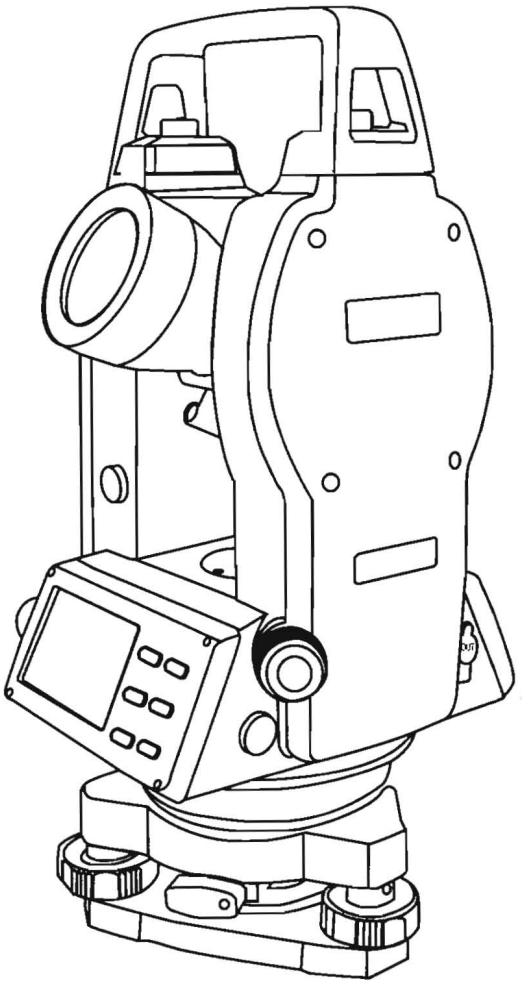
Electronic Theodolite



User Guide

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Catalogue

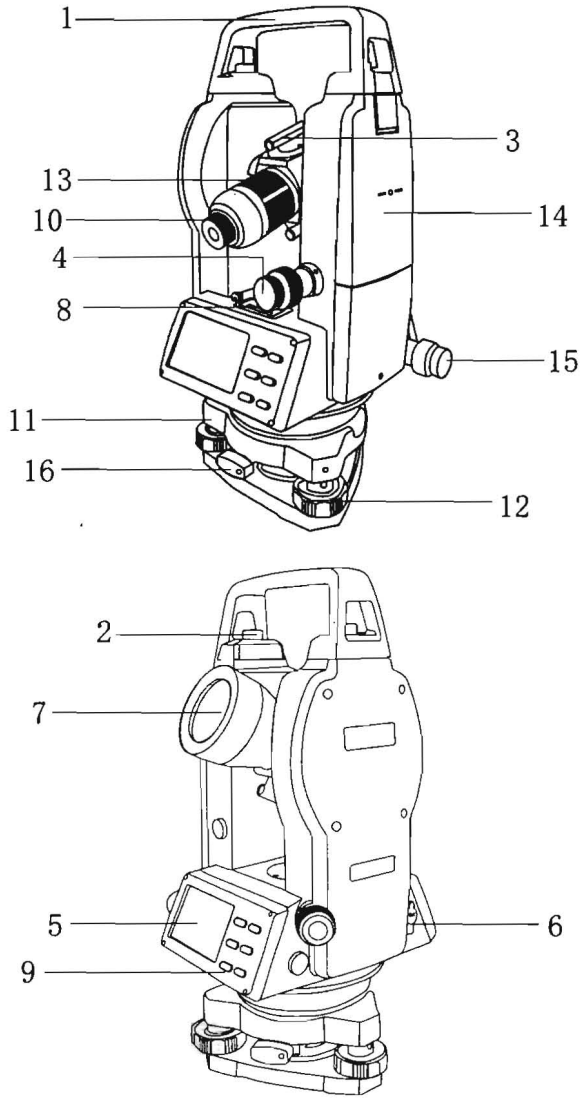
1. Application

The electronic theodolite adopts incrrmental digit angle measurement system. The resolution of horizontal angle reading and vertical angle reading is 1″ , 5″ (0.2mgon、1mgon). The angle precision is 2″ , 5″ (0.5mgon、1mgon).

Meanwhile microcomputer techniques adopted in the instrument realizes automatic calculation, storage, and display. The instrument can display the readings of horizontal angle and vertical angle simultaneously. It can use with the DCH range finder made in MATO, PDA and EDM made in the other factory international. Then you can get the electric speed measurement instrument. It can display, put down the angle, distance and coordinate data. It can correct the instrument error. Many measuring modes as angle, slope etc can be fulfilled.

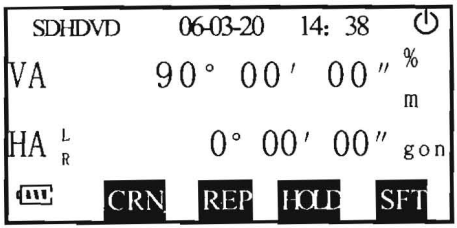
The electronic theodolite can be used for the control surveying, mine, railway, and irrigation etc projects surveys Still capable of topographic surveys and general projects surveys.

