

Electronic Theodolite/ Laser Theodolite ET-02/02L ET-05/05L

Instruction Manual



PREFACE

Dear users:

Welcome to purchase and use our products and thank you for your confidence in our company's products!

It has been our target to innovate the international-level advanced surveying instrument since our company was established. All our surveying products are good-looking, reliable and multifunctional. Please read this operational manual carefully before usage of the instrument.

If you have any questions or suggestions, please do not hesitate to contact with the nearest sales department. We will do our best to serve you.

(In order to keep the instrument in good condition, we suggest that you should maintain it once annually at the sales department.)

The rights for revising technology and product specification are reserved by manufacturer and do not inform in advance.

CONTENTS

1. FEATURES	1
2. PREPARATIONS	2
2.1 PRECAUTIONS	2
2.2 PARTS	4
2.3 UNPACKING AND STORAGE.....	8
2.4 BATTERY AND CHARGER	8
2.5 ASSEMBLE AND DISASSEMBLE THE BASAL STUMP.....	10
3. KEYBOARD AND PANEL.....	12
3.1 KEYBOARD	12
3.2 PANEL	14
3.3 DISPLAY INFORMATION.....	15
4. INITIAL SETTING	16
4.1 SETTING ITEMS	16
4.2 SETTING METHOD.....	17
5. PREPARATION FOR SURVEY	20
5.1 CENTERING AND LEVELING.....	20
5.2 EYEPIECE ADJUSTMENT AND OBJECT SIGHTING	23
5.3 POWER ON OR OFF	25
5.4 VERTICAL INDEX ZERO SETTING (V 0SET)	26
6. BASIC SURVEY	27
6.1 OBSERVATION FROM NORMAL/REVERSED POSITION	27

6.2 HORIZONTAL ANGLE “0” SETTING (0 SET).....	28
6.3 HORIZONTAL AND VERTICAL ANGLE MEASUREMENT	28
6.4 LOCK AND UNLOCK HORIZONTAL ANGLE (HOLD)	29
6.5 QUADRANT SOUND OF HORIZONTAL ANGLE SETTING ...	29
6.6 VERTICAL ANGLE “0” SETTING	30
6.7 MEASURE ZENITH DISTANCE AND VERTICAL ANGLE.....	31
6.8 SLOPE PERCENTAGE	32
6.9 REPEAT ANGLE MEASURE	33
6.10 OUTPUT ANGLE	35
6.11 SAVE ANGLE	35
6.12 MEASURE DISTANCE WITH STADIA	36
7. MEMORY	37
7.1 REVIEW INSTRUMENT’S SERIAL NUMBER.....	37
7.2 REVIEW ANGLE DATA IN MEMORY	37
7.3 CLEAR ANGLE DATA IN MEMORY	38
7.4 TRANSMIT DATA IN MEMORY TO SERIAL-PORT.....	39
7.5 DATA DOWNLOAD FROM NEW THEODOLITE (SAMPLE WITH ACCESS PORT).....	39
8. LASER POINT (ONLY FOR LASER THEODOLITE)	41
8.1 TURN ON AND TURN OFF THE LASER POINT FUNCTION .	41
8.2 LASER POINT.....	41
9. CONNECTION WITH CONTROLLER	42

10. INSPECTION AND ADJUSTMENT	42
10.1 PLATE VIAL	42
10.2 CIRCULAR VIAL	43
10.3 INCLINATION OF RETICLE	43
10.4 PERPENDICULARITY OF AIMING AXIS AND HORIZONTAL AXIS (2C)	44
10.5 AUTOMATIC COMPENSATION FOR VERTICAL INDEX	45
10.6 VERTICAL INDEX DIFFERENCE AND SET TO ZERO	46
10.7 OPTICAL PLUMMET	48
10.8 LASER PLUMB (ONLY FOR THE INSTRUMENT WITH LASER PLUMMET)	50
10.9 LASER POINT AND AIMING AXIS COAXIAL	51
10.10 OTHER ADJUSTMENT	52
11. SPECIFICATIONS	53
12. COMMON ERROR	55
13. ACCESSORIES	58

1. FEATURES

Electronic theodolite is designed by our company according to the concept of reasonable structure, smart appearance, reliable performance, various functions and easy operation. Not only it is easy to be realized all functions, but also it has the features below:

Able to Connect with Electronic Controller

Able to connect with most of the electronic controllers on the market to complete field data collection automatically.

Easy to Operate Key-press

It only has 6 keys which can realize all measure functions and can show distance data from range finder on monitor.

Can operate in dark place

Telescope's crosshairs and screen are equipped with illumination resource so that you can operate it in dark place.

Laser Point

The laser theodolite is able to emit visible laser, which can be used as visible alignment for application in construction, field work, etc.

2. PREPARATIONS

2.1 Precautions

- (1) Avoid aiming the objective lens directly at the sun. When performing a measurement under sunshine, attach the filter to the objective lens.
- (2) Avoid storage or usage at extremely high or low temperature and rapid changes of temperature (refer to working temperature range).
- (3) Put the equipment into the carrying case for storage and place it in a dry area when it isn't used, do not subject it to vibrating, dust or high humidity.
- (4) When the storage temperature and usage temperature is widely different, left the instrument in the case until it adapt to the surrounding temperature.
- (5) When not in use for a long period, disassemble battery from ET and recharge the battery once per month.
- (6) Put the instrument into its case when transport. Make sure to keep it from squeeze, clash and shake. Had better to put soft pad around the case during line-haul.
- (7) Be sure to secure the instrument with one hand when mounting or removing from the tripod.
- (8) When the exposed optical parts need to be cleaned, clean them with degreased cotton or lens-head paper gently, not with other clean tools.
- (9) Be sure to clean the plastic parts and organic glass with

water-soaked cloth, rather than chemical reagent.

(10) When the measure is finished, clean the surface of your instrument with woolen cloth or fur brush. If it is wetted, never turn it on. Put it in the ventilation place for a period and rub it dry with clean cloth.

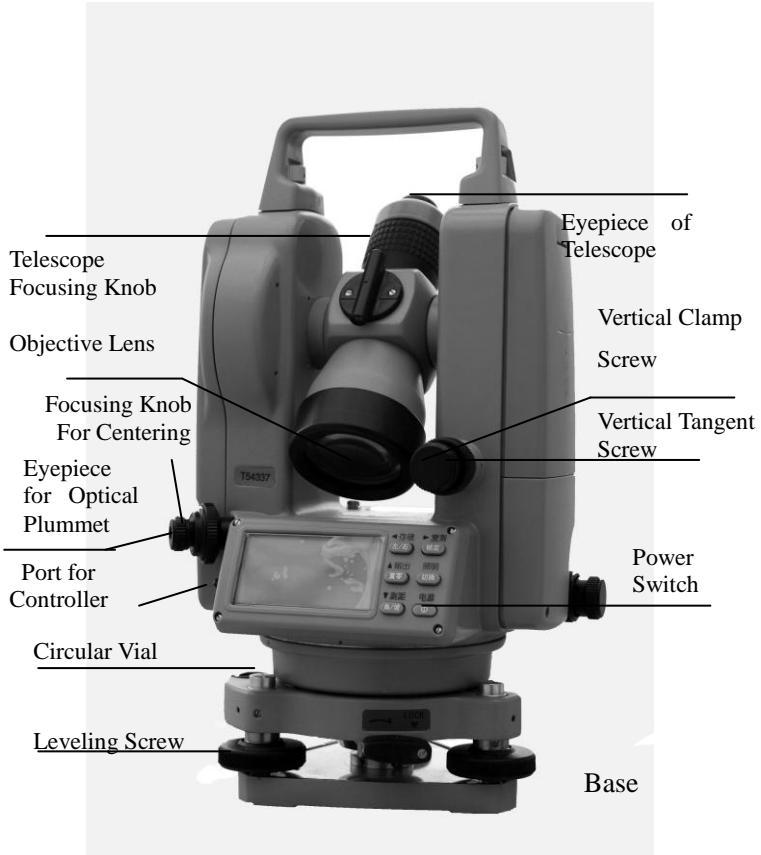
(11) Before operation, carefully inspect the power, functions and indexes of the instrument, initial setting and correction parameters.

