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1. Preface

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

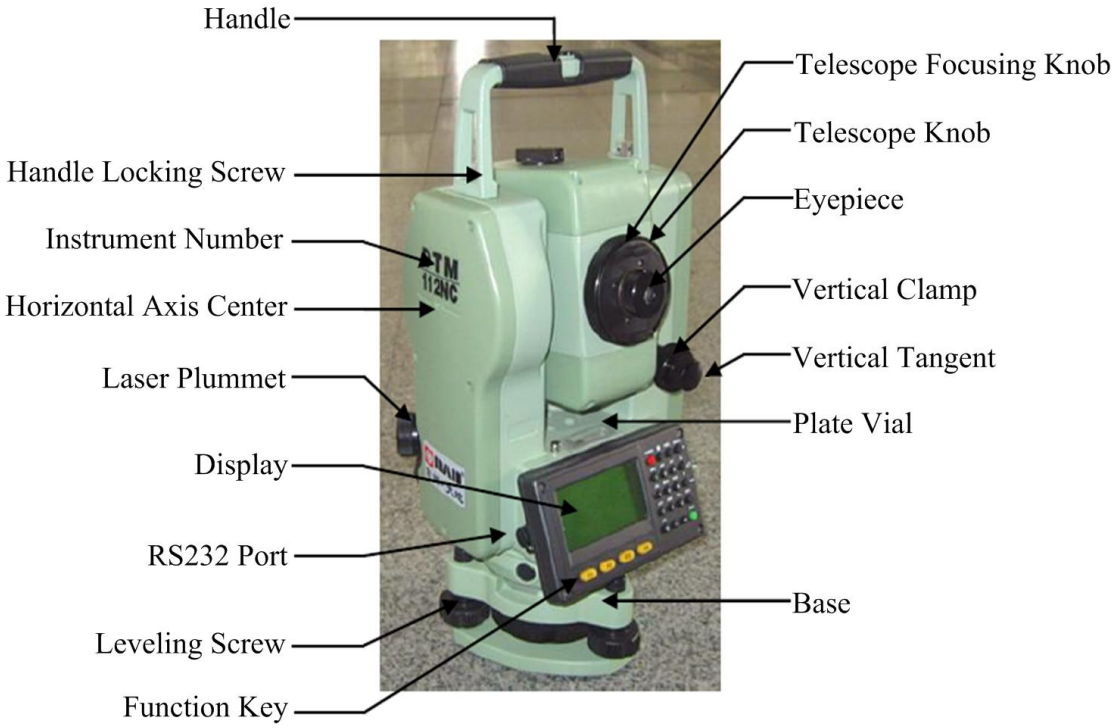
The DTM Series can be widely applied to the class 3/4 triangle survey. It can also be used in various engineering surveys, such as railway, highway, bridge, water conservancy, mine, etc. and the installation of buildings and large equipments, as well as cadastral and topographic surveying.

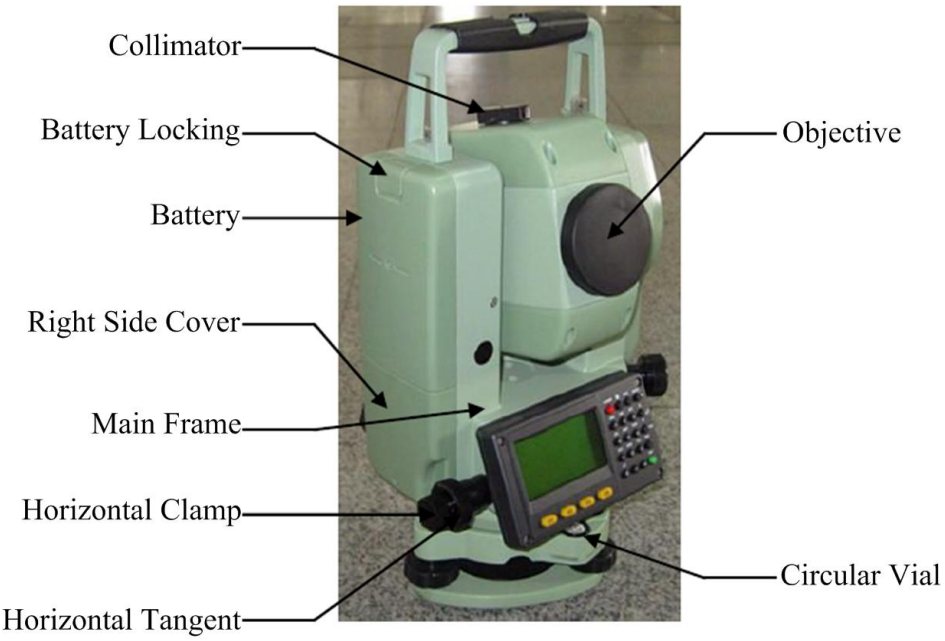
2. Precautions

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. Total station 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 DTM Series of Changzhou Dadi Surveying Science & Technology Co., Ltd. Anything unclear during maintenance, please contact us.

