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1. Preface

The DE Series electronic theodolite uses the incremental grating and absolute encoder system for angle measurement. Microcomputer technology is employed to realize measurement, calculation, display, storage and other functions. Horizontal or vertical angle and other measurement results can be displayed at the same time. There is variety of modes to survey the angle, slope, etc.

The DE Series can be widely applied to the class 3/4 triangle survey. It can also be used in various engineering surveys, such as railway, highway, bridge, water conservancy, mine, etc. and the installation of buildings and large equipments, as well as cadastral and topographic surveying.

This manual is applicable to DE2A, DE2A-L, DE2B, DE5A, DE5B, DE10A, DE10B and other DE Series electronic theodolite. The numbers 2, 5, 10 means the precision of angle measurement; A means with compensator; B means without compensator.

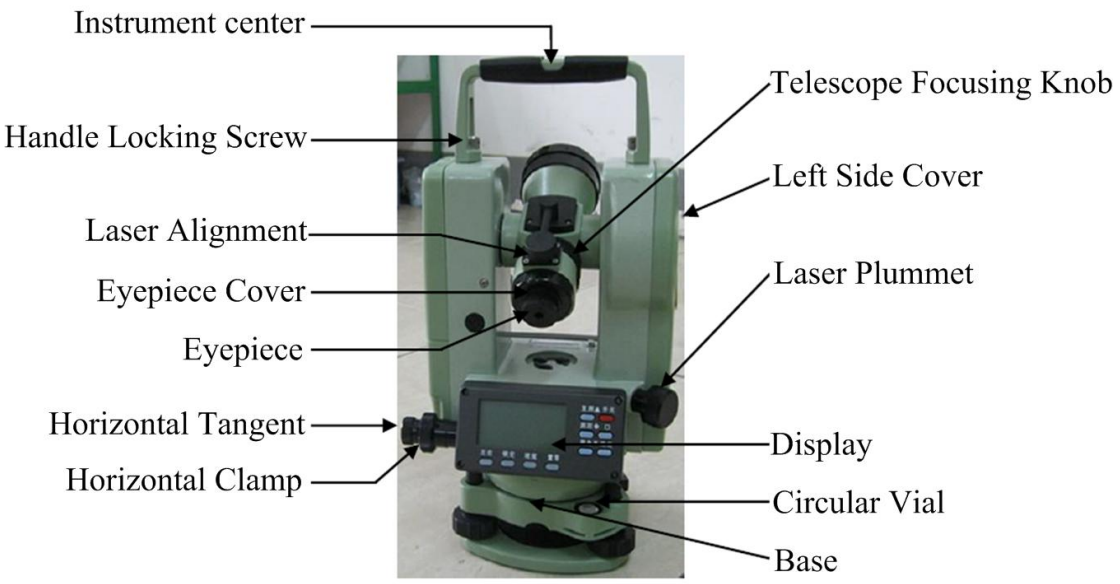
2. Precautions

1. When failure occurs, please follow the instruction of this manual and debug as the photos guidance. If the instrument damage is caused by personal behavior going against service manual, the responsibility is definitely belongs to individual.
2. If the instrument failures involving some main components, such as mainboard, grating disk, reading terminal, telescope LCD, etc., please replace the whole component. Do not repair it.
3. When replacing components, please strictly according to the service manual. Do not disassemble the instrument unauthorized if the repairing method is not involved in this manual. In this case, please send it back to our company for repair.
4. After replacing components, you should calibrate the overall specifications. Before using the instrument, please confirm all the specifications eligible.
5. Electronic theodolite is a precision instrument. If you don't have professional maintenance skills or equipment, do not repair the total station unauthorized to avoid damaging it.
6. This service manual is only for the DE Series of Changzhou Dadi Surveying Science & Technology Co., Ltd. Anything unclear during maintenance, please contact us.

3. Product Instruction

3.1 External Components

DE2A-L Laser Electronic theodolite



3.2 Display And Keypad

a. Display

The adopted LCD can display angle, words, date, time or other information. There are ten buttons on display. The red button is a power switch button. Under angle measurement mode, other functions are illustrated as follow:

L/R: switch left/ right of horizontal angle measuring direction
HOLD: lock horizontal angle measurement result
%: switch vertical angle/ slope percent
OSET: set horizontal angle as 0°00′00″
¤-▲: turn on/ off directing laser
¤-▼: turn on/ off laser plummet
¤-◆: turn on/ off background light of LCD
¤-ENT: enter main menu
¤-ENT-ENT: save and exit

b. Illustration Of Symbols On Screen

⏻: automatic shutdown symbol

▮: battery power symbol

⌂: special function symbol;

shows when press ¤ button and disappears after another press

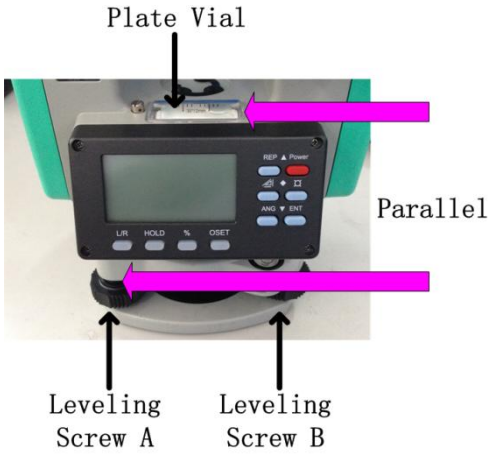
%: slope percent
b-OUT: vertical angle over compensated
OUT: slope over ±100%
m: unit in meters
°, ′, ″: unit of angle

4. Specifications Check And Adjustment

4.1 Plat Vial

a. Check

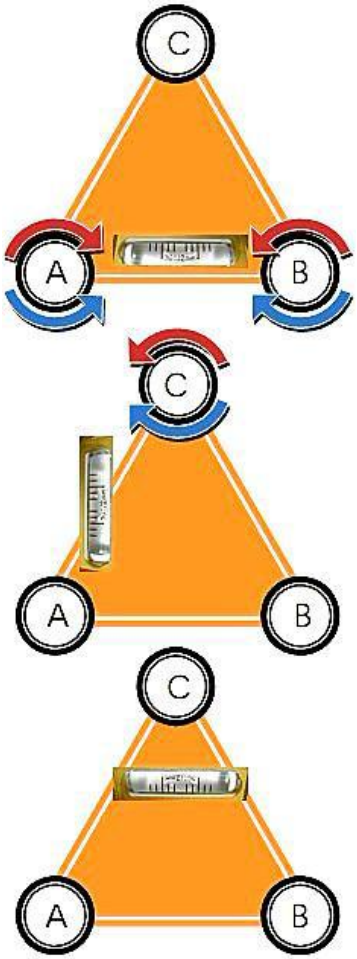
(1) Place the instrument on a stable device (a tripod or calibration table) and fix it.
(2) Parallel the plate vial and the line between two out of three leveling screws. Adjust the two screws to keep the bubble in the middle of plate vial.
(3) Rotate the instrument around the vertical axis and observe the offset of bubble. If the bubble remains in the middle, no adjustment is necessary. Otherwise, the following adjustment is required.