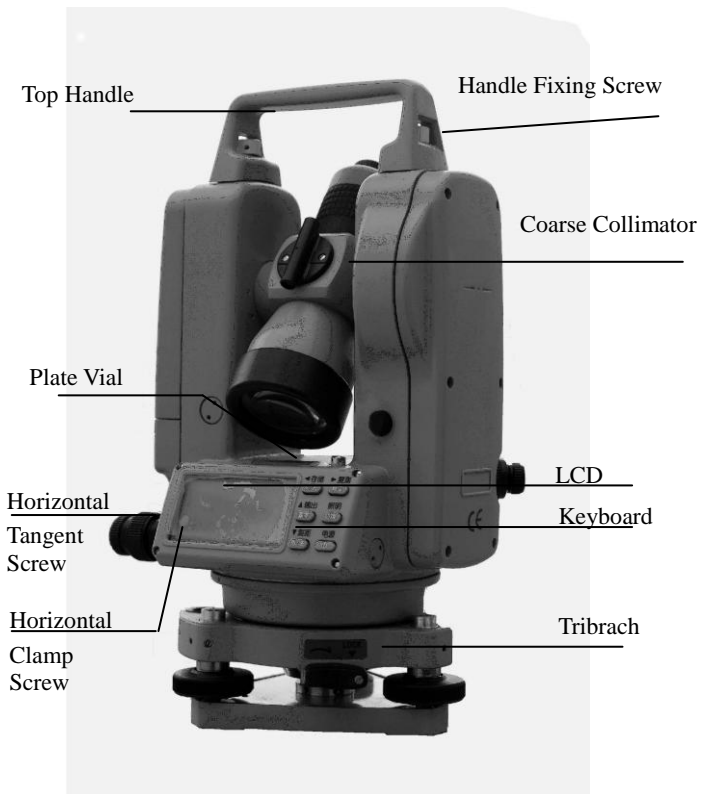
(12) Do not disassemble the instrument by yourself, even if a malfunction is found, unless you are a professional.

(13) When the laser is working, never collimate the eyes with the laser beam

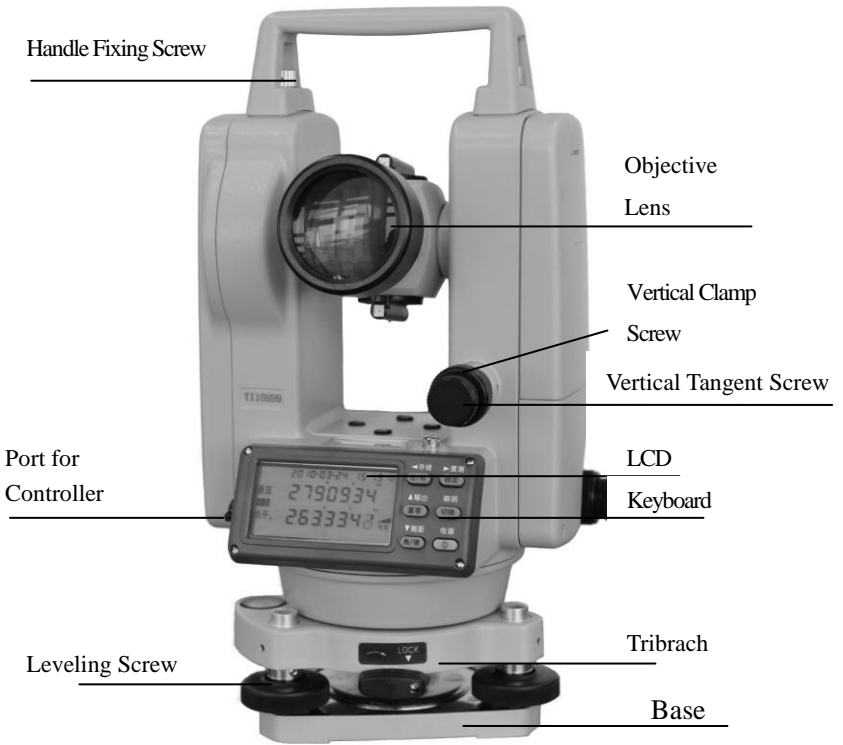
2.2 Parts

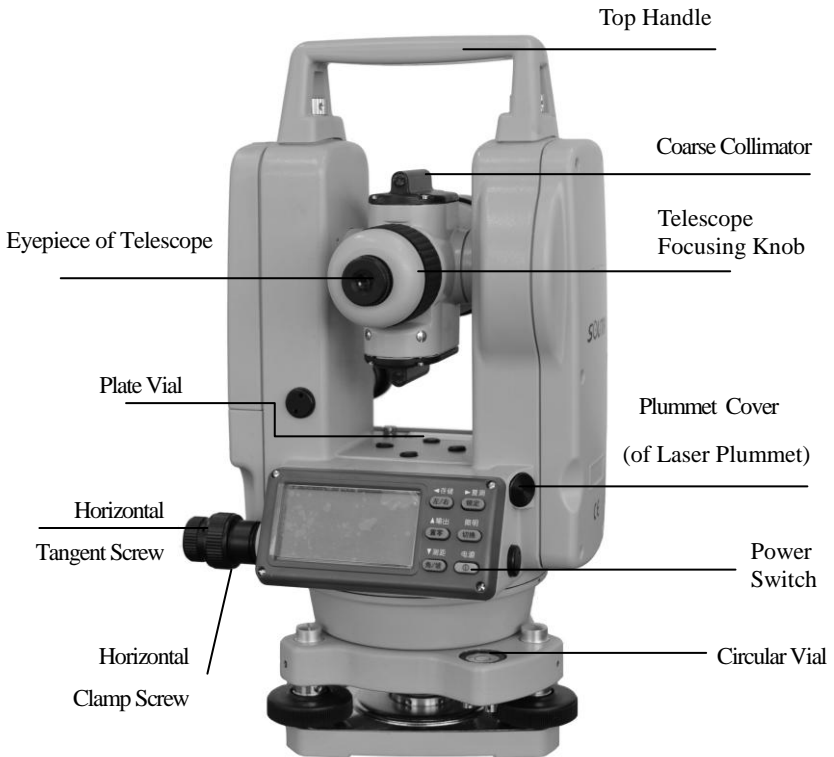
Electronic Theodolite





Laser Theodolite





2.3 Unpacking and Storage

Unpacking

Gently lay down the carrying case and set its cover upward, unlatch and open the case. Then, take the instrument out of the case.

Storage

Set the telescope close to vertical, and lightly tighten the telescope clamp screw. Align the white dot; place the instrument into the case with the white dot towards you. close the case lid and lock the latch.


2.4 Battery and Charger



Assemble and Unassembled Battery


(1) Press the top button of the battery box to take off battery box.


(2) Insert the bottom edge of the battery into the slot of the equipment, and press the top button of the battery to lock.

Battery Information

Full battery can last for 8 to 10 hours continuously. The symbol “” in the lower right corner of the screen displays power consumption message. Power consumption is as follows:

 and  indicate that energy is abundant.

 indicates there is a little energy left, and ready to replace or recharge it .

 twinkling indicates it will turn off in few minutes due to

lack of energy, so stop operating and change battery ASAP.

Charging Battery

Please use special charger (10A) to recharge battery which is 10A, NiMH rechargeable. Insert the battery charger into the power source with 220V, then red light lights. Take off the on-board battery from the main body and connect the plug of the charger to charge socket on the battery. The indicating lamp is red indicates the battery is recharging and it turns green in 6 hours means charge completes. Then remove the plug from the charge socket.

Warning: if the battery is placed improperly, it may cause explosion. Please deal with used battery according to manual.

Note on taking off the battery box!

- **Before you take off the battery box, make sure that the power of the instrument is turned off. Otherwise, the instrument can be damaged.**

Notes on recharging!

- **The charger has a built-in circuit for protection from overcharge. However, do not leave the charger plugged into the power after recharge is completed, because it will shorten the life of battery.**
- **Be sure to recharge the battery at a temperature of 0 °C ~ +45°C. Charge may be abnormal beyond the specified temperature range.**
- **Prohibit the use of any already broken charger and battery.**

Notes on storage!

