SMART MAX GEOSYSTEMS CO.,LTD
www.smartmaxgeosystems.com info@smartmaxgeosystems.com

SMART MAX GEOSYSTEMS

DE2A & DE2A-L Theodolite Manual

Precaution

1) If the instrument has not been used for a long time, check it regularly(3 monthes).
2) Avoid shocking or bumping.
3) No using in high dusty, not well ventilated, and easy burning environment.
4) No dismount and mount the instrument by yourselves.
5) Prohibit to see the sun with telescope.
6) Cover with umbrella in burning sun or rainy day.
7) Cover the instrument with rainy cover.
8) Power off before taking off battery, or the data will be lost.
9) Place instrument the case and avoid humidity.
10) Prohibit move the instrument with tripod.
11) It will cause measuring result is not correct if there is leaves and obstacle between the target and the instrument.
12) Place the instrument like the picture below:

13) Contact me if you got any problem.

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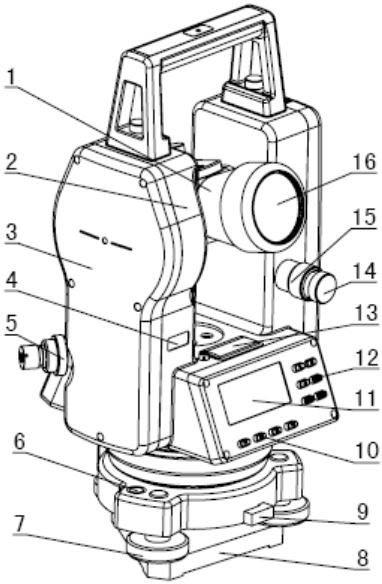
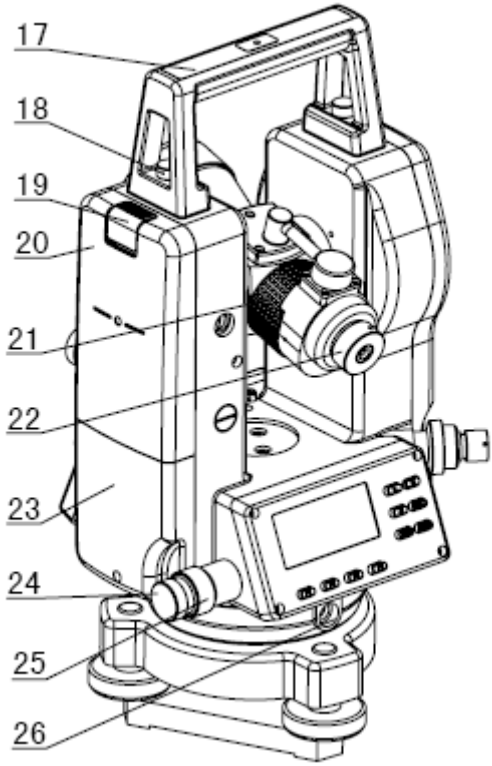
1. Description of All Parts

1.1 Name of Parts



1.Telescope 2.Main body 3.Left Side Cover
4.Series No. 5.Optical Plummet 6.Circular Vail
7.Leveling Screw 8.Tribrach
9.Connection Knob on Tribrach 10.Soft Key
11.Display 12.Function Key 13.Plate Vial
14.Vertical Tangent Screw 15.Vertical Clamp Screw
16.Objective Lens



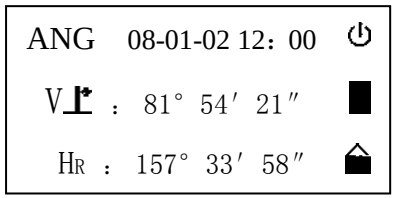
17. Handle	**18.Handle Screw**	**19. Battery locking Lever**
20. Battery	**21. Grip**	**22. Eyepiece**
23.Right Side Cover		**24. Horizontal Tangent crew**
25. Horizontal Clamp Screw		**26.RS232 Port**

1.2Display

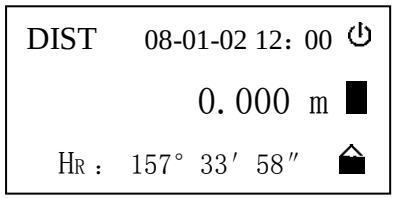
The figure LCD can display angle,characters,date and time,etc. There are two modes on display:Measurement Mode & Menu Mode.