2. Nomenclature



（1）carrying handle （2）handle screw （3）sighting collimator
（4）vertical tangent screw and motion clamp（5）operating key
（6）RS-232C communication interface（7）objective lens
（8）plate level（9）display window (10) eyepiece
(11) base plate (12) foot screw(13) focusing knob (14)battery
(15)horizontal tangent screw and motion clamp
(16) base locking lever

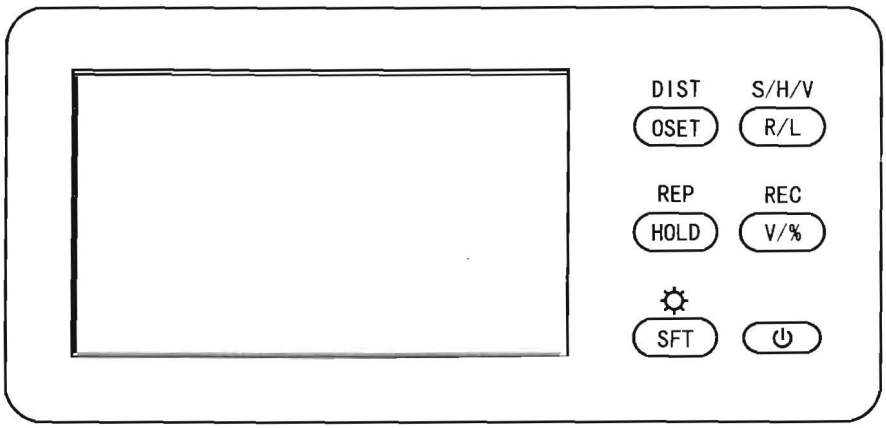
3. Display and display mark



Display	Function	Display	Function
SD	Slope distance	HOLD	Hold the horizontal angle
HD	Horizontal distance	%	Percent grade
VD	Height difference	m	Distance unit : m
VA	Vertical angle	gon	Angle unit

HA_R	Horizontal angle right	07-03-06	Date
SFT	The second function	14：38	Time
REP	Repeat the horizontal angel	⏻	Auto power off
CRN	Tilt correction		

4.Operating keyboard and operating key



keys	Function1	Function2
OSET	Set horizontal angle 0	Distance measurement
HOLD	Hold the horizontal angle	Repeat measurement horizontal angle
☼	Turn on or off illumination	Select the second function
R/L	Switch horizontal angle right or left	switch SD/HD/VD display
V%	Percent grade of vertical angel	Record measurement data
⏻	Power switch	

5、Preparative before measurement

5.1 Level the instrument

Level and center the instrument correctly to insure the best performance.

①Place the tripod

First, put the tripod leg in the proper position and tighten the locking screws.

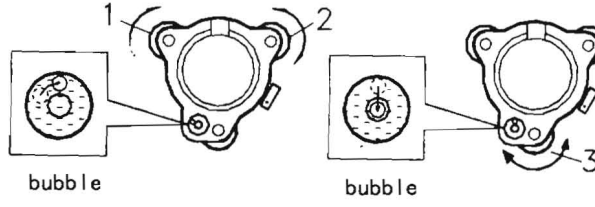
②Attaching the instrument to the tripod head

Place the instrument carefully on the tripod head, and move the instrument slowly by loosening adjusting screw. Align the plumb bob with the point on the ground When aligned, tighten the adjusting screw.

③Initial rough leveling the instrument with circular level

（1）Use leveling screws 1,2 to move the bubble of the circular level until the bubble of the circular level until the bubble is now located on a line perpendicular to a line running through the centers of the two leveling screws being adjusted.

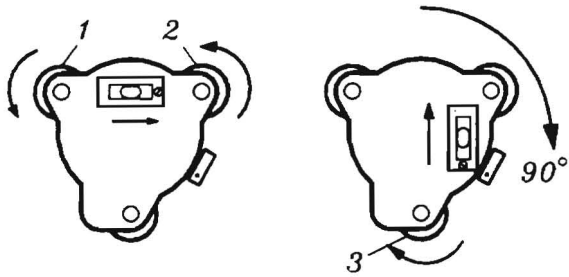
（2）Revolve the leveling screw 3 to shift the bubble to the center of the circular.



④Further leveling the instrument with plate level

(1) Loosen horizontal motion clamp and revolve the instrument. By adjusting leveling screws 1,2 , the plate level vial is parallel to a line running through the centers of two leveling screws, and place the bubble in the center of the level vial.

(2) Next, revolve the instrument 90° (100g) around its vertical axis and use the remaining screw 3 to center the level bubble once more.

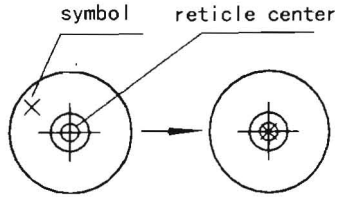


(3) Repeat the above procedure for each 90° revolution of the instrument and check whether the level bubble is correctly centered for all points.