3. Product Instruction

3.1 External Components





3.2 Display And Keypad

a. Display

Dot matrix LCD is adopted, which can display 4 rows of information: the top three rows shows measurement data, and the bottom row shows information corresponding to function keys.

b. Functions Of Keys

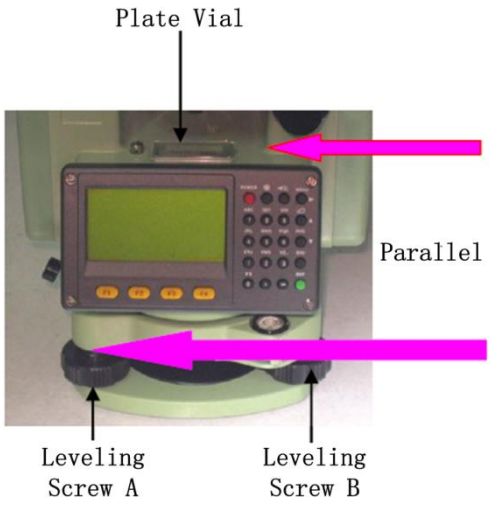
(1) F1~F4: refers to the function displayed in the fourth row
(2) 0~9: input desired numbers, letters or symbols
(3) -: input minus sign
(4) .: input dot
(5) ESC: quit previous display or mode
(6) ENT: finish and accept the data input
(7) ☆: light on/off button, adjust contrast ratio
(8) POWER: power on/off button
(9) MENU: enter main menu/move right
(10) : enter coordinate surveying mode/move left
(11) : enter distance surveying mode/switch horizontal distance, slope distance and height difference/move up
(12) ANG: enter angle surveying mode/move down

4. Specifications Check And Adjustment

4.1 Plat Vial

a. Check

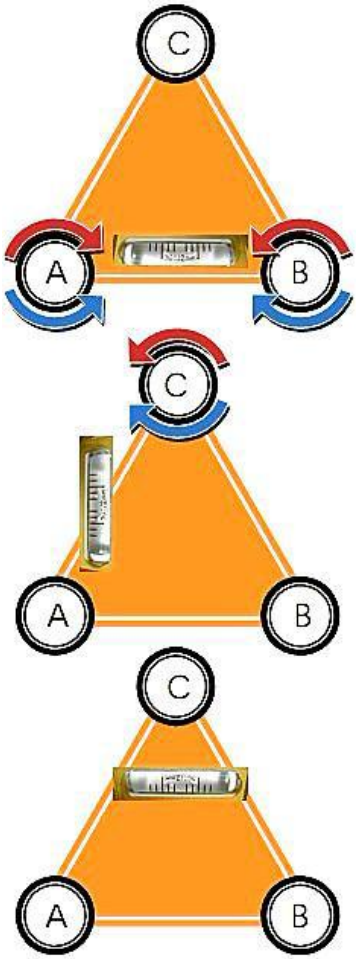
(1) Place the instrument on a stable device (a tripod or calibration table) and fix it.
(2) Parallel the plate vial and the line between two out of three leveling screws. Adjust the two screws to keep the bubble in the middle of plate vial.
(3) Rotate the instrument around the vertical axis and observe 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

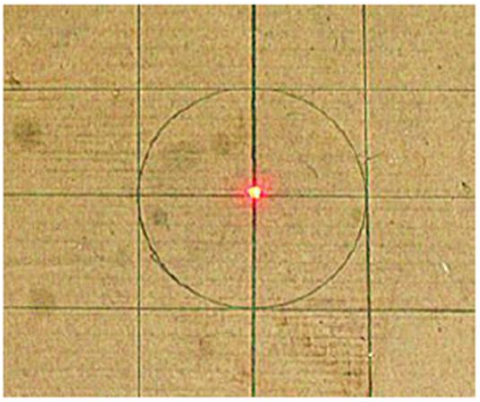
4.3 Laser Plummet

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

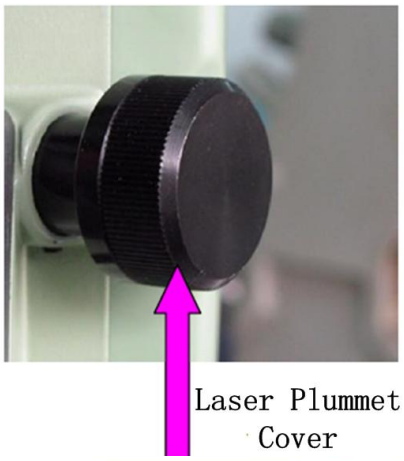
(1) Adjust 3 leveling screws to overlap the laser spot and cross symbol on the ground.
(2) Rotate the instrument 180°and remove the cover of laser plummet. Adjust 4 screws to make the laser spot moves half of the offset back.
(3) Repeat step (1) and (2) until the laser spot coincides with the intersection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

