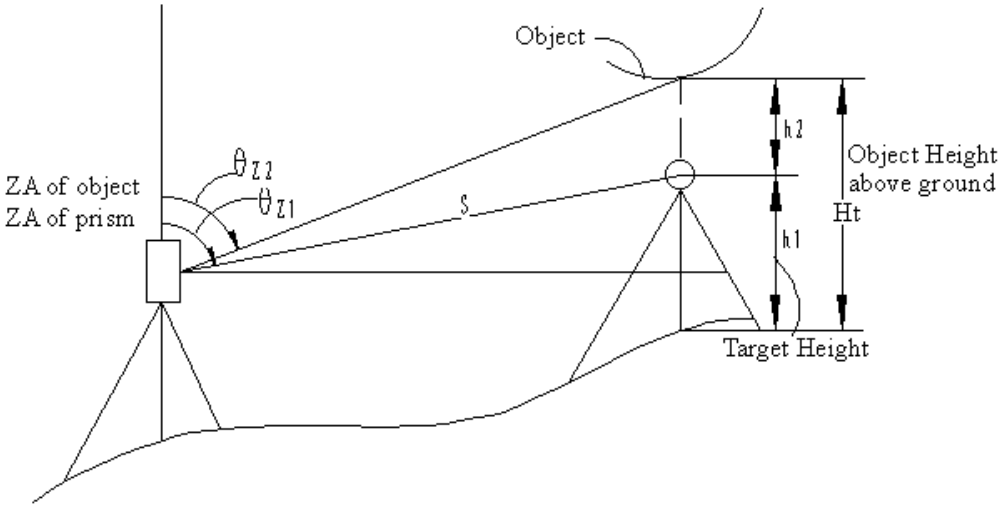


Operating	Keys	Display
1 Observe the starting position and target following steps 1 to 3 in "15.1 Measuring the distance between 2 or more points"		MLM Sop 27.354m Hop 20.354m Vop 1.012m OBS MOVE S/% MLM
2.After measuring the targets, press【MOVE】.	【MOVE】	MLM Move ? NO YES

Operating	Keys	Display
3. Press 【 YES 】 to change the last measured point to the next starting position. I Perform MLM following steps 2 to 3 in "15.1 Measuring the Distance between 2 or more points"	【YES】	

16.REM MEASUREMENT

REM measurement is used to measure the height to a point where a prism cannot be directly installed such as power lines , bridge and overhead cables, etc.



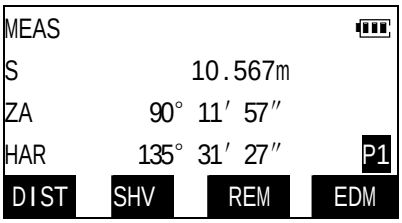
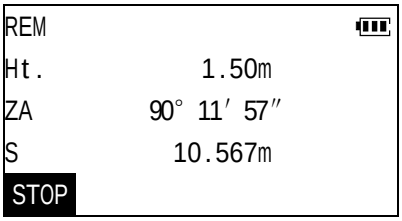
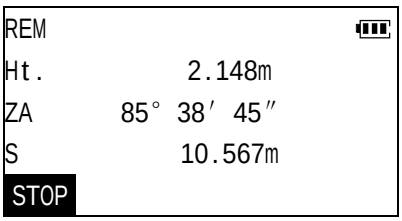
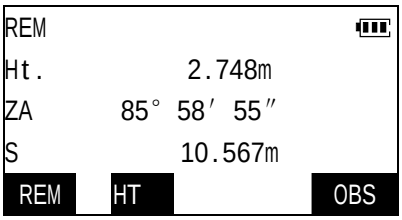
- The height of the target is calculated using the following formula:

  $Ht=h1+h2$

  $h2=S\sin\theta_{z1}\times\cos\theta_{z2}-S\cos\theta_{z1}$

- Before this measurement , the softkey 【REM】 must be allocated in the Meas mode according to “22.3.1 Defining softkeys”.
  Selecting “5.REM” in the menu mode can perform the same function.

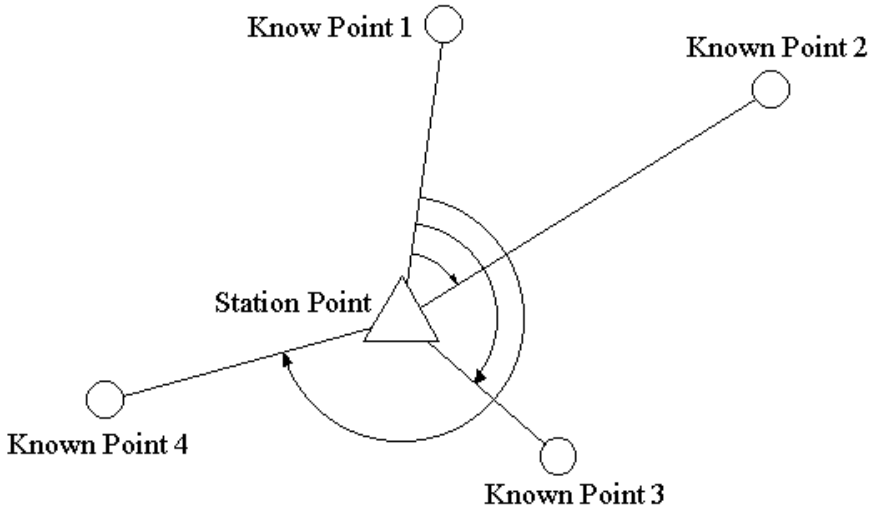
Operating	Keys	Display
1. Place the prism directly under or directly over the object and measure the prism height. 2. In the third page of the Meas mode, press 【HT】 to enter the prism height. Then press 【OK】 to return.	【HT】 【OK】	Ins.h & tgt.h Tgt.h<m>: 1.50 Ins.h<m>: 1.35 OK

3. Accurately sight the prism, press 【DIST】 in the first page of the Meas mode to begin measurement. The measurement results are displayed. Press 【STOP】 to stop the measurement.	【DIST】	
4. Press 【REM】or select "5.REM" in the menu mode to come in the REM function screen.	【REM】	
5.Sight the object, the height from the ground to the object is displayed. While rotating the telescope, the height are calculated and displayed in real time.		
6. Press 【STOP】 to stop the measurement. l Press 【OBS】 to re-observe the prism. l When the prism has been adjusted, press 【HT】to reenter the prism height. l Press 【REM】 begin measurement again.	【STOP】	
7. Press 【ESC】 to finish this function and return.	【ESC】	

17. RESECTION MEASUREMENT

Resection is used to determine the coordinates of an instrument station by performing multiple measurements of points whose coordinate values are known.

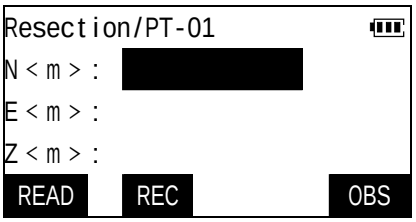
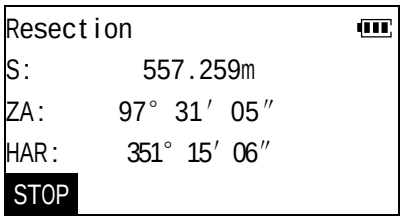
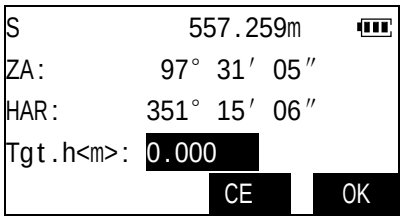
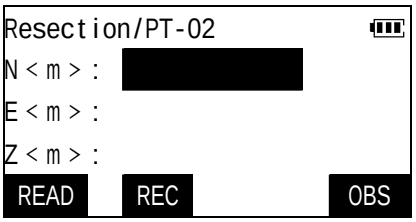
Entry		Output
Ni, Ei, Zi:	Coordinates of known point	N0,E0,Z0: station point coordinates
Hi:	Observed horizontal angle	
Vi:	Observed vertical angle	
Di:	Observed distance	

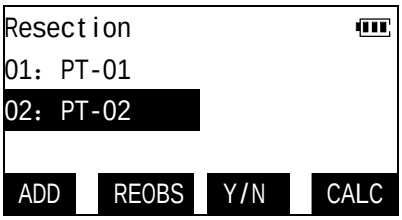
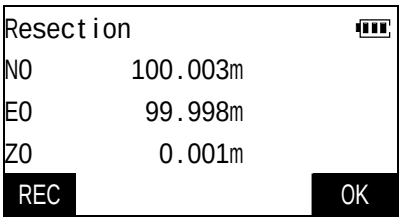
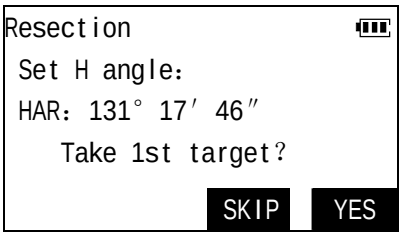


ETS-800 can calculate the instrument station coordinates by measuring 2 to 10 known points. When the measured point more than 2 points, the N,E coordinates of the instrument station are found using the method of least squares. Therefore the more known points are measured, the higher the calculation precision can be got.

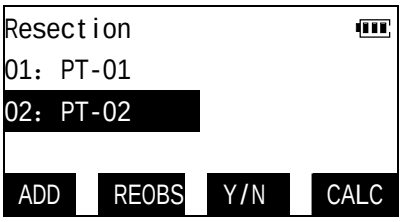
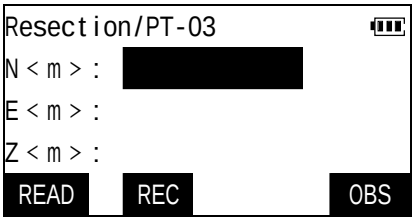
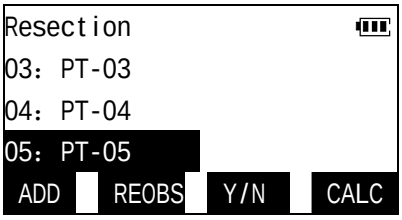
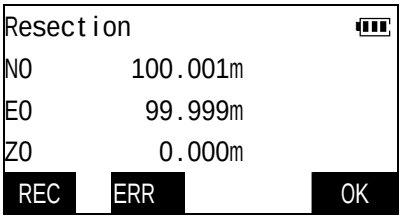
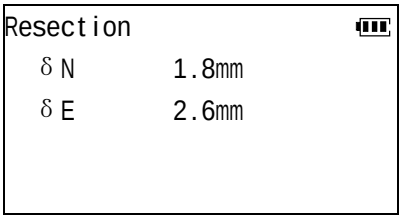
- The function can be performed also by selecting "3.Resection" in the menu mode.
- Using the resection measurement function provided by this instrument need the known point input and measured in a clockwise direction, or the result maybe incorrect .