⑤Centering the instrument with optical plummet

Adjust the eyepiece of the optical plummet telescope to the user's eyesight. Move the instrument by loosening

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



⑥Final leveling of the instrument

Repeat procedure of ④. and check whether the level bubble is in the center of the level vial. Finally tighter adjusting screw.

5.2 Power switch on

① Press 【⏻】, all segments of the display will light on. The display shows that vertical angle should be set to zero.

② Rotate the telescope to set the instrument to a vertical angle reading of 0.

③Press 【⏻】over 2 seconds, it can be power off.

- In order to make sure instrument work continuously, pay attention to battery power display. If battery power is insufficient, replace battery. Please see 5.3. Battery power display.
- For setting the vertical angle at 0, a datum 0 is provided on the vertical angle scale circumference. If the telescope is turned and the sensor passes the datum 0, angle measurement begins.

5.3 Battery power display

Mark	Meannings
	Sufficient battery power (%90-%100).
	Effective battery power.(%50-%90).
	Effective battery power (%10-%50).
	Poor battery power (0-%10).Need to replace battery
	Measurement is impossible. The power will be cut off in one minute.

5.4 Change the batteries

For removing

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

Installation

- Put the battery in the battery case.
- Press the release button and hold the battery case toward the groove in the instrument.

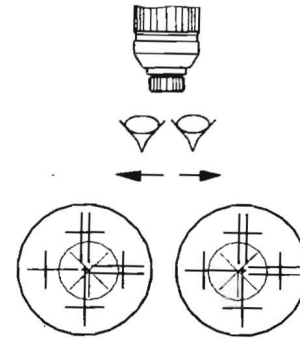
6. Angle measurement

6.1 Measuring a HA_R and vertical angle

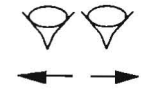
Operating	Display
1.Collimate the first target.	
2.Press 【OSET】 twice , and set horizontal angel of target A at 0° 00′ 00″ .	07-03-06 14: 38 VA 90° 00′ 00″ HA_R 0° 00′ 00″
3.Collimate the second target B, and the horizontal and vertical angel are displayed.	07-03-06 14: 38 VA 90° 00′ 00″ HA_R 0° 10′ 00″

- **How to collimate**

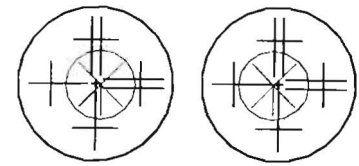
①Point the telescope towards the light. Turn the diopter ring and adjust the diopter so that the cross-hair is clearly observed. (Turn the ring coward you first and then backward to



②Observe the target with sighting collimator. Allow a certain space between the collimator and yourself, if for collimating.



③Focus the target with the focusing knob.



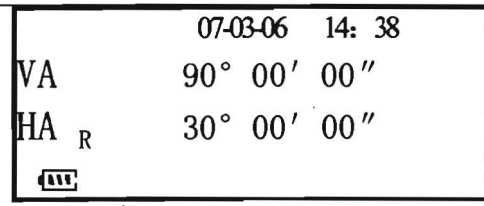
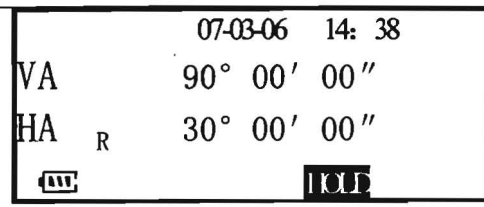
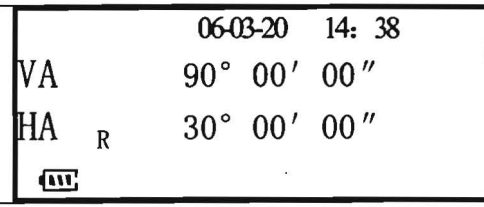
- **Note:**

If parallax is created between the cross-hair and target when viewing vertically or horizontally while looking into the telescope. Focusing is incorrect or diopter adjustment is poor. This adversely affects precision in measurement or survey. Elimate the parallax by carefully focusing and diopter adjustment.

6.2 Switching horizontal angle HA_R /HA_L

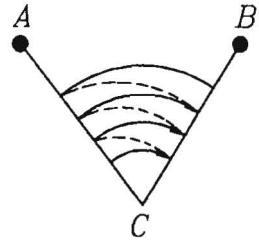
Operating	Display
1.Collimate the target A.	07-03-06 14: 38 VA 90° 00′ 00″ HA_R 0° 10′ 01″
2.Press 【R/L】, The mode Horizontal angle Right(HA_R) switches to HA_L mode.	07-03-06 14: 38 VA 90° 00′ 00″ HA_L 359° 49′ 59″
3.Measure the target in the same manner as HA_R mode.	
● Everytime 【R/L】key is pressed, HA_R / HA_L mode switches.	