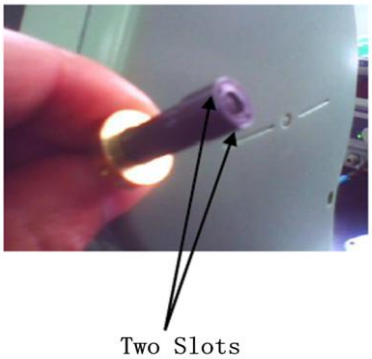


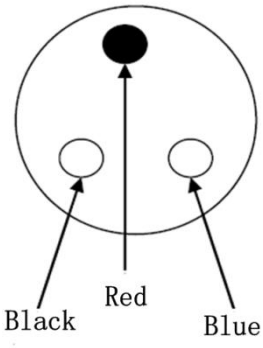
Picture D (a)

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.







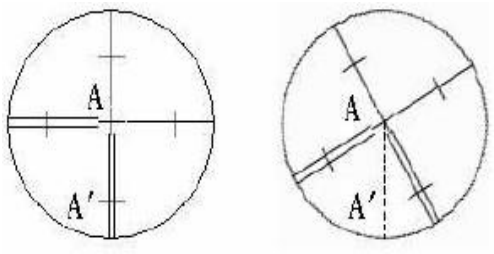
Schematic Position of Three Wires with Different Colour

Picture D (b)

4.4 Inclination Of Telescope Reticle

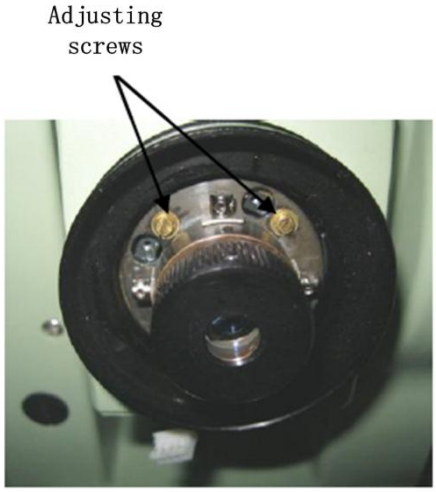
a. Check

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

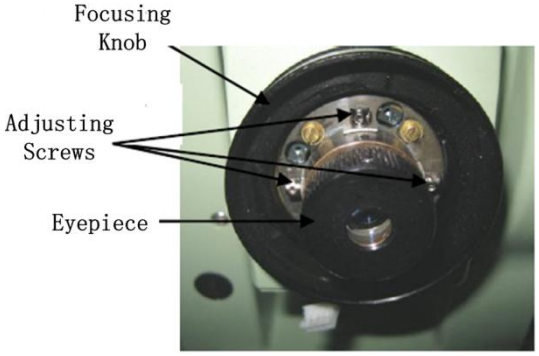
a. Check

(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

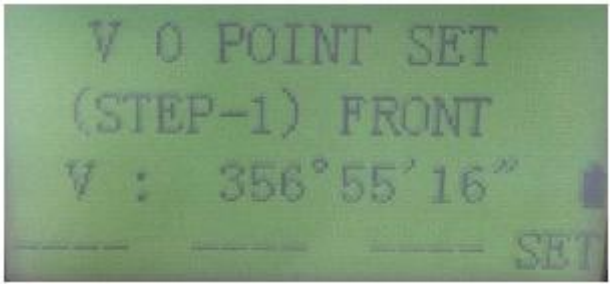
(1) Adjust the horizontal tangent in reverse face and make the horizontal angle value HR’=HR+C.
(2) Take off the cover of the reticle between eyepiece and focusing knob. Tweak the left and right adjusting screws by loosening one and tightening the other to make the vertical line of reticle coincides 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.



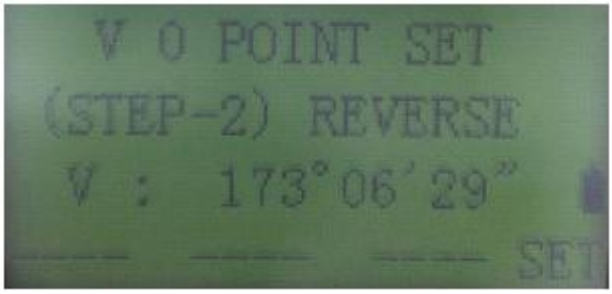
Picture F

4.6 Vertical Index Difference (i)

(1) Place the instrument on a stable device and level it precisely.
(2) Press and hold “F1” button when turn on the power.
(3) In front face, collimate the reticle of a horizontal collimator and press “F4” (SET) shown as picture G (a).
(4) Collimate the target in reverse face and press “F4” (SET) (Picture G (b)). Record the vertical angle as VR.
(5) 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 G (a)

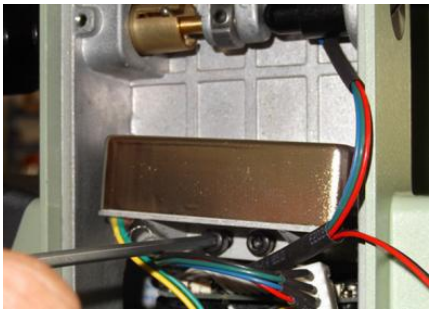


Picture G (b)

4.7 Vertical 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 "MENU-F4-F2" to enter parameters setting interface. Press "F3" to turn on the compensator and press "F4-F4-F3" to save and exit.
(4) 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.
(5) Repeat step (4) until |BC1+BC2|＜30″.