- **Rechargeable battery can be repeatedly recharged 300-500 times. Complete discharge of the battery may shorten its service life.**
 - **In order to maximum the battery life, be sure to recharge it once per month.**
 - **Do not place the battery in the hot and wet place and never make it short-circuit, or the battery will be destroyed.**
- Dispose and recycle battery properly according to local rules. Do not flip it into fire.**

2.5 Assemble and Disassemble the Basal Stump

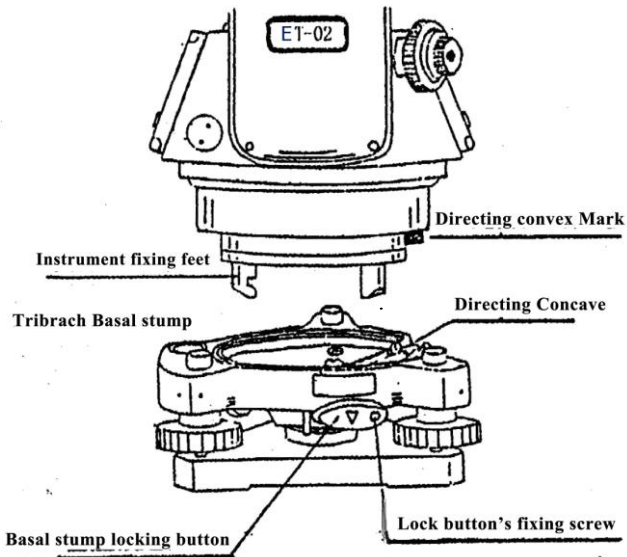
Disassembly

If necessary, the instrument can be removed from the

triangle basal stump. Firstly, loosen the triangle basal stump locking screw with a screw-driver. Then, turn the locking button about 180° in counter clockwise and take off the instrument from the triangle basal stump.

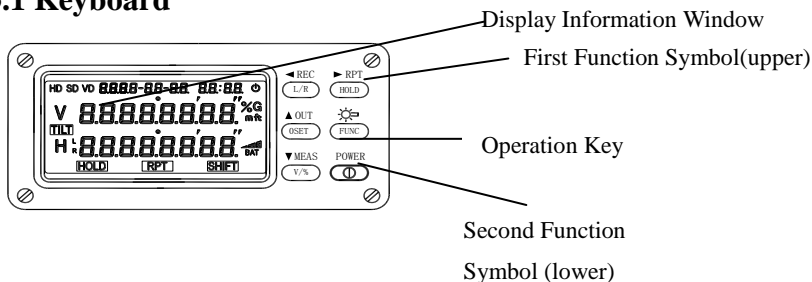
Installation

Fit directing convex mark to the directing concave of the tribrach. Put the three fixing feet into the holes respectively. Turn the locking button clockwise about 180° to lock the instrument and the tribrach, then tighten the fixing screw of the locking button with a screw driver.




3. KEYBOARD AND PANEL

3.1 Keyboard



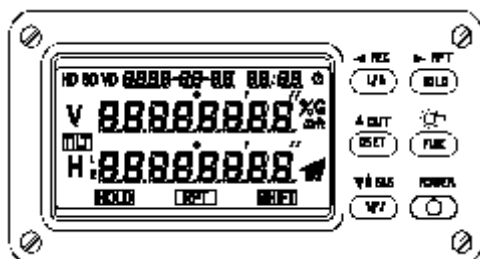
Each key on the keyboard has double functions. Generally, instrument performs the first basic function. It will carry out the second extended function marked above the key after pressing FUNC.

<p>(◀) REC L/F</p>	<p>Save key. Press it under shift mode, current angle twinkles twice, and then saved in memory. Press it to move cursor to left under special functional mode.</p> <p>Selection key for right or left horizontal angle. Press the key alternately to display two angles value accordingly</p> <p>Press it for 3 seconds to turn on laser plummet function (only for laser theodolite). Press it for 3 seconds to turn it off.</p>
	<p>Repeated measure key. Press it to enter repeated state under shift mode. Press it to move cursor to right under special functional mode.</p>

<p style="text-align: center;">▶ RPT HOLD</p>	<p>The horizontal angle locking key. Press the key twice to lock the horizontal angle. Press the key again to return to unlock.</p> <p>Press it for 3 seconds to turn on laser point function (for Laser theodolite only), and then press it for 3 seconds to turn off.</p>
<p style="text-align: center;">(▲)OUT 0 SET</p>	<p>Output key. Press it under shift mode to output current angle to serial-port or to electronic controller.</p> <p>Decreasing key. Press it under special functional mode to move cursor down or decrease number.</p> <p>Horizontal angle “0” setting key. Press it twice to set horizontal angle 0.</p>
<p style="text-align: center;">(▼)MEAS V/%</p>	<p>Distance measure key. Press it under shift mode to make tracking measure once per second and precision is 0.01m (valid to connect with range finder).</p> <p>Press it continuously to display slope distance, horizontal distance, vertical distance and angle alternately. Increasing key. Press it in special functional mode to move cursor moves up or increase number.</p> <p>The shift key to display between vertical angle and slope percentage. Press it continuously to display the two types of value alternately.</p>
<p style="text-align: center;"> FUNC</p>	<p>Crosshairs and LCD illuminating key. Press it for 3 seconds to turn on light, and then press it for 3 seconds to turn off.</p> <p>Mode shift key. Press it continuously to enter different mode alternatively performing functions marked on the</p>

	key or panel respectively. Press it under special functional mode to quit or confirm.
POWER	Power switch. Press the key to turn on; Press the key for over two seconds to turn off.

3.2 Panel



Press-key	Function 1	Function 2
(◀) REC L/F	Increment of right and left horizontal angle.	Save measured data
(▶) RPT HOLD	Hold horizontal angle	measure angle repeatedly
(▲) OUT 0SET	Reset horizontal angle	Output measured data through serial-port
(☀) FUNC	Select the second function	Illumination for LCD and graduation board

(▼)MEAS V/%	Vertical angle/slope angle percentage	Measure slope / horizontal/vertical distance
POWER	Power switch	



3.3 Display Information

Liquid Crystal Display is lined and commonly used symbols are all displayed in the following figure:

Angle or distance or tip is displayed in the two middle lines with 8 digits. Symbol or character in both right side and left side represents the content or unit of data.



Symbol	Content	Symbol	Content
VA	Vertical angle	%	Slope percentage
HA	Horizontal angle	G	Angle unit: division (Gon)(no symbol if unit is degree and mill)
H(R)	Level dextro-rotation increment(clockwise)		
H(L)	Level laevorotatory increment(clockwise)	m	Distance unit: meter

SD	Slope distance	ft	Distance unit: foot
HD	Horizontal distance		Batter capacity
VD	Vertical distance	HOLD	Lock mode
TILT	Tilt Compensator		Automatic close mark
RPT	Repeat mode	SHIFT	Shift to the second function

4. INITIAL SETTING

The instrument has many functions for selection in order to fit needs of result that different jobs require. Therefore, before using the instrument, we have to do initial setting according to different jobs' need.

4.1 Setting Items

- (1) Unit of angle measurement: 360° ,400gon, 6400mil (factory setting: 360°).
- (2) Vertical angle zero direction setting: horizontal zero orzenith zero (factory setting: zenith zero)
- (3) Automatic power off function: 30 minutes or 10 minutes (factory setting: 30min).
- (4) Minimum unit of angle displayed: 1" or 5" (factory setting: 1").
- (5) Vertical zero compensation choosing: Auto compensation

or uncompensated (factory setting: auto compensation. This item is not available for those instruments that have no compensation with them.)

(6) Horizontal angle reading passes through the quadrants of 0° , 90° , 180° , 270° with the beeps or no beeps (factory setting: beep).

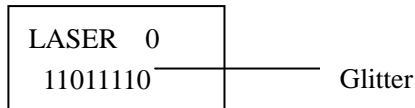
(7)Laser Plumb setting: For ET-02/05L only (totally 5 grades: 0, 1, 2, 3, 4; factory default setting: LASER 4.)

(8) Current time setting

(factory setting: YYYY - MM-DD HH:MM).