6.3 Setting a horizontal angle

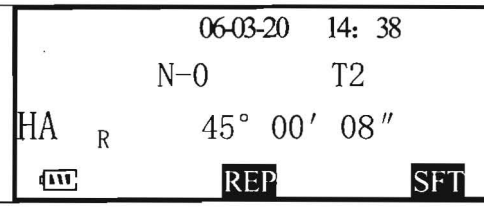
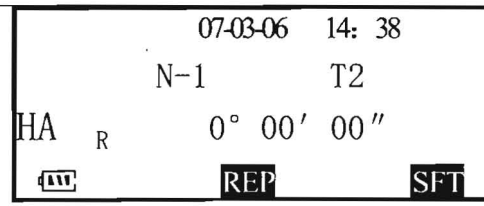
Operating	Display
1.Turn Horizontal tangent screw and set the horizontal angle required.	
2.Press【HOLD】key twice and the horizontal angle is hold.	
3.Collimate the target.	
4. Press【HOLD】key again to stop holding the horizontal angle.	

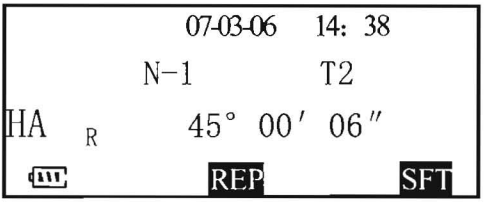
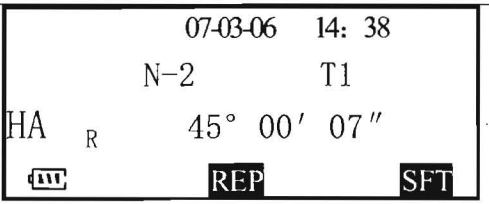
6.4 Repetition angle measurement

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



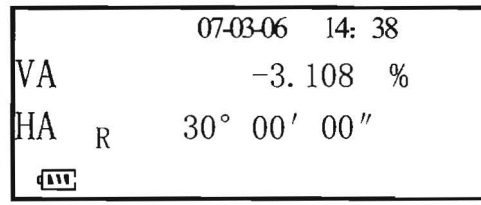
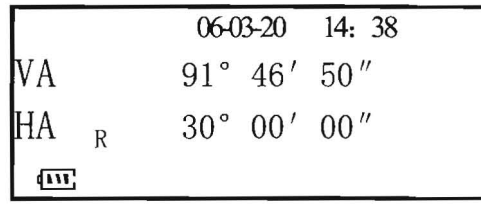
Operating	Display
1. Press 【SFT】, and then press 【HOLD】 to begin repetition angle measurement.	07-03-06 14: 38 N-0 T1 HA R 30° 00′ 00″ REP SFT
2.Collimate the target A.	
3. Press 【0SET】, and make the horizontal angle of A is 0° 00′ 00″.	07-03-06 14: 38 N-0 T2 HA R 0° 00′ 00″ REP SFT

4.Collimate the second target B using the horizontal tangent screw and motion clamp.	
5. Press 【HOLD】, and hold the horizontal angle.	
6. Recollimate the first target A using the horizontal tangent screw and motion clamp.	
7. Press 【0SET】, and make the horizontal angle of A is 0° 00′ 00″.	

8.Recollimate the second target B using the horizontal tangent screw and motion clamp.	
9.Press【HOLD】.The average of angle is shown.	
10. Repeat 2～9 to measure the desired number of repetitions.	

- The maximum number of angle measurements that can be made is 9.
- Press 【SFT】 to exit from this mode.

6.5 Measuring a percent of grade (Slope measurement)

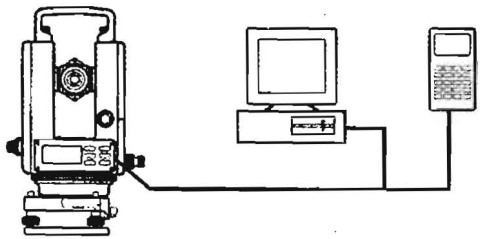
Operating	Display
1. Press 【V%】, the display of vertical angle switches to percent grade.	
2. Press 【V%】 again.The display turns back to normal angle measurement mode	
Every time pressing【V%】, the display mode will switches. When measured grade is exceeding ± 100% "EEEEE.EEE" is displayed.	

7. Recording and outputting data

THE provide function of recording measurement data. The angle data and the distance data can be stored in the instrument's memory (up to 500 groups) or output through communication interface. The recorded data include time information. Before recording data, the recording method should be selected. if recording data through communication interface is selected, the communication settings should be made properly. (please see "function setting ")

7.1 RS-232 serial communication interface

THE series instrument has the RS-232 interface joined the THE with the computer or the PDA through the cable. the measurement data can be transferred to the computer or the data collection equipment. Remember the interface is under the vertical knob



