40-6540 Automatic Rotating Laser Service Manual

Contents

1.0 Introduction

40-6540 rotating laser is a highly accurate instrument. Out side of a few customer adjustments (outlined in the owners manual), all adjustments/service operations are internal to the instrument and to be performed only by authorized service personnel. Authorized personnel should adhere to the guidelines described within this service manual for all repairs and/or service work. This manual is written with the assumption that a unit is disassembled or assembled from start to finish. In reality, only component parts or modules would be replaced during a repair. Given this, procedures discussed in this manual should be adjusted according to the repair being made.

2.0 Overall Unit Disassembly

Item	JLT Part #	Description	Qty
1	AP1785	Main housing	1
2	AP1786	Key Pad Circuit Board Assembly	1
3	AP1787	Main Control Board	1
4	AP1022	M3 x 6 cross plate screws	2
5	AP1788	Base Assembly	1
6	AP1762	Plastic Grommets	4
7	AP1530	M3×25 crosshead plate screws	4
8	AP1677	ST2.9 x 8 Self Tapping Cross Plate screw	2
9	AP1767	Battery Circuit board	1
10	AP1789	Battery Cover Gasket	1
11	AP1763	Battery Cover	1
12	AP1026	M2.9 x 13 Cross Plate Self taping screws	4
13	AP1790	Core Module	1
14	AP1451	ST2.2 x 6 Self Tapping Cross Plate screw	2
15	AP1782	#3 PCB Outlet Circuit board	1

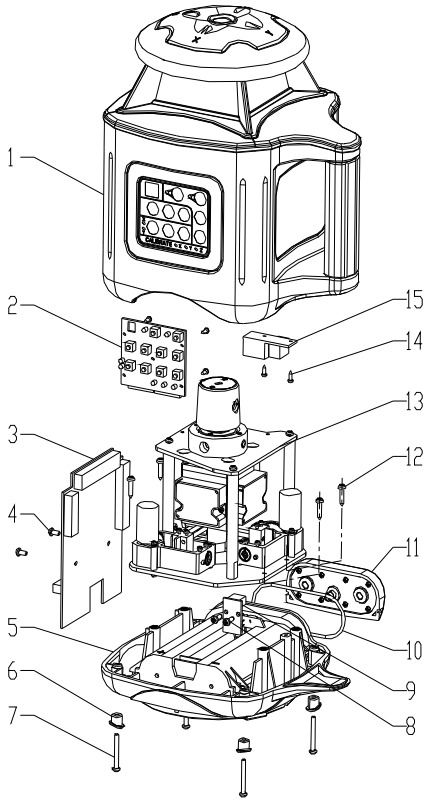


Fig 1

1. Using Phillips screw driver, remove 4 screws (7) from the bottom of the housing module (1)
2. To remove housing module (1), remove plastic grommets (6) from screw holes (7) and fold back rubber corners, exposing main base seal.

- Because the gasket material can take a set over time, it may be necessary to apply force in order to separate the housing module (1) from the base (5)
- Once loose, pay specific attention not to damage any of the wires and connectors from the keypad assembly (2) and the main control board assembly (3)

3. Carefully disconnect socket connectors from the keypad assembly (2) and the main control board assembly (3)
4. Using Phillips screw driver, remove 2 screws (14) and remove 3# PCB (15) from housing module.
5. Using Phillips screw driver, remove 5 screws (14) and remove 5# PCB (2) from housing module.
6. Using Phillips screw driver, remove 2 screws (4), disconnect the sockets and the take off 1# PCB (3).
7. Using Phillips screw driver, remove 4 screws (12) and then remove the core module from the base.
8. Using Phillips screw driver, remove 2 screws (8) and remove 4# PCB (9)