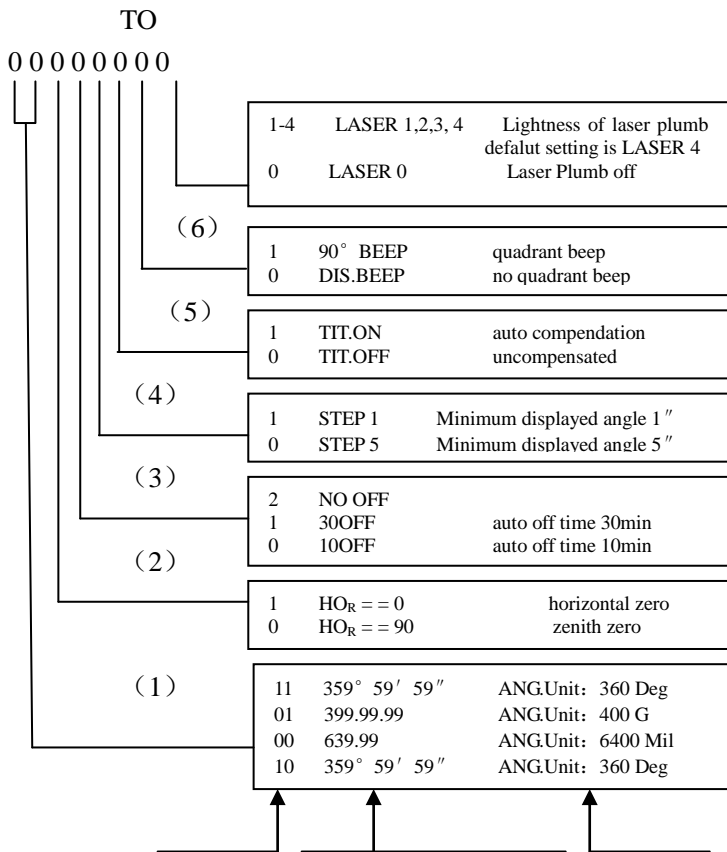
4.2 Setting Method

(1) Press L/R to power on and loosen it until hearing three beeps. It enters initial setting mode state, monitor displays:



Eight digits in the next line of monitor respectively represent the content of initial setting as follows:

11111110



DIGITALLY CODE

CONTENT CODE

CONTENT

(2) Press (◀) or (▶) key to move cursor to the figure digit needed to be modified.

(3) Press ▲ or ▼ key to alter figures displayed in the upper line of the monitor by code form.

(4) Repeat step (2) and (3) to set other items until all complete.

(5) Press **FUNC** to confirm after setting, and then it enters the interface of time setting.

(6) Time format: **Y-M-D H:M**, for example, **2007-01-01 00:00**, then press (◀) or (▶) key to move cursor to the figure digit needed to be modified.

(7) Press ▲ or ▼ key to alter figures displayed in the upper line of the monitor by code form.

(8) For example, set time as **2007-01-01 00:00**. Set year as 2007 firstly through ▲ or ▼, the same goes with month, day, hour and minute (note: unnecessary to set second).

(9) Press **FUNC** to confirm after setting, and save the new time to the instrument.

- After finishing initial settings are finished, the key **FUNC** must be pressed to confirm and save the setting, or the instrument will keep the original setting.
- During long-term usage, it is possible that the battery of real-time clock breaks off or lacks power, which causes a great difference between displayed time and current actual time, moreover, it is inconvenient to set time by the previous method (6) (7) and (8). (For example, the displayed time is 1234 caused by an unexpected reason but the real time is 2007, obviously using the former setting method will be troublesome.) There are another method: press **L/R** key for over 5s in the time setting interface, then the instrument will be automatically initialize time as 2007-01-01 00:00. Reuse the previous approaches to set time on the based on it.
- For the instrument with laser plummet, the factory default setting for laser plummet is Grade 4. It is the maximum grade. Users can decrease the grade according to their demands.
- For the laser theodolite, on the menu of the laser plummet grade setting, it is better not to choose grade 0, which is so weak that it equals to switch off the laser plummet.

5. PREPARATION FOR SURVEY

5.1 Centering and Leveling

Setting up the instrument and the tripod

(1) Adjust the tripod legs to obtain a height suitable for observation after selecting a solid ground.

(2) Hang a plumb bob on the hook of the tripod, and center over

the station on the ground coarsely. At this time, set the tripod and fix the tripod legs firmly into the ground.

(3) Adjust the length of each leg to make the tripod head as level as possible. Fix the lock screws of the tripod legs, then put the instrument on the tripod head and lock with the screws.

Centering and leveling with the optical plummet

(1) Adjust the three leveling screws to make the bubble in the center of the vial. Observe through the optical plummet eyepiece and rotate the eyepiece knob until the reticle can be seen clearly.

(2) Rotate the focusing knob of the optical plummet until the measurement land mark can be seen clearly and is in the same plane together with the mid-split graduation mark.

(3) Loosen the center screw of the tripod. Observe through the optical plummet, and shift the instrument based on the tripod, carefully level the instrument (avoid rotating the instrument) until the center mark coincides with the station.

(4) By adjusting any two leveling screws, the bubble is in the center of the vial.

(5) Observe through the optical plummet to confirm the land mark coincides with the center of the reticle. If not, repeat the step (3) and step (4) until they are coincided.

(6) Make sure that the land mark coincides with the center of the reticle, then lock the instrument.

Centering and leveling with the Laser Plummet (only for theodolite with laser plummet)

(1) Adjust the three leveling screws to make the bubble centered in the vial.

(2) Press **L/R** for 3 seconds to turn on the laser plummet.

Loosen the center screw of the tripod until the theodolite is moveable on the tripod. Observe the laser facula and the center point on the ground, and carefully level the instrument (avoid rotating the instrument) until the laser facula coincides with the center point.

(3) Adjusting any two leveling screws to drive the bubble to center of the plate vial.

(4) Observe the laser facula to confirm that the laser facula coincides with the center point. If not, repeat the step (3) and (4) until they are coincided.

(5) Make sure that the instrument is completely centered, then lock the instrument.

(6) Press **L/R** for 3 seconds, turn off the laser plummet.

Caution: do not touch the tripod legs after centering successfully to avoid altering the position.

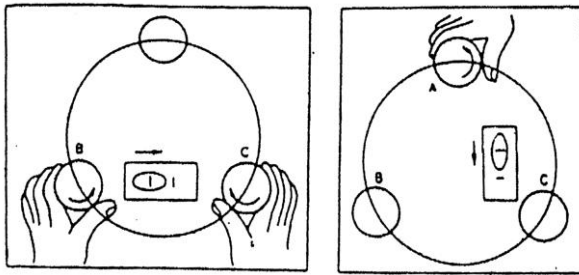
Leveling precisely with plate vial

(1) Let the plate vial be in parallel with a line jointing of any two of leveling screws. Adjust these two leveling screws in opposite directions at the same time to move the bubble to the center of the vial.

(2) Rotate the plate vial 90° around the vertical axis, make sure that the bubble is in the center by adjusting the third screw.

(3) Rotate the plate vial 90° , repeat(1) and (2), make sure that the bubble is in the center when plate vial is moved to any directions.

(4) Rotate the instrument 180° from position (1) . If the bubble is in the center and always in the center while the plate vial is moved to any directions, the plate vial is set correctly and the instrument is leveled.




- Notice the relation between the directions of leveling screws' rotation and the bubble shifting direction.
- If the bubble does not remain in center in (4), "Adjustment of plate vial" is necessary. Refer to chapter (8.1) adjustment method.

5.2 Eyepiece Adjustment and Object Sighting

Eyepiece adjustment

(1) Remove the telescope lens cover.

(2) Sight the telescope at the sky and rotate the eyepiece ring until the reticle appears most clearly.

When looking into the eyepiece, avoid an intense observation to prevent parallax and eye fatigue. If it is hard to see the reticle due to poor brightness, press () key to illuminate it.

Object Sighting

(1) Sight the telescope at the object by the collimator.


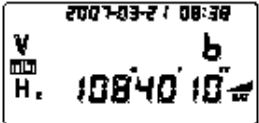

(2) Look through the telescope eyepiece and finely adjust the focusing knob until the object is perfectly focused.

(3) Use the clamp screw, then the tangent screws to sight at the object exactly. If focusing is correct, the reticle will not move related to the object, even when you move your eye slightly around.