Display(example)：

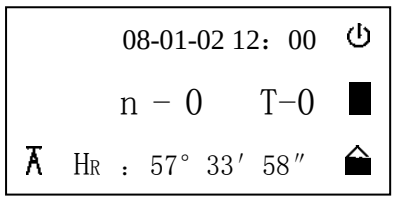
① Angle Measurement Mode



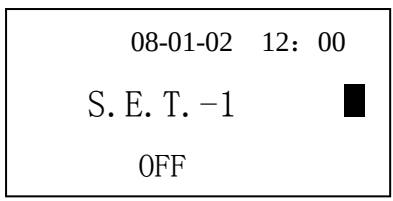
② Distance Measurement Mode



③Remeasurement Mode



④Menu Mode

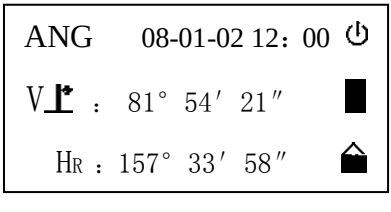


Symbol	Contents
	Vertical compensation
	Horizontal remeansure
	Automatic Power off
	Battery
	Horizontal locked
	Special Function,press ¤twice,it will be disappeared
%	Gradient Display
b-OUT	Vertical angle is over the compensation
OUT	Slope is over ±100%
m	Meter unit
°′″	Set 360 °as angle unit

1.3 Operation Key

The function of the soft key is different in different measurement mode.

①Angle Measurement Mode



REP▲ Power

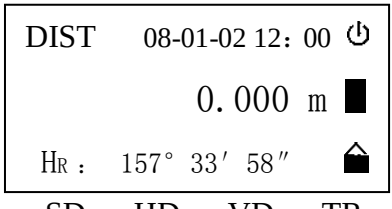
◆ ¤

ANG▼ ENT

L/R HOLD % 0SET

Soft Key	Function
L/R	Switches R/L rotation of horizontal angle
HOLD	Hold the horizontal angle
%	Vertical angle percent grade(%) mode
0SET	Set horizontal angle as 0°00′00″

②Distance Measurement Mode



REP▲ Power

ANG▼ ENT

Soft Key	Function
SD	Enter into SD Measurement
HD	Enter into HD Measurement
VD	Enter into VD Measurement
TR	Enter into TR Measurement

③Special function Measurement mode(This will be valid only in the Angle Measurement Mode)

Soft Key	Function
First press ¤, when it display ⌂ , press▲	Turn on /off laser alignment
First press ¤, when it display ⌂ , press▼	Turn on /off laser plummet
First press ¤, when it display ⌂ , press◆	Turn on /off LCD
First press ¤, when it display ⌂ , press **ENT**	Enter into Menu mode,press ENT one more time will save and exit

1.4 RS232

RS232 is used to connect the Theodolite with computer or PC to transfer measured data to computer or PC.

2. Battery

2.1 Battery Replacement

1. Battery Insert

Insert battery correctly. Check and insert battery holder true to side into the housing.

2. Battery Removement
Remove battery and replace.

2.2 Battery Recharging

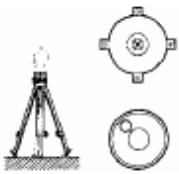
1. Insert recharger into battery's hole.

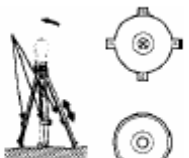
2. Insert the plug of the recharger into 220V AC power supply. It shows green light after finishing recharging.
3. Cut the power supply of the recharger and drew the battery out from the recharger.

3. Measurement Preparation

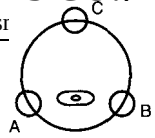
3.1 Instrument Setting Up

1. Setting up the tripod.Pull out to required length and tighten screws.



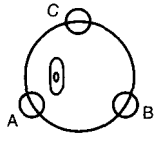


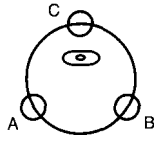
2. Place the INSTRUMENT onto the tripod head. Tighten central fixing screw of tripod.



3.2 Instrument leveling

1.Level the instrument with circular vial





a. Turn the leveling screw A and B to move the bubble in the circular vail. The bubble is now located on a line perpendicular to a line running through the centers of the two leveling screw being adjusted.

b. Turn the leveling screw C to bring the bubble to the center of the circular vail.

2. Level the instrument with plate vial

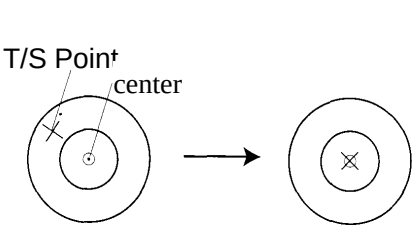
a. Rotate the instrument horizontally by loosening the Horizontal Clamp Screw and place the plate vial parallel with the line connecting leveling screw A and B, and then bring the bubble to the center of the plate vial by turning the leveling screws A and B.

b. Rotate the instrument 90 º(100g) around its vertical axis and turn the remaining leveling screw or leveling C to center the bubble once more.

c. Repeat the procedures 1& 2 for each 90 º(100g) rotation of the instrument and check the whether the bubble is correctly centered for all four points.