17.1 Calculating the station coordinate by measuring 2 known point

Operating	Keys	Display
1. In the third page of the Meas mode, press 【RESE】to perform this function. Selecting "3.Resection" in the menu mode can also perform this function.	【RESE】	
2.Input the coordinates of the first known point. Then sight it and press 【OBS】to start measurement. Press 【STOP】to stop measurement.	【OBS】	
3. The measurement results are displayed on the screen. Input the prism height of the known point.		
4.Press 【OK】and then input and measure the second known point in the same way.	【OK】	

5.When the two known points have been input and measured, the list of the known points is displayed. l Press 【 5 】/【 6 】to move the cursor and select the known point. l Press 【ADD】to add a known point for resection. l Press 【 REOBS 】 to reenter or re-observe the known point selected. l Press 【CALC】to start calculations. l Press 【Y/N】 to make the known point selected joining for calculation or not.		
6. Press 【CALC】. The instrument station coordinates are calculated and displayed. l Press 【REC】to store the results in the memory. l Press 【REC】to accept the calculated results as the new station coordinates.	【CALC】	
7. Press 【OK】 to set the instrument station coordinates, then the azimuth angle of the first known point as the backsight point is calculated and displayed. Sight the known point 1，press 【YES】 to set the azimuth angle and return to the Meas mode. l Press【SKIP】to return the Meas mode without setting the azimuth angle.	【OK】	

17.2 Calculating the station coordinate by measuring multiple known points

Operating	Keys	Display
1.Following the steps described in "18.1 Calculate the station coordinates by measuring two known points",input and measure two known point, and then the list of the known points are displayed.		
2.Press 【ADD】to Input and measure the other points (in clockwise) in the same way as described above.	【ADD】	
3.Repeat the operation until all required known points are input and measured.		
4. Press 【CALC】 to calculate the coordinate of the instrument station. Press 【OK】to set the coordinate of the station and return to the Meas mode.	【CALC】	
5.Press 【ERR】. The standard deviation which describes the measurement accuracy are displayed. Press 【ESC】 to return to the previous screen.	【ERR】	

- Caution:

  In some cases it is impossible to calculate the coordinates of an unknown point if the unknown point and three or more known points are arranged on the edge of a single circle. If it occured,Try to take one of the following:

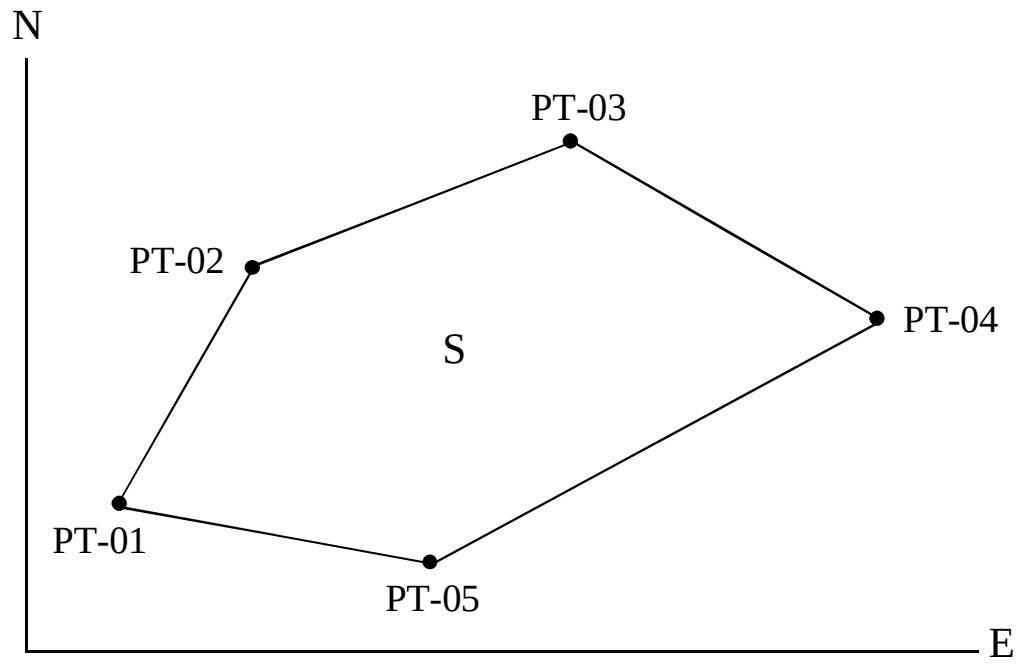
  a) Move the instrument station as close as possible to the center of the triangle.
  b) Observe one more known point that is not on the circle.
  c) Perform a distance measurement on at least one of the three points.

  In some cases it is impossible to calculate the coordinates of the instrument station if the included angle between the known points is too small. It is difficult to imagine that the longer the distance between the instrument station and the known points, the narrower the included angle between the known points. Be careful because the points can easily be aligned on the edge of a single circle.

18. AREA CALCULATION

This function can calculate the area of polegon land enclosed with three or more points. The coordinates of the point can be specified by measuring the point, reading in from memory , and entering directly.

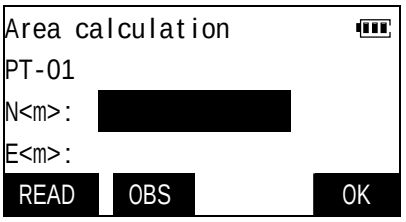
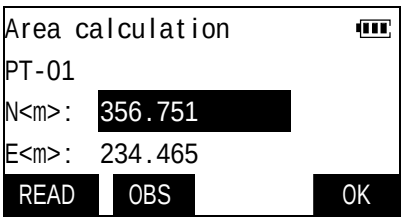
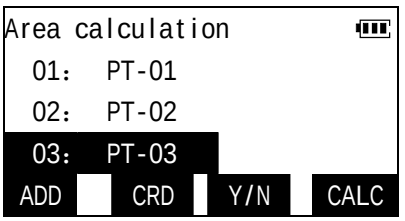
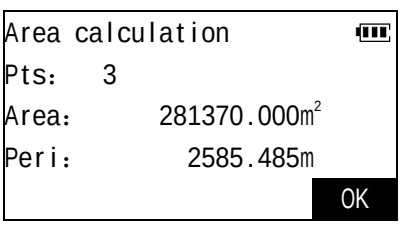
Input	Output
Coordinate：P1（N1，E1）	Area ： S
P1（N1，E1）	
P1（N1，E1）	



Before this measurement , the softkey 【AREA】 must be allocated in the Meas mode following the steps in “22.3.1 Defining softkeys”.

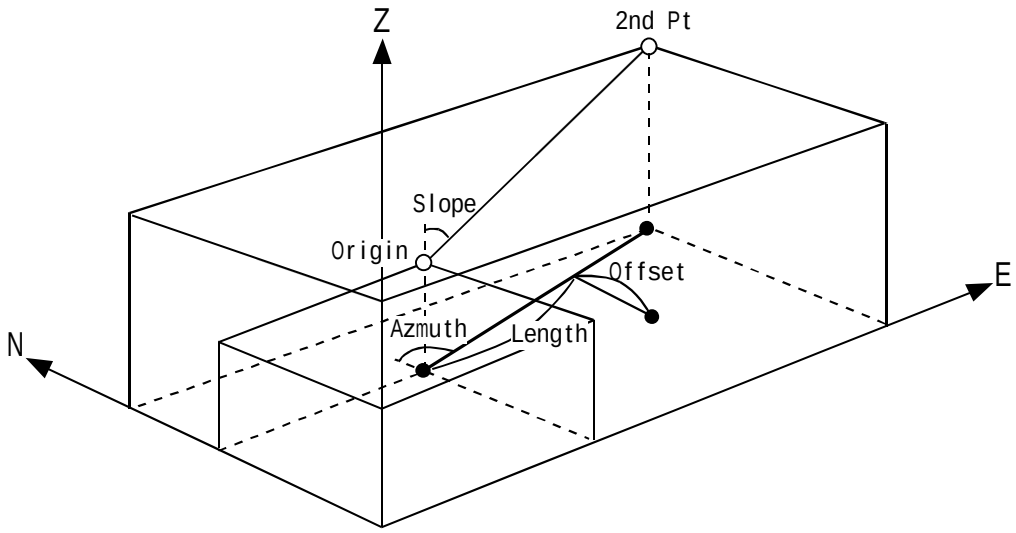
Selecting “6.Area calcul.” in the menu mode can perform the same function.

- The number of specified coordinates points:3 or more,30 or less.
- Be sure to specify points on an enclosed area in a clockwise or counterclockwise direction, or the calculated result will not be correctly.

Operating	Keys	Display
1. Press 【Area】 in the Meas mode or select "6.Area Calcul." In the menu mode to come in this function screen.	【AREA】	
2. Sight the first point ,and press 【OBS】to begin measurement. When measurement finished, the measured values are displayed . l When 【READ】 is pressed, registered coordinates can be recalled.（Please see "12.1.2 Reading in registered coordinate data"）.	【OBS】	
3.Press 【OK】,and then specify the next point. Following step 2, complete specify the second point and third point, then the list of the known points is displayed, and the area of the polegon enclosed with the known points can be calculated. l Press 【5】/【6】to move the cursor and select the known point. l Press 【ADD】to add a known point to enclose the polegon area. l Press 【CRD】to enter or measure the coordinates of the known point selected again. l Press 【CALC】to start calculations. l Press 【Y/N】 to make the known point selected joining for calculation or not.	【OK】	
4.Press【CALC】. The area and the perimeter of the polegon enclosed with the all known points are calculated and displayed. Press 【OK】 to finish the area calculation function and return to the Meas mode. Press 【ESC】to return to the last screen.	【CALC】	

19. SETTING-OUT LINE

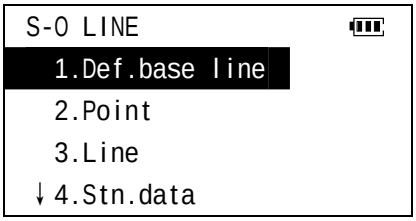
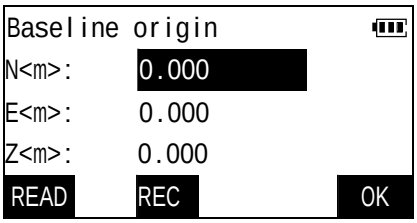
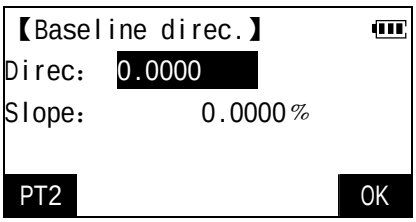
Setting-out line is used for setting out a required point at a designated distance from the baseline and for finding the distance from the baseline to a measured point.

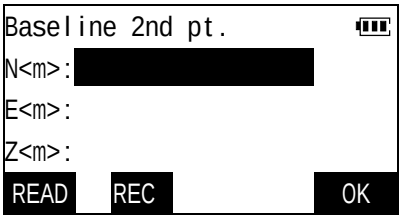
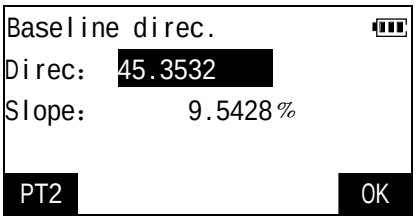


To perform setting-out line function, define the softkey 【LINE】 in the Meas mode following the steps in “22.3.1 defining softkeys”.
Selecting “9.S-O line” can perform this function also .

19.1 Defining baseline

To perform setting-out line measurement, the baseline should be defined at first. The baseline can be defined by inputting the coordinates of the two points,or by inputting starting point coordinates, direction angle and gradient of the baseline.

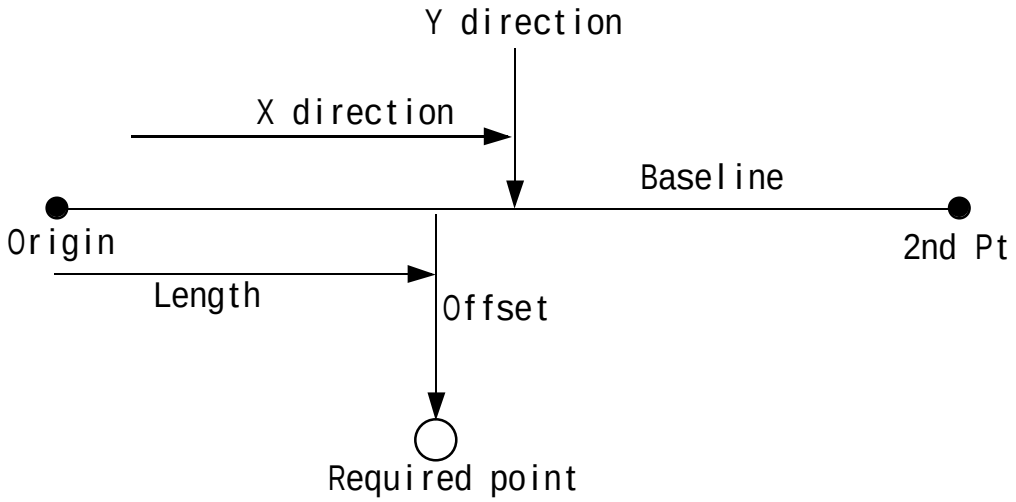
Operating	Keys	Display
1. Press 【LINE】in the Meas mode or select "9.S-O line" in the menu mode come in <S-O LINE> menu. Select "4.Stn.data"to input the instrument station data. Select "5.Stn. orient" to set the azimuth angle. Select "6.Ins.h&tgt.h" to input the instrument height and the prism height.（Please see "12.1inputting instrument station coordinate", "12.2 Azimuth angle setting", "12.3 inputting the height of instrument and prism"）.	【LINE】	
2.Press【↵】to select "Def. baseline". Input the coordinate of the baseline starting point. l To recall the coordinate data registered in the memory, press【READ】.（Please see "12.1.2 Reading in registered coordinate data"）. l Press 【REC】to record the coordinate data in the memory.	【↵】	
3. Press【OK】after inputting the data, then input the azimuth and the grade of the baseline. Press【OK】to finish the definition of baseline. l When【PT2】is pressed,, the azimuth and the grade of the baseline can be calculated by inputting the coordinate of the second point at the baseline.	【OK】	

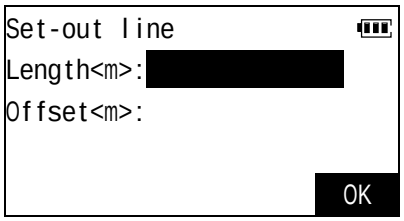
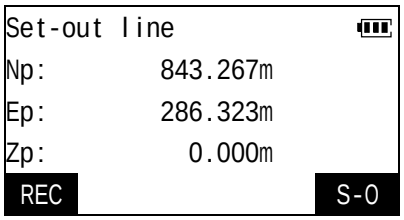
4. Press 【PT2】.Input the coordinate of the second point at baseline. l To recall the coordinate data registered in the memory, press【READ】.（Please see "12.1.2 Reading in registered coordinate data"）. l Press 【REC】to record the coordinate data in the memory.	【PT2】	
5.After inputting the data, press 【OK】. The azimuth and the grade of the baseline are calculated and displayed. Press 【OK】to define the baseline and return to <S-O LINE> menu.	【OK】	

20.2 Setting-out line point

This function can be used to calculate the required point coordinate by inputting the length and the offset based on the baseline, then this point can be set out by setting-out coordination measurement.