- **Turn the focusing knob clockwise to focus a near object. Turn the knob counterclockwise to focus a far object.**
- **If do not adjust (3) well, parallax may distort the relation between the object and reticle, resulting in the observation error.**
- **When aligning to an object using the tangent screw, always align by rotating the screw clockwise. If the screw is overturned, turn it back to the original position and sight the object by rotating the screw clockwise again.**
- **Even when vertical angle measurement is not required, it is recommended that the object be placed to the center of the reticle as exactly as possible.**

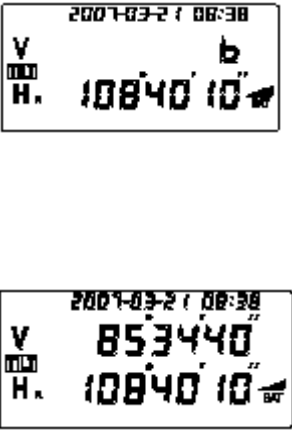
5.3 Power On or Off

Key style power switch

operation	display
<p>Press [POWER] key and hold it until all the symbols are displayed. The power is on.</p>	 The display shows various status indicators: HD, SD, VD, a battery level indicator (8888-88-88), a clock (88:88), a signal strength indicator (G), and a battery icon. The main display shows 'V 8888.8888' with a '%G' and 'mft' indicator. Below that, it shows '(TILT) H: 8888.8888' with a 'BAT' icon. At the bottom, there are three buttons labeled '(HOLD)', '(RPT)', and '(SHIFT)'.
<p>Horizontal angle will be displayed in 2 seconds and then the measurement can be started.</p>	 The display shows the date '2007-03-21' and time '08:38'. Below that, it shows 'V 8' and 'TILT'. The main display shows 'H: 108°40'10"'. At the bottom right, there is a small icon of a level.
<p>Press and hold [POWER] key over 2 seconds to turn power off.</p>	 The display shows the word 'OFF' in large, bold letters.

- When the power is turned on, the displayed angle value is the value saved in memory last time. If the displayed angle is no use anymore, do the horizontal zero setting.
- If no operation is performed in 10 or 30 minutes. The power will be turned off automatically due to “power auto off function” and the horizontal angle will be stored in memory automatically.

5.4 Vertical Index Zero Setting (V 0SET)

operation	display
<p>Turn on the instrument. Displaying “b” means that the vertical axis is not vertical. If the instrument is leveled exactly, “b” will disappear. After the instrument is leveled exactly, turn on the instrument and it displays “V 0SET” which means that the vertical index has been set to zero.</p> <p>Turn the telescope up and down in normal position in horizontal direction. Vertical index zero is set when the telescope passes level and the vertical angle is displayed. The instrument is now ready for angle measurement.</p>	
<ul style="list-style-type: none"> ● If vertical index automatic compensation set is used, the vertical index can be compensated. When the vertical index is beyond the designed criterion, “b” will be displayed. Level the instrument precisely until “b” disappears. Then the instrument gets its breath again. ● If no operation is performed in 10 or 30 minutes. The power will be turned off automatically due to “power auto off function” and the horizontal angle will be stored in memory automatically. 	

6. BASIC SURVEY

6.1 Observation from Normal/Reversed Position

“Normal position telescope” means that the shaft disc is on the left side of the telescope when observers face eyepiece lens (see figure). “Reversed position telescope” means that the shaft disc is on the right side of the telescope when observers face eyepiece lens. In angle measuring, we should get the measuring result through averaging the two values got from both observations above. And it can eliminate the influence caused by the instrument’s systematic errors effectively. Therefore, when doing horizontal and vertical observation, rotate telescope 180° to do reversed position observation after finishing normal position observation



Normal Position Observation



Reversed Position Observation

6.2 Horizontal Angle “0” Setting (0 SET)

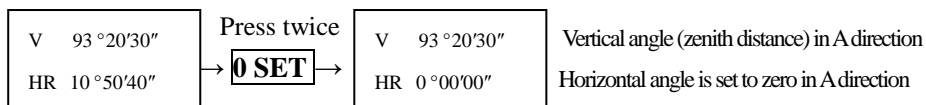
Sight reticle of the telescope at object A, press 0 SET twice to set the horizontal angle as $0^{\circ} 00'00''$.

For instance,
sight at object A displaying \rightarrow HR $50^{\circ} 10'20''$ \rightarrow press 0 SET twice \rightarrow displaying HR $0^{\circ} 00'00''$

- [OSET] key is valid only for horizontal angle.
- Horizontal angle can be set to “0” any time except when [HOLD] key is set. If [OSET] is pressed by mistake during operation, there is no effect unless the key is pressed again. When the beep stops, the instrument is ready for next operation.

6.3 Horizontal and Vertical Angle Measurement

(1) Set horizontal angle dextro-rotation and vertical angle as zero Turn the instrument clockwise to sight at the object A exactly, press OSET twice to set horizontal angle to $0^{\circ} 0'00''$ as the initial zero direction. The steps and displaying contents are as follows:



Turn the instrument clockwise and sight at object B,

V $91^{\circ}05'10''$	Vertical angle (zenith distance) in B direction
HR $50^{\circ}10'20''$	Dextro-rotation horizontal angle in AB direction

(2) Press R/L to change horizontal angle from right to left mode.

Turn the instrument counterclockwise (HL), sight at the object A exactly, press OSET twice to set horizontal angle to $0^{\circ} 00'00''$ as the initial zero direction. The displayed results are the same as (1).

Turn the instrument counterclockwise (HL) and sight at objects B.

The displayed contents are the followings:

V 91 05'10"	Vertical .angle (zenith distance.) in B direction
HR 309 49'40"	Horizontal .angle left in AB direction.

6.4 Lock and Unlock Horizontal Angle (HOLD)

During horizontal angle observation, if you want to retain the measured value, press [HOLD] twice. Once horizontal angle is locked, "HRL" is displayed and the horizontal angle value will not change even if you rotate the instrument. When you sight at the needed direction, press [HOLD] again to release lock function.

Then the horizontal angle value is the original locked value.

- [HOLD] is invalid for vertical angle or distance.
- If [HOLD] key is pressed by mistake during operation, it does not matter unless the key is pressed again. When the beep stops, next operation can be continued.

6.5 Quadrant Sound of Horizontal Angle Setting

(1) Sight at the first objective and then press [O SET] twice to set the horizontal angle to zero.

(2) Turn the instrument around the vertical axis about 90° until

the beep starts ,displaying $HR89^{\circ} 59'20''$

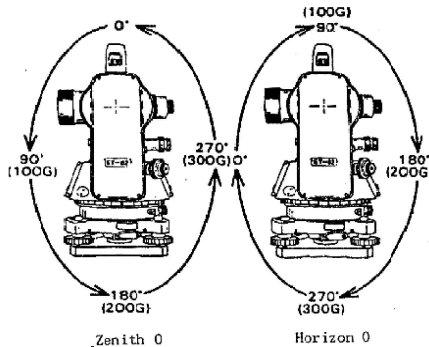
(3) Lock the instrument by the clamp screw and set the horizontal angle to $90^{\circ} 00'00''$ by the tangent screw. Then, fix the quadrant target direction by the telescope reticle.

(4) determine the quadrant target direction of 180° and 270° by the same method.

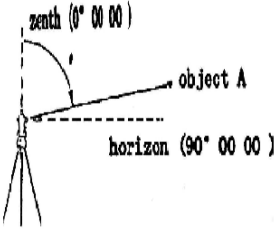
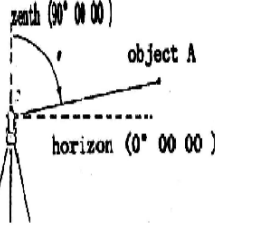
- The beep beeps when the reading passes any of 0° , 90° , 180° , 270° . It beeps in the range of $\pm 1'$ -- $\pm 20'$.
- The beep can be canceled in the initial setting.