3.3 Centering by optical plummet

Adjust the eyepiece of the optical plummet telescope to your eyesight. Slide the instrument by loosening the tripod screw, place the point on the center mark of the optical plummet. Sliding the instrument carefully not to rotate that allows you to get the least dislocation of the bubble.



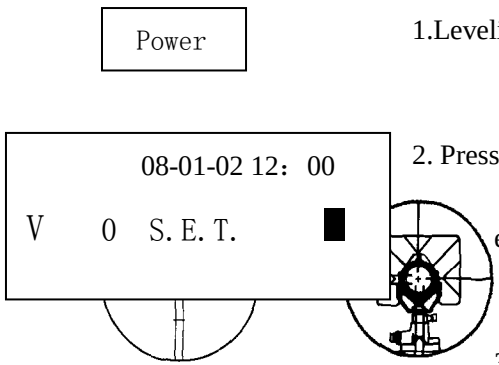
Note:Centering by foot screw first and then leveled-up by tripod.

3.4 Eyepiece Adjustment and Object Sighting

1. Sight the Telescope to the sky and rotate the eyepiece tube to make the reticle clear.

2. Make the target image clear with the telescope focusing screw. If there parallax when your eye move up, down or left, right, that show the diopter of eyepiece lens or focus is not adjusted well and accuracy will be influenced, so you should adjust the eyepiece tube carefully to eliminate the parallax.

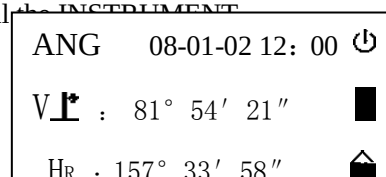
3.5 Power on



1.Leveling INSTRUMENT

2. Press the Power key (red ey).

3. Turn telescope to initial the INSTRUMENT



Confirm the battery is full, if not so,please replace and recharge the battery.

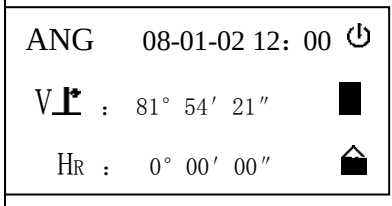
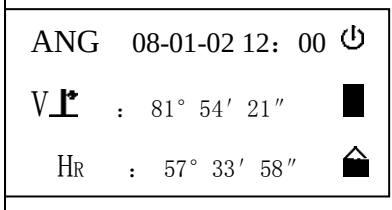
3.6 Power off

Press the Power key (red key).

4. Angle Measurement

4.1 Measuring Horizontal Angle Right and Vertical Angle

Operation Procedure	Display
①Press ANG to enter into Angle Measurement. Aim at the first target A	ANG 08-01-02 12：00 V ： 81° 54′ 21″ HR ： 157° 33′ 58″

②Press 0SET to set horizontal reading of target A as 0°00′00″	
③Aim at the second target B. The required V/H angle to target B will be displayed.	
★Press ENT,the vertical and horizontal angle can be sent out through RS232.	

How to Collimate (Reference)

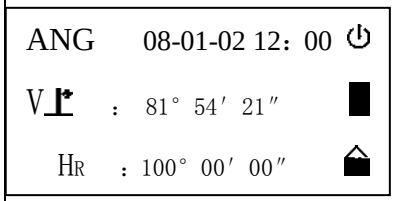
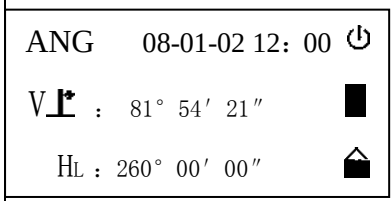
1. Point the telescope toward the light. Turn the diopter ring and adjust the diopter so that the cross hairs are clearly observed. (Turn the diopter toward you first and then backward to focus).

2. Aim the target at the peak of the triangle mark of the sighting collimator. Allow a certain space between the sighting collimator and yourself for collimating.

3. Focus the target with the focusing knob.If parallax is created between the cross hairs and the 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; eliminate the parallax by carefully focusing and using diopter adjustment.

