

## **Precautions**

1. Special care should be taken to avoid any situation that might result in the theodolite being dropped or otherwise subjected to a severe shock.
2. Inspect the theodolite for loose parts and screws. Remove dust from the objective lens and eyepiece with a lens brush and lens tissue using procedures consistent with delicate optics. Keep the lens covered with the theodolite when it is not in use. Use a sun shade to protect the lens from the direct rays of the sun.
3. The graduated circles and venires are coated with a lacquer to retard oxidation. Avoid touching these parts. A thin film of oil applied with a lint less cloth will aid in keeping the surfaces clean.
4. Store the theodolite in its case or another dry dust free location when it is not in use.
5. If the theodolite is to be taken from a cool environment to a warm one (especially in humid conditions) allow the theodolite to warm up inside its case where it will not be subject to condensation.

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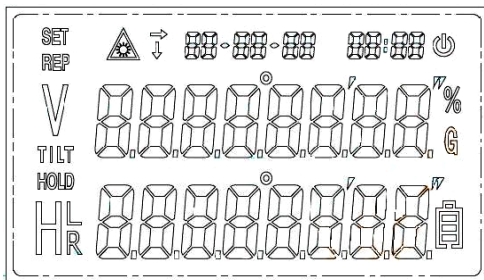
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# 1. Instrument Structure



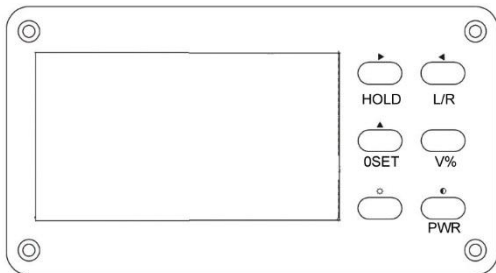
## 2. Display Marks and Keyboard



### 2.1 Display marks



Marks	Meanings	Marks	Meanings
V	Vertical Angle	REP	Repeat horizontal angel
TILT	Tilt Compensation		Laser
HOLD	Hold Horizontal Angle	%	Angle Percent
HL	Horizontal Angle Left	G	Gon
HR	Horizontal Angle Right		Battery

## 2.2 keyboards

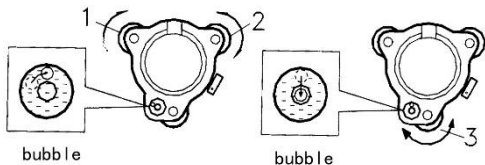


Keys	Surveying Function	Setting Function
V%	Percent grade of vertical angel	Press 2 sec turn on laser plummet
L/R	Switch horizontal angle right or left	Left move the cursor
HOLD	Hold horizontal angle	Right move the cursor
OSET	Set horizontal angle to 0°	Up move the cursor
	Display back light	Press 2 sec turn on laser pointer
	Power switch	

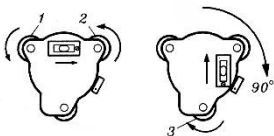
### 3. Preparation for Measurement

#### 3.1 Setup the Theodolite

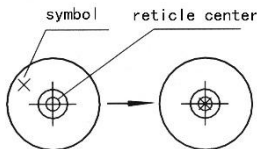
1. Set the tripod over the surveying point with the head level and legs making about a 70-degree angle with the ground. Mount the theodolite on the tripod.
2. Secure the front tripod leg and move the two other legs to center the theodolite by using the plumb bob. Secure the back two legs.
3. Adjust the length of one leg of the tripod at a time, while keeping the other two still. Use the plumb bob to level the circular bubble without disturbing the centering.



4. Rotate the theodolite on the tripod head until its plate bubble is parallel to any two footscrews. Adjust those two footscrews to center the bubble.
5. Rotate the theodolite body 90 degrees to the left. Center the bubble with the third foot screw. Repeat until the bubble is centered for all four positions.