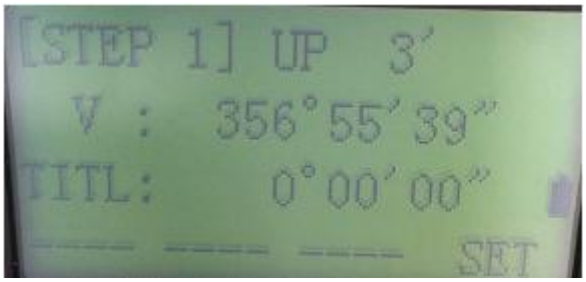


Picture H

b. Linear Compensation Of The Compensator

(1) Place the instrument on a stable device and level it precisely.
(2) Press and hold “F1” and “0” button when turn on the power. The interface is shown as picture I (a).
(3) Press “F1” and come to the interface shown as picture I (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 “F4” as picture I (c) indicated.
(5) Adjust vertical tangent to make the vertical angle θ-3′. Adjust the leveling screw to collimate the reticle again and press “F4” to save the adjustment (picture I (d)).

Picture I (a)



Picture I (b)

Picture I (c)

Picture I (d)

c. Zero Compensation Of The Compensator

(1) Place the instrument on a stable device and level it precisely.
(2) Press and hold “F1” and “0” button when turn on the power. The interface is shown as picture I (a).
(3) Press “F1” and come to the interface shown as picture J (a).
(4) In front face, collimate the reticle of a horizontal collimator and press “F4” (SET).
(5) In reverse face, after collimating the reticle, press “F4” (SET) shown as picture J (b) and turn off the power.

Picture J (a)

Picture J (b)

d. Judgment Of Two Compensating Results

(1) Turn on the power and collimate a horizontal collimator in front face. Press “F4-F1” to enter the compensation interface. Adjust vertical tangent to make the compensating angle +3′, - 3′and 0′separately. Then press “F4” to record the vertical angle as X1, X2 and X3 separately.

(2) Mark the maximum angle as X_{max} and the minimum X_{min}. Calculate $X= X_{max} -X_{min}$. If X≥3″, readjust two kinds of compensation until X＜3″.

(3) Turn on the power and press “F4-F1” to enter the compensation interface. 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 two kinds of compensation until Y＜30″.

Picture K

4.8 Adjust The Optical Coaxiality

(1) The optical coaxiality means that the axis of emitter, receiver and telescope are coincide in a line and it is the prerequisite to survey distance accurately.

(2) The following devices is required in the optical coaxiality adjustment:

a) A stabilized voltage supply: AP2000

b) A collimator with 550mm-focal length

c) A monitor: PTS-101

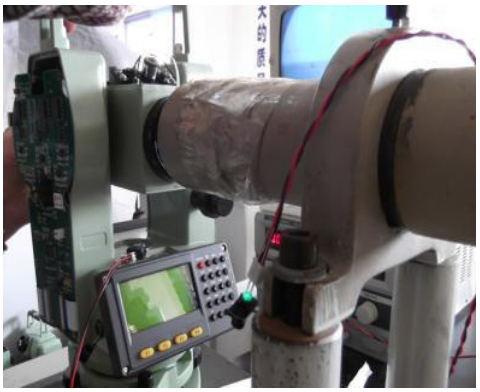
d) A green light-emitting diode

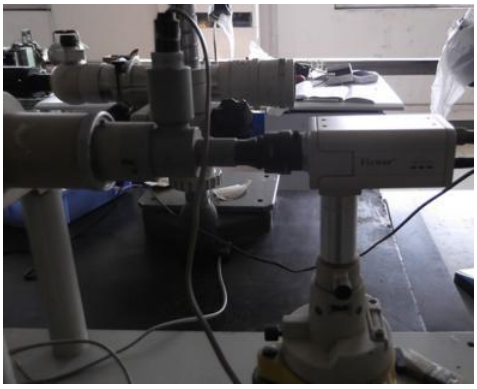
e) A 0.9mm hexagonal spanner

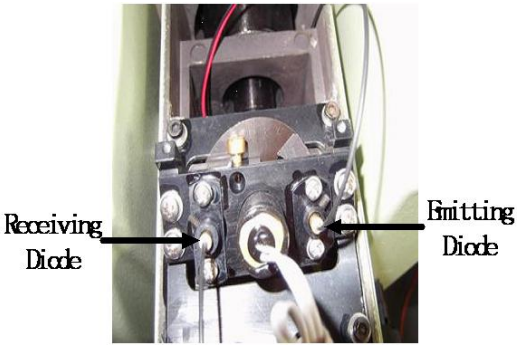
(4) Illumine the emitting diode and focus the spot on the monitor screen as clear as possible. Adjust the position of emitter to collimate the center of telescope reticle and turn off the emitter. Use the green light-emitting diode to illumine the receiving fiber and focus the spot on the monitor screen as clear as possible. Adjust the position of receiver to collimate the center of telescope reticle.