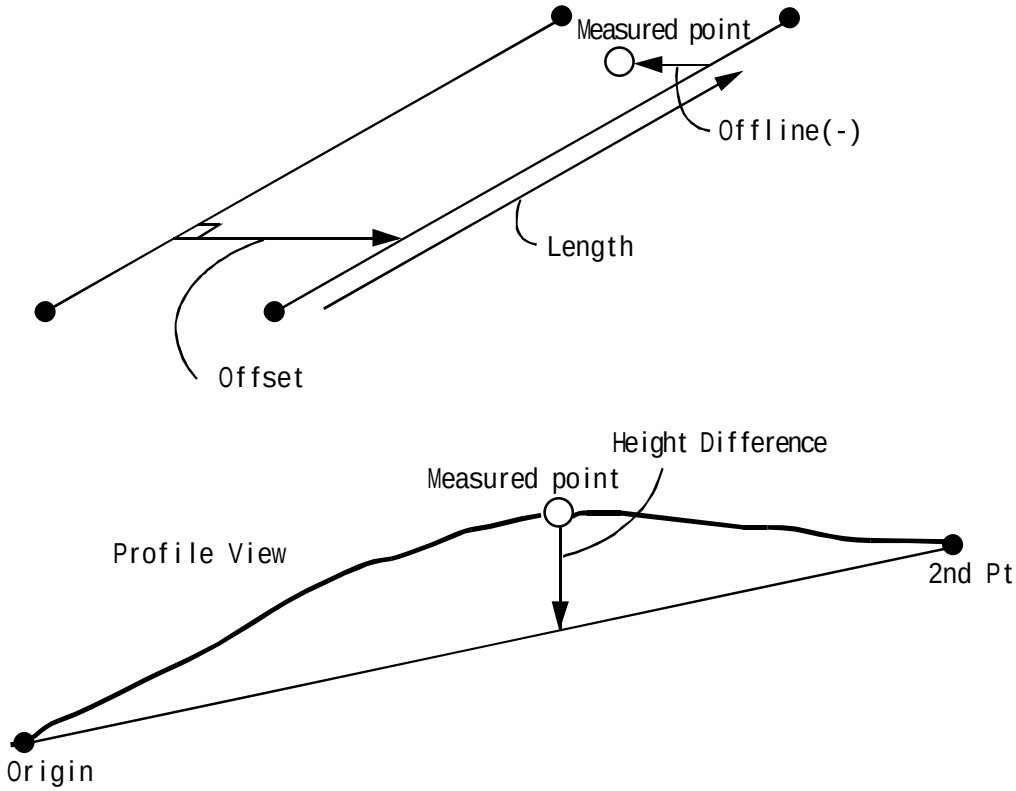
Before performing setting-out line point, the baseline must be defined.

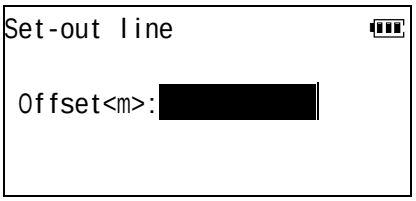
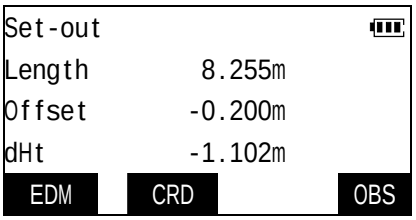


Operating	Keys	Display
1.Select “2.Point” in <S-O LINE> menu. Input the following items： (1)Length: Distance along the baseline from the origin point to the position at which a line extending from the required point intersects the baseline at right angles(X direction). (2)Offset: Distance along the baseline from the origin point to the position at which a line extending from the required point intersects the baseline at right angles (Y direction).	【5】 【6】 【↵】	
2. After inputting the data , press 【OK】.The coordinate value of the required point is calculated and displayed. l Press 【REC】to record the coordinate value as a known point data. （Please see “21.3 Recording coordinate measurement data”）. l Press 【S-O】to begin the setting-out measurement of the required point. （ please see “13.2 coordinates setting-out measurement”）.		
3. Press 【ESC】.Repeat the steps and continue the measurement.	【ESC】	

19.3 Setting-out line line

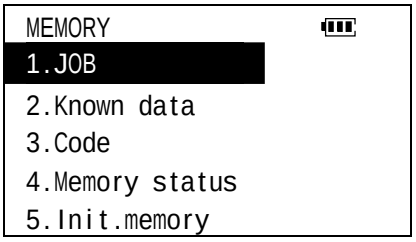
Setting-out line line measurement tells how far horizontally the measured point is from the baseline and how far vertically the measured point is from the connected line. The baseline can be offset in a horizontal direction if necessary. Before performing setting-out line line, the baseline must be defined.



Operating	Keys	Display
1.Select “3.Line” in <S-O LINE> menu. Input the offset value of the line to be set-out. l Offset： How much to move the baseline. Right side indicates positive values and left lide indicates negative value.		
2.After inputting it, press 【↵】. Sight the target and press 【OBS】. After the measurement finished, the difference between the measured point and the baseline is displayed. l Length: Distance along the baseline from the origin point to the measured point. l Offset: A positive value indicates the point is on the right of the baseline and a negative value indicates it is on the left l dHt: Height difference between the measured point and the baseline	【↵】 【OBS】	
l When repeat measurement mode or tracking measurement mode is selected, without any key press, the difference between the measured point and the baseline will be displayed continuously while sighting the prism .Pressing 【STOP】can stop the measurement. l Press 【CRD】to display the coordinate of the measured point. l To change EDM settings, Press 【EDM】. Please see “11.1 EDM settings” l Press 【ESC】to return to <S-O LINE> menu.		

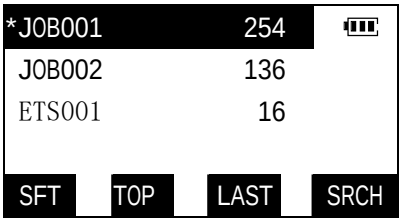
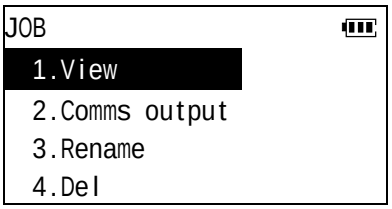
20. THE OPERATION IN THE MEMORY MODE

Memory mode



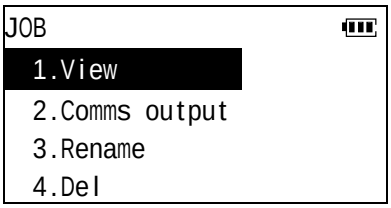
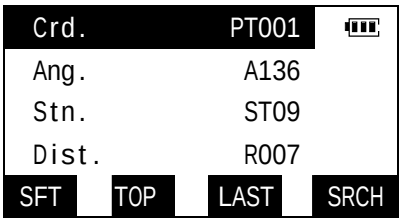
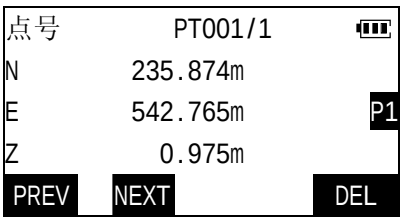
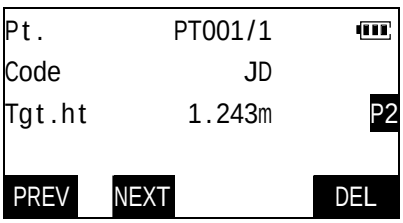
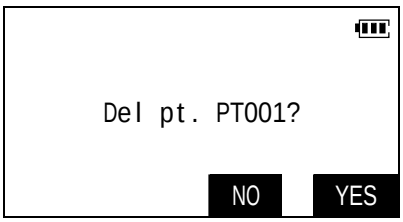
In Status screen, Press 【MEM】to come in memory mode. In this mode, you can do the operations with the data of the job file and the data in memory. These operations included reading data from job file, changing file name, deleting or storing job file, outputting data to computer; inputting coordinate data by hand or from computer, recalling or deleting the coordinate of known point, inputting ID code of object beforehand for recalled in later measurement, etc.

20.1 Managing the job file

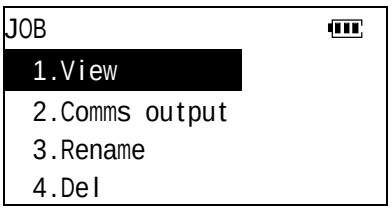
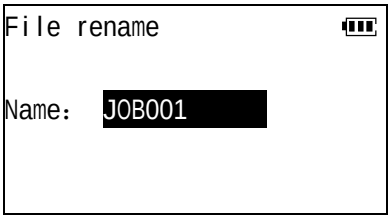
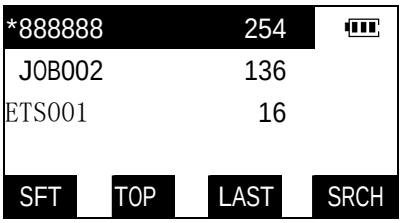
Operating	Keys	Display
1.In the Memory mode main screen, Select "1.Job" and press 【↵】. A list of the jobs exist in the memory is displayed, and the number to the right represents the number of data items in each job.	【↵】	
2. Press 【5】/【6】 to move the cursor to select the job file and press 【↵】to come in the screen of managing job file.	【5】 【6】 【↵】	

- The job file marked with "*" is the current job file selected to store data.
- Press 【▲】/【▼】to move the cursor up and down from line to line.
- Press 【SFT】and then Press 【▲】/【▼】to move the cursor from page to page.
- Press 【TOP】to move the cursor to the list's beginning, press 【LAST】to move the cursor to the list's end.
- Press 【SRCH】to input the name of job file and search it.
- Press 【ESC】to return to job list screen.