6. Loosen the tripod screw. Rotate the theodolite body around until centered over the survey point, then tighten the screws. Repeat the leveling process until the theodolite is level and centered.




### 3.2 laser plummet (For Laser Theodolite)

Press [V%] for 2 seconds to turn on the laser plummet.

Rotate the theodolite until it is centered over the surveying point, then tighten the screws.

### 3.3 Battery

1. When battery icon shows  it means the battery is low and needs to be charged.
2. Use specific battery charger that is supplied with the unit
3. Standard charging time: 6 hours. Temperature: 0-45°C



4. Keep batteries in a dry and cool place.

## 4. Instrument Settings

### 4.1 User setting

Press [HOLD] + [0SET] power on. Press [HOLD] or [L/R] shift items, press [0SET] shift options. Press [V%] save and quit.

Options followed by:

- |                                     |                            |
|-------------------------------------|----------------------------|
| 1) Angle value:                     | *360°/ 400gon/ 6400mil     |
| 2) Hhorizontal angle 90° beep       | ON / *OFF                  |
| 3) Vertical angle tilt compensation | *TILT OFF, TILT ON         |
| 4) Minimum angle                    | *DSP 1 / DSP 5             |
| 5) 30min Auto off                   | NO OFF,*30OFF              |
| 6) Vertical angle 0° position       | * ZENITH: 0, ZENITH:<br>90 |

\*\*\*\*\*The option marks with \* is the initial setting. \*\*\*\*\*

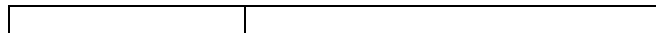
### 4.2 Time and Date Settings

Press [0SET] + [☀] then [POWER]. ADJ2 displayed. Press [HOLD] to shift date/time, Press [L/R] and [V%] as [+] and [-]. Press [☀] save and quit.


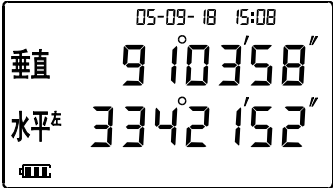
## 5. Measurement

### 5.1 Horizontal Angle and Vertical Angle Measurement



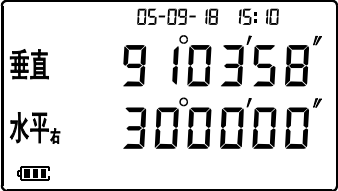
Operation	Display
1. Collimate the first target A.	<p>05-09-18 15:08</p> <p>垂直 9°10'35.8"</p> <p>水平<sub>右</sub> 25°38'08"</p> <p>▢▢▢▢</p>
2. Press [0SET], set horizontal angle of target A at 0°00'00".	<p>05-09-18 15:08</p> <p>垂直 9°10'35.8"</p> <p>水平<sub>右</sub> 00°00'00"</p> <p>▢▢▢▢</p>
3. Collimate target B. HA and VA of target B are displayed.	<p>05-09-18 15:08</p> <p>垂直 8°14'35.3"</p> <p>水平<sub>右</sub> 86°09'30"</p> <p>▢▢▢▢</p>



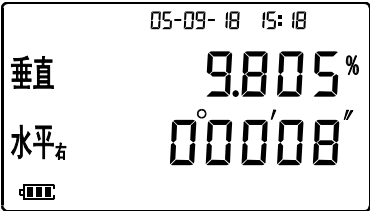

## 5.2 Switch Horizontal Angle HL/HR

Operation	Display
1. Collimate the target A.	 <p>The display shows the date and time '05-09-18 15:08' at the top. Below it, the vertical angle is '9° 10' 35.8" and the horizontal angle is '25° 38' 00"'. The Chinese characters '垂直' (Vertical) and '水平右' (Horizontal Right) are on the left. A battery icon is at the bottom left.</p>
2. Press [L/R], The mode of Horizontal Angle Right (H <sub>R</sub> ) switch to Horizontal Angle Left (H <sub>L</sub> ).	 <p>The display shows the date and time '05-09-18 15:08' at the top. Below it, the vertical angle is '9° 10' 35.8" and the horizontal angle is '334° 2' 15.2"'. The Chinese characters '垂直' (Vertical) and '水平左' (Horizontal Left) are on the left. A battery icon is at the bottom left.</p>
3. Measure the target in H <sub>L</sub> mode.	