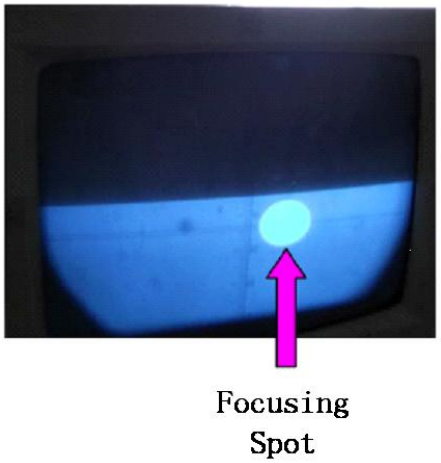
(5) Use a M2×4 hexagonal bolt to fix the fiber and screw all of the bolts to make emitter, receiver and telescope coincide in a line completely.

(6) If you found the optical coaxiality broken down and can't adjust it, send the instrument back to us for repair.

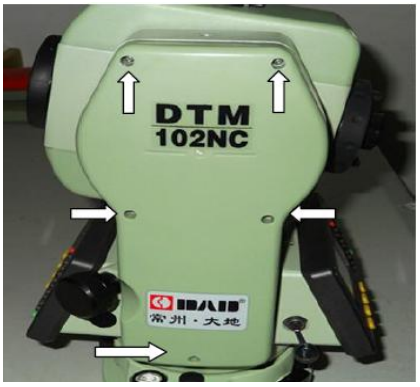
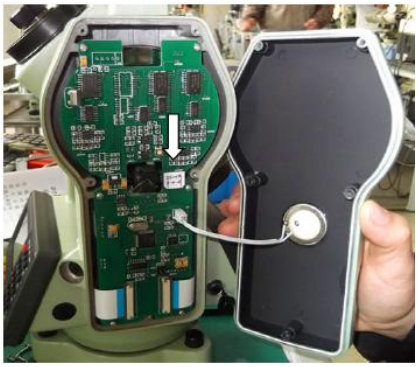


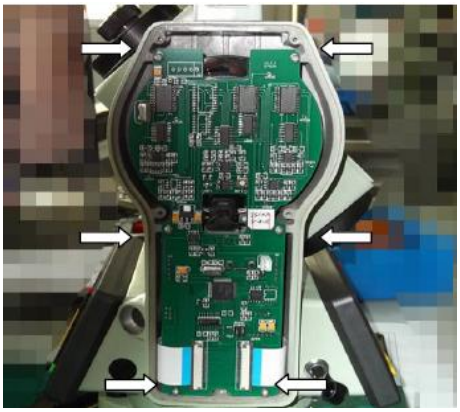
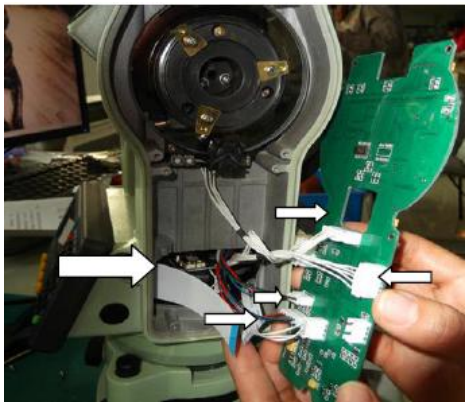