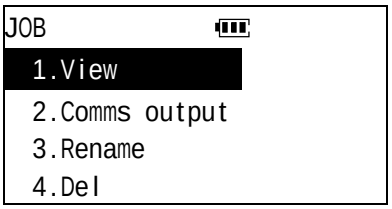
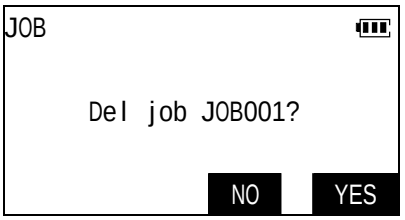
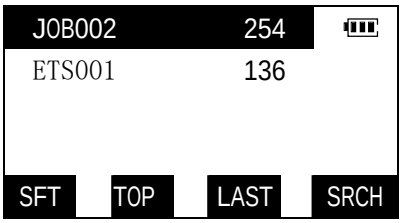
20.1.1 Reviewing and deleting record in job file

Operating	Keys	Display
1. Select the job file in the job file list, and press【↵】to come in the screen of managing job file.	【5】 【6】 【↵】	
2. The records within the job file list on the screen, including the record type and the name. l Ang: angle data l Crd: coordinate data l Stn： station data l Dist：distance data	【↵】	
3.Press 【5】/【6】to move the cursor and select the record. Press 【↵】to display the details of record in two pages. l Press 【PREV】to display previous record. l Press【NEXT】to display next record.	【5】 【6】 【↵】	
4.Press key【PAGE】to toggle between two pages.	【PAGE】	
5. Press 【DEL】. Deletion confirmation screen is viewed. l Press【YES】to confirm deletion of the record and return to the record list screen. l Press 【NO】to abort the operation and return to the record display screen.	【DEL】	

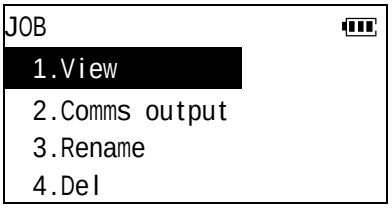
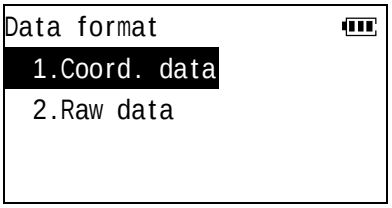
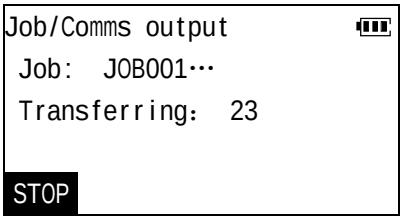
20.1.2 Change name of a job

Operating	Keys	Display
1. Select a job in the job list. Press【↵】 to come in the screen of managing job file.	【5】 【6】 【↵】	
2.Select “3.Rename ” to come in file name inputting screen.	【5】 【6】 【↵】	
3.Input the new name of the job. Press 【↵】 to accept it and return to the job list screen and the name of the job has changed.	【↵】	

20.1.3 Deleting a job

Operating	Keys	Display
1. Select a job in the job list. Press【↵】 to come in the screen of managing job file.	【5】 【6】 【↵】	
2.Select "4.Del", and a confirmation screen is viewed.	【5】 【6】 【↵】	
3.Press【YES】to confirm the deletion. The job together with the data in it are deleted. l Press【NO】to abort the operation.	【YES】	

20.1.4 Outputting job data to computer

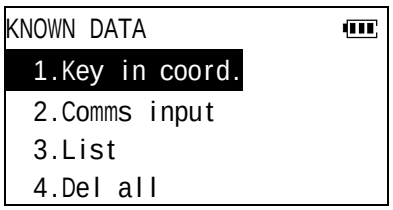
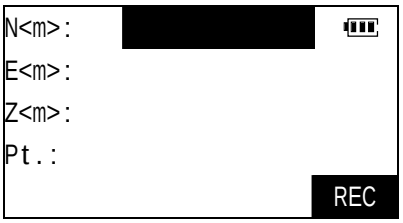
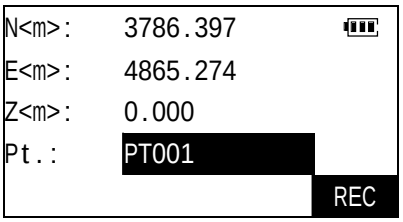
Operating	Keys	Display
1 Connect ETS800 and computer. Run ETS communication software on PC.		
2.Select the job in the job list, and Press【↵】to come in the screen of managing job file.	【5】 【6】 【↵】	
3.Select “2.Comms output” and press【↵】. Output format choice menu is displayed on the screen.	【5】 【6】 【↵】	
3.Select the output format and press【↵】. Output starts. When the output is complete ,the job file list is restored. l Press【STOP】to stop output.	【↵】	
l The UART communication protocal ETS800 comply with is：RS232 interface ,8 data bit,1 stop bit, none parity ,baud rate 1200,2400,4800,9600,19200。 Before output, make sure using the same communication setting as the computer. Please see “22.2 Instrument configuration”.		

20.2 Inputting coordinate data of known point

The coordinate data of known point can be input and stored in the instrument's memory. These coordinate data can be recalled when setting instrument station, inputting backsight point and setting-out point in later measurement. The known point coordinate data and job file data are stored in the difference position in the instrument's memory. Including job file data, The instrument can store up to 15000（15000 to 50000 optional）points of coordinate data.

The coordinate data can be input from the keyboard or from the other external equipment.

20.2.1 Inputting coordinate data of known point from the keyboard

Operating	Keys	Display
1. In memory mode ,select "2. Known data" and press 【↵】。	【5】 【6】 【↵】	
2. Select "1.Key in coord."and press【↵】come in the inputting coordinate data screen.	【↵】	
3. Input the coordinates and the name of known point. When each data item is finished , press 【↵】.	【↵】	
4. Press 【REC】or 【↵】. The data is recorded in the memory and screen in step 2 is restored. Continue to input other known point coordinate data follow this procedure.	【REC】	

- After all the data has been input, press【ESC】to return to <KNOWN DATA> menu screen.
- Maximum size of point name ： 8

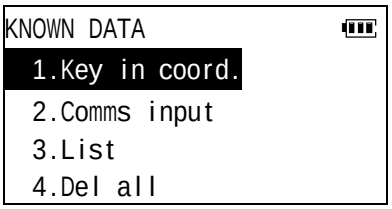
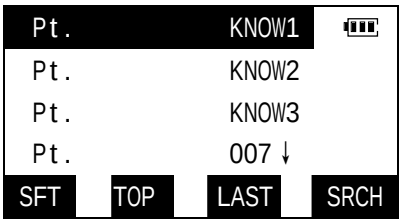
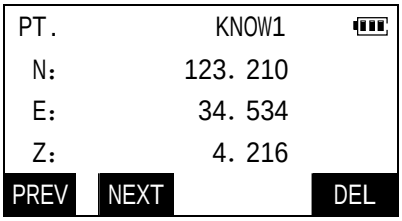
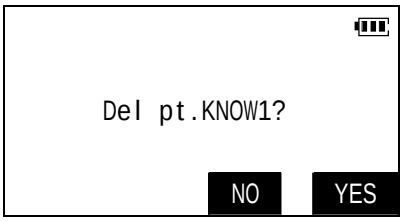
20.2.2 Inputting coordinate of known point from an external equipment

Running ETS communication software on PC , coordinate data of known point can be entered and edited., and the data that have been edited can be send to ETS800.Before the communication, Set the communication parameter following the communication agreement.

Operating	Keys	Display
1.Connect ETS800 and computer. Run ETS communication software on PC.		
2. Select "2.Known data" in the memory mode and press 【↵】.	【5】 【6】 【↵】	KNOWN DATA 1.Key in coord. 2.Comms input 3.List 4.Del all
3.Select "2.Comms input" and press 【↵】.known point coordinate data starts to be transferred from PC and the number of received items is displayed on the screen. Press 【STOP】to stop data reception in progress.	【5】 【6】 【↵】	Known data Transferring… Received: 45 STOP

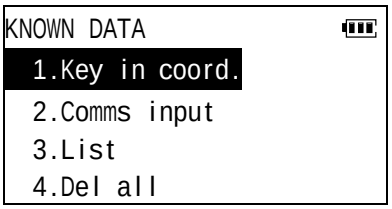
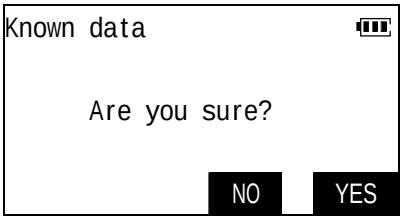
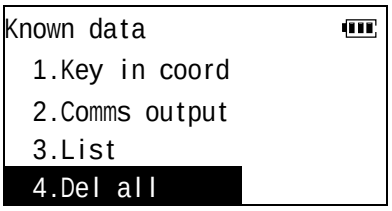
20.3 Reviewing and deleting known point data

All the known point stored in the memory can be reviewed and the data no more needed can be deleted.

Operating	Keys	Display
1. Select "2.Known data" in the memory mode and press 【↵】.	【5】 【6】 【↵】	
2. Select "3.List" in <KNOWN DATA> menu and press【↵】.The known point list is displayed.	【↵】	
3. Move the cursor to the point to be displayed and press【↵】. The coordinates of the selected point are displayed. l Press 【PREV】to display previous known point. l Press【NEXT】to display next known point.	【↵】	
4. Press 【DEL】 and a confirmation screen is viewed. l Press【YES】to confirm deletion of the known point and return to the known point list screen. l Press 【NO】to abort the operation and return to the previous screen.	【DEL】	
l Press 【▲】/【▼】to move the cursor up and down from line to line. l Press 【SFT】and then Press 【▲】/【▼】to move the cursor from page to page. l Press【TOP】to move the cursor to the list's beginning, press【LAST】to move the cursor to the list's end. l Press 【SRCH】to input name of the known point and search it.		

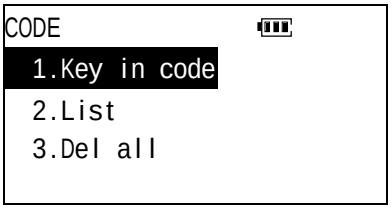
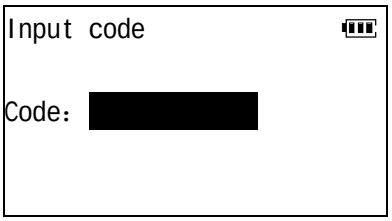
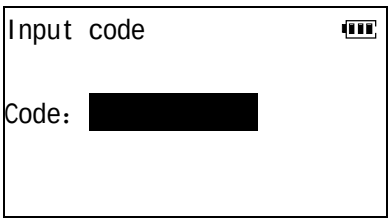
20.4 Deleting all the known point data

This function will delete all the known point coordinate in the memory.

Operating	Keys	Display
1. Select "2.Known data" in the memory mode and press 【↵】.	【5】 【6】 【↵】	
2. Select "4. Del all" in <KNOWN DATA> menu and press【↵】. A confirmation screen is viewed.	【5】 【6】 【↵】	
3.Press【YES】to confirm the operation and all the known point will be deleted. Press 【NO】 to abort the operation.	【YES】	

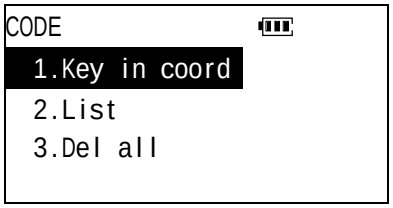
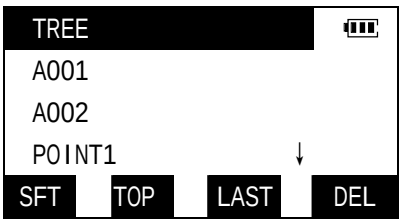
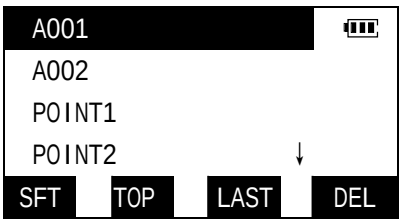
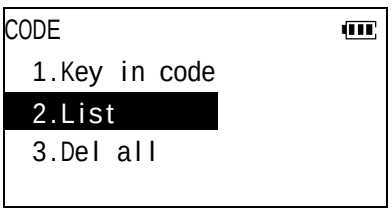
20.5 Inputting codes

ID code can be entered in the memory of the instrument in advance. When recording instrument station or observation data, these codes can be recalled and read in.

Operating	Keys	Display
1. Select "3.Code" in the memory mode, and press 【↵】 to come in <CODE> menu screen.	【5】 【6】 【↵】	
2. Select "1.Key in code" and press 【↵】 to be ready to input codes.	【↵】	
3. Enter the code and press 【↵】 to store it in the memory and the inputting code screen is restored. Press 【ESC】to stop and return to <CODE> menu screen.	【↵】	
■ Maximum code size：8 ■ Maximum number of codes stored: 64		

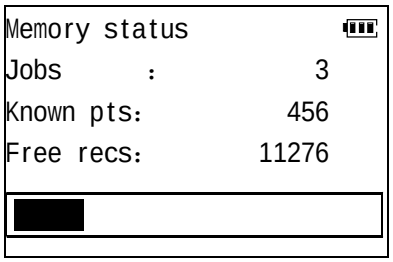
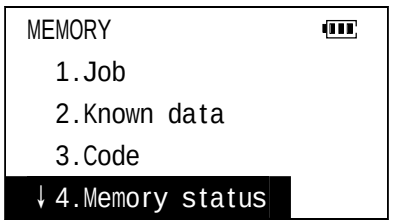
20.6 Reviewing and deleting codes

It is possible to review and delete codes stored in the memory.

