



ET2A Electronic Digital Theodolite


USER GUIDE



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 This product has been tested and found to comply with European Council Directive 2014/30/EU, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). These requirements are designed to provide reasonable protection against harmful interference when the device is operated in a residential or commercial environment.

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1 Before You Start

Before you start, please carefully read this part.

1.1 Precautions for Safe Operation

For the safety of your product and prevention of injury to operators and other persons as well as prevention of property damage, please read this part carefully before using your product.

Precautions can be divided into the following types according to the degree of loss or injury in case of negligence or omission:

- **Warning:** Precautions requiring special attention. Ignoring this indication may result in death or serious injury to the operator.
- **Caution:** Precautions mainly for informing, such as supplementary instructions and using limitations. Ignoring this indication may result in personal injury or property damage.

1.1.1 Warning

- This instrument is only for qualified surveyor or professional users who have a good knowledge of surveying.
- Only eSurvey authorized distributors can disassemble or rebuild the instrument.
- To avoid permanent eye damage, please do not point the laser beam at other's eyes, do not directly look into the laser beam source, do not stare at the laser beam, and do not look at the laser beam through a telescope or other optical devices.

- Please do not collimate the sun directly. Otherwise, eye injury or blindness and objective damage may occur.
- Please do not cover the charger when charging. Otherwise, fire may occur.
- Please do not use wet battery or charger, defective power cable, socket or plug, and power cable and battery not specified by eSurvey. Otherwise, fire or electric shock may occur.
- Please do not put the instrument close to burning gas or liquid and the battery in the fire or high temperature condition, and do not use the instrument in coal mine. Otherwise explosion may occur.
- Please avoid short circuit of the battery. Otherwise, fire may occur.
- Please avoid disturbance of severe electrostatic discharge. Otherwise, degraded performances of the instrument may occur, like switching on/off automatically, etc.

1.1.2 Caution

- For optimum usage, please regularly check and adjust the instrument (at least every three-month) especially after storage for a long time and transportation.
- Please make sure there is no leaves or obstacles between the target and the instrument for good measuring result.
- Please set up the instrument on the tripod, and make sure the connection between the tripod and instrument is firm.
- When transporting, please keep the instrument in the case provided and try your best to minimize vibration of the instrument.
- Please 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 avoid direct sunlight from passing through the objective and eyepiece which may cause interference.
- Please do not touch the lens with your fingers. And please clean the surface, buttons, screen and outer layer of the instrument with a soft cloth, and clean the optical parts only with lens paper.
- Please store the instrument and battery in a dry and cool place with proper temperature.
- When carrying the instrument, please tightly hold the handle.
- Please do not take out the battery when the instrument is on, and please replace the battery after powering off the instrument. Otherwise, the stored data may be lost.
- Please do not touch the instrument with wet hand. Otherwise, electric shock may occur.
- Please do not arbitrarily stand or seat on the carrying case, or turn over it. Otherwise, the instrument may be damaged.
- Please be careful of the tripod tiptoe when setting up or moving it.
- Once your work is completed, please clean the instrument, and keep it back into the case.
- Please do not drop the instrument or the carrying case, or use defective belt, agraffe or hinge. Otherwise, the instrument may be damaged.
- Please do not touch liquid leaking from the instrument or battery. Otherwise, harmful chemicals could cause burn or blisters.

1.2 Exemptions from Responsibility

You are expected to follow all operating instructions and regularly check the performance of this instrument.

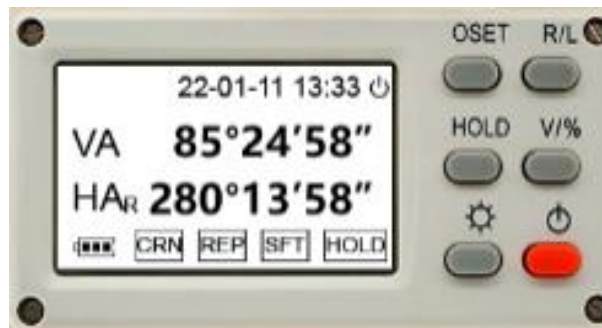
We assume no responsibility for any damage and loss of profits caused by the following conditions:

- A faulty or intentional usage or misuse.
- Any disasters, such as earthquakes, storms, floods etc.
- A change of data, loss of data, an interruption of business etc.
- Wrong transport.
- Use of non-original parts.
- Usage not explained in the user guide.





