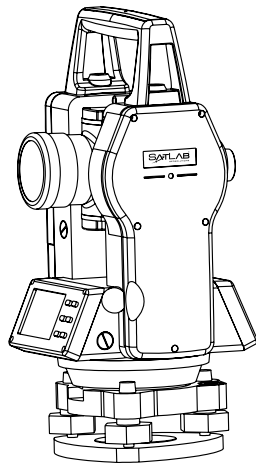


SDT2

Theodolite

USER MANUAL



FOREWORD

Thank you for purchasing the Satlab Theodolite SDT2. For the best performance of the instrument, please read this user manual carefully and keep them for future reference.

NOTICE

- For optimum usage, this instrument should be checked and adjusted especially after being stored for a long time or after being transported.
- Before measuring, please check that the instrument is operating properly.
- Do not store the instrument in high temperatures or set it up under strong sunlight to prevent the photosensor from heating up as it may affect the accuracy of the instrument.
- Please use trained staff when operating this measuring instrument.
- Avoid direct sunlight from passing through objective lens and the eyepiece which may cause interference.
- Please keep the instrument in the case provided during transportation.

- Once your work is completed, please clean the instrument and keep it back into the case.
- Do not touch the lens with your fingers. Please clean the surface, buttons, screen and outer layer of the instrument with a soft cloth. Clean the optical parts only with lens paper.
- Store the instrument in a dry room with consistent temperature.
- If the instrument requires repair, make sure that it is checked and repaired by Satlab technicians or by appointed dealers.

WARNING

- **Never observe the sun through the telescope system.**
- **Please be careful when working around high voltage facilities**
- **Do not handle staff during thunderstorms.**
- **Please place the instrument and battery in a dry and cool place.**
- **Keep the instrument away from flammable and explosive materials.**
- **The survey should be operated in a safe area.**
- **Please observe local safety and traffic rules.**
- **Do not overheat the battery.**

CONTENTS

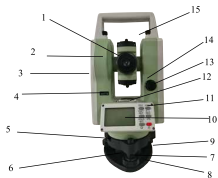
1. Important Parts and Operation Manual	5	4. Angle Measurement	12
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1. Important Parts and Operational Manual

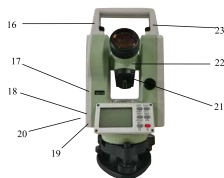
This figure shows the parts of the instrument

1.1 Important Parts

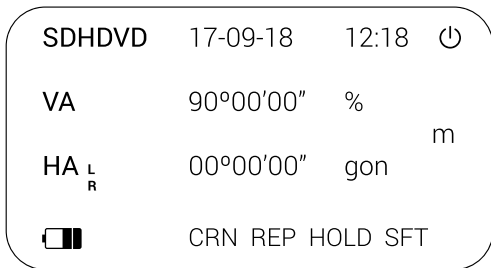
1. Telescope
2. Main Body
3. Left Side Cover
4. Series No.
5. Circular Vail
6. Laser Plummet
7. Leveling Screw
8. Tribrach
9. Tribrach Locking Knob
10. Display
11. Function Key
12. Late Level
13. Vertical Tangent Screw
14. Vertical Motion Clamp
15. Objective Lens
16. Handle





17. Battery
18. Right Side Cover
19. Horizontal Motion Clamp
20. Horizontal Tangent Screw
21. Eyepiece
22. Focusing Knob
23. Handle Screw



1.2 Display







Display	Function
SD	Slope Distance
HD	Horizontal Distance
VD	Height Difference
VA	Vertical Angle
HA	Horizontal Angle Left
HA	Horizontal Angle Right
SFT	The Second Function
REP	Repeat the Horizontal Angle
CRN	Tilt Correction

Display	Function
HOLD	Holding of horizontal angle
%	Percent Grade
m	Distance Unit
gon	Angle
	Battery Level
17-09-18	Date
12:18	Time
	Auto Power-off



1.3 Operation

The function of the soft key is different depending on the measurement mode.