Operating	Keys	Display
1. Select "3.Code" in the memory mode and press 【↵】 to come in <CODE> menu screen.	【5】 【6】 【↵】	
2. Select "2.List" and press 【↵】. The code list is displayed.	【5】 【6】 【↵】	
3. Press 【DEL】 to delete the code on the line which the cursor locates.	【DEL】	
4. Press 【ESC】to finish this procedure and return to <CODE> menu.	【ESC】	

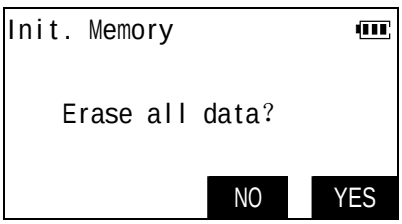
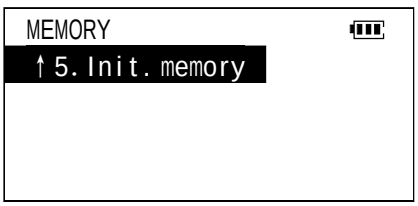
- Press 【▲】/【▼】to move the cursor up and down from line to line.
- Press 【SFT】and then Press 【▲】/【▼】to move the cursor from page to page.
- Press 【TOP】to move the cursor to the list's beginning, press 【LAST】to move the cursor to the list's end.
- Selecting "3.Del all" in <CODE> menu can delete all the codes in the memory.

20.7 Displaying the status of memory

Operating	Keys	Display
1. Select “4.Memory status” in the memory mode and press 【↵】. l Jobs：The number of job files in the memory. l Known pts：The number of known points in the memory. l Free recs：The number of the free record blocks can be used to store data in the memory. l The progress bar show the status of the memory is occupied..	【5】 【6】 【↵】	
2. Press 【ESC】to return to the memory mode menu.	【ESC】	

20.8 Initializing the memory

This function will delete all the data in the memory and resume the memory to factory status.

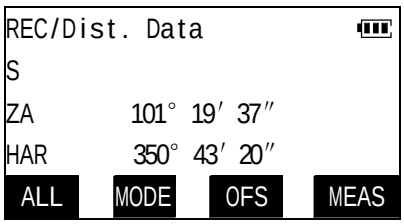
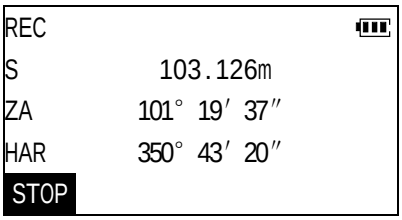
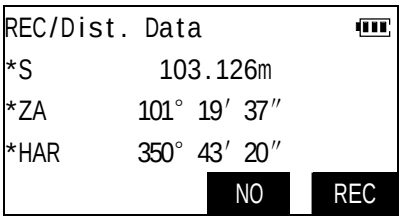
Operating	Keys	Display
1.Select “5.init.memory” in the memory mode and press 【↵】.	【5】 【6】 【↵】	
2. Press 【Yes】to delete all the data in the memory and return to the memory mode.	【YES】	

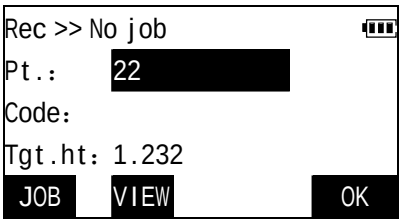
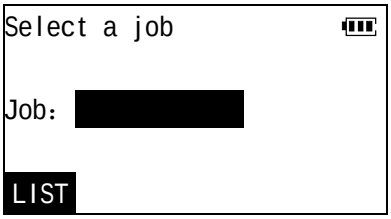
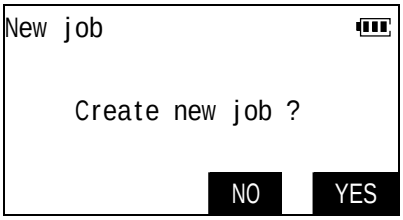
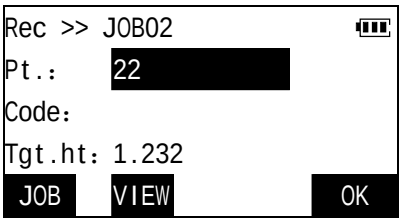
21. RECORDING DATA IN THE RECORD MODE

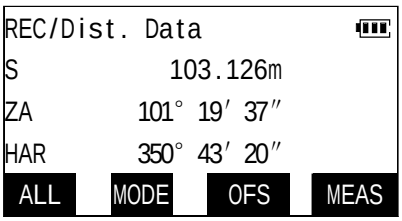
Press 【REC】on the second page of the Meas mode to come in the record mode. In this mode , you can stored the measurement data(distance, angle, coordinates) in the memory of the instrument.

21.1 Recording distance measurement data

In the record mode, distance measurement data , offset measurement data, etc, can be store in the current job file. It is convenient to use 【ALL】 to perform automatic operation from distance measurement to recording. The content of record include slope distance , vertical angle, horizontal angle , point name, code and height of the target.

Operating	Keys	Display
1.In the second page of Meas mode, press 【REC】to come in the record mode.	【REC】	
2.Sight the target and press 【MEAS】to begin distance measurement.	【MEAS】	
3. Press 【STOP】 to finish measurement. The measurement results of the target marked with “*” are displayed on from the second line to the forth line of screen.	【STOP】	

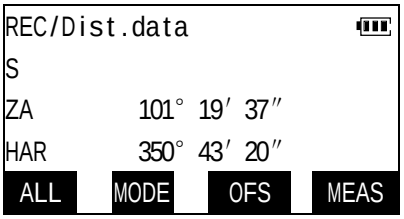
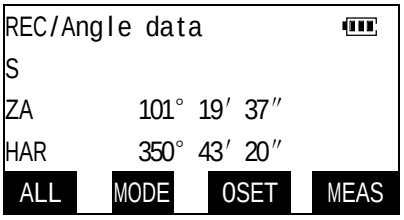
4. Press 【REC】 to record the data marked with "*". Input the follow items: (1)Point name (Maximum size：8) (2)Code(Maximum size：8) (3) Prism height l If no job file selected for storing the data, you should select it first. l Press 【VIEW】 to check the records that have been stored within the current job file. l When the cursor locates the code line, the code registered in memory can be recalled and read in.	【REC】	
5.Press【JOB】to select a job file for storing the data .	【JOB】	
6.Enter the name of the desired job file and press【↵】. If the job file exist in the memory, then it will be selected for storing the data, or the instrument will ask you if a new job should be created. l Press 【LIST】 to select a job in the job list.	【↵】	
7.Press 【YES】 to create a new job and select it as the current job file and return to the step 4.	【YES】	

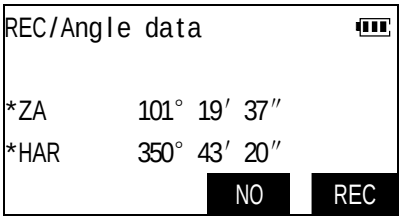
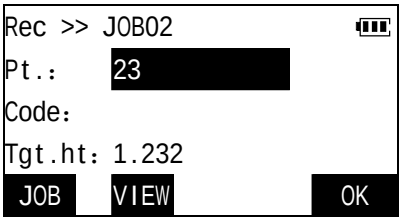
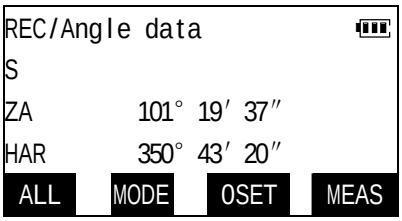
Operating	Keys	Display
8. Check the input items, then press 【OK】 to store the measurement data in the current job file and return to the step 1.	【OK】	

- Press 【ALL】to perform distance measurement and automatically record the results. In this case, the point number is the last point number add one, the code and target height remain the same. When the measurement results recording finished, the results will be displayed for two seconds, then the screen of step 1 is restored.
- When 【OFS】is pressed, offset measurement （distance offset、angle offset）can be performed. （Please see“14.Offset measurement”）.

21.2 Recording angle measurement data

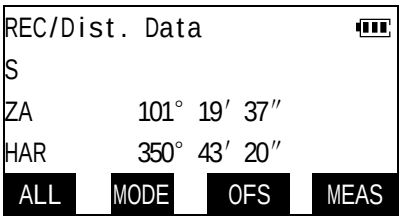
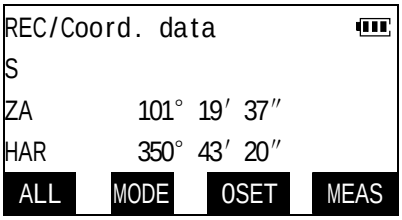
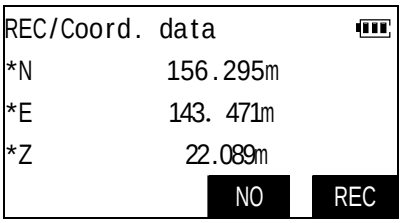
Angle measurement data can be stored in the current job. It is convenient to use 【ALL】 to perform automatic operation from angle measurement to recording. The content of record include vertical angle, horizontal angle , point name, code and height of the target.

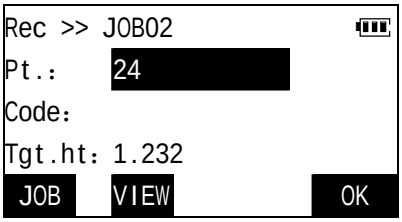
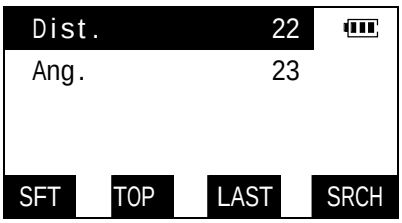
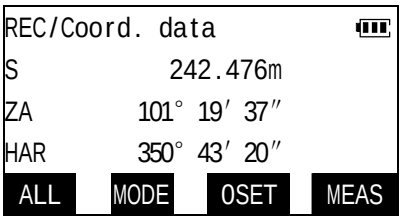
Operating	Keys	Display
1.In the second page of Meas mode, press 【REC】 to come in the record mode.	【REC】	
2. Press 【MODE】 to change mode to recording angle data mode. - Press 【0SET】 to set the horizontal angle to 0.	【MODE】	

Operating	Keys	Display
3.Sight the target and press 【MEAS】. The angle measurement results of the target marked with "*" are displayed.	【MEAS】	
4. Press 【REC】 to record the measured results. Input the follow items: (1)Point name (2)Code (3) Prism height l Press 【JOB】to change and select the current job. l Press 【VIEW】 to check the records that have been stored within the current job file. l When the cursor locates the code line, the code registered in memory can be recalled and read in.	【REC】	
5.Check the input data , then press 【OK】to store the angle measurement data of the target and return to the step 2.	【OK】	
l Press 【ALL】to perform angle measurement and automatically record the results. In this case, the point number is the last point number add one, the code and target height remain the same. When the measurement results recording finished, the results will be displayed for two seconds, then the screen of step 2 is restored.		

21.3 Recording coordinate measurement data

In the record mode, coordinate measurement data, offset measurement data, etc, can be store in the current job file. It is convenient to use 【ALL】 to perform automatic operation from distance measurement to recording. The content of record include coordinates, point name, code and height of the target.