2 ET2A at a Glance









1. Handle
2. Telescope
3. Objective
4. Battery
5. Diopter ring
6. Eyepiece cover
7. Focusing knob
8. Optical sight
9. Telescope cover
10. Eyepiece
11. Tribrach
12. Foot screw
13. Plate level
14. Vertical tangent screw
15. Horizontal tangent screw
16. Circular level
17. Display



Keyboard

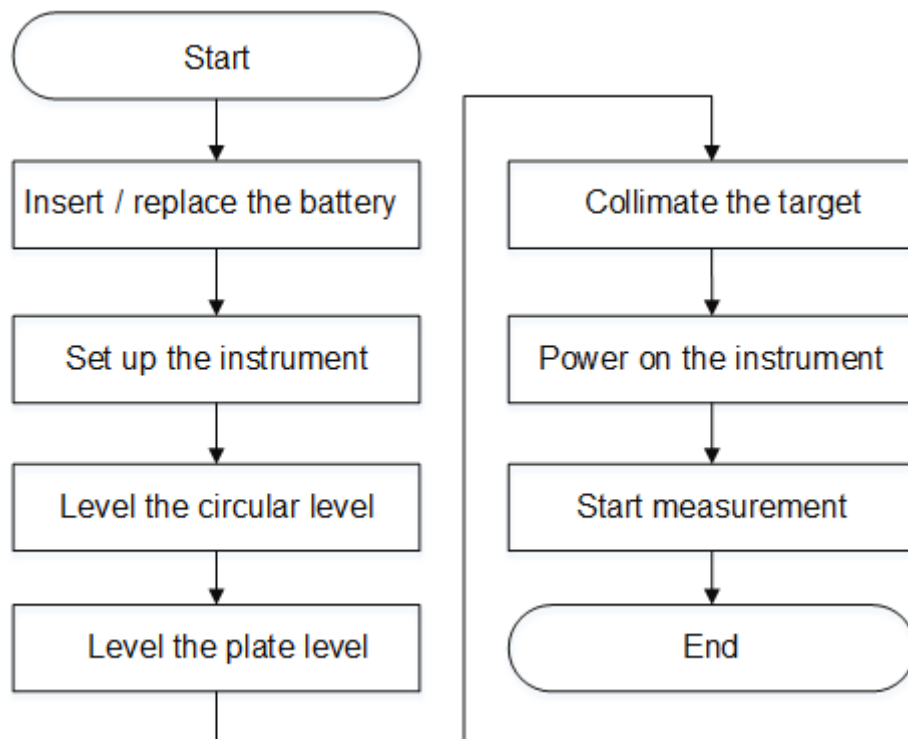
Keys	Meaning
0SET	Set the horizontal angle to 0.
R/L	Set the horizontal angle right or left.
HOLD	Hold the horizontal angle.
V/%	Set the display unit of the vertical angle ($^{\circ}$ or %) by pressing 1 second and turn on or off the laser pointer by pressing 3 seconds.
	Turn on or off the light by pressing 3 seconds.
	Power on or off the instrument by pressing 3 seconds and turn on or off the laser plummet by pressing 1 second after powering on the instrument.
 + R/L	Configure the instrument.
 + HOLD	Measure the same horizontal angle several times.

Display

Characters	Meaning
22-01-11	The current date (year-month-day).
13:33	The current time.
	The instrument will automatically power off within 30 minutes if no action is carried out.
VA	The vertical angle.
HA ^L	The horizontal angle left.
HA _R	The horizontal angle right.
	The battery level.
	The compensator is ON.
	Measure the same horizontal angle several times.
	Hold the horizontal angle.
	Change the function.

3 Quick Start

The process of quick start is as follows:



3.1 Insert / Replace the Battery

Battery Inserting / Replacing

To insert / replace the battery, do the following:



Battery Charging

To charge the battery, do the following:

1. Insert the charger cable to the battery:



2. Insert the plug of the charger into 220 V ac power supply.
3. Unplug the charger and take the battery out from the charger when the green light appears.

3.2 Set up the Instrument


It is to set up the instrument over a marked ground point by using the laser plummet.

The laser plummet is built into the vertical axis of the instrument. It projects a red spot onto the ground, making it appreciably easier to center the instrument.



CAUTION: When setting up the tripod, please pay attention to ensure a horizontal position of the tripod plate. Slight corrections of inclination can be made with the foot screws of the tribrach, while larger corrections must be done with the tripod legs.

To set up the instrument, do the following:

1. Loosen the clamping screws on the tripod legs, and pull out to the required length to allow for a comfortable working posture.
2. Position the tripod over the marked ground point, centering it as best as possible, sufficiently press the tripod legs into the ground to guarantee a firm foothold, and tighten the clamps. When pressing the tripod legs into the ground note that the force must be applied along the legs.
3. Fasten the tribrach and instrument onto the tripod.
4. Press  to turn on the instrument and laser plummet.



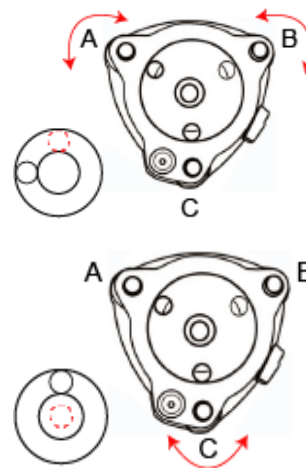
3.3 Level the Circular Level

It is used to do basic levelling-up with the circular level.

To level the circular level, do the following:

1. Adjust foot screw A and B in the opposite direction until the circular bubble is perpendicular to a line shaped with foot screw A and B.

The direction of your left thumb indicates the movement of the circular bubble.