6.6 Vertical Angle “0” Setting

Before starting operation, initial setting in vertical angle is doing according to operation’s requirement selecting zenith 0/horizontal 0(Refer to 4.2 initial setting.).Vertical disk structures of two setting



6.7 Measure Zenith Distance and Vertical Angle

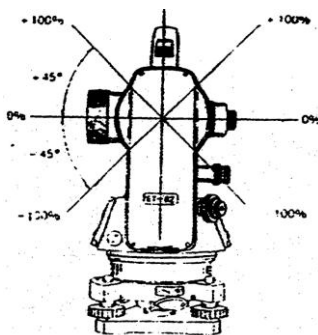
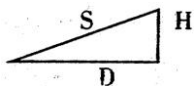
operation	display
<p>(1) Zenith distance: If vertical angle is 0° in zenith direction, then the vertical angle measured in this way is the zenith distance. (shown as the figure)</p> <p>Zenith distance = $(L + 360^\circ - R) / 2$</p> <p>Index difference = $(L + R - 360^\circ) / 2$</p> <p>(2) Vertical angle: If vertical angle is 0° in horizontal direction, then the vertical angle measured in this way is the perpendicular angle. (See the figure).</p> <p>Vertical angle = $(L \pm 180^\circ - R) / 2$</p> <p>Index difference = $(L + R - 180^\circ / 540) / 2$</p>	 

● If the absolute value of index difference is larger than $10''$ (i.e. $|I| \geq 10''$), adjustment should be made as introduced in chapter 8.5 and 8.6 in this manual.

6.8 Slope Percentage

The vertical angle can be converted into slope percentage in angle measurement mode. Press V/% and the display shows vertical angle or grade percentage alternately.

$$\text{Slope \%} = H/D \times 100\%$$




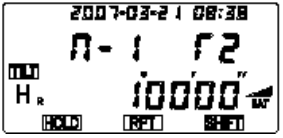


The range of slope percentage should be between the horizon direction and $\pm 45^\circ$ ($\pm 50\%$). Otherwise the instrument will display over EEE.EEE%

6.9 Repeat Angle Measure

Turn on the instrument in angle measure mode

Operation	Display
① Press FUNC key.	
② Press RPT key to enter repeat measure mode. ③ Sight at the first target A.	
④ Press L/R key to set the reading of the first target as 0°00'00\".	
⑤ Sight at the second target B with horizontal tangent screw and clamp screw.	
⑥ Press HOLD key to hold and save it into the instrument.	

<p>⑦ Sight at the target A again with horizontal tangent screw and clamp screw.</p>	
<p>⑧ Press L/R key to set the first target as 0° 00' 00" .</p>	
<p>⑨ Sight at the second target B again with horizontal tangent screw and clamp screw.</p>	
<p>⑩ Press HOLD key to hold and save it into the instrument. Average angle reading appears. Repeat steps ⑥ to ⑩ to measure with the number you want . Press FUNC to exit after completion.</p>	
<p>※ The number of repeat measure in repeat measure mode is limited to 8. If exceeds 8 times, it will quit automatically.</p> <p>※ Sight at the target and begin with step ③ when doing repeat measure again.</p> <p>※ Press FUNC key to quit repeat measure mode and return to angle measure mode.</p>	

6.10 Output Angle

Turn on and enter angle measure mode, and press FUNC key to enter the second function selection mode. Press OUT key to transmit the current angle to serial-port or electronic controller (baud rate is 1200), “-----” will be displayed on the screen for one second after successful transmission.

6.11 Save Angle

Turn on and enter angle measure mode, press FUNC key to enter the second function selection mode, and then press REC to save angle. At that time, the current angle glitters twice, which represents it has been saved to the memory. If you want to save angle again, press REC key after regulating an angle.

If you want to review saved angle data, please refer to Chapter 7 about memory.

Notice: the instrument only supplies 256 groups of angle data (each group of angle data includes one vertical angle and one horizontal angle). If angle data saved exceeds 256 groups, “FULL” will be displayed on the interface which means that memory is full. Users then need to clear manually to resave angle, please refer to the chapter about memory for more details.

6.12 Measure Distance with Stadia

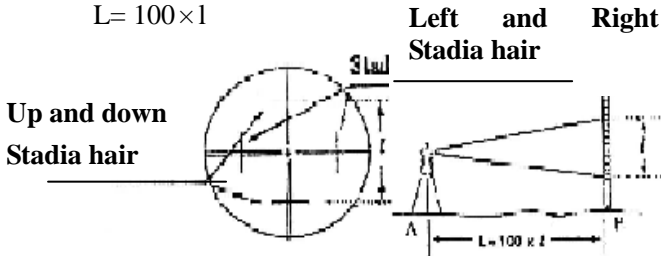
The distance from the measuring object to the instrument can be obtained by using the stadia hair of the telescope with the accuracy $\leq 0.4\%D$.

Set up the instrument at point A and put the surveying rod on target point B.

Read the intercept d of apparent lines from up and down from the reticle on the survey rod.

The horizontal distance (D) between A and B can be calculated with the formula below:

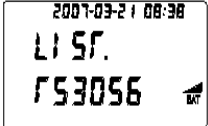
$$L = 100 \times d$$



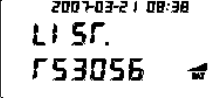
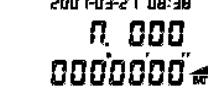
- The precision of the distance measurement is not very high. Do not use this method when high precision is required.

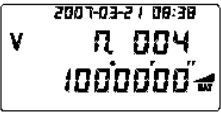
7. MEMORY

7.1 Review Instrument's Serial Number

Operation	Display
<p>① Press FUNC key and POWER key to turn on. After beeping three times, it enters memory reviewing interface. What displayed on the main interface is instrument's serial number that is the same as the number printed on the instrument's body, for instance, T53056, shown as the right picture. Hope users check it carefully to protect their own interests.</p> <p>② Press FUNC to quit.</p>	

7.2 Review Angle Data in Memory

Operation	display
<p>① Press FUNC key and POWER key to turn on. After beeping three times, it enters memory Review interface.</p>	
<p>② Press V/% key to display angle data in memory mode. N. 000 means there is no angle data in memory.</p>	

<p>③ N. 001 means there are angle data in memory, so we can use (◀) and (▶) to select angle in memory to look over. Use ▲ or ▼ to select vertical angle and horizontal angle displayed in the second line. What shown in the right picture is vertical angle data of the 4th group in memory.</p>	
<p>④ press FUNC to quit and return to review instrument's serial number. Press FUNC again to quit memory mode and return to angle measure mode.</p>	

7.3 Clear Angle Data in Memory

After step(7.2) to enter into angle data reviewing mode, press ▼ for over 5 seconds, it beeps three times, and “CLEAR” appears on the interface, which represents all angle data in memory are cleared.

(Note: memory can save at most 256 groups of data and system will hint you when storage is full. Then users should transmit the useful angle in memory through serial-port and clear data in memory manually.

7.4 Transmit Data in Memory to Serial-port

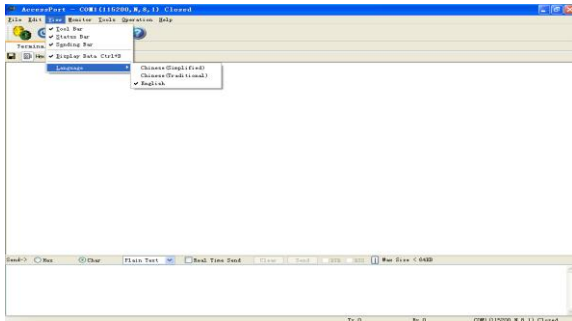
After step(7.2) to enter into angle data reviewing mode, the angle data is transmitted through serial-port when users press or ▲▼(◀)(▶) to review the angle data in the memory (delete) (“-----” instantly appears in the second line illustrate that the current angle has been transmitted through serial-port, which can be reviewed by serial-port facility such as Serial-port Genius. Baud rate is 9600.)

In addition, the function to transmit all angle data to serial-port at a time is furnished. In the light of steps of examining angle data in memory, press ▲ in examining angle interface for over 5 seconds, it beeps three times which means it starts to send all angle data to serial-port. Baud rate is 9600 and sending time depends on the number of angle in memory.

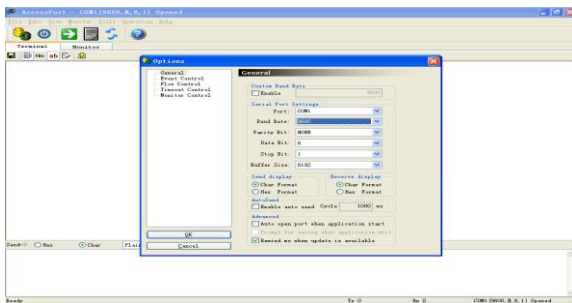
7.5 Data Download from New THEODOLITE (Sample with Access port)

Step:

1. Connect series port on ET with the CE-203U to the series port or USB of PC.
2. If connect PC with USB port, please install the drive firstly. Open the file like ‘Scomassistant’ or ‘AccessPort’ (example: AccessPort)



3. Set Baud rate to 9600 and select the correct COM



4. Refer to '7.2 Examine Angle Data in Memory'

Press (◀) (▶) or ▲ ▼ to review angle data in memory which is transmitted to PC through serial-port at the same time one by one.

press ▲ in examining angle interface for over 5 seconds, it beeps three times which means it starts to send all angle data to serial-port. Baud rate is 9600 and sending time depends on the number of angle in memory.