Operating	Keys	Display
1.In the second page of Meas mode, press 【REC】to come in the record mode.	【REC】	
2. Press 【MODE】 twice to change mode to recording coordinate data mode.	【MODE】	
3. Sight the target and press 【MEAS】to observe the target. The measurement results of the target marked with "*" are displayed on from the second line to the forth line of screen.	【MEAS】	

<table>
<tr>
<td>4. Press 【REC】 to record the measured results.
Input the follow items:
(1)Point name
(2)Code
(3) Prism height
l Press 【JOB】to change and select the current job.
l Press 【VIEW】 to check the records that have been stored within the current job file.
l When the cursor locates the code line, the code registered in memory can be recalled and read in.</td>
<td>【REC】</td>
<td> 
</td>
</tr>
<tr>
<td>5.Press 【VIEW】.The records within the current job file list on the screen. please see “20.1.1 Reviewing and deleting record in job file”.
Press 【ESC】to return.</td>
<td>【VIEW】</td>
<td> 
</td>
</tr>
<tr>
<td>6.Check the input data , then press 【OK】to store the coordinate measurement data of the target and return to the step 2.</td>
<td>【OK】</td>
<td> 
</td>
</tr>
<tr>
<td colspan="3">l Press 【ALL】to perform coordinate measurement and automatically record the results.
In this case, the point number is the last point number add one, the code and target height remain the same. When the measurement results recording finished, the results will be displayed for two seconds, then the screen of step 2 is restored.
l When 【OFS】is pressed, offset measurement （distance offset、angle offset）can be performed.（please see “14.offset measurement”）.</td>
</tr>
</table>

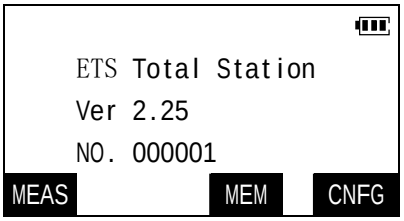
22. CHANGING THE PARAMETER SETTINGS

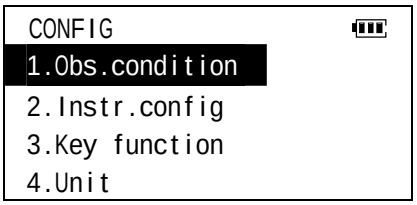
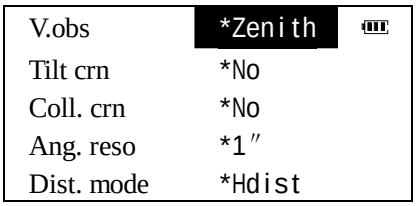
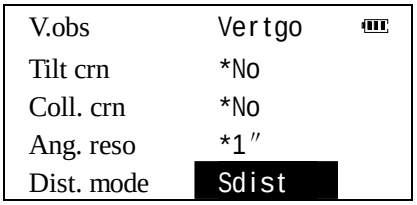
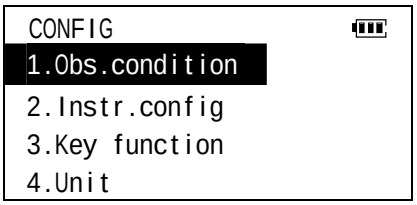
This section explains the contents of parameter settings and how to change settings, Each item can be changed to meet your measurement requirements and remains until it is changed again, ,even when the power is cut off.

22.1 Observation Condition

The items and their options list in the following table can be set in Observation Condition setting. The option marked with "*" is factory setting.

Items	Options	Explanation
V.obs	*Zenith	Select vertical angle display method from zenith （0~360°）or vertgo（0~±90°）。
	Vertgo	
Tilt crn	*No	Select whether tilt angle compensation function is enabled.
	Yes	
Coll. crn	*No	Select whether collimation correction function is enabled.
	Yes	
Ang. reso	*1″	Select angle resolution..
	5″	
	10″	
Dist. mode	* Hdist	Select priority distance display mode in the Meas mode
	Sdist	
	Vdist	

Operating	Keys	Display
1. In the Meas mode, press 【ESC】 to come in the status screen.	【ESC】	

Operating	Keys	Display
2. Press 【CNFG】to come in the config mode.	【CNFG】	
3.Select “1.Obs.condition” and press 【↵】to come in the observation condition setting screen.	【↵】	
4. Press 【5】/【6】to move the cursor up and down to select item. Press 【3】/【4】to change the option of the item. Example: Change the vertical angle display method to “Vertgo”，change the distance display mode to “Sdist”.	【5】 【6】 【3】 【4】	
5. Press 【↵】to accept the option change and return to the config mode menu.	【↵】	

22.2 Instrument configuration

The items and their options list in the following table can be set in Instrument Configuration setting. The option marked with "*" is factory setting.

Items	Options	Explanation
Auto off	*No	To save power, select whether to turn power supply off automatically if no key press in twenty minutes.
	20min	
EDM standby	No	To shorten time of the first distance measurement, select whether to make EDM on standby and the time interval of turnning off power to EDM.
	*2min	
	5min	
Baud rate	1200	Select the baud rate of communication with external equipment.
	2400	
	4800	
	*9600	
	19200	

Operating	Keys	Display
1.In the config mode , Select "2.Instr.config" and press 【↵】 to come in the instrument configuration screen.	【5】 【6】 【↵】	Auto off *NO EDM standby *2min Baud rate *9600
2. Press 【5】/【6】to move the cursor up and down to select item. Press 【3】/【4】 to change the option of the item.	【5】 【6】 【3】 【4】	Auto off 20min EDM standby No Baud rate 1200
3. Press 【↵】 to accept the option change and return to the config mode menu.	【↵】	CONFIG 1.Obs.condition 2.Instr.config 3.Key function 4.Unit

22.3 Allocating key function

It is possible to allocate the softkeys in Meas mode to suit the measurement conditions. The current softkey allocations are retained until they are revised again, even when the power is cut off. It is possible to register three sets of key function allocations:Def.1,Def.2 and Def.3.,and these allocations can be recalled at anytime.

It is possible to improve the efficiency of measurement operation in high degree because unique softkey allocation can be preset to suit various applications and the ways that different operators handle the instrument.

In the status mode screen , press 【CNFG】to come in the config mode. Select "3.Key function" and press 【↵】to come in key function menu. In this menu,The following operation can be done.

- Allocating softkeys
- Registering a softkeys allocation
- Recalling a softkeys allocation

When softkey allocations are recorded and registered, the previously recorded key settings are cleared. When a softkey array is recalled, the key array is changed to the key array that has been recalled, clearing the previous key array.

23.3.1 Defining softkeys

The following are the softkey allocations in Meas mode when the instrument was shipped:

Page 1	【DIST】	【SHV】	【HSET】	【EDM】
Page 2	【0SET】	【CRD】	【S-O】	【REC】
Page 3	【MLM】	【RESE】	【MENU】	【HT】

The following functions can be allocated to the softkeys.

【DIST】: Distance measurement

【SHV】: Switch between angle display and distance display

【HSET】: Set required horizontal angle

【EDM】: Setting EDM

【0SET】: Set horizontal angle to 0

【CRD】: Coordinates measurement

【S-O】: Setting-out measurement

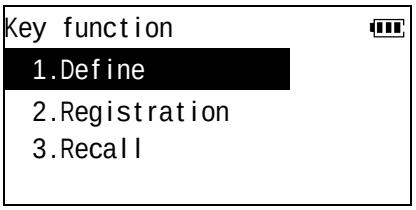
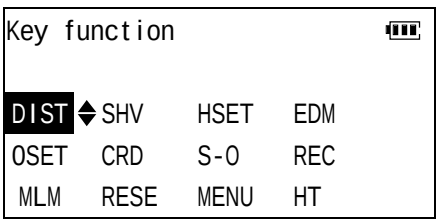
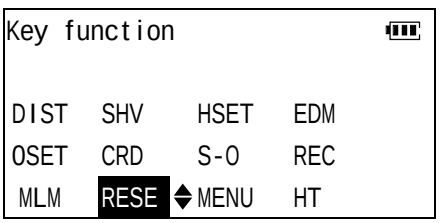
【REC】: To record mode

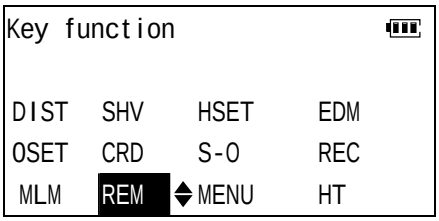
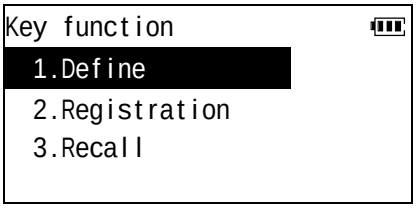
【MLM】: Missing line measurement

【RESE】: Resection measurement

【MENU】: To menu mode（coordinates measurement , setting-out measurement , resection measurement, missing line measurement , REM measurement , area calculation, offset measurement , repetition measurement, setting-out line）

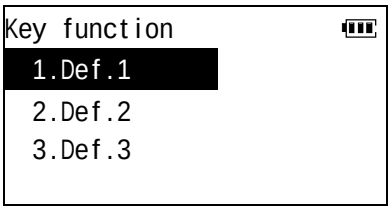
【HT】Set the instrument station height and target height
【HOLD】Hold horizontal angle /release horizontal angle
【R/L】Select horizontal angle right / left
【REP】Repetition measurement
【A/%】Switch vertical angle/slope in %
【VIEW】Display data within the current job
【OFS】Offset measurement
【FT/M】Switch unit of distance between meter/feet
【SEND】Output measurement results to an external equipment
【REM】REM measurement
【AREA】Surface area calculation
【COMM】To communication mode
【LINE】Setting-out line measurement

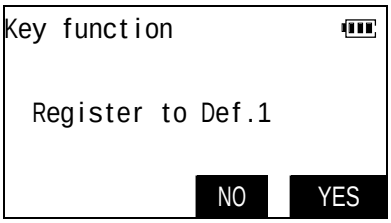
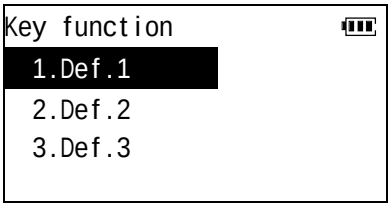
Operating	Keys	Display
1. In config mode menu, select "3.Key function", and then press【↵】to come in <Key function> menu.	【↵】	
2. Select "1.Define" and press【↵】. Currently allocated softkeys in Meas mode are displayed. The cursor of the selected softkey flashes.	【↵】	
3. Press【3】/【4】to move the cursor to the softkey whose function you want to change.	【3】 【4】	

4. Press 【5】/【6】 to change the function of this softkey.	【5】 【6】	
5.Repeat step 3 to 4 until all required softkeys have been allocated.		
6. Press 【↵】 to record the allocations and return to <Key function> menu.	【↵】	

22.3.2 Registering a softkeys allocation

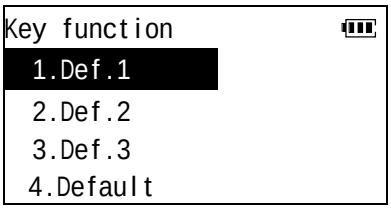
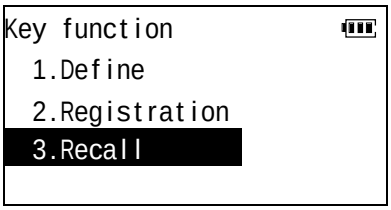
After the softkey allocation defined, it can be registered in user setting 1 to 3 ,and the factory setting and user setting can be recalled later whenever you want.

Operating	Keys	Display
1. In <Key function> menu, select "2.Registration" and press 【↵】.	【5】 【6】 【↵】	

2. Select one of the three position as the softkey array to be registered and press 【↵】.	【5】 【6】 【↵】	
3. Press 【YES】.The softkey array is registered and the key function menu screen restored.	【YES】	

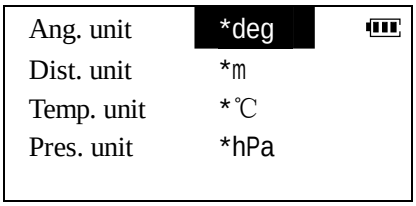
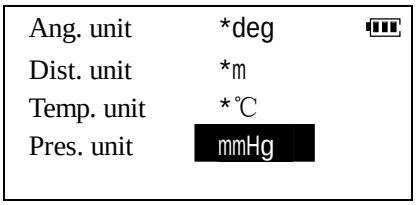
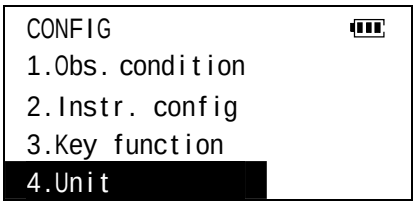
22.3.3 Recalling a softkeys allocations

The softkey array registered in memory and the factory setting can be recalled when necessary. At the same time, the current softkey allocations are cleared.