Picture A

b. Adjust

(1) Place the instrument on a stable device.
(2) Rotate the instrument to parallel plate vial and the line connecting two leveling screws A, B. Adjust screws A and B inside or outside simultaneously to make plate bubble in the middle.
(3) Rotate the instrument 90 ° to plumb plate vial and the line between two leveling screws A, B. Then adjust screw C to make plate bubble in the middle. Repeat step (2) and (3) until the bubble remains in the middle in these two directions.
(4) Rotate the instrument 180 °. When the bubble is not stop in the middle, tweak adjusting screw with a adjusting pin to make plate bubble move half of the offset back.
(5) Repeat step (2) (3) (4) until the bubble keeps in the middle of vial in all directions.



Adjusting Process

Tweak the adjusting screw with an adjusting pin

Picture B

4.2 Circular Vial

a. Check

(1) Place the instrument on a stable device.
(2) Check and adjust the plate vial.
(3) Observe the bubble in circular vial. If the bubble remains in the center, no adjustment is necessary. Otherwise, the following adjustment is required.

b. Adjust

(1) Place the instrument on a stable device.
(2) Check and adjust the plate vial.
(3) Tweak two adjusting screws with a correction pin to keep the bubble centered in the vial: loosen the screw (one or two) opposite with bubble deflective direction; tighten the screw on the direction accordant deflective until circular bubble is centered.
Note: Be gentle while using adjusting pin to calibrate screws. The force power fixing two adjusting screws must be consistent when circular level is centered at last.

Picture C

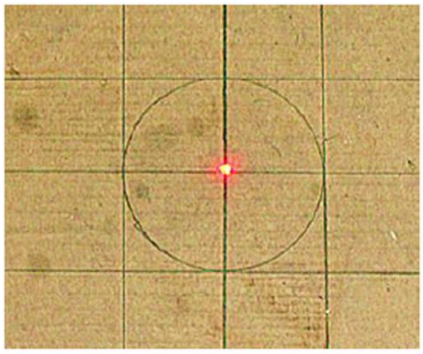
4.3 Laser Plummet

a. Check

(1) Place the instrument on a tripod and fix it.
(2) Put a piece of paper with two crisscross lines on it right below the instrument.
(3) Turn on the laser plummet and adjust the laser luminance to a proper level.
(4) Adjust 3 leveling screws to make the laser spot coincides with the intersection point of the paper.
(5) Rotate the instrument around the vertical axis. If the laser spot always coincides with the intersection point, no adjustment is necessary. Otherwise, the following adjustment is required.

b. Adjust

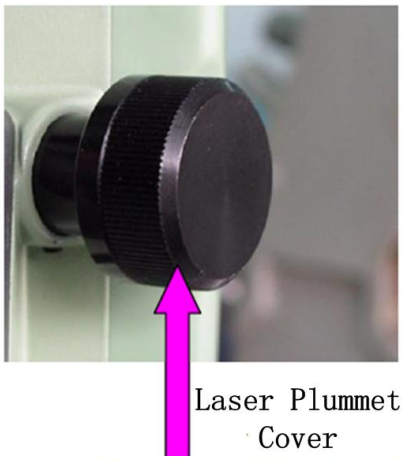
(1) Adjust 3 leveling screws to make the laser spot coincide with the intersection point.
(2) Rotate the instrument 180°and remove the cover of laser plummet. Adjust 4 screws to make the laser spot moves half of the offset back.
(3) Repeat step (1) and (2) until the laser spot coincides with the intersection point in all directions.

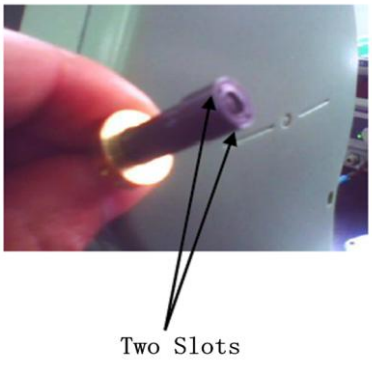


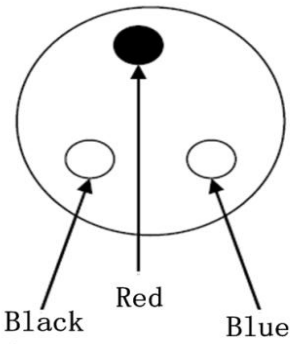
Picture D (a)

c. Replace The Laser Tube

(1) If you turn on the laser plummet with correct operation and the wire of laser tube is well connected, and still can't get laser beam. In this case, replace the laser tube.
(2) Remove the cover of laser plummet counterclockwise.
(3) Remove 4 adjusting screws counterclockwise and pull the laser collimator out gently.
(4) Put tweezers into the slots as the picture indicated and tweak the laser collimator off. Use an electric iron to weld 3 wires off and then take out the laser tube.
(5) Install a new laser tube as the picture indicated and make sure 3 wires with different colors (red, black and blue) match.
Note: After replacing laser tube and still can't get laser beam, recheck your operation and make sure it is not caused by bad welding or broken wire. In this case, send the instrument back to us.