5. Save the data transmitted to the program, then you can edit.
If you do not need the data, you can clear them.

8. LASER POINTER (ONLY FOR LASER THEODOLITE)

Laser theodolite is equipped with laser pointer system on the telescope system. In the telescope, the laser facula coincides with the telescope reticle, and the laser beam is visible and synchronized with the telescope imaging, so it can be used as visible alignment for application in construction, field work, etc.

8.1 Turn on and Turn off the Laser Pointer

Press **HOLD** for more than 3 seconds to turn on the laser pointer. And press **HOLD** for more than 3 seconds to turn off the laser pointer.

8.2 Laser Point

Look through the telescope and finely adjust the focus screw until the object is clear. When the laser pointer is turned on, the center of reticle is the same as laser facula. The laser facula is the smallest and the brightest. In a dark environment, focus the object first, then turn on the laser pointer, otherwise you may not observe the object clearly.

! Be Careful

• Laser is harmful to eyes! Do not observe the laser directly through eyes.

9. CONNECTION WITH CONTROLLER

A data output and input port that locates at the lower part of the electronic theodolite/laser theodolite can be used for connecting the electronic theodolite/laser theodolite with the electronic controller. After connection, the measurement data can be transferred to electronic controller with CE-201 cable.

10. INSPECTION AND ADJUSTMENT

10.1 Plate Vial

Inspection

Refer to Chapter 5.1 about “**Leveling precisely with plate vial**”.

Adjustment

(1) Check the step(4) in inspection. If the bubble of the plate vial drifts away from the center, bring it half excursion back to the center by adjusting the two leveling hand wheels which are parallel to the plate vial.

(2) Correcting the remaining half by turning the bubble adjusting screw with the adjusting pin.

(3) Confirm that the bubble does not move away from the center when the instrument is rotated to 180° . If not, repeat the steps above.

(4) Turn the instrument by around 90° and adjust the third screw to center the bubble in the vial. Repeat inspection and adjustment steps until the bubble remains in center in any directions.

10.2 Circular Vial

Inspection

It is not necessary to adjust if the bubble of the circular vial is in the center after inspecting and adjusting of the plate vial.

Adjustment

If the bubble of the circular vial is not in the center, bring the bubble to the center by turning adjusting screw with adjusting pin or adjustable wrench. When adjusting, first loosen one or two screws on the opposite of the offset direction, then, tighten the adjusting screw in the offset direction to bring the bubble to the center. When the bubble stays in the center, keep the fastening strength of the three screws in uniformity.

10.3 Inclination of Reticle

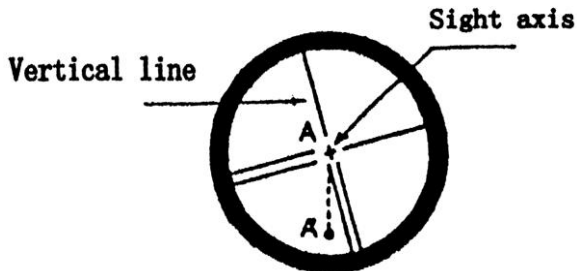
Inspection

(1) Level the instrument and select a target A in the line of sight of telescope, sight at A through the center of reticle of graduation board and lock the horizontal and vertical clamp screws.

(2) Move point A to the edge (point A') of the field of view by rotating the vertical tangent screw.

(3) No adjustment is necessary if point A moves along the vertical line of the reticle.

If point A' deviates the vertical line of the reticle, It proof what reticle is tilted, so we need to do correction on graduation board.



Adjustment

(1) Firstly, remove the eyepiece cover between eyepiece and focusing screw and you can see four screws.

(2) Loosen the four reticle adjusting screws equably with a screwdriver. Rotate the reticle around the aiming axis, and align the vertical line of the reticle with point A'.

(3) Rotate the fastened screw equably. Repeat the inspection and adjustment to confirm the result.

(4) Remount the eyepiece cover.

10.4 Perpendicularity of Aiming Axis and Horizontal Axis (2C)

Inspection

(1) Set an object A at a far distance, the same height as the instrument, level and center the instrument and turn on the power.

(2) Sight at the object A in normal position and read the horizontal angle value. (Suppose that: $L=10^{\circ}13'10''$).

(3) Loosen vertical and horizontal clamp screws, and reverse the telescope. Sight at the object A in reversed position and read

the horizontal angle value. (Suppose that : $R=190^{\circ}13'40''$)

$$(4) 2C = |L - (R \pm 180^{\circ})| = |10^{\circ}13'10'' - (190^{\circ}13'40'' - 180^{\circ})| = 30'' \quad \text{then } 30'' \geq 20''.$$

That means adjustment is needed.

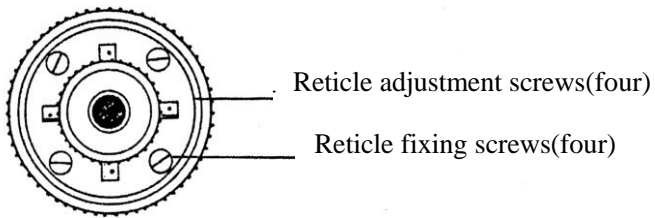
Adjustment

(1) To eliminate the big error, use the horizontal tangent screw to adjust the horizontal reading to the deduce a C: $R+C=190^{\circ}13'40''-15''=190^{\circ}13'25''$.

(2) Take off the cover of the reticle between eyepiece and focusing screw. Adjust the two adjusting screws by loosening one and tightening the other one. Move the reticle to sight at the object A exactly.

(3) Repeat inspection and adjustment until $|2C| < 20''$.

(4) Remount the cover of reticle back.



10.5 Automatic Compensation for Vertical Index zeroing Inspection

Liquid condenser automatic compensation set is used for vertical index zeroing compensation. We can check if the function works well by the following method.

(1) Mount and level the instrument and make the telescope

parallel with the line connecting the center of the instrument to any one of the screws. Then, lock the horizontal clamp screw.

(2) Zero the vertical index after turning on the power. Lock the vertical clamp screw and the instrument displays current vertical angle value.

(3) Rotate the above screw in a direction slowly to about 10mm circumference. The displayed value will change correspondingly and then disappear and display the message “b”. It indicate that vertical axis inclines is more than 3’ at this time and exceeds the designed compensation range. When you rotate the above screw reversely to the original position, the instrument displays the vertical angle again which means that the vertical index difference compensation function works well. (Experiment repeatedly and observe its change at critical position.)

- | |
|--|
| <ul style="list-style-type: none">● -10/20 model instrument does not have vertical zero automatic compensation set. |
|--|

10.6 Vertical Index Difference and Set to Zero

After making adjustments as described in 9-3 and 9-5, make the inspection as follows:

Inspection

Set up the instrument and turn on. Sight at a reference A and obtain the vertical angle (Left).

Reverse the telescope and sight at the object A again and obtain the vertical angle (Right).

If vertical angle is zero at zenith, then, $I=(L+R-360^\circ)/2$; If vertical angle is zero at horizon, then, $I=(L+R-180^\circ)/2$ or $(L+R-540^\circ)/2$.

If $|i| \geq 10''$, vertical index zeroing should be set again.

Adjustment (Setting up vertical index zeroing)

(1) After leveling the instrument, press **0 SET** to turn on and hold it until three beeps. The instrument displays that:

V	90° 20' 30"
C	SET -- 1

(2) Rotate the telescope around near the horizontal direction to sight at a clear and stable objective A, which is nearly the same height as the instrument. Press **0 SET** key, displaying:

V	90° 20' 30"
C	SET -- 2

(3) Reverse the telescope and sight at the object A again. Press **0 SET** key to finish vertical index zeroing setting. The instrument returns to angle measurement mode.