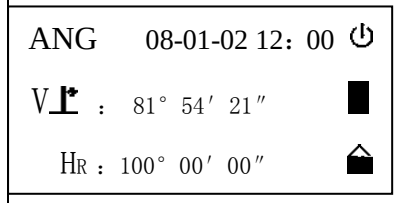
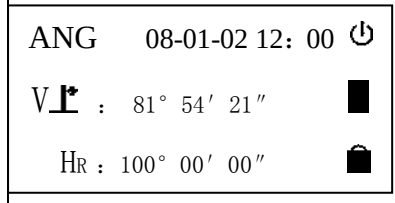
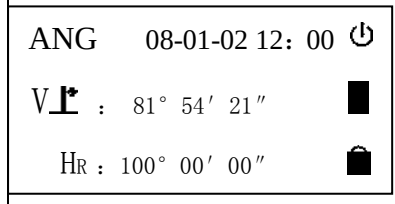
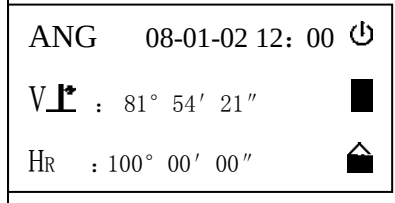
4.2 Switching Horizontal Angle Right/Left

Operation Procedure	Display
①Press ANG to enter into Angle Measurement.	
②Press L/R. The mode Horizontal angle Right (HR) Switches to (HL) mode.	
★Press L/R to switch Right mode and Left mode.	
★Press ENT,the vertical and horizontal angle can be sent out through RS232.	

4.3 Setting Horizontal Angle

Setting by Holding the Angle

Operation Procedure	Display

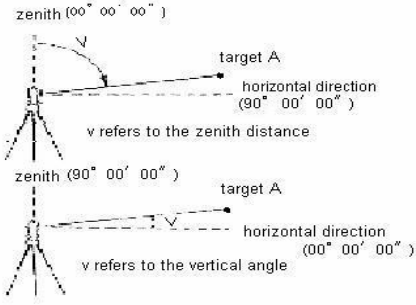
①Press ANG to enter into Angle Measurement.	
②Set the required horizontal angle, using Horizontal tangent screw.Then press HOLD.	
③Aim at the target which need to be set up the angle	
④Press the ENT to finish holding the horizontal angle.The display returns back to normal angle measurement mode.	

4.4 Vertical Angle Percent Grade (%) Mode

Operation Procedure	Display
①Press ANG to enter into Angle Measurement.	ANG 08-01-02 12：00 V ：81° 54′ 21″ HR：100° 00′ 00″
②Press % to enter into Slope Measurement.	ANG 08-01-02 12：00 V ： 50 % HR：100° 00′ 00″
★The display mode switches when pressing % key every time.	
★While the measurement is carried out over ±45°(±100%) from the horizontal,the display shows <OUT>.	

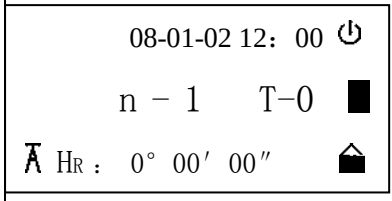
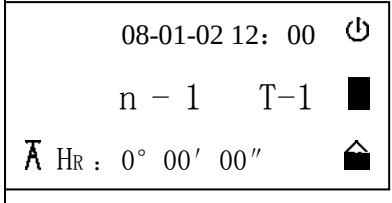
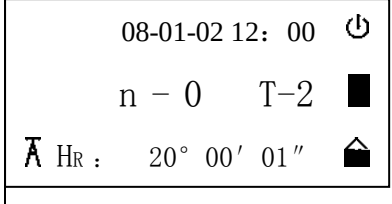
4.5Compasses (vertical angle)(Refer to Parameter Setting Up)

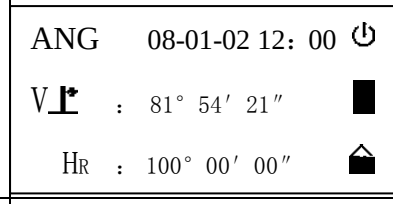
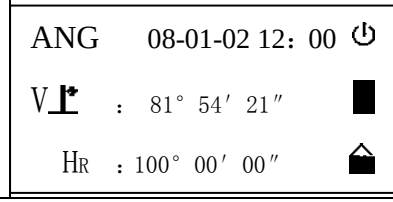
Vertical angle is displayed as shown below：



4.6 Remeasuring Horizontal Angle

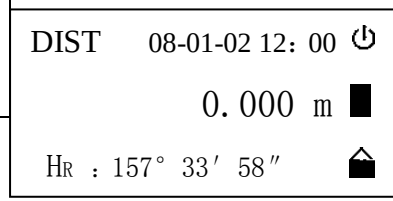
Operation Procedure	Display
①Press REP to get into the mode of Horizontal Angle Remeasurement	08-01-02 12：00 n – 0 T–0 HR：57° 33′ 58″