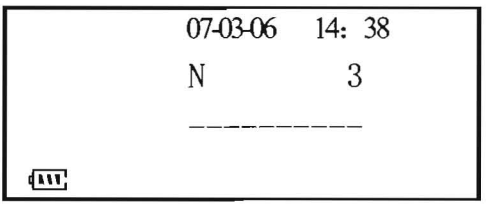
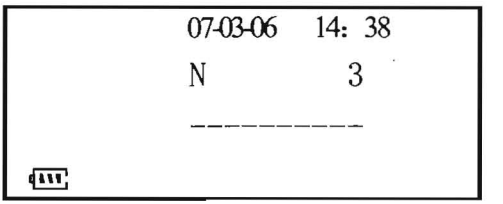
7.2 Recording measurement data

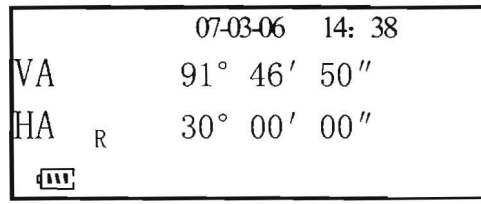
In the different measuring mode, press 【SFT】, and then press 【V%】,the measurement data can be outputted to the computer or the PDA （when selecting method of recording data through communication interface）, or stored in the memory of the instrument（when selecting method of recording data in the memory）.

Mode	Output （record ）
Angle mode	VA、HAR (vertical angel 、horizontal angle)
Distance mode	VA、 HAR、 SD(vertical angle 、 horizontal angle 、 slope distance)

8. Memory mode

In the memory mode, the data recorded in the memory can be cleared or be outputted to the communication interface.

Operating	Display
1. Press 【V%】, power on ,come in the memory mode. ● The first line display the effective data items in the memory.	
2. Press 【REC】, the second line will glint , and the instrument output the data to the interface, until it finished, it will not glint.	

3. Press【HOLD】, the first line will glint, press【HOLD】again in 5 seconds , then all the data in the memory will be cleared, and after doing this, the instrument exit from the memory mode and enter the angle measurement mode.	
● In the memory mode, press【SFT】, exit from the memory mode, return to the angle measurement mode.	

9. Function setting

9.1 Function setting

This series instrument provide many functions can be configed by user

①Tilt angle compensation: OFF,ON

②Vertical angle level 0: 90° （OFF）,0° （ON）。

③Automatic power off ： OFF, ON (If no operation in 20minutes, turn power supply off automatically

④Minimum angle display ： 1″ 、5″ 、10″

⑤Setting communication baud rate：1200、2400、4800、9600

⑥ Selecting data recording method ： interface （OFF）,memory （ON）

⑦Collimation error correction: OFF,ON

⑧Selecting angle unit：dms（OFF）,gon（ON）

9.2 Function setting method

In the setting mode, the keys are assigned function as following：

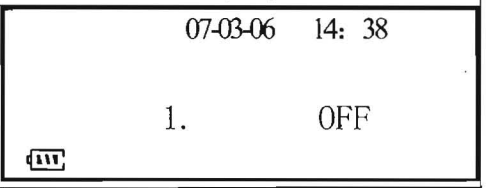
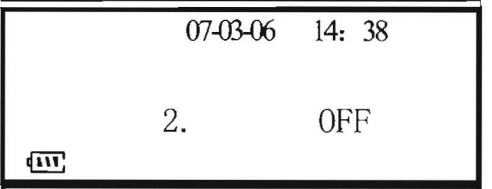
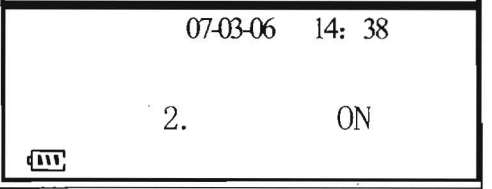
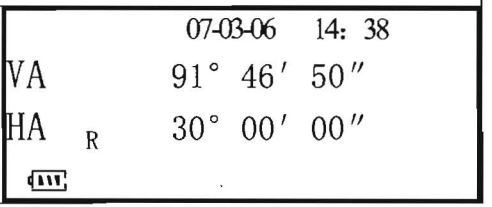
【OSET】: Select the item circle.

【HOLD】: Select the time item（month、date、year、hour、minute）.

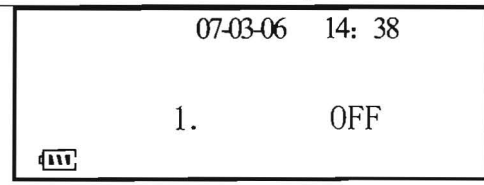
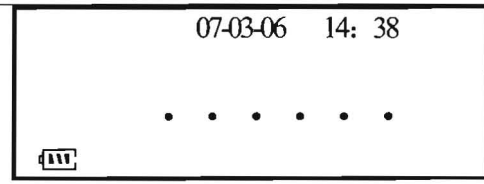
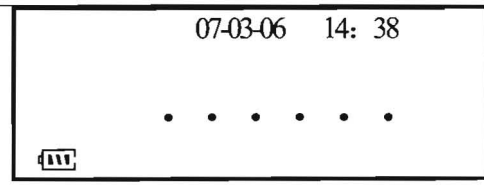
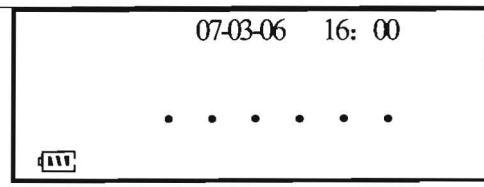
【L/R】: Select the upwards item or the time item add 1.