### 5.3 Setting a Horizontal Angle

Operation	Display
<p>1. Turn horizontal tangent screw and set the horizontal angle required.</p>	 <p>05-09-18 15:08</p> <p>垂直 9°10'35.8"</p> <p>水平<sub>右</sub> 25°38'08"</p> <p>⏻</p>
<p>2. Press [HOLD] to lock the horizontal angle.</p>	 <p>05-09-18 15:10</p> <p>垂直 9°10'35.8"</p> <p>水平<sub>右</sub> 30°00'00"</p> <p>⏻ 鎖定</p>
<p>3. Collimate the target.</p>	
<p>4. Press [HOLD] unlock the horizontal angle.</p>	 <p>05-09-18 15:10</p> <p>垂直 9°10'35.8"</p> <p>水平<sub>右</sub> 30°00'00"</p> <p>⏻</p>

## 5.4 Switch Vertical Angle and Percent Slope

Operation	Display
<p>1. Press [V%], the display of vertical angle switches to percent slope.</p>	
<p>2. Press [V%] again. The display turns back to normal angle measurement mode.</p>	
<p>Percent slope=<math>H/D \times 100\%</math>            When measured slope is exceeding <math>\pm 45\%</math> "EEEE.EEE%" displayed.</p>	

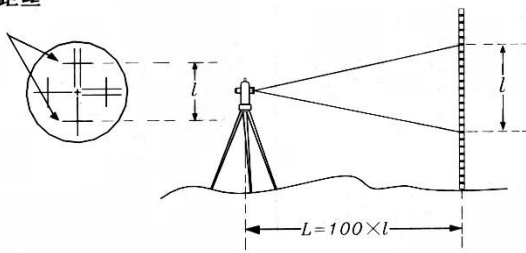
## 5.5 Measuring Distance by Telescope Stadia

The *Stadia* is a method of measuring distances rapidly with a telescope and a graduated rod. When the telescope is focused on the rod, the distance is intercepted on the vertically-held rod between two *stadia hairs* seen in the eyepiece gives the distance  $D$ .

$$D = KS \quad \text{Stadia constant } k=100$$

Stadia can give results correct to about 1 ft under the best conditions, which is often sufficient, and can also serve as a check on more precise measurements.

视距丝



## 6. Check and Adjustment Guide

- ◆ Accurate focus, eliminate parallax.
- ◆ The adjustment should be followed by guidance order, because each result is based on the step before.
- ◆ The screws must be properly tightening after correction.
- ◆ Repeat check after adjustment.

### 6.1 Plate Bubble Level

#### 6.1.1 Check

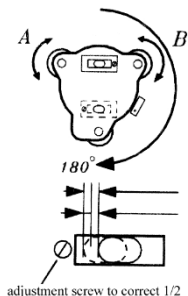
- 1) Make the plate level, bubble right and centered by turning the foot screws (A and B).
- 2) Rotate the instrument  $180^\circ$  (200gon) to see whether the bubble remain its position. It needs to be calibrated if moved.

#### 6.1.2 Adjustment

- 1) Rotate the instrument 180 degrees and observe the position of the level. Use an adjusting pin to reset the bubble level, adjusting the screws so that the bubble returns exactly 1/2 the distance to the centered position. Re-level the theodolite with the leveling screws. Rotate the theodolite 180 degrees again, the bubble should maintain its position in the center.

2) Repeat the Plate Bubble Level Adjustment procedure, for the other bubble to level. After doing both levels you should be able to level the theodolite using the procedure in the preceding section.