SDHDVD	17-09-18	12:18		0 SET	L/R
VA	81°54'21"			HOLD	V/%
HA _R	157°33'58"			Light	
	CRN	REP	HOLD	SFT	

Keys	Function 1	Function 2
0 SET	Set horizontal angle 0	Distance measurement
HOLD	Hold horizontal angle	Repeat measurement horizontal angle
α	Press 3s to turn lights on/off	Select the second function
R/L	Switch horizontal angle right/left	Switch SD/HD/VD display
V/%	Percent grade of vertical angle	Record measurement
	Power Switch	

Special Function Model

Keys	Function
Press "REO" for 3 seconds	Open laser point, press again to close
Press Once 	Open the laser plummet, press again to close
Press V/% + R/L + 	Open compensator
Press α + R/L	Enter to menu, press α again to save and exit

2. Battery

2.1 *Battery Replacement*

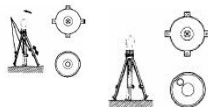
1. Insert the battery correctly into the battery holder and slide it into the housing.
2. Remove the battery and replace it with the spare

2.2. *Battery Recharging*

1. Insert recharger into the battery socket
2. Insert the plug into the 220V AC power supply, once it turns green, it is fully recharged.
3. Turn off the switch and remove the battery from the charger

3. Measurement Preparation

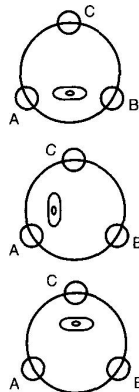
3.1 Instrument Setting Up



1. Setting up the tripod, pull out the required length and tighten the screws.
2. Place the instrument onto the tripod head, tighten the central fixing screw of the 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 vial. 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 vial.
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 90o (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 90o (100g) rotation of the instrument and check the whether the bubble is correctly centered for all four points.

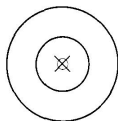
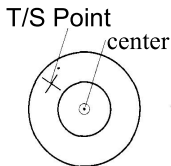
3.3 Centering by Laser plummet

Place the INSTRUMENT onto the tripod head,open the laser plummet (reference to the special function model on section No.1.3)

Slide the instrument by loosening the tripod screw, place the point on the center mark of the laser plummet.

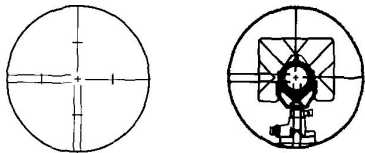
Slide the instrument carefully not to rotate that allows you to get the least dislocation of the bubble.

Note: Centering by foot screw first and then level it 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. Focus the target image with the telescope focusing knob. If it is parallax when the eye moves up, down, or left or right, it shows that the diopeter of the eyepiece lens or focus is not well adjusted. This will affect the accuracy, thus the eyepiece tube should be adjusted carefully to eliminate the parallax.



3.5 Power On

1. Leveling Instrument
2. Press the power key (red key). First, confirm that the battery is full, otherwise, please replace or recharge the battery before using.

Power

17-09-18 12: 18
VA : 88° 58' 28"
HAR : 158° 28' 58"
G.M.S.
G.M.S.

3.6 Power Off

Press the power key for 2 seconds (red key).

4. Angle Measurement

4.1 Measuring horizontal angle right and vertical angle

Operation Procedure	Display
①Enter into Angle Measurement once after power on Aim at the first target A	<div data-bbox="545 578 1019 830" style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"><p style="text-align: center;">08-01-02 12: 00</p><p>VA : 81° 54' 21"</p><p>HAR : 157° 33' 58"</p></div>

<p>② Press OSET, horizontal reading start jitte, press OSET again to set horizontal reading of target A as 0°00'00"</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>08-01-02 12: 00</p> <p>VA : 81° 54' 21"</p> <p>HAR : 0° 00' 00"</p> </div>
<p>③ Aim at the second target B. The required V/H angle to target B will be displayed.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>08-01-02 12: 00</p> <p>VA : 81° 54' 21"</p> <p>HAR : 57° 33' 58"</p> </div>

How to Collimate (reference)

1. Point the telescope towards the light, turn the diopter ring and adjust it so that the cross hairs match. (Turn the diopter towards you, 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 to collimate.
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
①Enter into Angle Measurement once after power on	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> 08-01-02 12: 00 VA : 81° 54' 21" HAR : 100° 00' 00" </div>
②Press L/R. The mode Horizontal angle Right (HR) Switches to (HL) mode.	<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;"> 08-01-02 12: 00 VA: 81° 54' 21" HAL : 260° 00' 00" </div>
★Press L/R to switch Right mode and Left mode.	