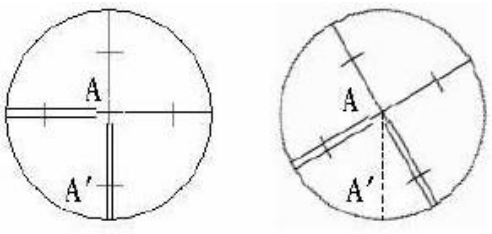
Schematic Position of Three Wires with Different Colour

Picture D (b)

4.4 Inclination Of Telescope Reticle

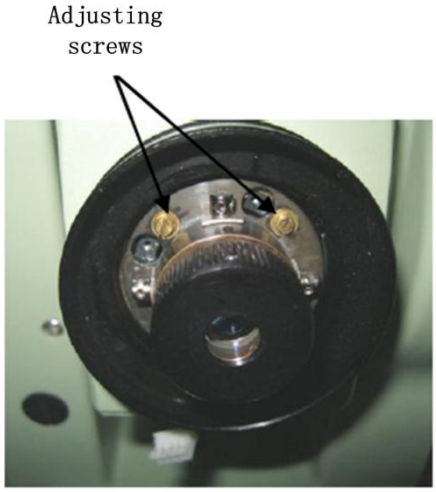
a. Check

(1) Place the instrument on a tripod and level it precisely.
(2) Set an object A 50 meters away from the instrument.
(3) Collimate object A through the telescope and move object A to edge of the field of view with vertical tangent screw (point A'). Adjustment is not necessary if object A moves along the vertical line of the reticle and point A' still in the vertical line. As illustrated, if A' offsets from the center to the cross hair tilts, need to adjust the reticle.



b. Adjust

(1) Mount the instrument and set objet A 50 meters away.
(2) Remove the eyepiece cover to expose the four reticle adjusting screws. Loosen all the adjusting screws uniformly with an adjusting pin and rotate the reticle around the sight line. Align the vertical line of reticle with point A' and then tighten reticle adjusting screws uniformly.
(3) Repeat step (3) in 4.5-a, and (2) in 4.5-b until there is no deviation.



Picture E

4.5 Laser Alignment Component

a. Check

(1) Place the instrument on a tripod and level it precisely. Put a piece of paper with two crisscross lines on it 50 meters right before the instrument.
(2) Turn on the laser alignment and adjust the laser luminance to a proper level. Adjust the laser spot to coincide with the intersection point.
(3) Adjust the telescope eyepiece and focusing knob to make the telescope reticle and the front crisscross both clear. Observe through the telescope whether the laser spot is in the center of reticle. If the laser spot coincides with the reticle center, no adjustment is necessary. Otherwise, the following adjustment is required.

b. Adjust

(1) Adjust the telescope eyepiece and focusing knob to make the telescope reticle and the front crisscross both clear and coincide with each other.
(2) Observe the move of laser spot through telescope while adjusting 4 screws on laser alignment until the laser spot coincide with reticle center.
Note: The force power fixing 4 adjusting screws must be consistent at last.

Picture F

c. Replace The Laser Tube

(1) If you turn on the laser plummet with correct operation and the wire of laser tube is well connected, and still can't get laser beam. In this case, replace the laser tube.

(2) Remove 3 fixing screws (M2×12) counterclockwise and take off the cover of laser alignment.

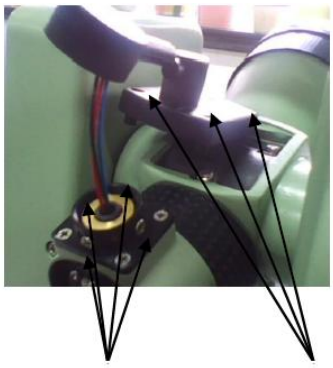
(3) Remove 4 adjusting screws (M2×5) counterclockwise and pull the laser collimator out gently.

(4) Put tweezers into the slots as the picture indicated and tweak the laser collimator off. Use an electric iron to weld 3 wires off and then take out the laser tube.

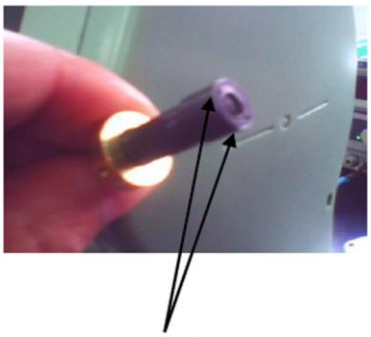
(5) Install a new laser tube as the picture indicated and make sure 3 wires with different colors (red, black and blue) match.

Note: The power of diode used in laser alignment is higher than that in laser plummet. Don't mix them up.

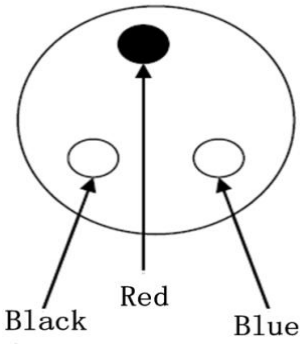
After replacing laser tube and still can't get laser beam, recheck your operation and make sure it is not caused by bad welding or broken wire. In this case, send the instrument back to us.



M2×5 M2×12



Two Slots



Schematic Position of Three Wires with Different Colour

Picture G

4.6 Perpendicularity Between Line Of Sight And Horizontal Axis (C)

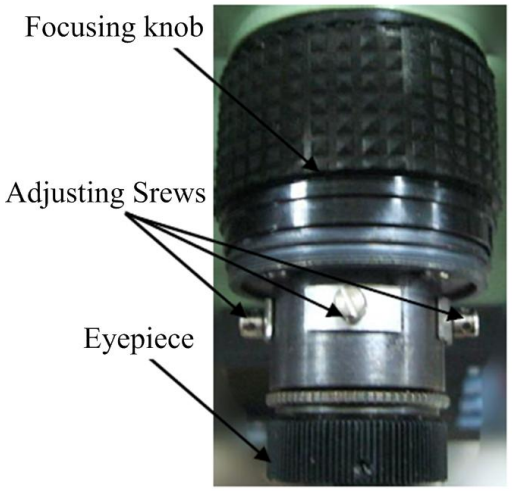
a. Check

(1) Place the instrument on a stable device and level it precisely.
(2) Collimate the reticle of a collimator or a clear object far away (about 100 meters) from the instrument and turn on the power. Read the horizontal angle value in front face. Loosen the vertical and horizontal clamp screws and rotate the telescope. Sight the reticle in reverse face and read the horizontal angle value.
(3) After getting two angle values HL and HR, calculate the difference: C=(HL-HR±180°)/2. If C＜10″, no adjustment is necessary. If C≥10″, the following adjustment is required.

Example:
HL=000°00′00″
HR=180°00′40″
C=(HL-HR±180°)/2=-20″
C≥10″，the adjustment is required
HR’=HR+C=180°00′20″

b. Adjust

(1) Adjust the horizontal tangent in reverse face and make the horizontal angle value HR’=HR+C.
(2) Take off the cover of the reticle between eyepiece and focusing knob. Tweak the left and right adjusting screws by loosening one and tightening the other to make the vertical line of reticle coincides with the collimator or the object.
(3) Repeat the check and adjustment until C＜10″.
Note: After adjustment, need to check the photo-electricity coaxiality.