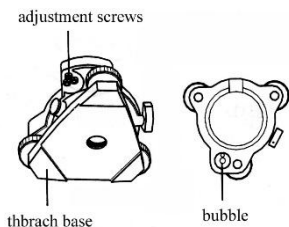
3) If the theodolite is in use for a long period of time it may require re-leveling periodically due to temperature effects on the tripod and theodolite base.



## 6.2 Circular Bubble Level

### 6.2.1 Check

Carefully level the instrument with the plate level. If the bubble or the circular level is easily centered, adjustment is not required. Otherwise, proceed with the following step.





## 6.2.2 Adjustment

Find the adjust screws under the circular bubble. Center the bubble by half and half adjustment.

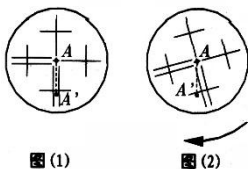
## 6.3 Vertical Stadia Adjustment

### 6.3.1 Check

- 1). Set and aim a point 50 meters away (A) from the instrument.
- 2). Use a vertical tangent screw to move the telescope up and down slowly, observe whether the point (A) moves along the vertical stadia.
- 3). If an offset occurred between point A and vertical stadia when moving, the reticule adjustment is required.

### 6.3.2 Adjustment

- 1). When you remove the reticule protect cover, you will see

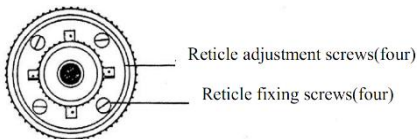


four adjustment screws and four fixing screws.

- 2). Use a screwdriver to loosen the fixing screws a little. Remember the cycles of the numbers loosened. Then move the eyepiece lens so that the vertical wire and point A'

coincide, then tighten the four screws.

3). Repeat check to make sure it's all well-adjusted.



## 6.4 Perpendicularity of sight axis and horizontal axis2C

### 6.4.1 Check

(1) Level and center the theodolite in position. Set a target at about 50M away and so it is the same height with the theodolite.

(2) Aim target A with the circle facing left. Read the horizontal angle L.

(3) Aim target A with the circle facing right. Read the horizontal angle R.

(4)  $|2C| = [L - (R \pm 180^\circ)]$

(5) If  $|2C| \geq 20''$  That means adjustment is needed.

### 6.4.2 Adjustment

(1) Use the horizontal tangent screw to correct the horizontal reading to:  $R + C$ .

(2) Move the reticle by loosening one and tightening the

other reticle screw. Make sure reticle aim at target A exactly.

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

## 6.5 Plummet Adjustment

### 6.5.1 Check

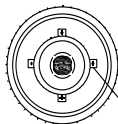
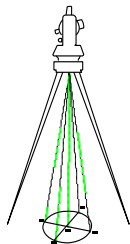
Centre the theodolite over the survey point. Rotate the theodolite  $180^\circ$  to check if the instrument is still centered. Otherwise it needs adjustment.

### 6.5.2 Adjustment

1). Remove the optical plummet protection cover, adjust the optical plummet to be center to the mark on the ground. Movement is  $1/2$  deviation.

2). Coincide the surveying mark with the optical plummet by the foot screws.

3). Repeat checks 1 & 2 until plummet center is correct.



对心器校正螺丝(四个)

**Note: Laser plummets have the same check and**

## **adjustment method with 6.5**

### **6.6 Laser Pointer**

#### **6.6.1 Check**

- 1) Aim target at about 10M away from the instrument.
- 2) Focus the laser spot and observe if the laser spot is at the center of the reticle cross hair or not. It should be adjusted when it is not in center.

#### **6.6.2 Adjustment**

- 1) Open the small cap of the laser base near the focus knob.
- 2) Center the laser spot by adjusting the pin.