2.1 Core Module Disassembly (AP1790)

Item	JLT Part #	Description	Qty
13-1	AP1791	M2 x 22 Cross Plate Screw	2
13-2	AP1792	Cover Board	1
13-3	AP1793	Rotating head	1
13-4	AP1794	Prism	1
13-5	AP1795	Prism Head	1
13-6	AP1796	M3 x 6 Inner Hex Set Screw	1
13-7	AP1493	M2.5 x 8 Cross Plate Screw	4
13-8	AP1582	M2.5 Washer	4
13-9	AP1513	M3 x 8 Cross Plate Screw	4
13-10	AP1516	M3 Washer	4
13-11	AP1797	Shaft Coupling Module	1
13-12	AP1464	M2 x 6 Cross Plate Screw	2
13-13	AP1798	Alarm Adjusting Module	1
13-14	AP1799	Laser/ Motor Module	1
13-15	AP1800	X Direction Leveling Module	1
13-16	AP1801	Bottom Plate	1
13-17	AP1491	M2 x 8 Cross Plate Screw	6
13-18	AP1802	M2 Washer	6
13-19	AP1513	M3 x 8 Cross Plate Screw	4
13-20	AP1516	M3 Washer	4
13-21	AP1804	M3 x 6 Spacer	2
13-22	AP1805	#2 Alarm Circuit Board	1
13-23	AP1511	M3 x 12 Cross Plate Screw	2
13-24	AP1516	M3 Washer	2
13-25	AP1806	Y Direction Leveling Module	1
13-26	AP1807	Support Shaft	4
13-27	AP1808	Optical Wedge	1

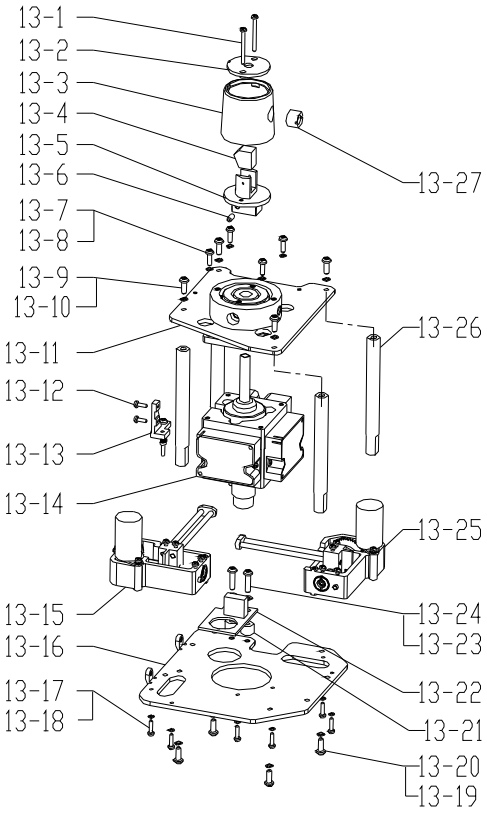


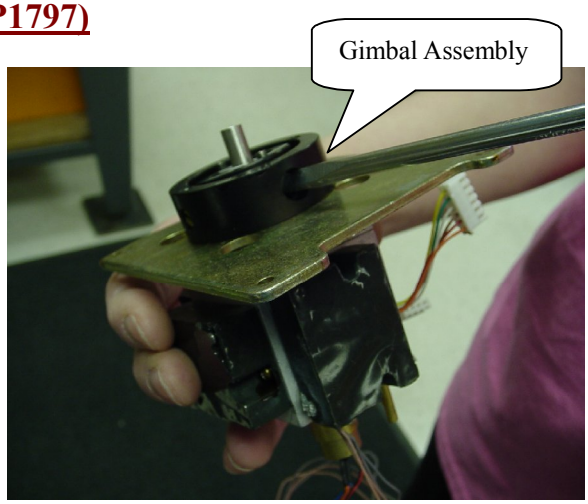
Fig 2

2.1.1 Rotating Head/Prism Disassembly (AP1793/AP1795)

1. Using a Phillips screw driver, remove 2 screws (13-1) from 13-5 and gently lift off 13-2 and 13-3.
2. Using a Phillips screw driver, remove 4 screws/washers (13-9, 13-10) from 13-26 and gently lift off 13-11

2.1.2 Shaft Coupling Module Disassembly (AP1797)

3. Using a 1.5 mm Allen Wrench, loosen set screw located on the top side of the gimbal assembly pictured to the right.
4. Using a flat screw driver, remove 2 inner screws that connect the gimbal assembly to the laser/motor assembly (13-14). Reference the picture to the right.
5. Due to the nature of the laser/motor assembly (13-14) and the fact that the x, y, and z level indicators are factor calibrated, no further disassembly instructions are provided.
    - If any component of this assembly is suspect, the entire assembly should be replaced.