Picture H

4.7 Check of 2C

(1) Place the instrument on a stable device and level it precisely.
(2) Press and hold “L/R” button when turn on the power. The interface is shown as picture I (a).
(3) In front face, collimate the reticle of a horizontal collimator and press “OSET” shown as picture I (b).
(4) Collimate the reticle in reverse face and press “OSET”.
(5) Collimate the reticle in front face again and press “OSET”. The horizontal angle is 0°00′00″ as picture I (c) indicated.
(6) Collimate the reticle in reverse face again and record the present horizontal angle as X.
(7) Calculate: Δ C=|180°-X|. IfΔ C ＞8″, recheck the perpendicularity between line of sight and horizontal axis (C). IfΔ C＞8″ after rechecking the instrument, send it back to our company for repair.

Picture I (a)

Picture I (b)

Picture I (c)

4.8 Vertical Index Difference (I)

(1) Place the instrument on a stable device and level it precisely.
(2) Turn on the power and press "⌑-ENT" to enter main menu. Press "◆" (Measure distance) to choose SET-2. Press "▼" to show "ON" on screen bottom, as picture J (a) indicated. Press "ENT" and turn off the power.
(3) Press and hold "L/R" button when turn on the power. The interface is shown as picture J (b).
(4) In front face, collimate the reticle of a horizontal collimator and press "OSET".
(5) Collimate the target in reverse face and press "OSET" (Picture J (c)). Record the vertical angle as VR. Collimate the target again in front face and record the vertical angle as VL.
(6) Calculate the vertical index difference: I=(VL+VR-360°)/2.
(7) If I＞15″, recheck the vertical index difference. If I ＞ 15″ after rechecking the instrument, send it back to our company for repair.

Picture J (a)

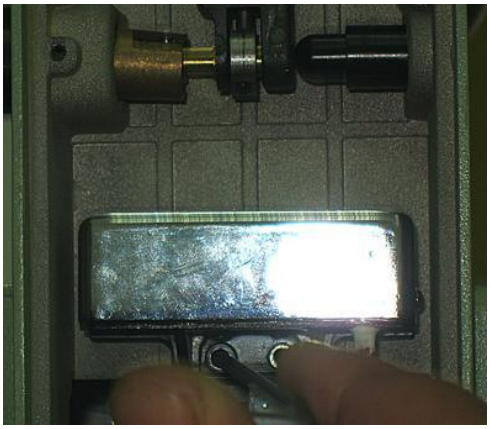
Picture J (b)

Picture J (c)

4.9 Vertical Index Difference Compensation

a. Installation And Adjustment

(1) Place the instrument on a stable device and level it precisely. Put the plate vial face to operator (front face).
(2) Use two pairs of M3×8 hexagonal bolts and ø3 spring washers to fix the compensator and wire up the plug as picture H indicated.
(3) After turn on the power, press "¤-ENT" to enter main menu. Press "◆" (Measure distance) to choose SET-1. Press "▼" to show "ON" on screen bottom, as picture L (a) indicated. Press "ENT" to save the settings.
(4) Press "¤- L/R" to show the compensating angle as picture L (b) indicated.
(5) Use a hammer (or other tools with plastic or wooden handle) to knock one side of the compensator gently (do not deform or damage it), until the compensating angle on the screen less than 20″. Tighten the compensator fixing bolts and record present compensating angle as BC1. After rotating the instrument 180°, knock the compensator again to adjust the angle and record present value as BC2.
(6) Repeat step (4) until |BC1+BC2|＜30″.



Picture K

Picture L (a)

Picture L (b)

b. Linear Compensation Of The Compensator

(1) Place the instrument on a stable device and level it precisely.
(2) Press and hold “OSET” and “ANG” button when turn on the power. The interface is shown as picture M (a).
(3) Press “L/R” and come to the interface shown as picture M (b). Adjust leveling screws to make the compensating angle on the screen zero. The present vertical angle is recorded as θ.
(4) In front face, collimate the reticle of a horizontal collimator and adjust vertical tangent to make the vertical angle θ+3′. Adjust the leveling screw to collimate the reticle again and press “OSET” as picture M (c) indicated. Record the present vertical angle as X1.
(5) Adjust vertical tangent to make the vertical angle θ-3′. Adjust the leveling screw to collimate the reticle again and press “OSET” to save the adjustment (picture M (d)). Record the present vertical angle as X2.
(6) Press “¤- L/R” to show the compensating angle. Adjust leveling screws to make it zero (as picture G (a) indicated) and press “OSET”. Record the present vertical angle as X3.
(7) Mark the maximum angle as X_{max} and the minimum X_{min}. Calculate $X= X_{max} -X_{min}$. If $X\geq 6''$, readjust the compensation until $X<6''$.

Picture M (a)

Picture M (b)

Picture M (c)

Picture M (d)

c. Zero Compensation Of The Compensator

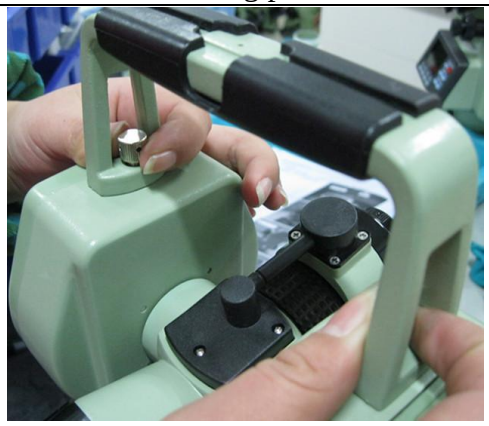
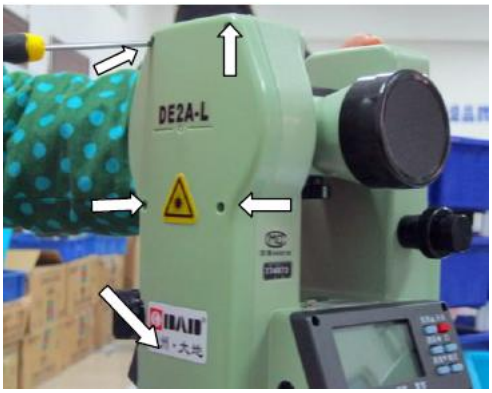
(1) Place the instrument on a stable device and level it precisely.
(2) Press and hold “OSET” and “ANG” button when turn on the power. The interface is shown as picture N (a).
(3) Press “HOLD” and come to the interface shown as picture N (b).
(4) In front face, collimate the reticle of a horizontal collimator and press “OSET”.
(5) In reverse face, after collimating the reticle, press “OSET”.
(6) Press “⌑ L/R” to show the compensating angle (picture N (c)). Record the compensating angle in front and reverse face as Y1 and Y2 separately, shown as picture K. Calculate Y=Y1+Y2. If Y≥30″, readjust the compensation until Y＜30″.