【V%】: Select the downwards item or the time item minus 1.

【SFT】: Confirm the setting, exit the setting mode, return to the angle mode.

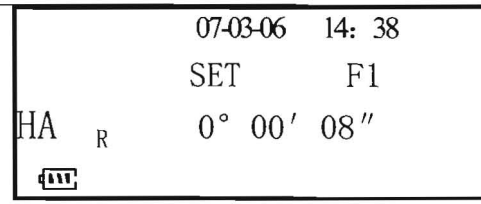
Operating	Display
1.Press 【SFT】, and then press 【L/R】, come in the setting mode.	
2.Press 【0SET】 to select the item (①~⑦)。	
3.Press 【L/R】 or 【V%】, change the setting of the selected item.	
4.Setting all the item as you need.	
5.Press 【SFT】 to finish setting return to the angle measurement mode.	

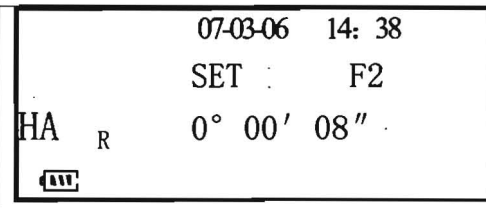
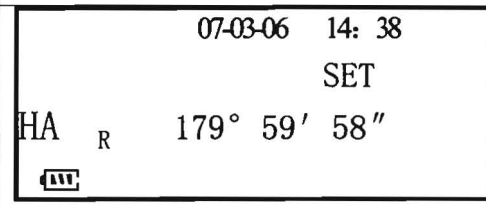
9.3 Time setting

Operating	Display
1. Press 【SFT】, and then press 【L/R】, come in the setting mode.	
2. Press 【HOLD】 to select the item （month 、 data 、 year、hour、minute、 second ） , the selected item will glint.	
3.Press 【L/R 】or 【V% 】, add or minus it.	
4.Finish settings of all item.	

10.Vertical angle 0 error and collimation error and tilt angle compensator 0 error correction

With this option, making both face angular observations , You can measure and adjust tilt compensator 0 position error. And 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	Display
1.Press 【R/L】and power , it will display "SETUP" and " SET 0 ", rotate the telescope, the first line will display "SET F1"and will glint.	

2.Level the instrument and make the plate at left, collimate the target at infinitude, press 【0SET】, the first line will glint and display "SET F2".	
3. Make the plate at right and then collimate the same target, press 【0SET】, the first line will glint and display "SET".	
4. Press 【OSET】, the instrument perform the new data of the vertical error, the telescope axis error and the compensator 0 error, and return to the angle mode.	

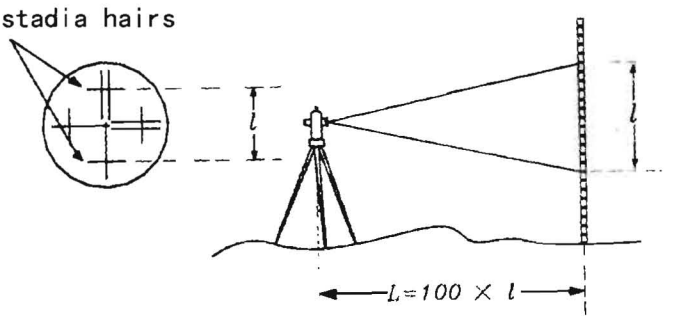
● If you want to exit at any time , you can press 【SFT】.

Note: After adjustment above finished, you should check

11. Other function

11.1 Measuring distance

Measuring distance with cross-hair is another application of THE. So scale station pole is needed, for example horizontal measuring staff and apparent distance staff. By viewing through the telescope, the length between upper and under stadia hairs which multiplies 100 is the distance from instrument center to station pole. (The length refers to the reading from station pole between two stadia hairs.)



①First fix the station pole at the measuring point.

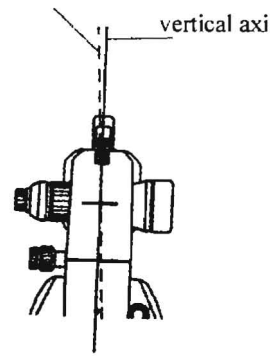
②Level instrument. By viewing through the telescope, make sure the reading " " between two stadia lines.

③The distance from instrument plumb bob center to station staff "L" is 100 times of "l".L=100X l

11.2 Tilt correction function

THE provide vertical axis incline compensator. It can compensate the incline angle automatically.. When the incline sensor is switch on, the instrument can detect the vertical axis incline angle. When instrument incline over the compensation range, it display "TILT". You should level the instrument manually.