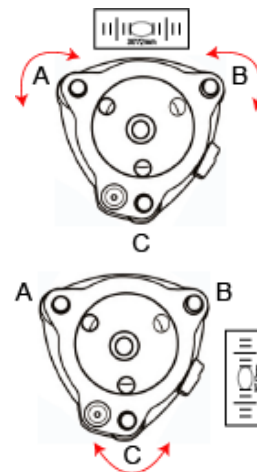
2. Move the bubble to the center of the circle by adjusting foot screw C:

3.4 Level the Plate Level

The plate level can be used to precisely level up the instrument using the foot screws of the tribrach.

To level the plate level, do the following:

1. Loosen the horizontal tangent screw, rotate the instrument and lock it until the plate level is parallel to a line shaped with foot screw A and B, and adjust foot screw A and B to make the bubble in the center of the plate level.
2. Loosen the horizontal tangent screw, rotate the instrument approximately 90° and lock it, and adjust foot screw C until the bubble is in the center of the plate level.
3. Repeat above steps until the bubble remains in the center of the plate level while the instrument is rotated to any position.



At this time, the instrument has been perfectly levelled up.

3.5 Collimate the Target

To collimate the target, do the following:

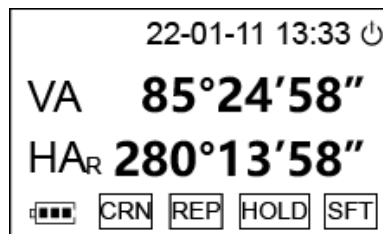
1. To clearly observe the reticle, point the telescope towards the light, turn the diopter ring and adjust the diopter.
2. Aim the target at the peak of the triangle mark of the optical sight, and allow a certain space between the optical sight and yourself for collimation.
3. Focus the target with the focusing knob.
4. **Optional:** To eliminate the parallax between the reticle and the target when viewing vertically or horizontally while looking into the telescope, carefully focus and adjust the diopter adjustment.

It indicates that focusing is incorrect or diopter adjustment is poor, which will adversely affect the precision of measurement or survey.

3.6 Power on the Instrument

Before powering on the instrument, make sure the battery is full, replace and charge the battery if not.

To power on the instrument, press :



3.7 Start Measurement

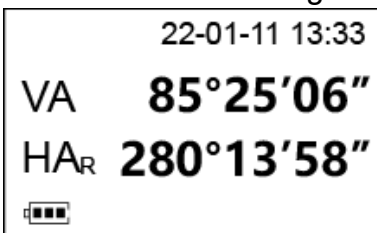
See Angle Measurement for details.

4 Angle Measurement

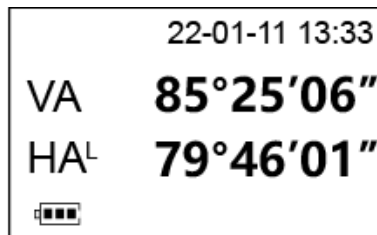
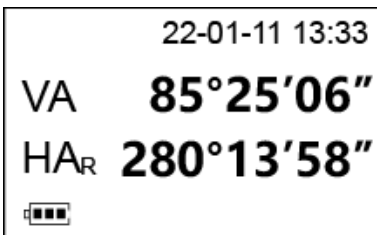
4.1 Measure a Horizontal Angle

To measure a horizontal angle, do the following:

1. Enter angle measurement after powering on the instrument.
2. Aim at the first target A.
3. Press **0SET**.
4. Press **0SET** again to set the horizontal reading of target A as $0^{\circ}00'00''$.
5. Aim at the second target B. The required V/H angle to target B shows:



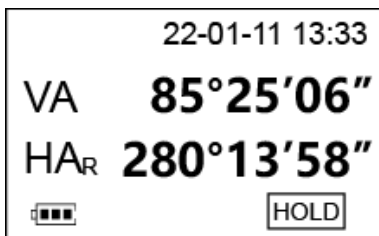
6. **Optional:** To switch the horizontal angle between right mode and left mode, press **R/L**:



4.2 Hold the Horizontal Angle

To hold the horizontal angle, do the following:

1. Enter angle measurement after powering on the instrument.
2. Set the required horizontal angle, and press **HOLD**.
3. Press **HOLD** to hold the horizontal angle:



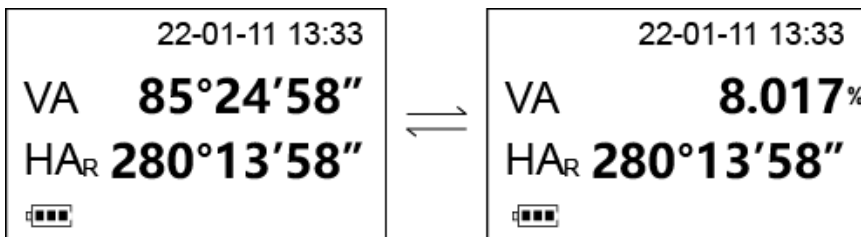
4. Aim at the target.
5. **Optional:** To unlock the horizontal angle, press **HOLD** again.

4.3 Show the Vertical Angle in Percentage

Before showing the vertical angle in percentage, make sure position 0 (vertical angle) is set as **OFF** (0°).

To show the vertical angle in percentage, do the following:

1. Enter angle measurement after powering on the instrument.
2. Press **V/%**:



CAUTION: EEEE.EEE appears on the display while the measurement angle is carried out over $\pm 45^\circ$ ($\pm 100\%$) from the horizon.