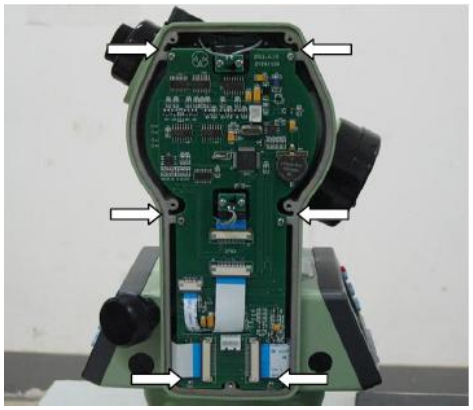
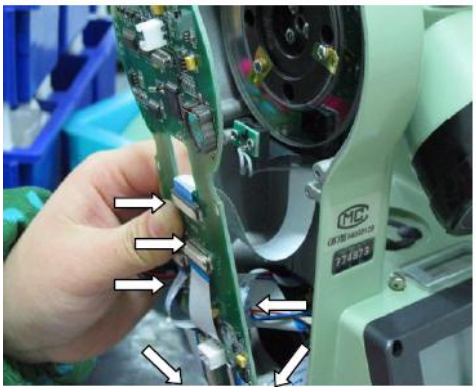
Picture N (a)

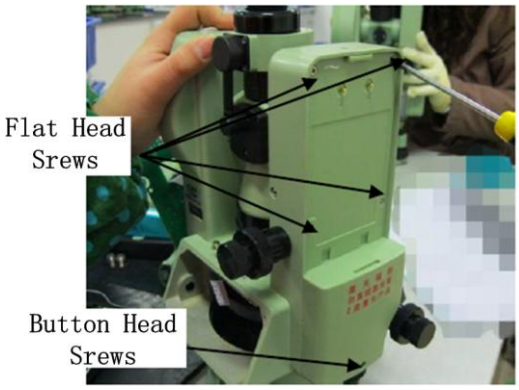
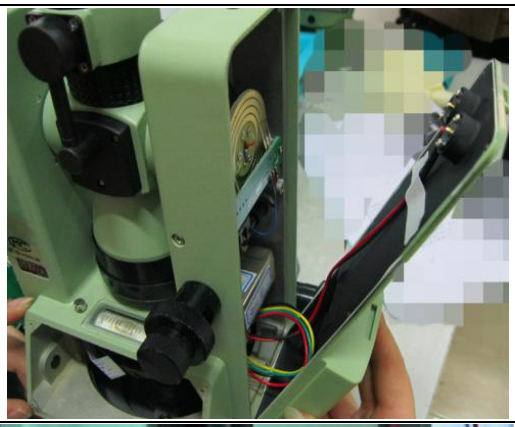
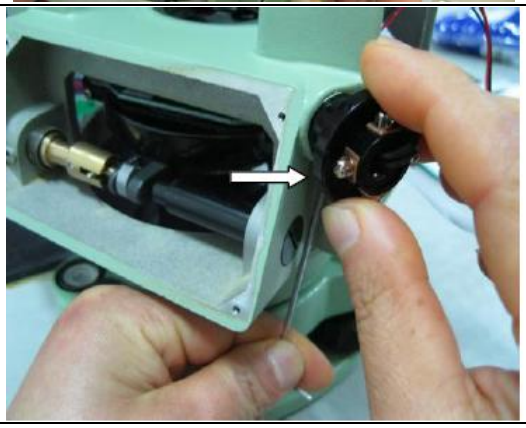
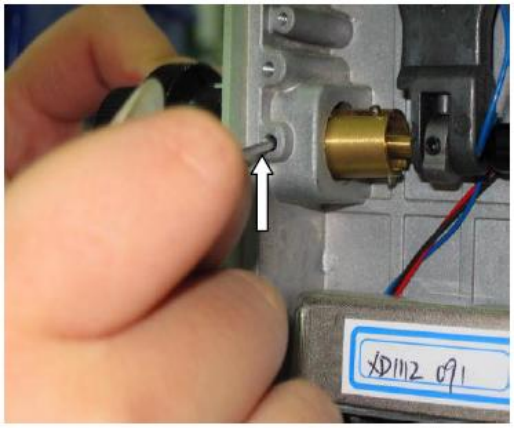
Picture N (b)

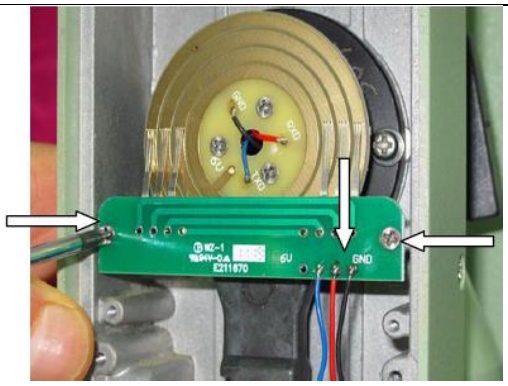
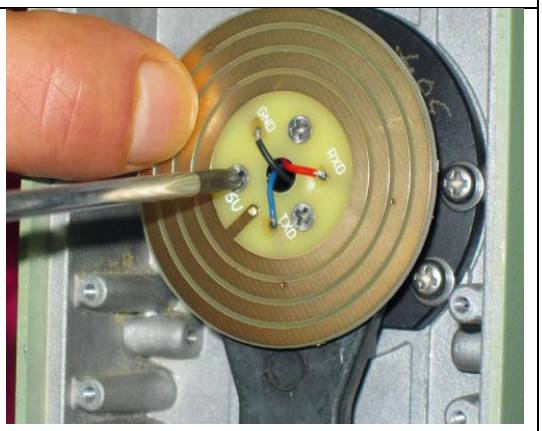
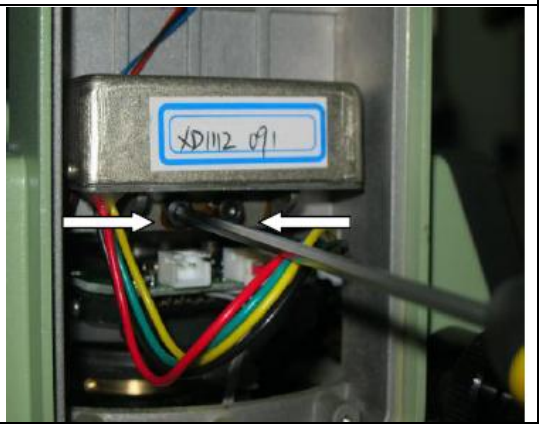
Picture N (c)