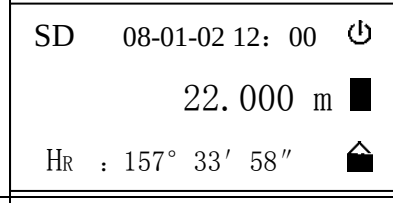
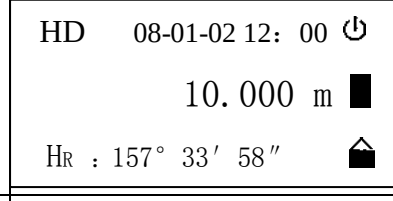
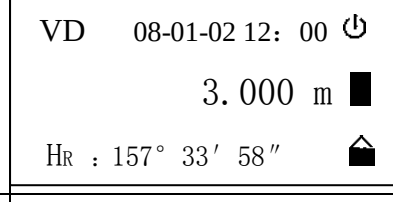
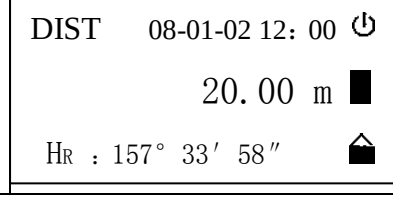
②Aim at the Target A Press 0SET（one time）to set the reading of A as: 0°00′00″	
③Aim at the Target B by Horizontal Tangent and Clamp Screws. Press ENT（one time）to remain the horizontal angle and it will be saved	
④Aim at the Target A again Press 0SET (one time）to set the reading of A as:0 ̊00′00″.(It begins the first remeasurement.)	
⑤Aim at the Target B again by Horizontal Tangent and Clamp Screws Press ENT（one time）to remain and save the	n-1:the beginning of the angle n-0: the ending of the angle T-0 ～ T-8: the times of remeasurement

horizontal angle.	
⑥Repeat step ④～⑤ to do the required remeasurement	
⑦Measurement is over. Press ANG to enter into Angle Measurement.	
★The remeasure times is limited,the Max is 9. It will show “E-09” if more remeasurement done.Press REP and restart.	
★When do remeasurement,it will display “E-08” if ｜Measured Value- Average Value ｜≥ 30″. Press REP and restart.	

5. DISTANCE MEASUREMENT

Please confirm the cable can be connected with our Distance Meter before measurement.

Operation Procedure	**Display**
①Press to enter into the mode of distance	

measurement	
②Aim at Prism center.	
③Press L/R to start SD Measurement while press ENT to stop.	
④Press HOLD to start HD Measurement while press ENT to stop.	
⑤Press % to start VD Measurement while press ENT to stop.	
⑥Press 0SET to start Tracking Measurement while press ENT to stop.	

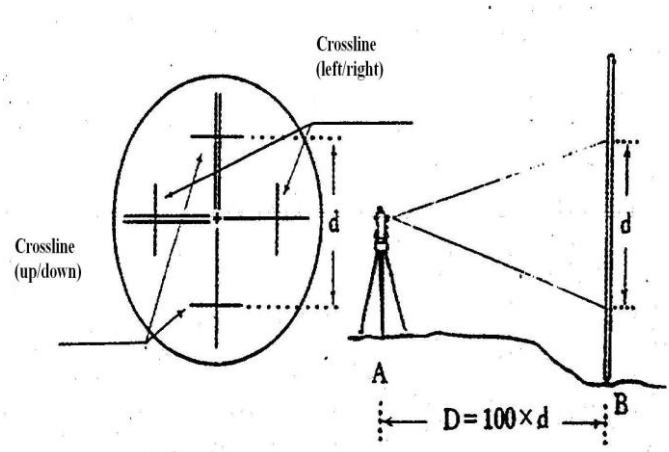
6. Distance Measurement through the crossline in the telescope

Through the sightline (up/down or left/right) in the telescope to measure the distance between the target and the instrument.(Accuracy ≤ 0.4%D)

⑴ Place the instrument at point A,and place the leveling staff at B.

⑵ Read the intercepted distance of the crossline(up/down or left/right) on the leveling staff as “d”.

⑶The horizontal Distance between A and B is D(D= 100×d.)



Note: 100 means the Stadia Proportion Constant of the instrument. (But because of such a low accuracy,it can not be used to measure distance which requires high accuracy.)

7. Laser Measurement

Attention：Please don't watch the laser with eyes directly, when it is turned on!

7.1 Orientation Measurement

Find out the other points on the line of the two known points ,which should be based on the known two points,this is

Laser Orientation Measurement.

Steps as bellows：

1.Leveling the instrument, then power on.

2.Aim at the target through the horizontal Tangent & Clamp Screws.Turn on the laser.The other points can be found out with a board which can make the laser focus together.

7.2 Angle Designment

Angle Designment is based on the line of two points,then design a horizontal angle according with the requirement.

Steps as bellows：

1.Leveling the instrument, then power on.This must be done on a fiducial point.

2.Aim at another fiducial point carefully,and set the horizontal angle as 0°00′00″.

3.Move the telescope to make the horizontal angle be the required value.Turn the laser on,the laser and the fiducial line will make up an angle.