2.1.3 X Direction Leveling Module Disassembly (AP1800)

6. Remove X direction leveling module (13-15) by removing the 3 cross head screws located on the bottom side of 13-16 Bottom Plate.
    - Due to the mechanical nature of this assembly, some of the components can become worn and may require period lubrication and/or readjustment (i.e. gear, shaft, motor, etc.)
    - In the event that the unit is damaged due to being dropped, all bent or damaged components should be replaced as this assembly is integral to the self leveling of the device.

2.1.4 Y Direction Leveling Module Disassembly (AP1806)

7. Remove Y direction leveling module (13-25) by removing the 3 cross head screws located on the bottom side of 13-16 Bottom Plate.
    - Due to the mechanical nature of this assembly, some of the components can become worn and may require period lubrication and/or readjustment (i.e. gear, shaft, motor, etc.)
    - In the event that the unit is damaged due to being dropped, all bent or damaged components should be replaced as this assembly is integral to the self leveling of the device.

2.1.5 Alarm Board Removal/Replacement (AP1805)

1. Using a Phillips screw driver, remove 2 screws/washers (13-23, 13-24) from 13-16 and gently remove circuit board from assembly.

2.2 Vertical Mounting Bracket Disassembly (40-6850)

Item	JLT Part #	Description	Qty
16-1	AP1809	Set Shaft	1
16-2	AP1810	Bracket Side Plate	1
16-3	AP1811	M4 Hexagon Nut	4
16-4	AP1812	Adjusting Shaft	2
16-5	AP1813	Adjusting Knob	2
16-6	AP1814	M4 x 12 Cross Plate Screw	4
16-7	AP1513	M3 X 8 Cross Plate Screw	1
16-8	AP1815	Locking Knob	1
16-9	AP1816	Locking Gasket	1
16-10	AP1817	Bracket Base Board	1
16-11	AP1818	Locking Bolt	1