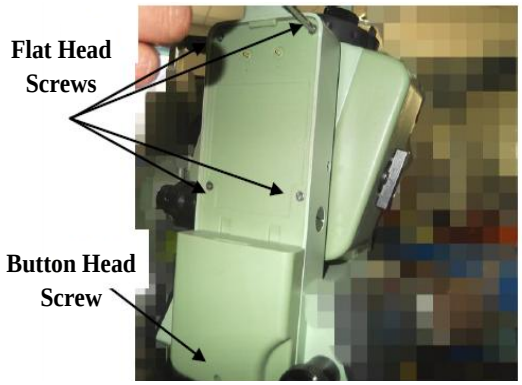


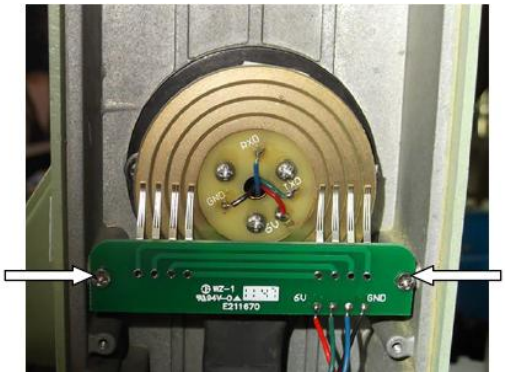
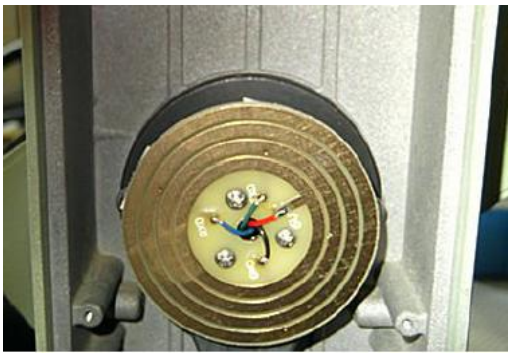
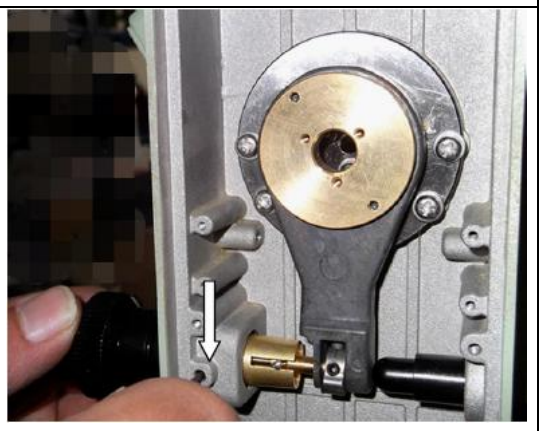
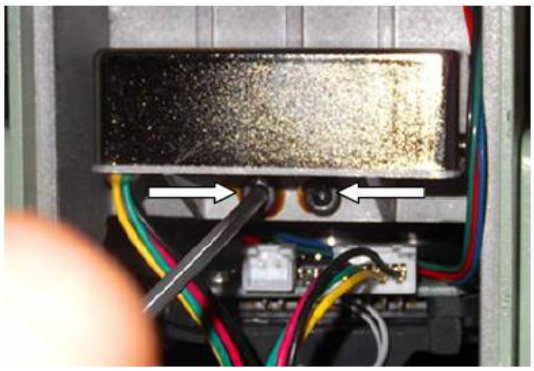


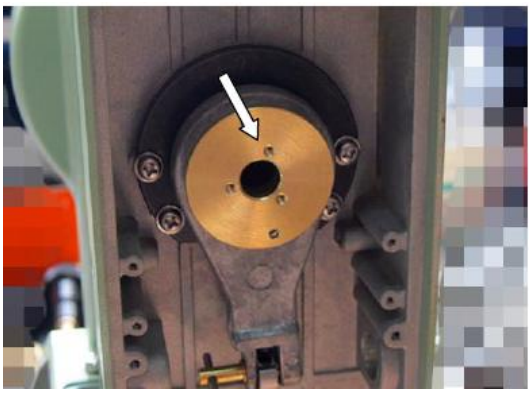
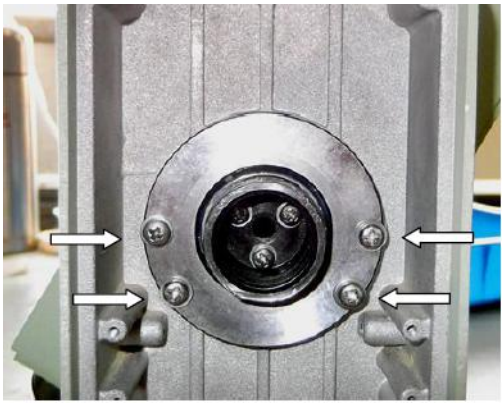
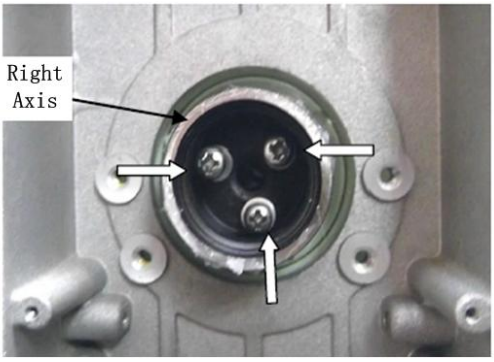
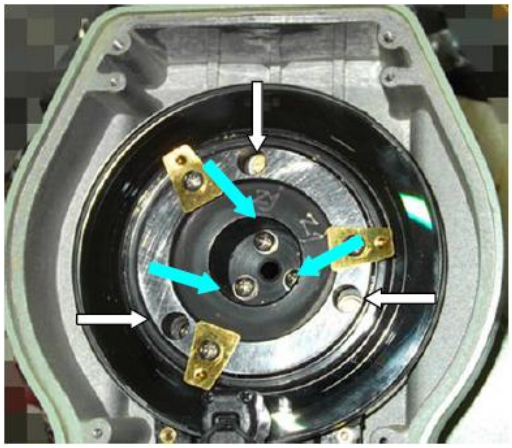
5. Disassemble the Inatrument