(4) Repeat the inspection procedures. If $|I| \geq 10''$, check if anything is wrong in operation and repeat the adjustment again.

(5) If the vertical index difference does not meet the standard yet after being adjusted repeatedly, the instrument should be sent to factory to be repaired.

- **The vertical angle displayed in the process of zeroing setting is not compensated and corrected, so it cannot be used formally but as a reference value.**

10.7 Optical Plummet

Inspection

- (1) Set the instrument on the tripod, and place a piece of white paper with a cross on the ground right under the instrument.
- (2) Adjust the optical plummet focus, and move the paper to make the crosshair to the center of the field of view.
- (3) Adjust the leveling screws to make the center mark of the optical plummet coincide with the intersecting point of the reticle.
- (4) Rotate the instrument around the vertical axis at every 90° and observe that whether the center mark position coincides with the intersecting point of the reticle.
- (5) If the center mark always coincides with intersecting point when rotating the instrument, no adjustment is necessary. Otherwise, the following adjustment is needed.



Adjustment

- (1) Take off the protecting cover between the optical plummet eyepiece and focusing knob.
- (2) when the instrument moves at every 90° , mark the place of the center mark On the white paper with a crosshairs, so the paper have four point A,B,C and D.
- (3) Join the diagonals with lines (A, C and B, D).The intersecting point of the two lines is called "0".
- (4) Adjust the four correction screws of the optical plummet by an adjusting pin until the center mark coincides with the above intersecting point.
- (5) Repeat the above inspecting and adjusting steps until it is up to the requirement.
- (6) Remount the protecting cover.

10.8 Laser Plummet (only for theodolite with laser plummet)

Inspection

- (1) Set the instrument on the tripod, and place a piece of white paper with a cross on the ground right under the instrument.
- (2) Turn on the laser plummet, then move the paper to make the cross center right on the laser facula.
- (3) Adjust the leveling screws to make the center of laser facula coincide with the center of the cross.
- (4) Rotate the instrument around the vertical axis at every 90° and observe that whether the center of laser facula coincides with the center of the cross.
- (5) If the center of laser facula always coincides with center of the cross at each observation, the laser plummet is precisely centered. Otherwise, the following replacement is needed (the laser plummet unit cannot be adjusted).

Replacement

- (1) Remove the base from the theodolite.
- (2) Remove the 3 pieces of M4 screws of the lower base unit by Allen Key, then the laser plummet under the vertical axis can be seen.
- (3) Separate the laser plummet by removing the 3 pieces of M4 screws with Allen Key.
- (4) Remove the cable plug.
- (5) Use a new laser plummet, and install it back into original position.

10.9 Coaxiality of Laser Pointer and Collimation Axis

Inspection

- (1) Put a cross mark 20 or 30 meters away from the instrument.
- (2) Sight at the cross with telescope, finely adjust the focus until the object can be seen clearly, and make the reticle of telescope coincides with the center of the cross.
- (3) Turn on laser pointer, and observe if the laser facula coincides with the center of the cross (Or observe if the reticle coincides with the laser facula inside).
- (4) If not, the following adjustment is required.

Adjustment

- (1) Release the rough collimator with correcting pin.
- (2) The four adjusting screws can be seen.
- (3) Adjust the telescope focusing slightly and confirm if the laser facula turns to be the minimum size. The cross mark “+” should be the clearest through eyepieces if the facula is in the smallest status. If the cross hair cannot be seen clearly, the adjusting pad must be changed (These processes have been done well in the factory. So do this step only when the laser tube is to be replaced).
- (4) Adjust the adjusting screws to make the center of facula coincide with the center of cross. Then observe the telescope and the center of telescope reticle must also be coincided with the center of the cross.

Repeat the processes above for several times to achieve the best status.

(5) After adjustment, add some screw glue to fix the screws.

(6) Then install the rough collimator and adjust it.

Requirement

(1) The laser beam and collimation axis are coaxial.

(2) Laser emitting point and the reticle of the telescope is conjugated.

It means when the object is the clearest, the laser convergence point is at the center of the center of the object, and the convergence point should be the smallest.

10.10 Other Adjustment

If the leveling screw looses, adjust it with two correction screws on the basal plate. Tighten the screws till they are fit.

11. SPECIFICATIONS

Telescope	Electronic Theodolite	Laser Theodolite
Image	Erect image	
Magnification	30X	
Effective aperture	45mm	
Resolution	3"	
Field of view	1°30'	
Shortest stadia	1.4m	1m
Stadia multiplication constant	100	
Stadia additive constant	0	
Stadia precision	≤0.40%L	
Tube length	157mm	154mm
Angle measurement		
Angle measurement mode	Absolute encoding mode	
Diameter of raster disks (vertical and horizontal)	79mm	
Minimum display reading	1" or 5", optional	
Detection mode	Horizontal angle: dual	
	Vertical angle : dual	
Angle measurement	360 ° 400gon/6400mil, optional	

Unit	
Precision	ET-02/02L: 2", ET-05/05L: 5"
Leveling vials	
Plate vial	30"/2mm
Circular vial	8'/2mm
Vertical compensator	
System	liquid condenser mode, optional
Working range	$\pm 3'$
Precision	$\pm 3''$
Optical plummet	
Image	Erect image
Magnification	3X
Focusing range	0.5 $\sim\infty$
Field of view	5°
Laser plummet (only for the instrument with laser plummet)	
Accuracy	$\pm 0.15\text{mm}$ (at 1.5m)
Diameter of laser facula	3mm(at 1.5m)
Wave length	630nm—670nm
Laser power	$\leq 1\text{mW}$
System	
Display	LCD, four lines, line segment
Internal Memory	Space for 256 pairs of H. & V. angle
Data input/output	
Interface	RS --232C

On-board battery	
Power source	Rechargeable NI-H Battery
Voltage	DC 4.8V
Continuous working hours	8h
Working environment	
Working Temperature	-20 ° ~ +45 °
Dimensions and weight	
Overall dimensions	160X150X330mm
Instrument weight	5.2kg
Laser Tube Specification (for laser theodolite only)	
Wave length	630nm—670nm
Telescope laser power	≤0.4mW
Maximum measuring range	150m (daytime, sun-shading)
Diameter of central facula	≤Φ5mm/100m
Laser axis and collimating axis non-coaxial difference	≤10"

12. COMMON ERROR

When operating the instrument improperly or circuit within the equipment has problems, error codes will be displayed on the screen, whose contents and solving methods are listed as

follows:

ErrorCode	Meaning and Solution
Err 01	Something wrong with horizontal disk measurement. Turn off the instrument, then power on,if Err01still appears, send it to be repaired.
Err 02	Telescope is rotated too fast .Press V/% , after displaying “V OSET”, show vertical disk index Return to 0 (namely rotate telescope up and down near the horizontal position when left disk).
Err 03	Collimator is rotated too fast .Press O SET to reset.
Err 04	Something wrong with vertical photo-electric convertor (I). Send it to be repaired.
Err 05	Something wrong with horizontal photo-electric convertor (I). Send it to be repaired.
Err 06	Something wrong with horizontal photo-electric convertor (II) . Send it to be repaired.
Err 07	Something wrong with vertical photo-electric convertor (II). Send it to be repaired.
Err 08	Something wrong with vertical disk. Turn off and level the instrument. If Err 08 still appears after power on, send it to be repaired.
Err 20	Something wrong with Oset of vertical disk index. Operate again according to chapter 8.6. If Err 20 still appears, press HOLD 、 OSET 、 HOLD to force setting.

Err 21	Exceeded zero-point of electronic compensator of vertical angle. Turn off and level the instrument. If Err 21 still appears after power on, send it to be repaired.
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- **When errors appear, check the instrument and your operation steps. If you confirm that something is wrong with the instrument, send it to factory to be repaired.**

13. ACCESSORIES

Standard Configuration

- Carrying Cass 1
- Main Body 1
- On-Board Battery 1
- Charger 1
- AA Battery Box 1
- Plumb 1
- Correction Pin 2
- Fur Brush 1
- Screwdriver 1
- Hexagon Wrench 2
- Cloth 1
- Dryer 1
- Certificate 1
- Operation Manual 1
- Porro Tester (only for
Laser Theodolite) 1

Optional Configuration

- Diagonal Eyepiece 1
- Solar Filter 1