3. **Optional:** To switch to the angle mode, press **V/%** again.

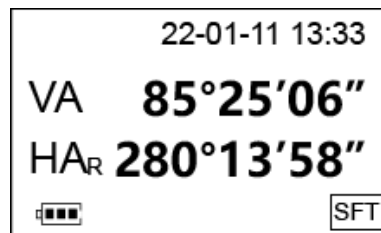
4.4 Measure the Horizontal Angle Several Times

It is used to make sure the high accuracy of angle measurement through measuring the same angle at most nine times.

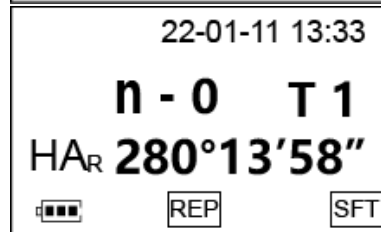
When the limited number of times is reached, error information will show.

To measure the horizontal angle several times, do the following:

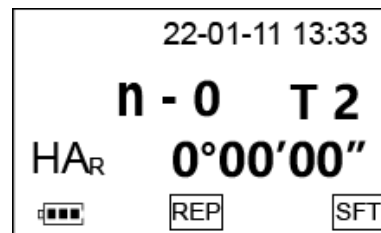
1. Press :



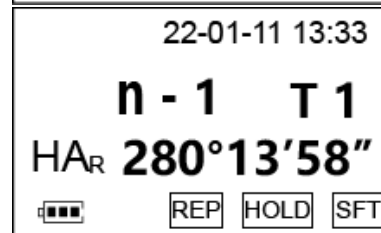
2. Press **HOLD**:



3. Aim at target A, and press **0SET** to set the reading of A as **0°00'00"**:



4. Aim at target B, and press **HOLD**. The horizontal angle shows:



5. Repeat step **3** and step **4** until the number of times for measuring the same horizontal angle has been finished.

4.5 Measure the Zenith

It is to comfortably observe steep sights with a diagonal eyepiece, up to the zenith.

To measure the zenith, do the following:

1. Take away the original eyepiece, fit on the diagonal eyepiece and lock it.
2. Level up the instrument and power on the instrument.
3. Rotate the telescope to make the vertical angle to any angle.

5 Distance Measurement

It is used to measure the horizontal distance between the instrument and the target point through the reticle in the telescope.

Through the reticle (up / down / left / right) in the telescope to measure the distance between the target and the instrument.

To measure the distance, do the following:

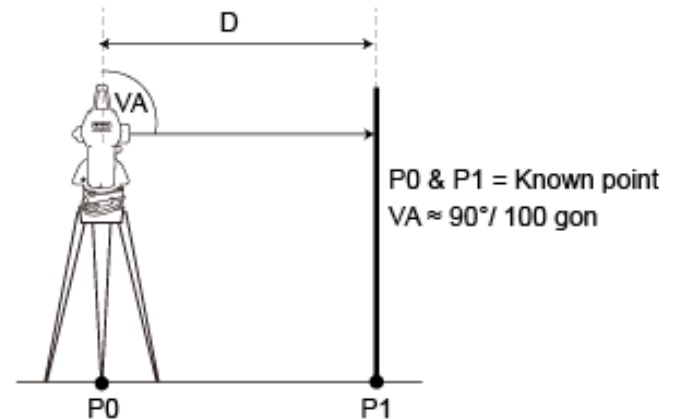
1. Place the instrument above point A and level up.
2. Place the levelling staff on point B.
3. Aim on the levelling staff and read the distance L.

$L = \text{Upper distance line} - \text{Lower distance line}$

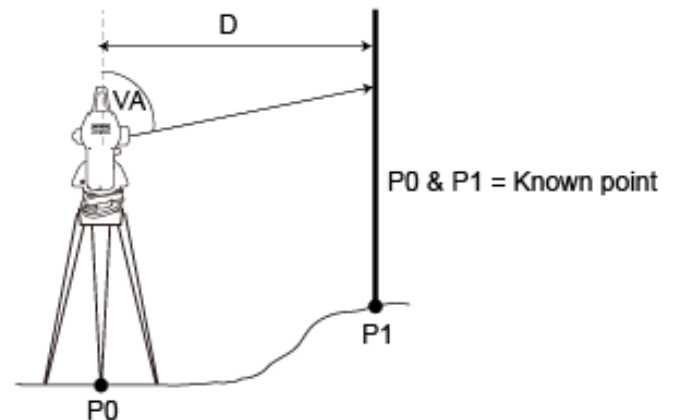
4. Do one of the following:

- If the zenith is 90° (the measurement ground is flat), calculate distance D following formula $D = 100 * L$:

100 refers to the stadia proportion constant of the instrument.