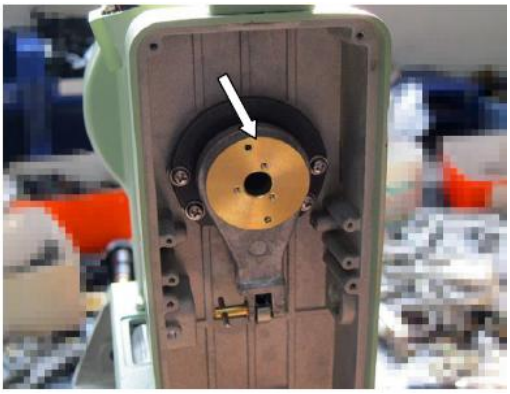
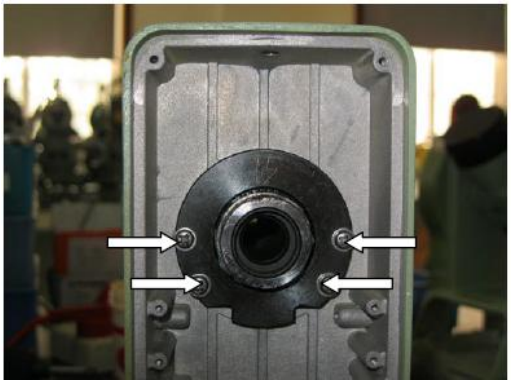
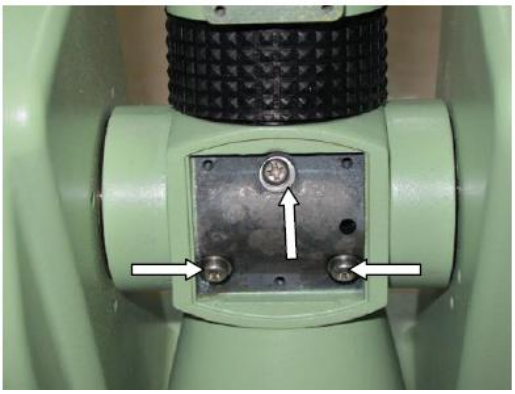
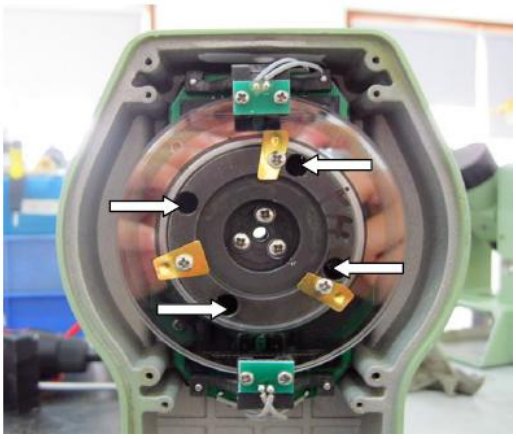
5. Disassemble the Inatrument

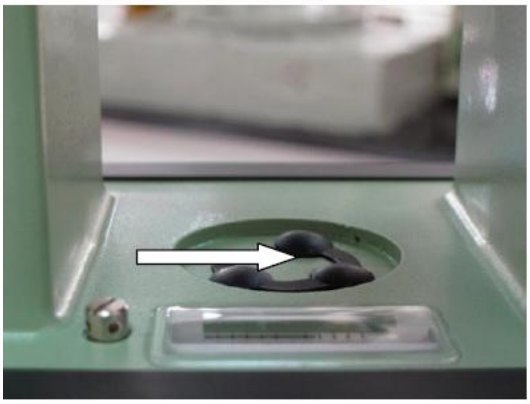
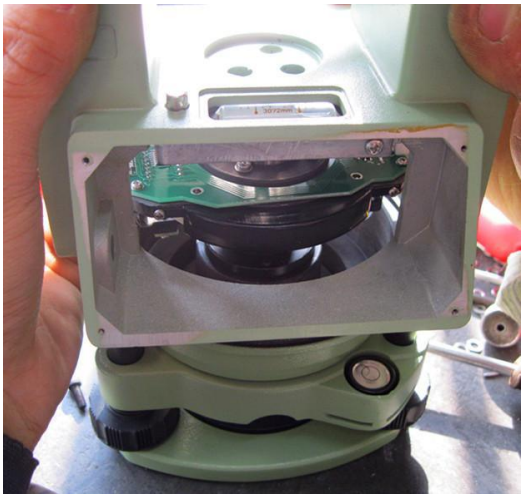
Operation steps	Indicating picture
(1) Remove handle: Loosen the handle locking screws counterclockwise and then remove the handle.	
(2) Press the battery locking button and remove the battery.	
(3) Remove and wash side cover: Remove 5 cross head screws (M2.5×10) as indicated counterclockwise using a cross screwdriver.	
(4) Use tweezers to pull the buzzer plug as indicated out from the socket and then remove the side cover.	

Operation steps	Indicating picture
(5) Remove 6 cross head screws (M2×6) as indicated counterclockwise using a cross screwdriver.	
(6) Use tweezers to pull the flat wire plug as indicated out from the socket and then remove the mainboard.	
(7) Remove 4 slotted head screws (M2×10) as indicated counterclockwise using a straight screwdriver.	
(8) Pull the flat wire plug as indicated out from the socket and then remove the LCD.	

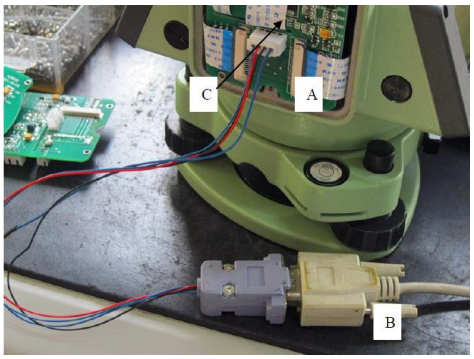
Operation steps	Indicating picture
(9) Remove 4 flat head screws (M2.5×6) and a button head screw (M2.5×6) as indicated counterclockwise using a cross screwdriver.	
(10) Take out the wire connecting mainboard and the battery side cover as indicated and then remove the cover.	
(11) Remove the flat head hexagonal screw (M3×4) as indicated counterclockwise using a hexagonal screwdriver. Take out the wire connecting mainboard and the laser plummet as indicated and then remove the laser plummet.	
(12) Remove the flat head hexagonal screw (M3×4) as indicated counterclockwise using a hexagonal screwdriver and then take out the vertical clamp/ tangent.	