Operating	Keys	Display
1.In <Key function> menu, select "3.Recall" and press 【↵】.	【5】 【6】 【↵】	
2. Select the softkey array you want to recall and press 【↵】. <Key function> menu screen is restored. This displays the functions in the recalled array in Meas mode.	【↵】	

22.4 Unit setting

The option Marked with "*" is the factory setting .

Operating	Keys	Display
1.Select "4.Unit" and press 【↵】to come in the unit setting screen.	【5】 【6】 【↵】	
2. Press 【5】/【6】to move the cursor up and down to select item. Press 【3】/【4】to change the option of the item. l Angle unit: *deg/gon/mil l Distance unit: *m/ft l Temperature unit: *℃/ °F、 l Pressure unit: *hPa/mmHg/inHg	【5】、 【6】 【3】、 【4】	
5. Press 【↵】to accept the option change and return to the config mode menu.	【↵】	

23. SETTING THE INSTRUMENT CONTANT

The instrument constant will affect the accuracy of measurement result, therefore setting of these should be performed with special care.

23.1 Tilt zero point error check and adjustment

If tilt angle compensation has been selected, the tilt zero point error will adversely affect vertical angle measurement. So it is necessary to check and adjust the tilt zero point error periodically.

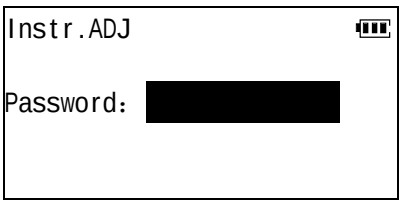
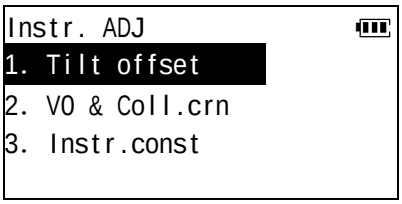
23.1.1 Checking zero point error

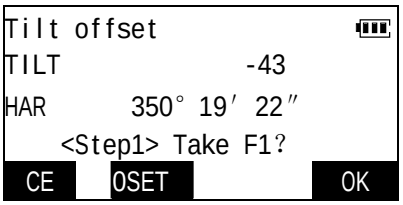
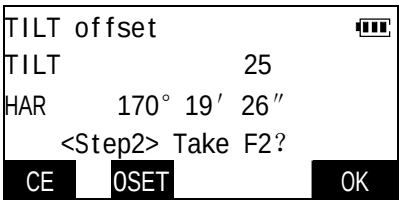
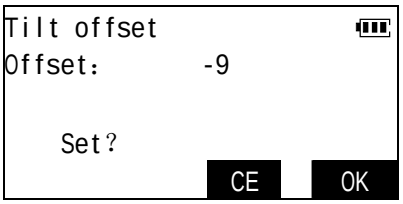
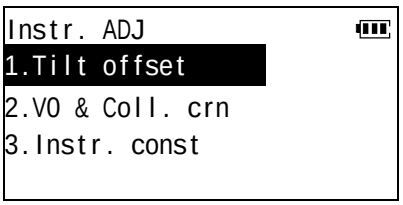
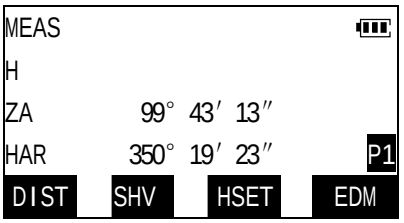
1. Carefully level the instrument. Press 【SFT】, and then press 【★】 to come in the star function mode.。
2. Sight the target, then press 【TILT】 to display the tilt angle in the X (sighting) direction. Wait for the display to stabilize, then read the tilt angle value t1.
3. Rotate the top of the instrument through 180° and sight the same target again. Wait for the display to stabilize, then read the tilt angle value t2.
4. Calculate the offset value (tilt point zero error).

   T_offset =（t1+t2）/2

   If the offset value falls within the range ±20″, adjustment is not necessary. Or adjust the value using the following procedure.

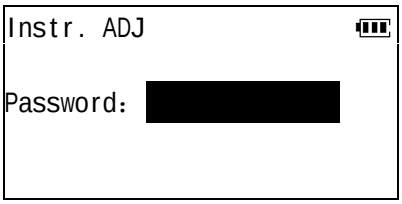
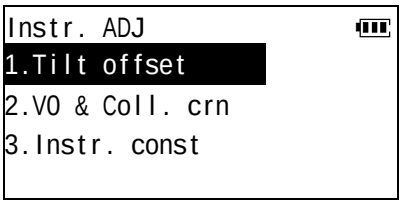
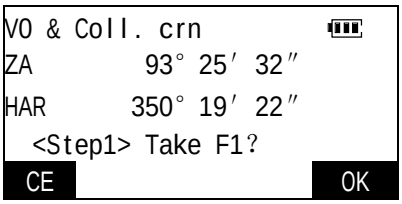
23.1.2 Tilt zero point error adjustment

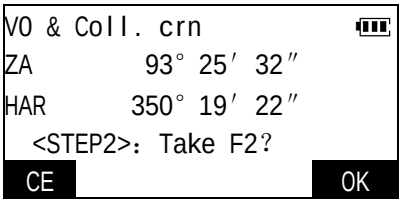
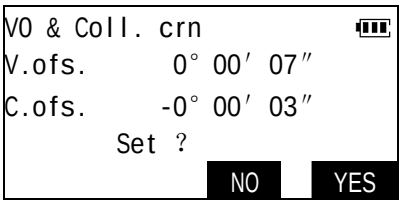
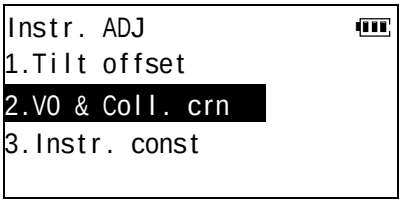
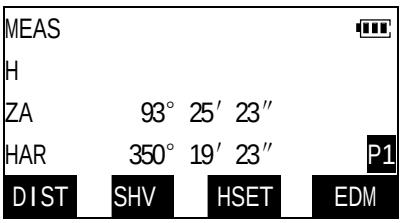
Operating	Keys	Display
1. Level instrument carefully, then turn the power on. When the message to prompt setting vertical angle to 0 is displayed, press【3】and hold on，while rotating the telescope at the same time until the screen of inputting password is viewed.	【3】	
2. Input “1234”, then press【↵】to come in <Instr. ADJ> menu.	【↵】	

3. Select "1.Tilt offset" and press 【↵】 to start adjustment. l Pressing 【0SET】can set horizontal angle to 0.	【↵】	
4. Sight the target point in Face 1. Wait for the display of tilt value to stabilize , then press 【OK】. l Press【CE】to cancel the last operation and redo it.	【OK】	
5.Loosen the horizontal clamp, rotate the top of the instrument through 180° ,then sight the same target in Face 2. Wait for the display of tilt value to stabilize , then press 【OK】. If there's no error in operation, the new offset value of tilt zero is displayed.	【OK】	
6. Press 【OK】 to accept the new value for correction and return to <Instr. ADJ> menu. l Press 【CE】to discard the value and repeat the procedures mentioned above.	【OK】	
7.Press 【ESC】 to return to the Meas mode and the new correction constant is in effect.	【ESC】	

23.2 Vertical circle index error and collimation error correction

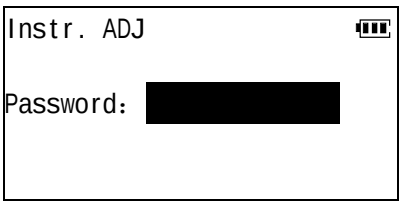
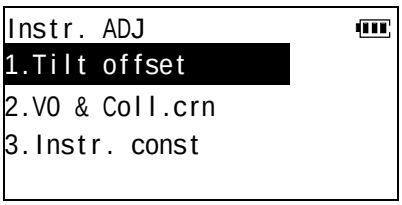
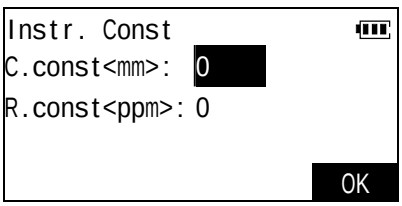
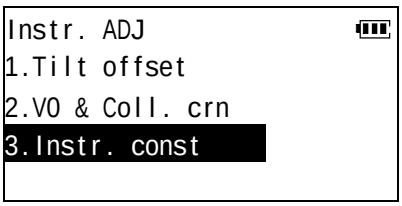
With this option, making both face angular observations , you can measure collimation error in your instrument so that the instrument can correct subsequent single face observations. The 0 index of the vertical circle of your instrument can be reset also, and the index error that will affect the accuracy of vertical angle measurement can be corrected.

Operating	Keys	Display
1. Level instrument carefully, then turn the power on. When the message to prompt setting vertical angle to 0 is displayed, press【3】and hold on，while rotating the telescope at the same time until the screen of inputting password is viewed.	【3】	
2. Input “1234”, then press【◄┘】to come in <Instr. ADJ> menu.	【◄┘】	
3. Select “2.V0 & Coll. crn” and press【◄┘】.	【5】 【6】 【◄┘】	

4. Accurately sight a target with a distance of 30m or further in Face1, then press【OK】. l Press【CE】to cancel the last operation and redo it.	【OK】	
5. Loosen the horizontal clamp, rotate the top of the instrument through 180°, accurately sight the same target in Face 2. If there's no error in operation, the offset value of vertical circle index and collimation are displayed.	【OK】	
6. Press【OK】to accept the values for correction and return to <Instr. ADJ> menu. l Press【CE】to discard the values and repeat the procedures mentioned above.	【YES】	
7.Press【ESC】to return to the Meas mode and the new correction constant is in effect.	【ESC】	

23.3 Setting additive constant and multiple constant of distance

In this setting , you can correct additive distance constant and multiple distance constant of the instrument.

Operating	Keys	Display
1. Level instrument carefully, then turn the power on. When the message to prompt setting vertical angle to 0 is displayed, press【3】and hold on，while rotating the telescope at the same time until the screen of inputting password is viewed.	【3】	
2. Input “1234”, then press【◄┘】to come in <Instr. ADJ> menu.	【5】 【6】 【◄┘】	
3. Select “3.Instr. const” and press【◄┘】.	【5】 【6】 【◄┘】	
4.Enter required value in each item, then press 【OK】to return to <Instr. ADJ> menu.	【OK】	

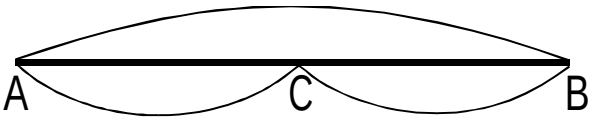
Note: The additive constant and multiple constant have been set accurately before delivery, and can not be changed casually.

Reference: Check the additive constant of the distance

The additive distance constant of the instrument is adjusted before delivery. It will deviates, use a baseline with a known distance precision to check the additive distance constant. If there is no baseline, perform these chicks as follows.

Caution : Errors is setting up the instrument and reflective prism or in sighting the target will influence the additive distance constant. Be extremely careful to prevent such errors when performing these procedures. Set up so that the instrument height and the target height are identical. If a flat place is not available, use an automatic level to make sure the heights are identical.

（1） Find an area of flat ground where two points 100m apart can be selected. Set up the instrument at point A and the reflective prism at point B, establish a point C half way between points A and B.



（2） Precisely measure the horizontal distance between point A and point B 10 times and calculate the average value.。

（3） Place the instrument at point C directly between points A and B and set up the reflective prism at point A.

（4） Precisely measure the horizontal distances CA and CB 10 times each and calculate the average value for each distance.

（5） Calculate the additive distance constant as follows：K=AB－(CA＋CB)

（6） If the result is different with the standard constant, please see “24.3setting the additive and multiply constant”.

（7） After set it , you should check it on another baseline.

24. CHECKS AND ADJUSTMENTS

- The total station is a precision instrument that requires fine adjustments. It must be inspected and adjusted before use so that it always performs accurate measurements.
- From "24.1Plate level and circular level", checking and adjustment it in the correct turns.
- In addition, the instrument should be inspected with special care after it has been stored a long time, transported, or when it may have been damaged by a strong shock..