- If the zenith is not 90° (the measurement ground is curve), calculate distance D following formula $D = 100 * L * \sin^2 V$:

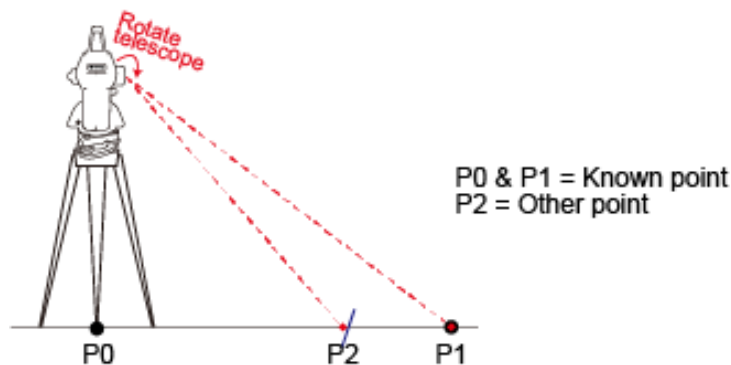


6 Laser Measurement

! WARNING Please do not directly watch the laser with eyes when the laser pointer is turned on.

6.1 Measure the Orientation

It is to find out the other points on the line of the two known points.

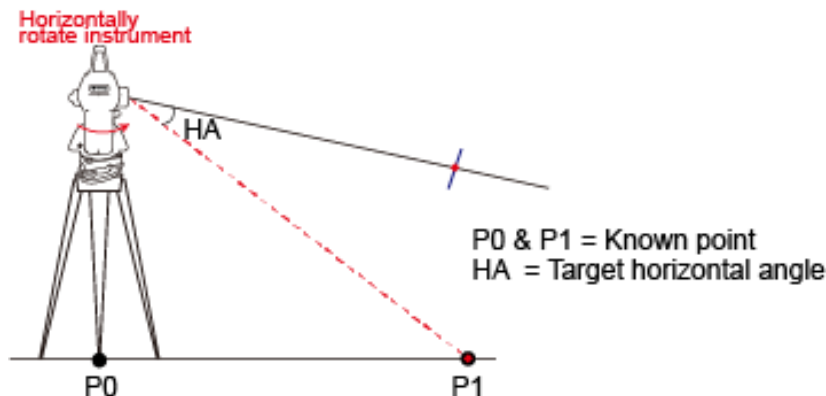


To measure the orientation, do the following:

1. Level up the instrument and power on the instrument.
2. Aim at the target point.
3. To turn on the laser, press **V/%** for three seconds.
4. Rotate the telescope.
5. To find other points, place a board on the target place. The laser point appears on the board.

6.2 Design the Target Angle

It is to find the fiducial line with the designed horizontal angle, based on the line of two known points.



To design the target angle, do the following:

1. Level up the instrument and power on the instrument.
2. Aim at the target point, and press **OSET** to set the horizontal angle as **0°00'00''**.
3. Horizontally rotate the instrument to make the horizontal angle the designed angle.
4. To turn on the laser, press **V/%** for three seconds.
5. To find the fiducial line, place a board on the target place. The laser point appears on the board and the fiducial line is found.

6.3 Set the Level Line

The red level line can be used as the level line.

To set the level line, do the following:

1. Level up the instrument and power on the instrument.
2. To turn on the laser, press **V/%** for three seconds. The red level line is the level line.

7 Configuration Menu

With the configuration menu, you can achieve the following:

- Switch on/off the tilt compensator of the vertical angle
- Define the zenith
- Set automatic power-off
- Set the minimum angle reading
- Set the baud rate
- Set the recording medium
- Set the beep
- Set the angle unit
- Set the date and time


7.1 Switch on/off the Tilt Compensator of the Vertical Angle

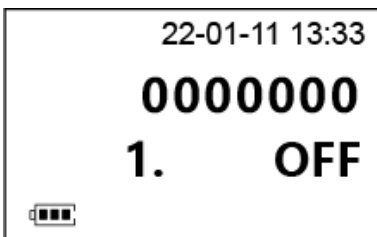
The compensator normally remains switched on.

If the instrument is used on an unstable base (e.g. shaking platform, ship, etc.) the compensator must be switched off, which can avoid the compensator drifting out of the measuring range and interrupting the measuring process by indicating an error.

The working range of the compensator is at $\pm 3'$ ($\pm 0.05.56$ gon). If the tilt angle exceeds the work range, the vertical angle will show **TILT** on the display.

To switch on/off the tilt compensator of the vertical angle, do the following:

1. Press  → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:

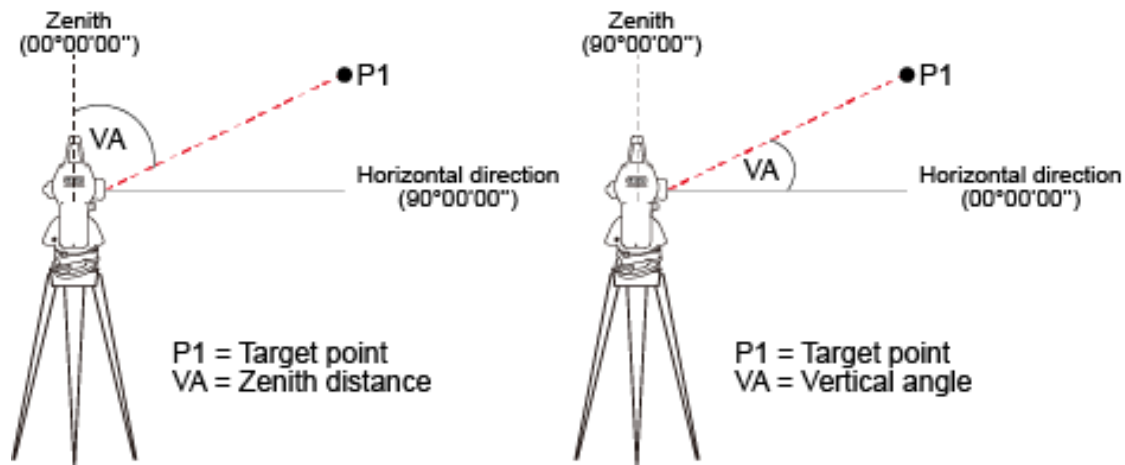


3. Do one of the following:
 - To switch on the compensator, press **R/L** to change the value to **ON**. Character **CRN** shows on the left lower of the display.
 - To switch off the compensator, press **R/L** to change the value to **OFF**.


4. Press  to confirm selection.

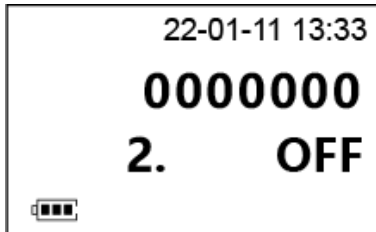
7.2 Define the Zenith


It is to define the zenith as $00^{\circ}00'00''$ or $90^{\circ}00'00''$.



To define the zenith, do the following:

1. Press  → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:




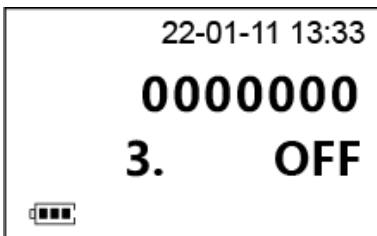
3. Do one of the following:
 - To define the zenith as 90°00'00", press **R/L** to change the value to **ON**.
 - To define the zenith as 00°00'00", press **R/L** to change the value to **OFF**.
4. Press  to confirm selection.



7.3 Set Automatic Power-off

Automatic power-off is to prevent unnecessary power consumption. With it activated, the instrument will automatically power off after 30 minutes if no action is carried out.

To set automatic power-off, do the following:

1. Press  → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:




3. Do one of the following:
 - To turn on automatic power-off function, press **R/L** to change the value to **ON**.  shows in the upper right on the display.
 - To turn off automatic power-off function, press **R/L** to change the value to **OFF**.
4. Press  to confirm selection.

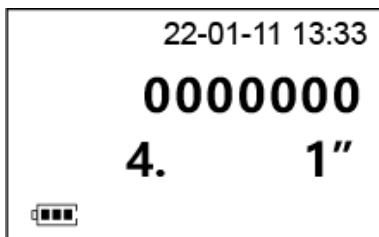
7.4 Set the Minimum Angle Reading


You can select the displayed angle format in three steps (1", 5" or 10"):

Step	Degree sexagesimal	Gon
1"	0° 00' 01"	0.00.03 gon
5"	0° 00' 05"	0.00.15 gon
10"	0° 00' 10"	0.00.30 gon

To set the minimum angle reading, do the following:


1. Press  → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:

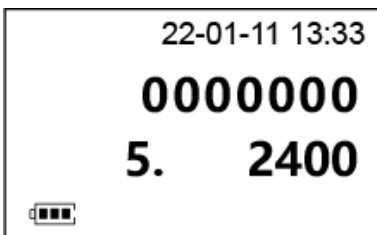



3. Press **R/L** to select one of the following:
 - 1"
 - 5"
 - 10"
4. Press  to confirm selection.

7.5 Set the Baud Rate

To set the baud rate, do the following:


1. Press  → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:

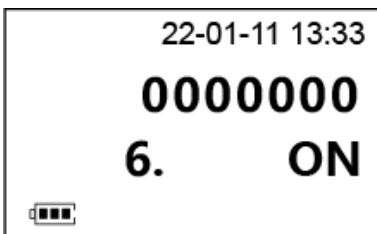



3. Do one of the following:
 - To set the baud rate to 1200, press **R/L** to change the value to **1200**.
 - To set the baud rate to 2400, press **R/L** to change the value to **2400**.
 - To set the baud rate to 4800, press **R/L** to change the value to **4800**.
 - To set the baud rate to 9600, press **R/L** to change the value to **9600**.
4. Press  to confirm selection.

7.6 Set the Recording Medium

To set the recording medium, do the following:

1. Press  → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:




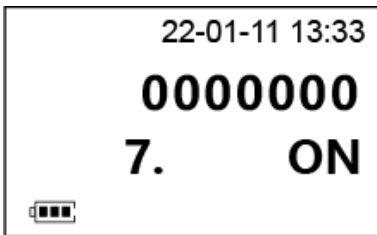
3. Do one of the following:
 - To set the recording medium to serial port, press **R/L** to change the value to **ON**.
 - To set the recording medium to instrument memory, press **R/L** to change the value to **OFF**.
4. Press  to confirm selection.