Operation steps	Indicating picture
(13) Remove the hexagonal screw (M3×4) as indicated counterclockwise using a hexagonal screwdriver and then take out the horizontal clamp/ tangent.	
(14) Remove 2 flat cross head screws (M2×5) as indicated counterclockwise using a cross screwdriver. Use an electric iron to weld 4 wires with different colors (red, green, blue and black) off and then take out the electric brushes.	
(15) Remove 3 cross head screws (M2×5) counterclockwise using a cross screwdriver. Use an electric iron to weld 4 wires with different colors (red, green, blue and black) off and then take out the conducting ring.	
(16) Remove 2 hexagonal screws (M3×8) as indicated counterclockwise using a hexagonal screwdriver. Pull out the plug of compensator and take it off.	

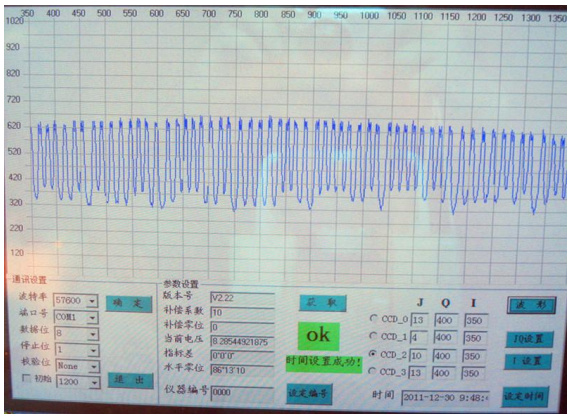
Operation steps	Indicating picture
(17) Use a screwdriver cooperated with a blunt to tweak the plate off through the holes as indicated and remove the horizontal axis clamping block.	
(18) Remove 4 cross screws (M3×9) as indicated counterclockwise using a cross screwdriver and take off the horizontal axis clamping cover.	
(19) Remove 3 cross screws (M3×8) as indicated counterclockwise using a cross screwdriver and tweak the focusing knob to the bottom clockwise.	
(20) Remove 4 screws (M3×10) as indicated counterclockwise using screwdriver and take off the telescope and the horizontal axis. Note: While taking off the horizontal axis, be careful with the grating for not being collided or rubbed. Do not disassemble the grating and signal receiving circuit board. If they are not working, send them back to us for repair.	

Operation steps	Indicating picture
(21) Pull the protective cover as indicated and remove 3 screws (M4×12) counterclockwise using a screwdriver.	
(22) Lift up main frame gently along the rabbet at the bottom and be careful not to break the vertical axis grating.	

6. Circuit Section Check



Picture 1



Picture 2

6.1. Adjusting Tools

A: a mainboard serial cable socket
B: a USB/ serial cable
C: a mainboard

Adjusting tools for horizontal axis signal receiver:

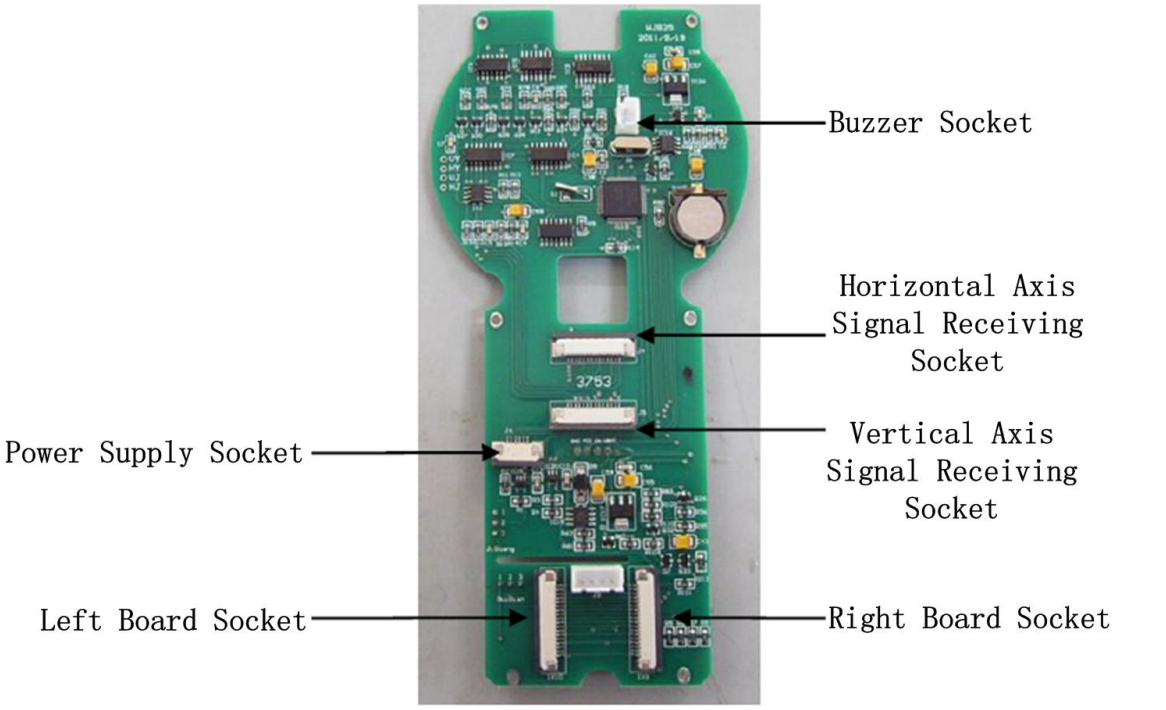
(1) A computer with specialized testing software
(2) A USB/ null modem cable