The vertical axis is inchined in "X"



Note:

- The angle display is unstable when instrument is on an unstable stage or a windy day. You should turn off the auto tilt compensation.
- Turn on or off auto tilt compensation function, please refer to "10.funtion setting".

11.3 Illumination and timing close

THE has a display and a illumination setting on the reticle. When you Press【FUNC】and hold on about two seconds, the display and the illumination setting will be open or closed.

If you don't operate the instrument for 20 minutes, the power will be closed. About this function, you can reference "10.funtion setting"

12. Check and adjustment

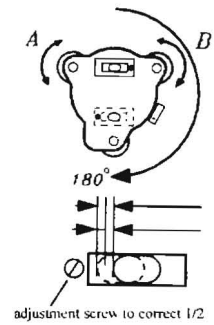
Pointers on adjustment

a. Adjust the eyepiece of the telescope properly prior to any checking operation which involves sighting through the telescope. Remember to focus properly, with parallax completely eliminated.
b. Carry out the adjustment in the order listed, as the adjustments are dependent one upon another. Adjustments carried out in the wrong sequence may even nullify previous adjustments.
c. Conclude adjustments by tightening the adjustment screws securely (but do not tightening them more than necessary, as you may strip the threads, twist off the screw necessary, as you may strip the threads, twist off the screw or place undue stress on the parts.)
d. The attachment screws must also be tightened sufficiently upon completion of adjustments.
e. Always repeat checking operations after adjustments are made in order to verify results.

12.1Check and adjust the plate level

Check

a. Place the plate level parallel to aline running through the centers of two leveling screws(e.g. A, B). Use these two screws to place the bubble in the center of the plate level



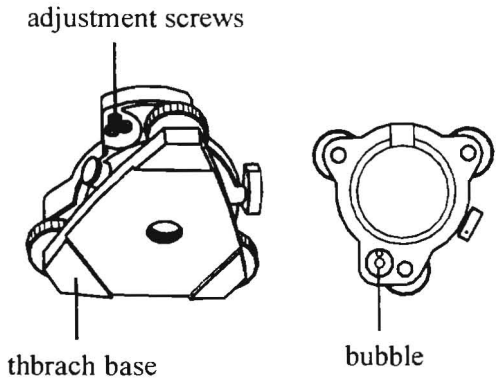
a. Next, revolve the instrument 180° or 200g around the vertical axis and check bubble movement of the plate level. If the bubble has been displaced, then proceed with the following adjustment

Adjustment

a. 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.

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

c. Revolve 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.



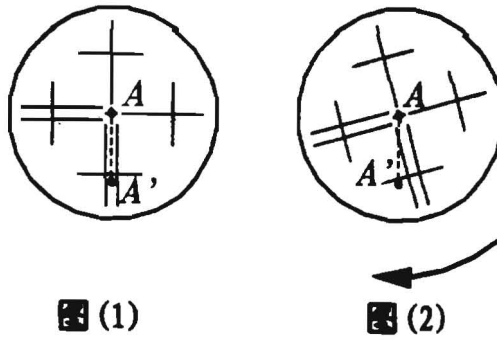
12.2 Check and adjust vertical cross-hair

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)



(1) (2)

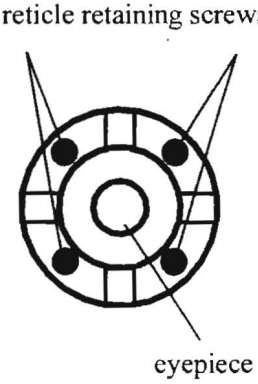
12.3 Check and adjust vertical cross-hair

Adjustment is required if the vertical cross-hair is not in a plane perpendicular to the horizontal axis of the telescope.(Since it must be possible to use any point on the hair for measuring horizontal angles.)

Check

a. Set the instrument on the tripod and carefully level it.
b. Sight the cross-hair on a well-defined point A on the wall at a distance of at least 50 meters. (160ft)
c. Next swing the telescope and check whether the point travels along the length of the vertical cross hair.
d. If the point appears to move continuously on the vertical hair (see fig.1), the vertical cross-hair lies in a plane perpendicular to the horizontal axis.(adjustment is not required.)
e. However if the point appears to be displayed from the vertical cross-hair (see fig.2) , adjustment is required in the reticule plate.

Adjustment



a. Unscrew the cross-hair adjustment section cover by revolving it in the counter-clockwise direction. This will expose four eyepiece section attachment screws.
b. Loosen 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.
c. Check if there is displacement in horizontal direction while point A travelling along vertical cross-hair. If not, check is concluded.

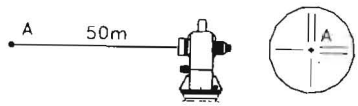
12.4 Collimation of the instrument

Collimation is required to make the line of sight of the telescope perpendicular to the horizontal axis of the instrument.

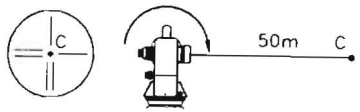
Check

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

b. Sight point A at approximately 50 meter distance.