4.3 Setting Horizontal Angle

Operational Procedure	Display
①Enter into Angle Measurement once after power on	<div style="border: 1px solid black; padding: 5px;"> 08-01-02 12: 00 VA : 81° 54' 21" HAR : 100° 00' 00" </div>
②Set the required horizontal angle, using Horizontal tangent screw. Then press HOLD.	<div style="border: 1px solid black; padding: 5px;"> 08-01-02 12: 00 VA: 81° 54' 21" HAR : 100° 00' 00" </div>
③Aim at the target which need to be set up the angle	<div style="border: 1px solid black; padding: 5px;"> 08-01-02 12: 00 VA : 81° 54' 21" HAR : 100° 00' 00" </div>
④Press the HOLD to holding the horizontal angle. .	<div style="border: 1px solid black; padding: 5px;"> 08-01-02 12: 00 VA : 81° 54' 21" HAR : 100° 00' 00" <div style="text-align: right; margin-top: 5px;">HOLD</div> </div>

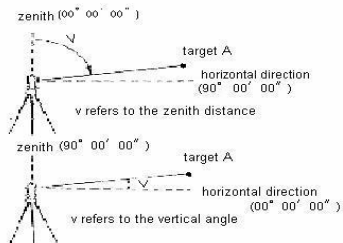
⑤Press HOLD to unlock
Horizontal angle holding

4.4 Vertical Angle Percent Grade (%) Mode

Operation Procedure	Display
①Enter into Angle Measurement once after power on	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">08-01-02 12: 00</p> <p>VA : 81° 54' 21"</p> <p>HAR : 100° 00' 00"</p> </div>
②Press % to enter into Slope Measurement.	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">08-01-02 12: 00</p> <p>VA: 50 %</p> <p>HAR : 100° 00' 00"</p> </div>
<p>★The display mode switches when pressing % key every time.</p>	
<p>★While the measurement is carried out over $\pm 45^\circ$ ($\pm 100\%$) from the horizontal, the display shows "EEEE.EEE" <OUT>.</p>	

4.5 Compasses (vertical angle) refer to parameter setting up

Vertical angle is displayed as shown below:



4.6 Remeasuring Horizontal Angle

Operation Procedure	Display
① Press \square and press HOLD to get into the mode of Horizontal Angle Remeasurement	08-01-02 12: 00 n-0 T1 HAR : 58° 23' 58" REP SFT

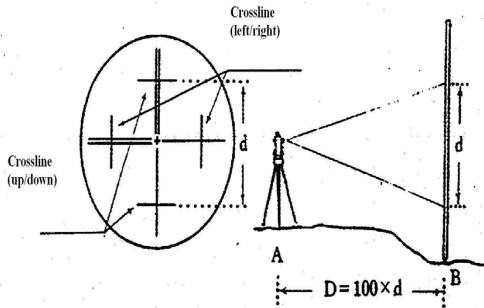
<p>② Aim at the Target A</p> <p>Press OSET (one time) to set the reading of A as: 0°00'00"</p>	<p>08-01-02 12: 00</p> <p>n-0 T2</p> <p>HAR : 0° 00' 00"</p> <p>REP SFT</p>
<p>③ Aim at the Target B by Horizontal Tangent and Clamp Screws.</p> <p>Press HOLD (one time) to remain the horizontal angle and it will be saved</p>	<p>08-01-02 12: 00</p> <p>n-1 T1</p> <p>HAR : 58° 23' 58"</p> <p>REP HOLD SFT</p>
<p>④ Aim at the Target A again</p> <p>Press OSET (one time) to set the reading of A as: 0°00'00".(It begins the first remeasurement.)</p>	<p>08-01-02 12: 00</p> <p>n-1 T2</p> <p>HAR : 58° 23' 58"</p> <p>REP SFT</p>
<p>⑤ Aim at the Target B again by Horizontal Tangent and Clamp Screws</p> <p>Press HOLD (one time) to remain and save the horizontal angle.</p>	<p>08-01-02 12: 00</p> <p>n-2 T1</p> <p>HAR : 58° 23' 58"</p> <p>REP HOLD SFT</p>

⑥ Repeat step ④ ~ ⑤ to do the required remeasurement	
Press \square , log off REP model	
★ The remeasure times is limited, the Max is 9. It will show error information	
★ When do remeasurement, it will display error information if $ \text{Measured Value} - \text{Average Value} \geq 30''$. start operation again from step 2	

5. 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 $\leq 0.4\%D$)

- 1) Place the instrument at point A, and place the leveling staff at B
- 2) Read the intercepted distance of the crossline (up/down or left/right) on the leveling staff as "d"
- 3) The horizontal distance between A and B is D ($D = 100 \times d$)



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.)

6. Laser Measurement

Attention: Please do not look into the laser directly with your eyes when it is turned on.

6.1 Orientation Measurement

Find out the other points on the line of the two known points, which should be based on the known two points, which is the laser orientation measurement.

- 1) Level the instrument first before powering it on
- 2) Aim at the target through the horizontal tangent and clamp screws.
Turn on the laser. The other points can be found out with a board which can focus the laser.