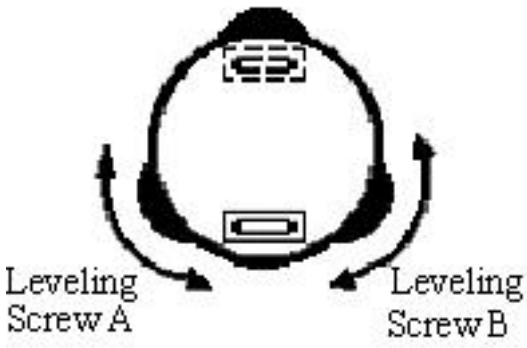
24.1 Plate level and circular level

1. Checking and adjusting the plate level

● Check

① Place the plate level parallel to a line running through the centers of two leveling screws (eg. A, B). Use these two screws to place the bubble in the center of the plate level vial.

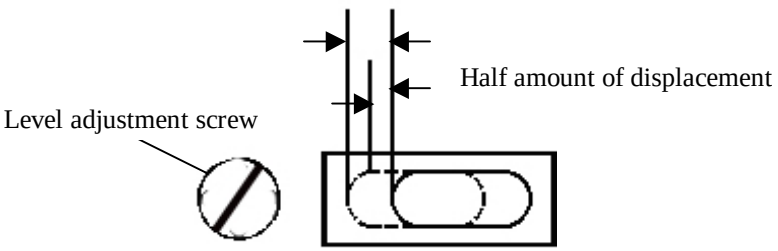
② Rotate the instrument 180° or 200g around the vertical axis and check bubble movement of the plate level. If the bubble has been displaced, then proceed with the following adjustment.



● Adjustment

① Adjust the level adjustment capstan screw , with the accessory adjusting pin and return the bubble towards the center of the plate level vial. However, correct only one-half of the displacement by this method.

② Correct the remaining 1/2 amount of the bubble displacement with the leveling



screws.

③ Rotate the instrument 180° or 200g around the vertical axis once more and check bubble movement. if the bubble is still displaced, then repeat the adjustment.

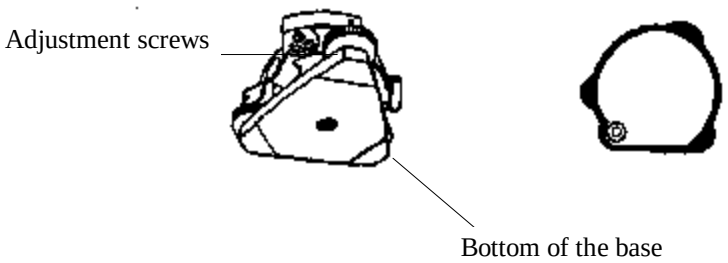
2 .Checking and adjusting the circular level

● Check

Carefully level the instrument with the plate level. If the bubble of the circular level is centered properly at this time, adjustment is not required. Otherwise, proceed with the following adjustment.

● Adjustment

Shift the bubble to the center of the level by adjusting three capstan adjustment screws on the bottom surface of the circular level, with the accessory adjusting pin.(see diagram)



24.2 **Reticle**

● Check

① Set the instrument on the tripod and carefully level it.

② Sight the cross-hair on a well-defined point A on the wall at a distance of at least 50 meters. (160ft)

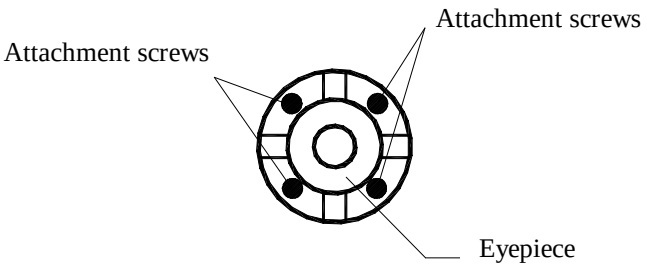
③ Next swing the telescope and check whether the point travels along the length of the vertical cross-hair.

④ If the point appears to move continuously on the vertical hair, the vertical cross-hair lies in a plane perpendicular to the horizontal axis.(adjustment is not required.)

● Adjustment

① Unscrew the cross-hair adjustment section cover by revolving it in the counterclockwise direction, and take it off. This will expose four eyepiece section attachment screws.

②Loosen all four attachment screws slightly with the accessory screw-driver. (while taking



note of the number of the revolutions) make vertical cross-hair coincide with A by turning eyepiece and tighten the four attachment screws.

③ Check if there is displacement in horizontal direction while point A traveling along vertical reticle. If not, check is concluded.

【**NOTE**】: After you finish it , you should perform adjustment as follows:

"24.3adjusting the telescope axis", "23.1 Tilt zero point error check and adjustment" "23.2Vertical circle index error and collimation error"

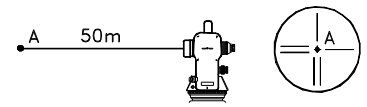
24.3 Adjusting the telescope axis

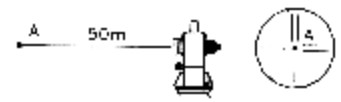
● Check

① Set the instrument up with clear sights of abort 50 to 60 meters of both sides of the instrument.

② Sight point A at approximately 50 meter distance.

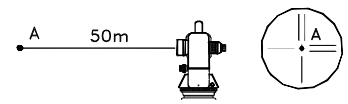
③ Loosen the vertical tangent screw only and plunge the telescope 180° around the horizontal axis so that the telescope is pointed in the opposite direction.



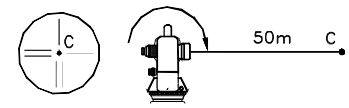


④ Sight point B, at equal distance as point A.

⑤ Loosen the horizontal motion clamp and tangent screw and revolve the instrument 180° or 200g. Fix a sight on point A once more and tighten the motion clamp and screw.



⑥ Loosen the vertical motion clamp and tangent screw and plunge the instrument 180° or 200g and fix a sight on point C, which should coincide with the previous point B.

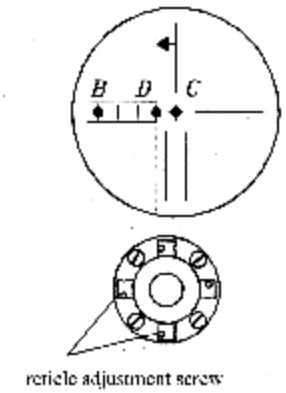


⑦ If point B and C do not coincide, adjust in the following order:

● **Adjustment**

①Unscrew the cross-hair adjustment section cover.

② Find point D at a point between points C. B, which should be equal to 1/4 the distance between points B and C, and measured from point C. This is because the



apparent error of BC is four times of the real error since the telescope has been reversed twice during checking operation.

③ Shift the vertical cross-hair line and coincide it with point D, by revolving the left and right capstan adjustment screws. Upon completing the adjustment, repeat the checking operation once more. If point B and C coincide, further adjustment is not required. Otherwise, repeat the adjustment.

24.4 Optical plummet

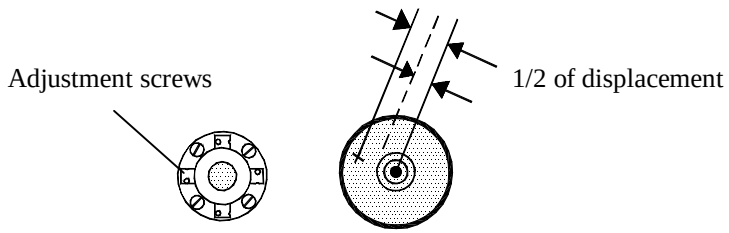
● Check

① Coincide the center point with the center mark of optical plummet telescope by adjusting optical plummet.

② Revolve the instrument 180° or 200g around the vertical axis and check the center mark. If the point is properly centered in the center mark, adjustment is not required. Otherwise, adjust in the following manner:

● Adjustment

① Unscrew the adjustment section cover of the optical plummet telescope eyepiece, by revolving it in the counterclockwise direction and take it off. This will expose four capstan adjustment screws which should be adjusted with the accessory adjusting pin to shift the center mark to the point. However, correct only 1/2 of the displacement in this manner.



② Next use the leveling screws and coincide the point and center mark.

③ Revolve the instrument 180° or 200g around the vertical axis, and check the center mark. If it is coincided to the point, then further adjustment is not required. Otherwise, repeat the adjustment.

25. MAINTENANCE

- If the instrument is moistened by the rain, please make it dry immediately.
- Always clean the instrument before returning it to the carrying case. Then lens requires special care. First, dust it off with the lens brush to remove tiny particles, then wipe it with the lens paper or clean soft cloth.
- If the display is dirty, carefully wipe it with a soft, dry cloth. To clean other parts of the instrument or the carrying case, carefully wipe the surface of the unit with a slightly damp cloth moistened in a mild detergent solution. Do not use any organic solvents cleaning the display, key panel and the carrying box.
- Store the instrument in a dry room where the temperature remains fairly constant.
- Often check the tripod for loose fit and loose screws when it is used for a long time.
- If any trouble is found on the rotatable portion, screws or optical parts ,please contact our company.
- If the instrument will be not used for a long time, disjoin the instrument and the battery and charge the battery at least once every month.
- When the instrument is not used for a long time, check it at least once every 3 months, following the steps in “24.check and adjust”.
- When removing the instrument from the carrying case, never pull it out by force. The empty carrying case should be closed to protect it from moisture.
- Check the instrument for proper adjustment periodically to maintain the instrument accuracy.

26. ERROR MESSAGE

Message	Meaning	What to do
Out of range	The instrument is tilted beyond the vertical compensation range. (±3')	Re-level the instrument or turn off the tilt compensation in the bad conditions. if the message displays again, repair is required.
Calcul. error	The N.E coordinates of backsight point are set the same as the instrument station coordinates during setting backsight azimuth.	Check and reenter the coordinate of sight point or resetting the instrument station.
Signal off	The prism is not sighted or the target is at a distance beyond the instrument measuring range.	Re-sight the prism or add the number of prisms used.
Excess point	The distance between setting-out point and the instrument station exceed the instrument measuring range	Check and reenter the setting-out point or reset the instrument station again.
V0 out of range	During setting of the 0 index of the vertical circle, the value measured is out of range.	Redo it and confirm the operation procedure is correct. if the message displays again, repair is required.
C.out of range	During measuring of the collimation error, the measured value measured is out of range.	Redo it and confirm the operation procedure is correct. if the message displays again, repair is required.
Tilt out of range	During measuring of the tilt zero point error, the measured value measured is out of range.	Redo it and confirm the operation procedure is correct. if the message displays again, repair is required.
Error detected	Displayed when any abnormality occurs in angle measuring system.	Turn off the power and turn it on again, if the message displays again, repair is required.

Message	Meaning	What to do
EDM wrong	Displayed during the system running a self-check, any abnormality is detected in EDM.	Turn off the power and turn it on again, if the message displays again, repair is required.
Bad memory	There's abnormality in internal memory system	Turn off the power and turn it on again, if the message displays again, repair is required.

27. SPECIFICATIONS

Angle Measurement	
Reading System	Absolute encoder
Display Resolution	1" / 5" / 10"
Minimum Reading	1"
Accuracy	2"

Telescope	
Magnification	30x
Field Angle	1°30'
Minimum Focus	1.5 m
Object Aperture	45 mm
Image	Erect

Compensator	
Compensator Range	±3'

Distance Measuring Range	
Single Prism Range	7500 m
Reflector Range	1000 m
Non-Prism Range	800 m

Distance Measuring Accuracy	
Minimum Reading	1 mm
Prism Accuracy	± (2 mm + 2 ppm • D)
Reflector Accuracy	± (2 mm + 2 ppm • D)
Non-Prism Accuracy	± (5 mm + 3 ppm • D)

Measurement Time	
Tracking/Rapid/Fine	0.4 s / 0.9 s / 1.8 s

Level Vial Sensitivity	
Plate Level	30" / 2 mm
Circular Leve	8' / 2 mm

Lase Plummet	
Laser Spot	1.5 mm/1.5 m

Data Management	
Memory	50,000 Points
USB Drive	Support
Bluetooth	Support

Battery	
Voltage	DC 7.2 V-7.4 V
Capacity	2500mAh
Working Time	6 hours angle and distance 20 hours angle

Physical Specification	
Dimension	190 x 210 x 350 mm
Weight	5.5 Kg
Screen	Dual 160 × 80 pixel
Interface	RS-232C
Water/Dust Proof	IP54
Working Temperature	-20 ℃ - +55 ℃
Storage Temperature	-40 ℃ - +60 ℃
Language	English, Spanish, Portuguese, French, German, Turkish, Italian, Russian, Ukrainian