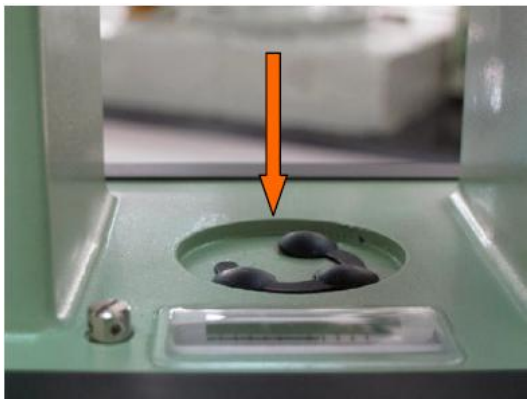
Operation steps	Indicating picture
(1) Remove handle: Loosen the handle locking screws counterclockwise and then remove the handle.	
(2) Press the battery locking button and remove the battery.	
(3) Remove and wash side cover: Remove 5 cross head screws (M2.5×10) as indicated counterclockwise using a 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 (M2×5) 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 horizontal clamp/ tangent.	

Operation steps	Indicating picture
(13) 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.	
(14) 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.	
(15) Remove the hexagonal screw (M3×4) as indicated counterclockwise using a hexagonal screwdriver and then take out the vertical clamp/ tangent.	
(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 (M2.5×18) as indicated counterclockwise using a cross screwdriver and take off the right axis fixing surveying head.	
(20) Remove 6 screws (3-M3×9 and 3-M2.5×18) as indicated counterclockwise using screwdrivers 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