7.7 Set the Beep

The beep is an acoustic signal at right angles (0°, 90°, 180°, 270° or 0 gon, 100 gon, 200 gon, 300 gon).

To set the beep, do the following:

1. Press  → **R/L** to enter configuration mode.
2. Press **0SET** to turn to the following page:




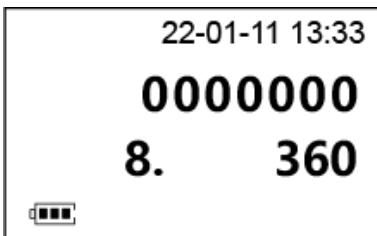
3. Do one of the following:
 - To switch on the beep, press **R/L** to change the value to **ON**.
 - To switch off the beep, press **R/L** to change the value to **OFF**.
4. Press  to confirm selection.


7.8 Set the Angle Unit

The setting of the angle unit can be changed at any time. And the actual values are converted according to the selected unit.

To set the angle unit, do the following:


1. Press  → **R/L** to enter configuration mode:
2. Press **0SET** to turn to the following page:



3. Do one of the following:
 - To set degree sexagesimal as the angle unit, press **R/L** to change the value to **360**.
Possible angle values: 0° to 359°59'59"
 - To set gon as the angle unit, press **R/L** to change the value to **400**.
Possible angle values: 0 gon to 399.99.99 gon
4. Press  to confirm selection.

7.9 Set the Date and Time

To set the date and time, do the following:

1. Press  → **R/L** to enter configuration mode:
2. Press **OSET** → **HOLD** to enter date and time setup.
3. To switch among year, month, day, hour and minute, press **HOLD**.
4. Press **R/L** to add 1, and press **V/%** to deduct 1.

8 Check and Adjustment

8.1 Check and Adjust the Plate Level

To check and adjust the plate level, do the following:

1. Level the Plate Level.
2. Rotate the instrument 180° (200 gon), and observe if the bubble moves from the center:
 - If it does, proceed to step **3 - 5**.
 - If not, no adjustment is required
3. Adjust the foot screw that is parallel to the plate level, and move the bubble half of the shift to the center of the plate level:

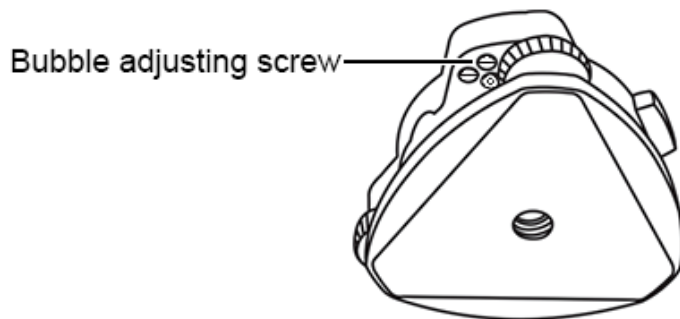


4. To move the bubble the remaining half distance towards the center of the plate level, adjust the adjusting screw of the plate level with the adjustment pin.
5. Repeat step **3 - 5** until the bubble can remain at the center of the plate level when the plate level rotates to any position.

8.2 Check and Adjust the Circular Level

To check and adjust the circular level, do the following:

1. Level the Circular Level.
2. Observe if the bubble is in the center:
 - If it is, no adjustment is required.
 - If not, proceed to step 3.
3. Adjust the two bubble adjusting screws with the adjustment pin:

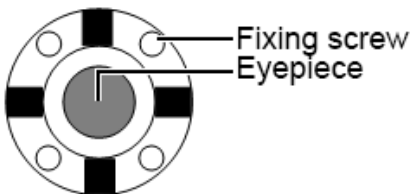


8.3 Check and Adjust the Vertical Line of the Reticle

If the vertical line of the telescope reticle is not perpendicular to the horizontal axis of the telescope, adjustment is required (because one point on the vertical line may be used to collimate the target for horizontal angle measurement or for vertical staking).

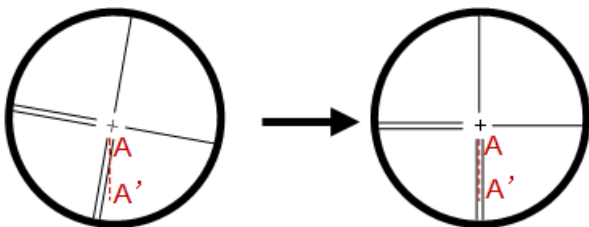
To check and adjust the vertical line of the reticle, do the following:

1. Set the instrument on a tripod and precisely level it.
2. Set a point A at 50 m away from the instrument.
3. Collimate the telescope of the instrument to point A, turn the vertical tangent screw, and observe if point A moves along the vertical line of the reticle:
 - If it does, no adjustment is required.
 - If not, proceed to step 4 - 8.
4. Turn the eyepiece cover of the reticle counterclockwise, and remove the cover to expose the four screws fixing the eyepiece:



5. Use a cross screwdriver to slightly loosen the four screws fixing the eyepiece.

6. Turn the eyepiece end until the vertical line of the reticle overlaps with point A:



7. Tighten the four screws fixing the eyepiece.
8. Repeat calibration until point A always moves along the vertical line of the reticle.