6.2. Adjusting Method

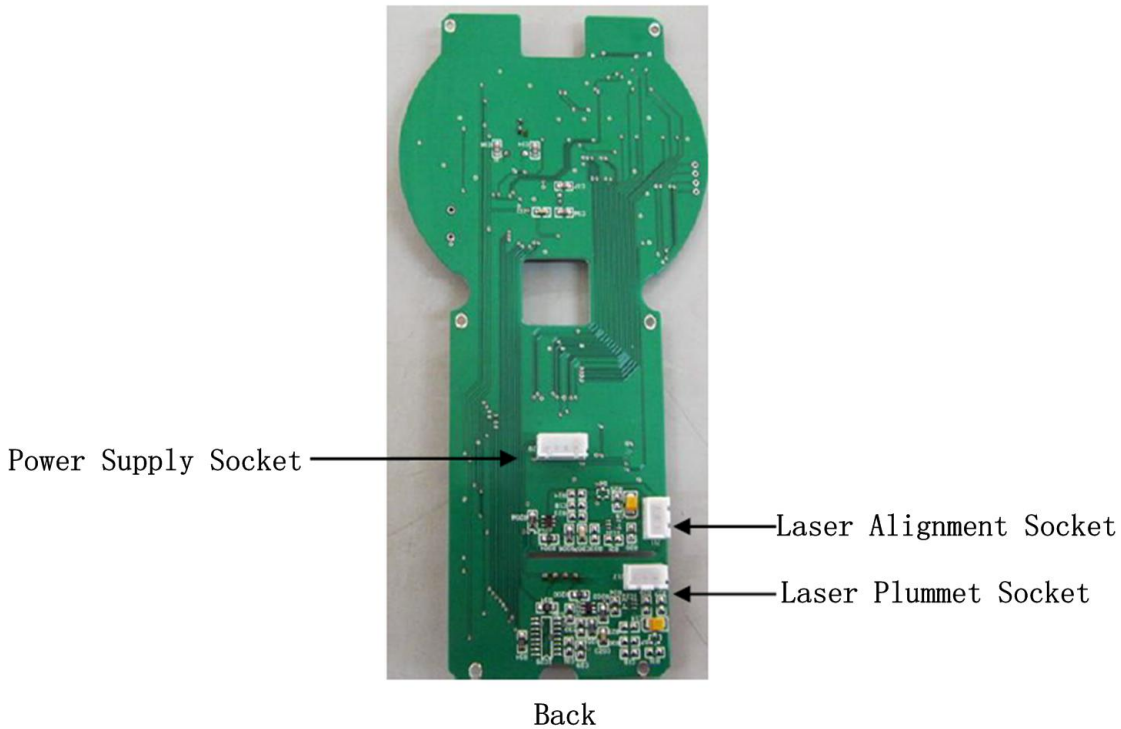
Connect the communication port of the instrument with computer as picture 1 indicated and open the software. Isolate the grating from outside light and after data acquisition, there will be a waveform on the screen.

The software settings are shown as picture 2. Adjust the grating from CCD_0 to CCD_3 and watch the waveform. It is qualified that the shape of wave envelope is a parabola; the amplitude is under 350mV; every waveform is oscillating and there is no interference or a sudden change in the waveform.

6.2 Mainboard



Front



Back

7. Failure Maintenance

7.1 Common Failure

(1) Horizontal/ vertical axis stuck or tight: Please do not disassemble the instrument by yourself. Send it back to us for repair.
(2) Horizontal/ vertical clamp/ tangent break down: According to the steps in section 5 to remove horizontal/ vertical clamp/ tangent. After adjusting the cam and checking other parts, reassemble the horizontal/ vertical clamp/ tangent. If it still can't work, please replace the horizontal/ vertical clamp/ tangent.
(3) Large vertical index difference (i): Adjust the vertical index difference according to steps in section 4. If i＞15″ after adjustment, turn off the compensator and adjust again. Zero drift of the compensator will result in a large vertical index difference. If you can't make i＜15″, send the instrument back to our company for repair.
(4) LCD display failure:
a) Stroke segment
Watch the LCD from one side. If there is a stroke segment, check if there is a button stuck in the board or the resistances on LCD are not damaged or the wire plug of LCD is still connected.
b) Nothing display
If there is nothing display, check if the wire plug of LCD is still connected and check the main single chip next. Use an oscilloscope to check if the crystal oscillator is still work. If the crystal oscillator is damaged, replace it. The mainboard should be replaced if there is still fault after replacing the oscillator.
Note: If you can't repair the fault by yourself, send the instrument back to us.
(5) Communication port: Connect the COM plug and the adjusting equipment to see if there is an output. Check the communicating cable if there is no output. If all the hardware are work well and it still can't communicate, send the instrument back.
(6) Time display adjustment and failure maintenance: If date or time can't display or there is always a deviation, replace the button cell of mainboard and readjust time and date. If it still can't display correctly, send the instrument back for repair.
(7) LCD background light failure: According to the steps in section 5 to remove LCD and check the connecting cables. Check background light diode if LCD connects well. Replace the diode of the same model to fix it. If there is still a failure after replacement, send the instrument back for repair.
(8) Laser emission failed: Check if the button can activate second functions. If it works well, check if the connecting cable plug is off or wires of conducting ring isn't connecting well or electric brushes deviate from slot. If you can't repair it by yourself, send the instrument back for repair.
(9) Compensator failure: Turn on the instrument to check if it works well. If you can't turn on the instrument, check if the ground electrode of compensator and

mainboard coincide. If you can turn on the instrument, check if the wires of compensator are connecting correctly. You can replace a new compensator to check if the old one if broke down or not.

(10) Start failure:

a) Power-on failure

Check the battery and power supply of mainboard. If it works well, check the mainboard.

b) Crash Fault

Check if buttons stuck in the board. Remove the board to adjust buttons and restart the instrument.

Note: While finding the above failures, please disassemble the instrument following steps in this manual and ask professional service guys to do the maintenance. If the instrument damage is caused by personal behavior going against service manual, the responsibility is definitely belongs to individual. If you need to replace some main components, please send the instrument back to our company. No other brand components allowed to be used on the instrument.

7.2 Error Code And Failure Maintenance

(1) “E-302”

a) Poor signal: adjust the signal input of horizontal grating

b) Dirty horizontal grating: clean the grating

c) Dirty or broken CCD: clean or replace CCD

d) Sunlight leak in through cover: check the cover

e) Broken angle measurement mainboard: replace the mainboard

f) The telescope rotating too fast: protective error

(2) “E-303”, “E-304”, “E-305”

a) Poor signal: adjust the signal input of vertical grating

b) Dirty vertical grating: clean the grating

c) Dirty or broken CCD: clean or replace CCD

d) Sunlight leak in through cover: check the cover

e) Broken angle measurement mainboard: replace the mainboard

f) The telescope rotating too fast: protective error

(3) “E-108”

Compensation failure: reassemble or replace the compensator

Note: The above shows error codes and their description. If you need to repair the instrument, please ask professional service guys to do the maintenance. If the instrument damage is caused by personal behavior going against service manual, the responsibility is definitely belongs to individual. If you can’t repair the above failures, please send the instrument back to our company for repair.