7.3 Zeith Measurement

Set a point as a standard, the laser will be set up vertically,this is Zeith Measurement.

Steps as bellows：

1.Take away the eyepiece, fit on the diagonal eyepiece, and locked.

2. Leveling the instrument, then power on.This must be done on a fiducial point.

3. Circumgyrate the telescope to make the vertical angle to 0°00′00″,turn the laser on.Then move the foucsing screw to make the facula minimum,loosenthe horizontal clamp screw, move the telescope,the geometry center of the facula's movig track is the Vertical Direction.

7.4 Level Measurement

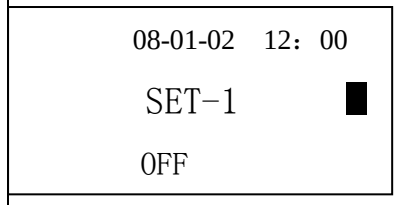
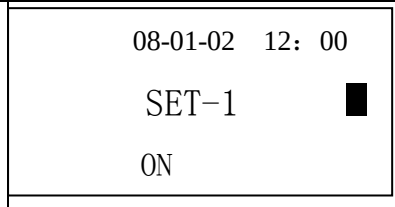
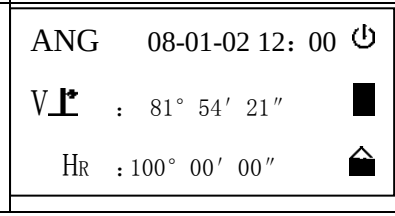
1. Leveling the instrument, then power on..

2. Lock the telescope after it is on the horizontal direction,aim at the target carefully.Turn on the laser,the red laser line can be used as level line.

8. Parameter Setting Up

8.1 Enter into Setting up Parameter

Operation Procedure	Display
①Press ¤ and then press ENT when in the angle measurement mode to	08-01-02 12：00 SET-1 OFF

enter into Menu Mode.	
② Press ◆ to choose parameter which need to be set up. （Continuous press）	
③Press▲、▼ to set up parameter. （Continuous press）	
④Press ENT to save.	

★When Setting up Parameter, press ¤ to escape back to angle measurement.The modified won't be saved.

8.2 Setting up the Parameters

①SET-0：Power off Automatically

ON---The instrument will power off automatically if there is no

operation within 30 minutes

OFF--- Not automatically power off

②SET-1：Compensator

ON---Turn on the compensator

OFF---Turn off the compensator

③SET-2：Position 0(Vertical Angle)

ON ---Zeith is 0 °,the Horizontal will be 90 °when turn left and it will be 270 °when turn right.

OFF---Zeith is 90 °,the Horizontal will be 0 °when turn left

④SET-3：Minimum Reading

1---Minimum Reading is 1"

5---Minimum Reading is 5"

10---Minimum Reading is 10"

20---Minimum Reading is 20"

⑤SET-4：Angle Unit

1---Set 360 °as angle unit

2---Set 6400mil as angle unit

3---Set 400g as angle unit

Remarks: SET-5、SET-6、SET-7、SET-8、SET-9means year,month,day,hour,minute(This is optional)

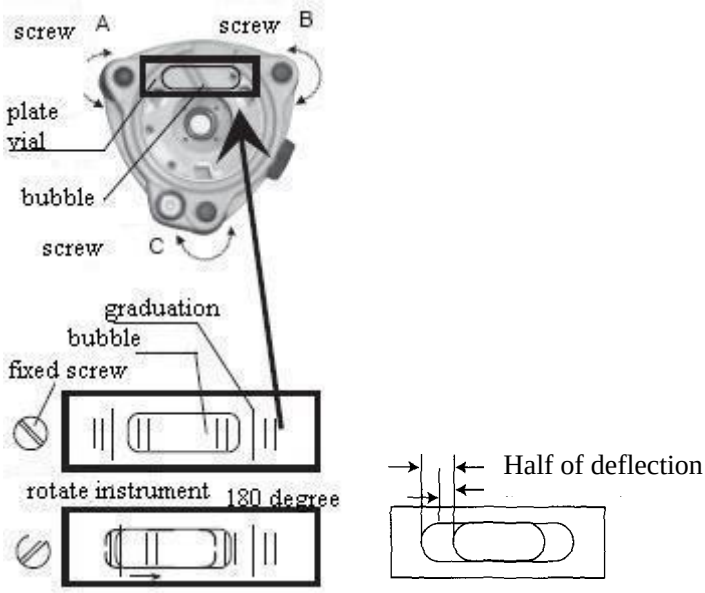
9. Check & Adjustment

9.1 Check & Adjustment of Plate Vial

Check

① Rotate the instrument horizontally by loosening the Horizontal Clamp Screw and place the plate vial parallel with the line connecting leveling screw A and B, and then bring the bubble to the center of the plate vial by turning the leveling screws A and B.