6.1 Adjust The Insreument

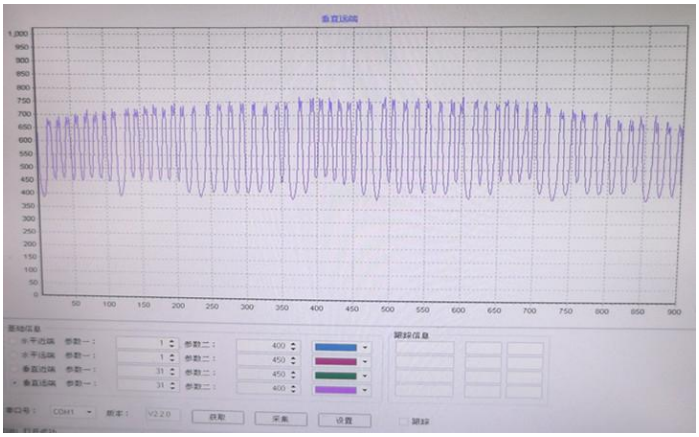
Picture 1

a. Adjusting Tools

(1) A computer with specialized testing software

(2) A USB/ serial cable

b. Adjusting Method

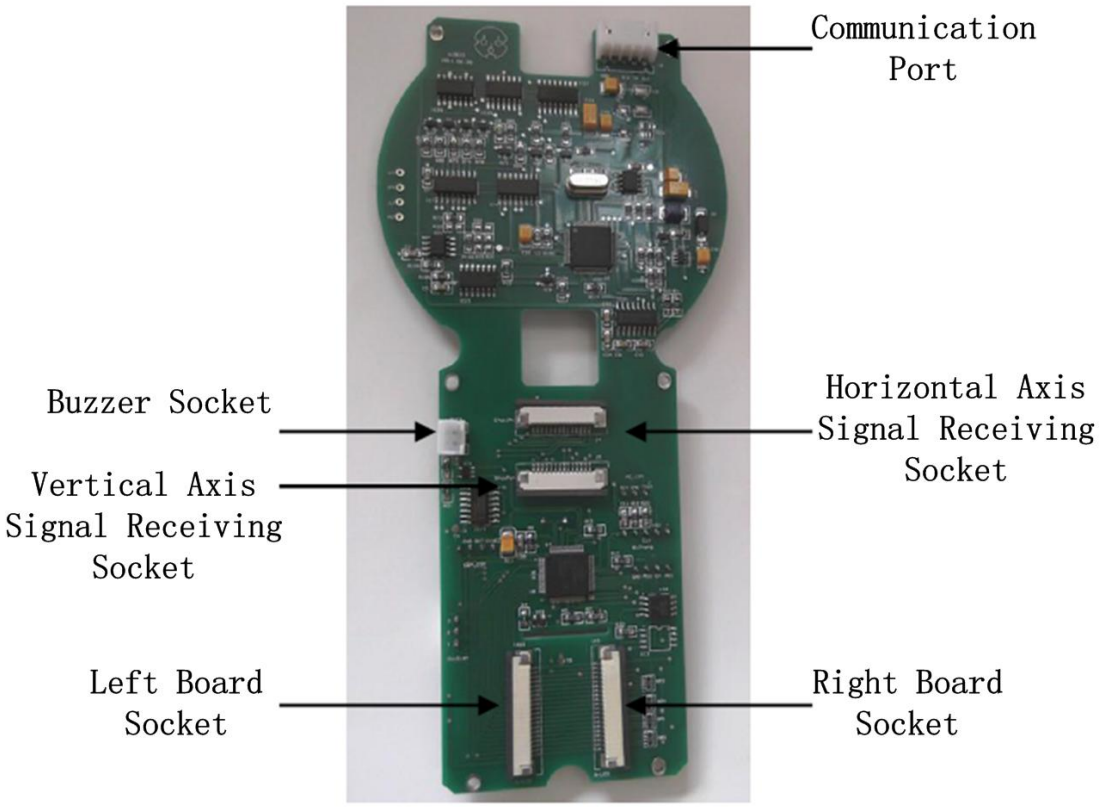


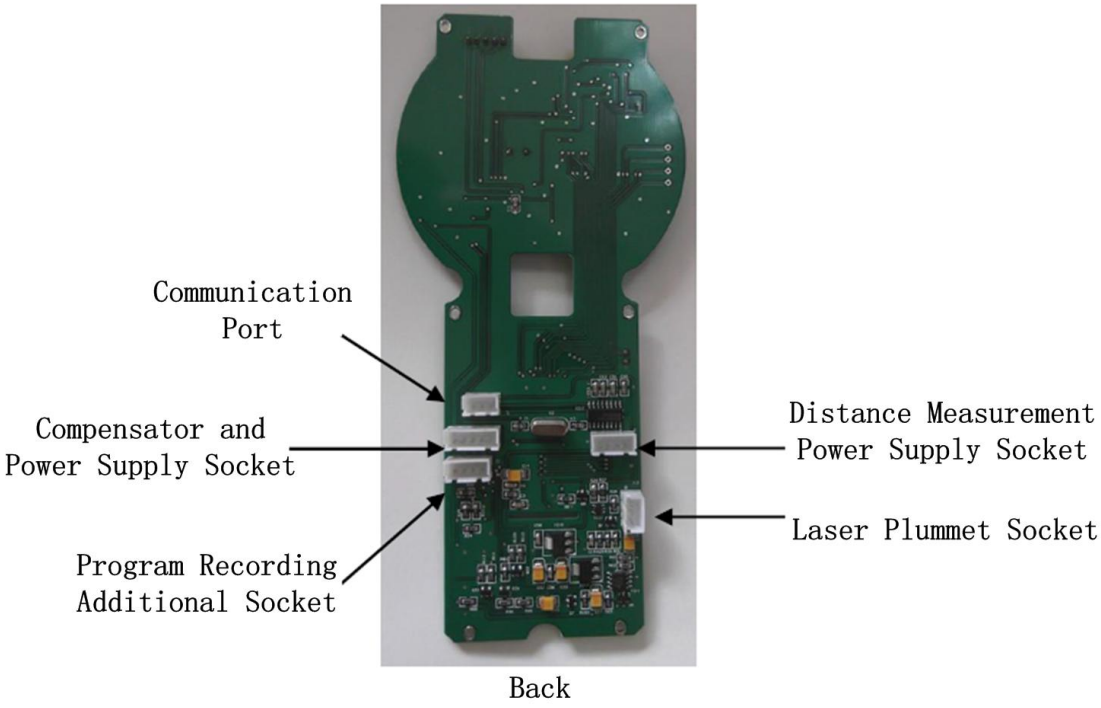
Picture 2

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 horizontal near-end to vertical far-end and watch the waveform. It is qualified that the shape of wave envelope is a parabola; the amplitude is between 300mV~700mV; every waveform is oscillating and there is no interference or a sudden change in the waveform.

6.2 Mainboard





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

A. Angle Measurement System

(1) “VJ767-Error”
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) “HJ767-Error”, “HY767-Error”
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

(4) Memory storage error
Broken storage chip or communication error: replace the storage chip

(5) Always warning low voltage
a) Lower battery voltage: charge or replace the battery
b) Broken integrated chip TLC549: replace the angle measurement mainboard

(6) Power-on failure
Broken IC 5202 or other problems: check cables connecting battery and mainboard or replace the angle measurement mainboard.

(7) After power on, the screen flash one time and then display nothing. Check connecting cables first. If they connect well, then it’s a program failure and you should replace the angle measurement mainboard.

B. Distance Measurement System

(1) “E03”
a. Broken mainboard: replace the mainboard
b. Broken signal-receiving circuit board: replace the signal-receiving circuit board
c. Broken emitting or receiving fiber: replace the fiber
d. Broken or stuck motor: replace the motor or send the instrument back to us

(2) “E01”
Connect the checking board to check the initial phase angle of the precision/ rough ruler, which should be 2500±500 and 7500±500 respectively. The CPLD program should be rewritten if the initial phase angle out of range.

Note: If there is a mistake while measuring distance, send the instrument back to us for repair. 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.