After doing correction for the vertical line of the telescope reticle, check the collimation error and index error of the instrument.

8.4 Check and Adjust the Line-of-Sight Error or Collimation Error

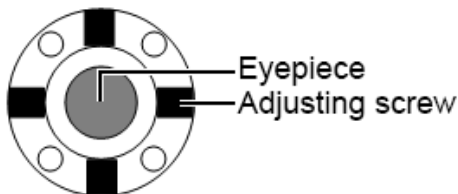
The line-of-sight error or collimation error (C) is the deviation from the perpendicular between the tilting axis and the line of sight, and it affects the horizontal angle readings and increases with steep sightings. When the error is greater than 8", adjustment of the collimation error is required.

These errors should be determined before the instrument is used for the first time, before precision surveys, after long periods of transport, before and after long periods of work, and if the temperature changes by more than 10°C (18°F).

To adjust the line-of-sight or collimation error, do the following:

1. Set the instrument on a tripod and precisely level it.

2. Enter angle measurement after powering on the instrument.
3. Aim at the first target A, and press **OSET** twice to set the horizontal reading of target A as 0°00'00".
4. Aim at the second target B. The horizontal angle to target B shows (HA1).
5. Rotate the instrument 180°.
6. Repeat step 3 - 4. The horizontal angle to target B shows again (HA2).
7. Calculate the collimation error:
$$C = (HA1 - HA2 \pm 180^\circ) / 2$$
8. Judge if the error is within the allowable range:
 - If it is less than or equal to 8", no adjustment is required.
 - If it is greater than 8", proceed to step 9 - 11.
9. Rotate the instrument in the right position, and make the reading is $HA2' = HA2 + C$.
10. Remove the eyepiece cover to adjust the two horizontal adjusting screws until the reticle coincides with the reticle of collimator or the target:



11. Repeat the whole process of checking and adjusting the collimation error until the error is less than or equal to 8".

8.5 Check and Adjust the Vertical Index Error

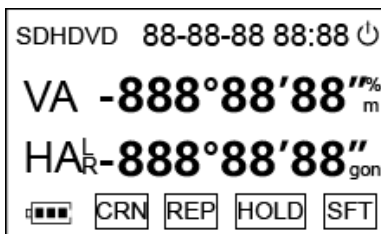
The deviation between vertical circle zero position and horizontal direction is vertical index. It is necessary to concern this error when measuring vertical angle.

Because of the close relationship between vertical index and compensator zero position, it is necessary to check and adjust compensator zero position when adjusting the vertical circle, to keep the value stable when reading.

To check and adjust the vertical index error, do the following:

1. Set the instrument on a tripod and precisely level it.
2. Enter angle measurement after powering on the instrument.
3. Aim at target A. The vertical angle shows (VA1).
4. Rotate the instrument 180°.
5. Aim at target A again. The vertical angle shows (VA2).
6. Calculate the vertical index error:
$$C = (VA1 - VA2 \pm 360^\circ) / 2$$
7. Judge if the error is within the allowable range:
 - If it is less than or equal to 10", no adjustment is required.
 - If it is greater than 10", proceed to step **8 - 12**.

8. Press  to power on the instrument, and long press **R/L** when the following display shows:



The following result shows:



9. Aim at the reticle of collimator or the obvious target at a distance, and press **0SET**:



10. Rotate the instrument 180°.
11. Aim at the reticle of collimator or the obvious target at a distance, and press **0SET** twice.



12. Repeat the whole process of checking and adjusting the vertical index error until the error is less than or equal to 10\".

8.6 Check and Adjust the Laser Spot

After aiming at the target, the laser spot should be the minimum when the laser is turned on. If not, you need to adjust the laser spot.

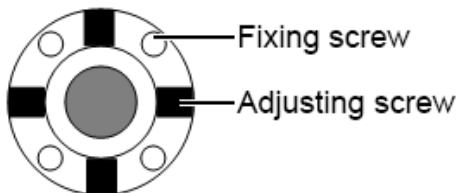
To check and adjust the laser beam, do the following:

1. Set the instrument on a tripod and precisely level it.
2. Enter angle measurement after powering on the instrument.
3. To turn on the laser, press **V/%** for three seconds.
4. Aim at the target.

5. Check if the laser spot is the minimum.

If not, do the following:

- a. Make the plate level and the eyepiece towards yourself.
- b. Loosen the fixing screws on the telescope cover.
- c. Loosen the fixing screws on the laser pedestal:



- d. Move the pedestal until the laser spot is the minimum.

6. Check if the laser spot overlaps with the reticle.

If the deviation is out of the allowable range, adjust the adjusting screws on the laser pedestal as follows:

- Up: tighten adjusting screw 1, and loosen adjusting screw 3.
- Down: tighten adjusting screw 3, and loosen adjusting screw 1.
- Left: tighten adjusting screw 4, and loosen adjusting screw 2.
- Right: tighten adjusting screw 2, and loosen adjusting screw 4.

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