②Rotate the instrument 180°（200g）around its vertical axis. Observe the bubble of plate vial. Fellow the steps below to adjust it if the bubble is not in the center.



Adjustment

① If the bubble of the plate vial moves from the center, bring it half way back to the center by adjusting the leveling screw, which is parallel to the plate vial. Correct the remaining half by adjusting the screw of plate vial with adjusting pin.

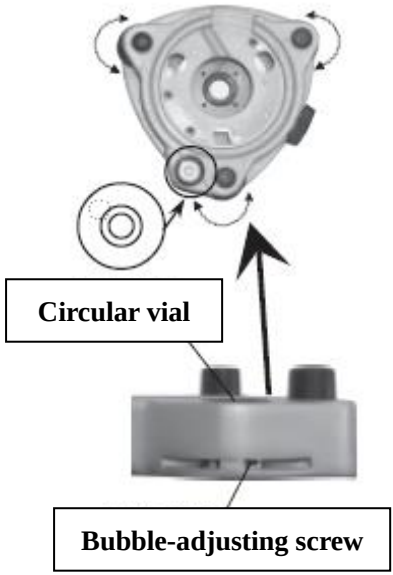
② Confirm whether the bubble does is in the center by rotating the instrument 180 º.If not, repeat step ①.

③ Turn the instrument 180 °（200g）and adjust the third screw to center the bubble in the vial.

9.2 Check & Adjustment of Circular Vial

Check

No adjustment is necessary if the bubble of the circular vial is in the center after inspection and adjustment of the plate vial.



Adjustment

If the bubble of the circular vial is not in the center, bring the bubble to the center by using the adjusting pin to adjust two bubble-adjusting screws.

9.3 Check & Adjustment of Optical Plummet

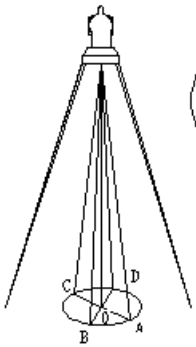
Check

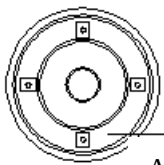
①Set the instrument on the tripod and place a piece of white paper with two perpendicular lines, then intersect drawn on it directly under the instrument. Adjust the leveling screws so that the center mark of the optical plummet coincides with the intersection point of the cross on the paper.

②Rotate the instrument around the horizontal axis 180°（200g）observe whether the center mark position coincides with the intersection point of the cross. If the center mark always coincides with intersection point, no adjustment is necessary. Otherwise, the following adjustment is necessary.

Adjustment

①Take off protective cover of the optical plummet, you may see four adjusting screws. Adjust four adjusting screws.





Adjusting Screw (4 pcs)

②Move woodscrew to make the center of optical plummet coincides with ground point.

③Rotate the instrument around the vertical axis 180°（200g）observe whether the center mark position coincides with the intersection point of the cross. If the center mark always coincides with intersection point, no adjustment is necessary.

Otherwise, repeat steps above mentioned.

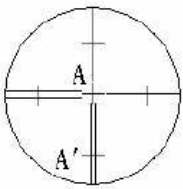
9.4 Check & Adjustment of Inclination of Reticle

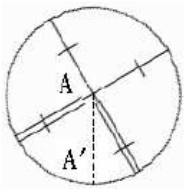
Check

①Set the instrument on a tripod and level it.

②Aim at target A with telescope（One point, 50m away）.

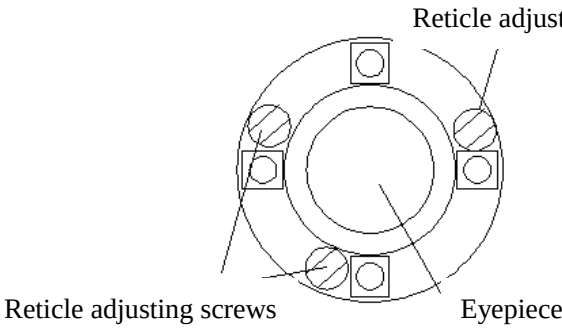
③Observe point A moves along the vertical line of the reticle or not by moving telescope up and down.. If so, no adjustment is necessary. If not so, then need to adjust the reticle.





Adjustment

① Remove the eyepiece cover to expose the four reticle adjusting screws.



② Loosen the four reticle adjusting screws uniformly with an adjusting pin. Rotate the reticle around the sight line and align the vertical line of the reticle with point A. Tighten the reticle adjusting screws.

③ Repeat the inspection and adjustment to see if the adjustment is correct.

Note：Remember to check the index of the instrument after adjusting.

9.5 Check & Adjustment of discrepancy between twice collimation errors(C)

Check

① Set the instrument on a tripod and level it.