6.2. Angle Designment

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

- 1) Level the instrument first before powering on. This must be done on a fiducial point.
- 2) Aim at another fiducial point carefully, and set the horizontal angle as $0^{\circ}00'00''$
- 3) Move the telescope to make the horizontal angle with the required value.
Turn on the laser and the fiducial line will make up an angle.

6.3 Zeith Measurement

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

- 1) Take away the eyepiece, fit on the diagonal eyepiece and lock it
- 2) Level the instrument, then power it on. This must be done on a fiducial point.
- 3) Circumgrate the telescope to make the vertical angle to $0^{\circ}00'00''$, then power the laser on. Focus the screw to make the facula minimum, loosen the horizontal clamp screw, move the telescope geometry center of the facula's moving track in a vertical direction.

6.4 Level Measurement

- 1) Level the instrument, then power it 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 a level line.

7. Parameter Setting up

7.1 Enter into Setting up Parameter

Operation Procedure	Display
①Power on, Press ☒ and press L/R at same time to enter into Menu Mode.	08-01-02 12: 00 0 0 0 0 0 0 0 1. OFF

<p>②Press OSET, page turning. (Continuous press)</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>08-01-02 12: 00 0 0 0 0 0 0 0 2. OFF</p> </div>
<p>③Press L/R to set up parameter.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>08-01-02 12: 00 0 0 0 0 0 0 0 1. ON</p> </div>
<p>④Press \square to save, back to angel measurement model.</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>08-01-02 12: 00 VA 88° 58' 28" HAR 118° 00' 00"</p> </div>

7.2 Setting up the Parameters

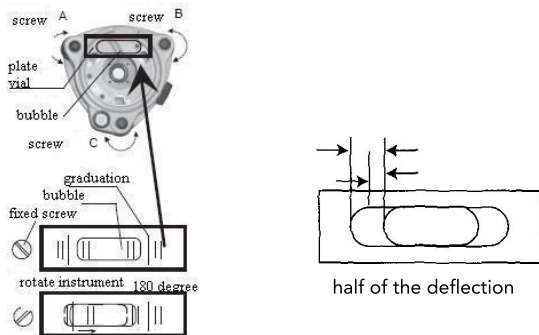
NO.	FUNCTION	STATUS
1	VA compensator	Open(ON)/ off (OFF)
2	Position 0 (Vertical Angle)	90°(ON)/ 0°(OFF)

3	Power off automatic	Instrucment will be power off within 30 seconds if there are nothing operation (ON)/ can't power off automatic (OFF0
4	Min. Angle reading	Min. Reading is 1",5",10"
5	Baud rate setup	1200,2400,4800,9600
6	Ringing when Horizontal 90°	Ringing(ON)/ No ringing(OFF)
7	Angle Unit	360°/ 400g

Remarks: Press "HOLD",under model "parameter setup", enter to TIME SETUP. Press "L/R" to add 1 more,press % to decrease 1, press "HOLD" to switch year,month, date, hour and minute(optional)

8. Check and Adjustment

8.1 Check and Adjustment of Plate Vial



Check: Rotate the instrument horizontally by loosening the horizontal clamp screw and 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.

Rotate the instrument 180° (200g) around its vertical axis.

Observe the bubble of the plate vial. Follow the steps to adjust it if the bubble is not centered

ADJUSTMENT

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.

Confirm whether the bubble does is in the center by rotating the instrument 180°. If not, repeat above step.

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

8.1 Check and Adjustment of Plate 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.

8.2 Check and Adjustment of Plate Vial

CHECK

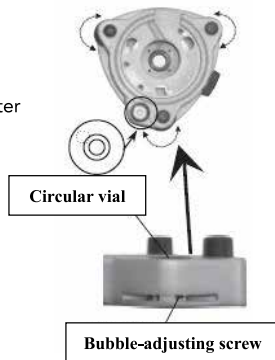
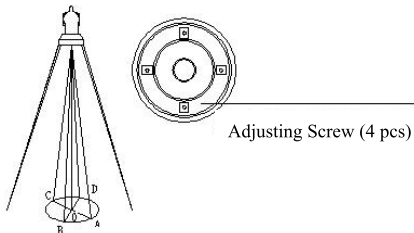
No adjustment is necessary if the bubble of the circular vial is in the center after inspection and adjustment of the plate vial.

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 the two bubble-adjusting screws.

8.3

Check and adjustment of optical plummet



CHECK

Set the instrument on the tripod and place a piece of white paper with two perpendicular lines, then intersect them 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.

Rotate 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, follow the adjustment necessary.

ADJUSTMENT

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

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

Rotate 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 the intersection point, no adjustment is necessary.

Otherwise, repeat steps above.