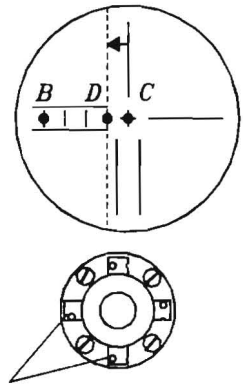
c. Loosen the vertical tangent screw only and plunge the telescope 180 ° around the horizontal axis so that the telescope is pointed in the opposite direction.



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

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

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



reticle adjustment screw

Adjustment

a. Unscrew the cross-hair adjustment section cover.
b. 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 parent error of BC is four times of the real error since the lescope has been reversed twice during checking operation.
c. Shift the vertical cross-hair line and coincide it with point D, by revolving the left and right capstan adjustment rews. 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.

Note:

To move vertical cross-hair, first loosen the capstan adjustment screw, then screw the capstan adjustment screws on the other side to

a. number. (loosen screw: counter clock-wise. Tighten screw: clock-wise. But rotate screws as little as possible.)

b. After concluding the above adjustment, the following adjustment is required: 6. Adjustment of vertical angle.

12.5 Check and adjust optical plummet

Adjustment is required to make the line of sight of optical plummet telescope coincide with the vertical axis (as otherwise the vertical axis will not be in the true vertical when the instrument is optically plumbed.)

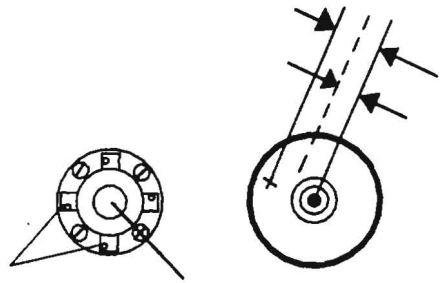
Check

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

b. 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

a. Unscrew the adjustment section cover of the optical plummet telescope eyepiece, by revolving it in the counter clock-wise 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.



adjustment screw optical plummet

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

b. 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.

Note:

To move center mark, loosen adjustment screw on one side and tighten adjustment screw on the other side according to the loosened number. (Loosen: counter clock-wise. Tighten: clock-wise. Rotate screws as little as possible.)

13. Tribrach

It is convenient to detach and attach instrument by loosening or tightening the locking lever.

Detachment

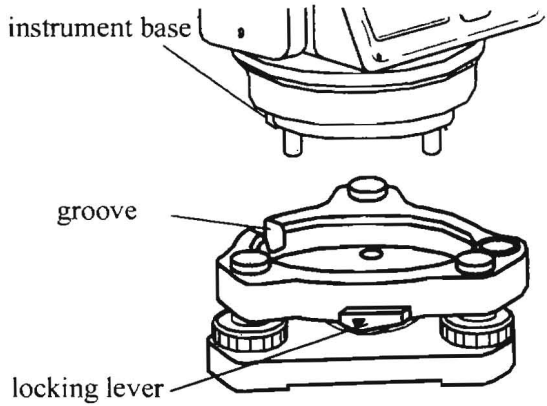
a. Turn locking lever 180° in counter clock-wise direction.

b. Lift the instrument up with one hand carrying handle and another hand holding the tribrach.

Attachment

a. Match the instrument base with the correct groove before putting the instrument on the board.

b. Tighten the locking lever



14.Error displays

E01	Vertical angle 0 position is out of range or set with incorrect procedure.
E02	Tilt angle compensator 0 position is out of range or set with incorrect procedure.
E03	During measuring of the collimation error, the measured value measured is out of range.
E04	There's abnormality in internal memory system.
E05	Reserved for adjustment in factory.
E06	There's abnormality in angle measuring system.
E07	The level collimation or the telescope revolve too fast(over 4 r/s).
E08	There's a error detected in angle measuring system. The instrument should be re-powered to distiguish this error.

15.SPECIFICATIONS

Telescope	Length	155mm
	Objective aperture	45mm
	Magnification	30X
	Image	Erect
	Field of view	1° 30′
	Resolving power	3.5″
	Minimum focus	1.3m
	Stadia ratio	100
	Stadia constant	0
Electronic angle measurement	Method	Absolutely Code
	Minimum reading	1″ / 5″ / 10″
	Accuracy (1)	2″ / 5″ / 10″
	Diameter of circle	71mm
Illuminator	LCD	Yes
	Reticle plate	Yes
Communi-ca tion	EDM interface	No
	Data export interface	Yes

Tilt Compensa-tion	Electric incline sensor	Vertical angle compensation
	arrange	±3′
	Minimum reading	1″
Optical plummet	Magnification	3X
	Field of view	5°
	Focusing range	0.5m—∞
Level sensibility	Plate level	30″ / 2mm
	Circular level	8′ / 2mm
Power working time	chargeable battery	10h
Dimension	Height of instrument	179.5mm
	Dimensions (DxHxM)	144X 175 X324mm
	Weight(with battery)	4.8kg

17. Accessories and equipment

- **Chargeable battery set**

  Voltage: DC6.0V

  Capacity:

BDC13	1300mAH
Angle measurement	10 hours