② Aim at cross line of the reticle of the collimator or a target away. Observe left position and right position.

③ Calculate difference after getting horizontal angle reading (left position) HI and(right position)HR

$$\mathbf{C = (\ HI - HR \pm 180^{\circ})/2}$$

If **C ≤ 8"**，no adjustment is necessary；If **C > 8"**，fellow these steps to adjust it.

Adjustment

① Rotate fine motion screw in the right position and make the reading is **HR + C**.

② Remove the eyepiece cover to adjust two adjusting screws, which makes reticle coincides

with cross line of collimator or one target away.

③ Repeat check and adjustment until C ≤ 8".

$$\mathbf{C = (\ HI - HR \pm 180^{\circ})/2}$$

9.6 Check & Adjustment of Vertical Index Difference (i angle)

(Inspect the item after finishing the inspection and adjustment of section 9.4 and 9.5.)

Check

① Set the instrument on a tripod and level it.

② Sight object A in left position and read the Vertical angle value VI. Rotate the telescope. Sight object B in right position and read the Verticail angle value VR.

③ Calculating， **i=(VI+VR-360°)/2**

④If **i ≤10"**， no adjustment is necessary. If **i ＞10"**， adjust it.

Adjustment

(Please adjust through the software if the differences between the index is too big.)

Operation Procedure	Display
①Keep to press L/R to power on until right screen occurs. Loose L/R	V 0 S.E.T. S.E.T.-301
②Rotate telescope and make vertical angle passing 0. Enter into the mode of V ANGLE 0 SET	V: 90° 00′ 00″ STEP - 1
	V: 270° 00′ 00″ STEP - 2

③Aim at target (left position). Press ENT	
④ Aim at target (right position).Press ENT Power on automatically.	
⑤Finish adjustment. Repeat,if not within standard.	

9.7 Check & Adjustment of the laser confocal and coaxial

(This step was done after finishing the inspection and adjustment of Item 9.4 and 9.5)

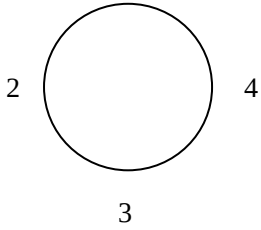
Laser confocal

Send the laser after aiming at the target,and then check the facula's diameter.It should be minimum.If it is not,loose the screw on the laser pedestal,and move the pedestal until the facula be smallest.

Laser coaxial

The crossline should be in superposition with the facula after aiming at the target.Make the facula in the center of the crossline through the four screws on the pedestal.(as the picture below)

1



Up，tighten screw 1，relax screw 3

Down，tighten screw 3，relax screw 1

Left，tighten screw 4，relax screw 2

Right，tighten screw 2，relax screw 4

10. Technical Index

Telescope

Image	Erect
Magnification	30×
Effective aperture	47mm
Resolving power	3.75″
Field of view	1°30′(26m/1000m)
Minimum focus	1 m
Stadia ratio	100

Sight distance precision	≤0.4%D
Tube length	162mm
Angle Measurement	
Measuring method	photoelectric detection by incremental encoder
Diameter of circle	79mm
Minimum reading	1″, 5″, 10″ , 20″Selectable
Measuring unit	360 °,400gon, 6400mil Selectable
Vertical angle 0 °	Zenith 0 °,Horizontal 0 °Selectable
Accuracy	2″、5″、10″Selectable
Vial	
Plate vial	30″/2mm
Circular vial	8′/2mm
Compensator	
System	Liquid-electric detection
Compensation range	±3′
Resolving power	1 ″
Optical Plummet	
Image	Erect
Magnification	3×
Focusing range	0.3m～∞
Field of view	5 °
Display	
Type	LCD，Four lines，digital
Data Communication	
Port	RS－232C

On-board Battery	
Power resource	Rechargeable Ni-H battery
Voltage	DC6 V
Operation time	BDC 1800mAh(about 20 hours)
Laser	
Length of the wave	635nm
Power	10mW
Effective range(during daytime)	150m
Position error with the sight	≤5″
Power	DC3.3V
Working temperature	－10℃～＋45℃
Operation Environment	
Operating temperature	－20℃～＋45℃
Size & weight	
Dimension	180mm×166mm×355mm
Weight	6.5kg

11. Packing List

Instrument	**1pc**
Battery	**2pcs**

Recharger	**1pc**
Plummet	**1pc**
Tool bag	**1pc**
Carrying case	**1pc**
Operator manual	**1pc**

12. Error Code Instruction

E-301 Memory Card-Error

E-302 VJ767-Error

E-303 HJ767-Error

E-304 HY767-Error

E-305 HJ767-Error AND HY767-Error

E-108 Compensator-Error

E-08 Remeasurment
| Measured Value − Average Value | > 30″

E-09 Remeasurement times more than 9