### **6.7 Vertical Tilt Compensation**

#### **6.7.1 Check**

- (1) The vertical tilt automatic compensator is used for vertical index zeroing compensation. We can check if the function works well by the following method.
- (2) Set and level the instrument and make the telescope perpendicular to the line of any two foot screws (A and B connection). Then lock the horizontal lock.
- (3) Zero the vertical angle.
- (4) Rotate the third foot screw C in one direction slowly. The displayed value will change correspondingly, then display

"TILT". When rotating reversely to the original position, the instrument displays the vertical angle again which means that the tilt compensator works well.

### **6.7.2 Adjustment**

If the compensation does not work well, send the instrument to your local Metsys service center.

## **6.8 Index error of vertical circle**

### **6.8.1 Check**

(1) Set up the instrument in position. Press [HOLD] + [L/R] power on. Sight unit at a reference A and obtain the vertical angle (Circle Left).

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

(3) 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  $(L+R-540^\circ)/2$ .

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

### **6.8.2 Adjustment** (Setting up vertical index zeroing)

(1) Set up the instrument and press [HOLD]+[L/R] turn on.

Displaying: FACE-1

(2) Sight the unit at reference A which is nearly the same

height as the instrument (Circle Left). Press [0 SET] key, displaying: FACE-2

(3) Reverse the telescope and aim to ref. A again (Circle Right). Press [0 SET] key to finish vertical index zeroing setting. The instrument will then return to its angle measurement mode.

(4) Repeat the check procedures. If  $|I| \geq 10''$ , check if zenith  $0^\circ$  is wrong.

**Note:** The vertical angle displayed during the settings is not corrected, so it can only be used as a reference value.

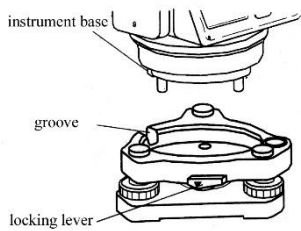
## 7. Tribrach

### Detachment

Turn the locking lever  $180^\circ$  in a counter clock-wise direction. Lift the instrument up with one hand carrying the handle and the other hand holding the tribrach.

### Attachment

Match the instrument base with the correct groove before putting the instrument on the board. Tighten the locking lever.



## 8. Error Code

<b>Code</b>	<b>Error Info and Solutions</b>
TILT	Vertical tilt beyond the compensator range. Level and center the instrument correctly.
E01	Optical electronic converter connection error. Reconnect converter.
E02	Optical electronic converter signal weak, Check and clean the converter.
E03	Optical electronic converter signal error, Check and clean the graduated Circle.
E04	Optical electronic converter ddecoding eerror, Check and clean the graduated circle.
E05	Complex error. Check and clean the converter and graduated circle.
E06	Index error of vertical circle setting mistake. Reset 6.8.2.



## 9. Technical Data

DE-2B/ DEL-2B		
Telescope	Image	Erect
	Magnification	30X
	Object lens aperture	45mm
	Resolving power	3"
	Field of view	1°30'
	Min.focus	1.35m
	Stadia ratio	100
	Additive constant	0
	Length	155mm
Angle Measurement	Code type	Absolute code
	Min. reading	1"/5"
	Accuracy(1)	2"/5"/10"
	Circle diameter	79mm
	Measuring unit	360°/400g/6400mil
	TILT Compensator range	±3'
Display	LED	Double side
Optical plummet	Magnification	3x
	Field of view	5°
	Focus range	0.5m—∞

Laser plummet & pointer	Wave length	630-670nm
	Power	5mW
	Laser range	250m
	Laser spot diameter	≤2mm
bubble	Plate level	30"/2mm
	Circular bubble	8'/2mm
Power	Rechargeable battery	Ni-MH 6V 1350mAH

## 10. Packing list

1. Electronic Theodolite x1.
2. Rechargeable battery x1.
3. Dry Battery Case x1.
4. Charger x1.
5. Mini tool bag x1.
6. User Guide x1.
7. Laser Target (provided with laser theodolite)
8. Bend Eyepiece (optional)
9. Instrument Suitcase x1.