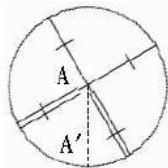
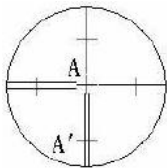
8.4 Check and Adjustment of Inclination of Reticle

CHECK

Set the instrument on a tripod and level it.

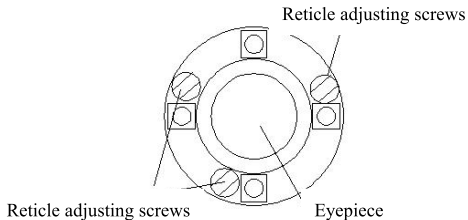
Aim at target A with telescope (One point, 50m away)

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



ADJUSTMENT

Remove the eyepiece cover to expose the four reticle screws.



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.

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

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

8.5 Check and adjust the Discrepancy between Twice Collimation Errors

CHECK

Set the instrument on a tripod and level it

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

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

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

If $C \leq 8''$, no adjustment is necessary; If $C > 8''$, follow these steps to adjust it.

ADJUSTMENT

Rotate the fine motion screw in the right position and make the reading $HR + C$

Remove the eyepiece cover to adjust two adjusting screws, which makes reticle coincides with the cross line of the collimator or one target away.

Repeat and check the adjustment until $C \leq 8''$

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

8.6 Check and Adjust the Vertical Index Difference

Inspect the item after finishing the inspection and adjustment of section 8.4 and 8.5

Set the instrument on a tripod and level it

Sight object A in the left position and read the vertical angle value VI.

Rotate the telescope. Sight object B in the right position and read the vertical angle value VR

Calculate, $i = (VI + VR - 360^\circ) / 2$

If $i \leq 10''$, no adjustment is necessary. If $i > 10''$, adjust it.

ADJUSTMENT

Please adjust through a software if the difference between the index is too big

Operation Procedure	Display
<p>①Keep to press L/R to power on until right screen occurs. Loose L/R</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>08-01-02 12: 00 SET F1 HAR 18° 00' 00"</p> </div>
<p>②Aim at target (left position). Press 1 time 0SET</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>08-01-02 12: 00 SET F2 HAR 118° 00' 00"</p> </div>
<p>③Aim at target (right position). Press 0SET, there is "SET" on display, Page turning when press 0SET again, record VR as VA reading. .</p>	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <p>08-01-02 12: 00 SET HAR 298° 00' 00"</p> </div>
<p>④.Aim at target (left position) again,record VI as VA reading. Press 1 time 0SET. Finish adjustment. Repeat,if not within standard</p>	

8.7 Check and Adjust the Laser Confocal and Coaxial

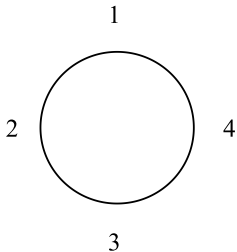
Finish the inspection of item 8.4 and 8.5

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 it until the facula is small.

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 pictured below).



Up, Tighten Screw 1, Loosen Screw 3

Down, Tighten Screw 3, Loosen Screw 1

Left, Tighten Screw 4, Loosen Screw 2

Right, Tighten Screw 2, Loosen Screw 4

9. Technical Data

Telescope

Image	Erect
Magnification	30x
Effective Aperture	47mm
Resolving Power	3.75"
Field of View	1°30' (26m/1000m)
Min. Focus	1.5m
Stadia Ratio	100
Tube Length	169mm

Angle Measurement

Measuring Method	Absolute Encoding
Diameter	79mm
Min. Reading	1", 5", 10"
Measuring Unit	360°, 400gon
Vertical Angle 0°	Zenith 0°, Horizontal 0°
Accuracy	2"

Vial

Plate Vial	30"/2mm
Circular Vial	8'/2mm

Compensator

Electronic tilt sensor	Vertical compensation
Compensation Range	±3'
Resolving Power	6"

Display

Type	Dual Face LCD
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On-board Battery

Power Resource	Rechargeable Li-ion battery
Voltage	DC 7.4V
Operation Time	BDC 1600 mAh (About 20 hours)

Laser

Length of the Wave	635nm
Power	10mW
Effective Range	150m
Position Error	≤5"
Power	DC 3.3V
Working Temperature	-10°C - +45°C

Others

Operating Temperature	-20°C - +50°C
Dimension	180mm x 166mm x 355mm
Weight	6.5kg

10. Packing List

Instrument	1 Piece
Manual	1 Piece
Carrying Case	1 Piece
Tool Bag	1 Piece
Battery	2 Pieces
Charger	1 Piece



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