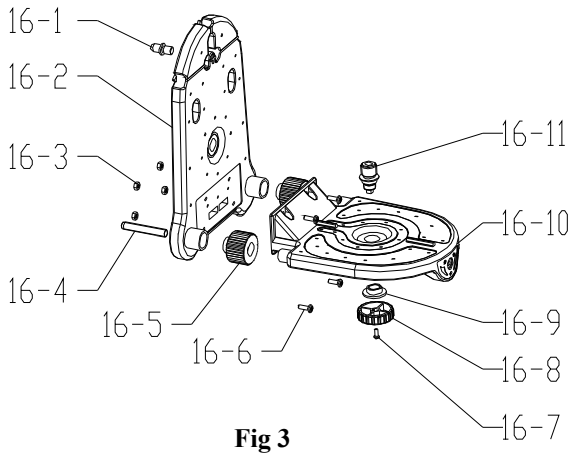
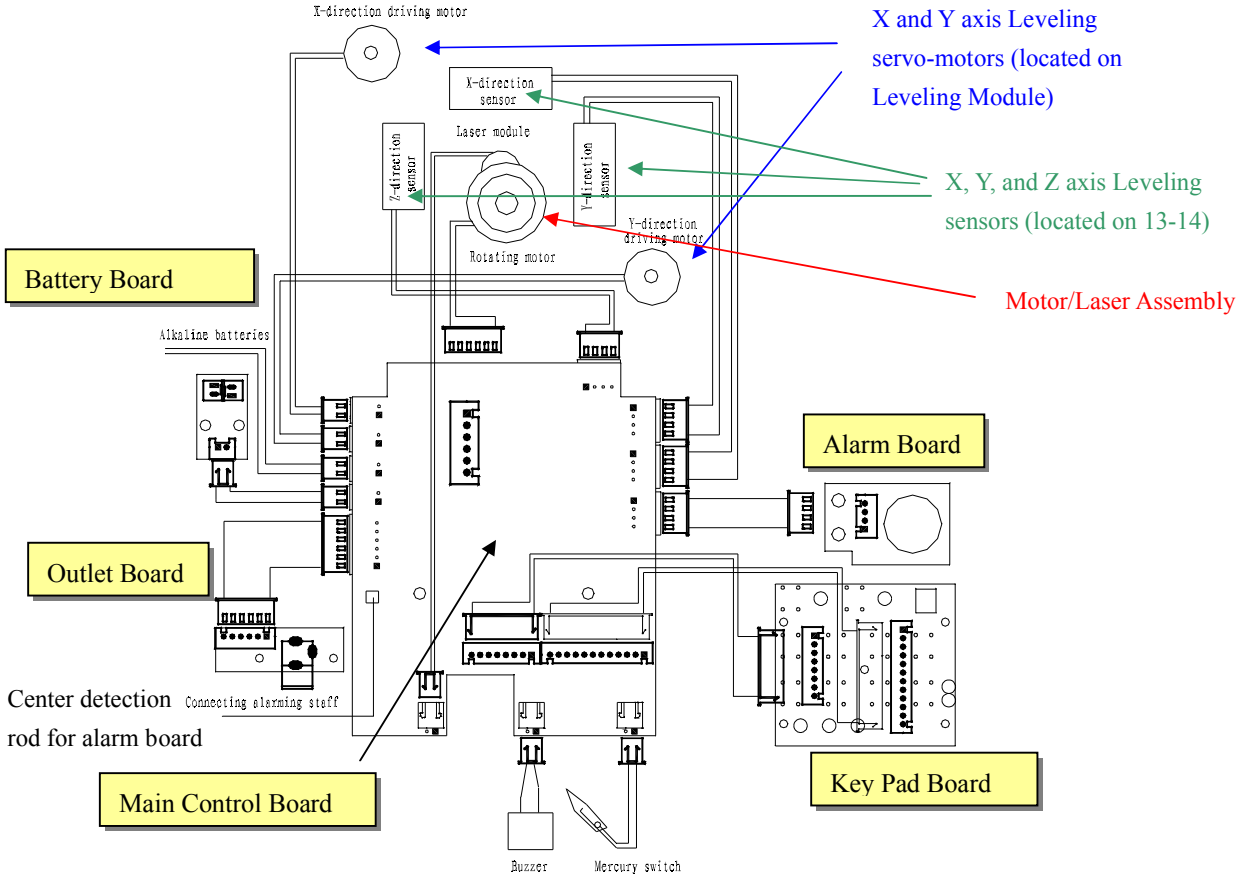


Fig 3

Assembly of the mounting bracket is very straight forward,
therefore this service manual only lists replacement parts and doesn't detail out assembly instructions.

3.0 Schematic Diagram



4.0 Calibration

Calibration is a process that is used to correct for accuracy and/or functional errors above and beyond those stated in published specifications. While Manual-leveling, Self-leveling, and Automatic-leveling (motor driven) devices have different mechanisms that require calibration, there are similarities with optics that is consistent regardless of the leveling mechanism. This section of the service manual discusses calibrations specific to the 40-6535. Each item discussed is shown below.

4.1 Horizontal Mode Operation

4.1.1 Quantifying Accuracy Error

4.1.2 Characterize the type of error

4.1.2.1 Oblique/Inclination Error

4.1.2.1.1 Fine calibration via Remote control

4.1.2.2 Taper/Cone Error

4.2 Vertical Mode Operation

4.2.1 Calibration

4.3 Alarm Adjustment

4.1. Horizontal Mode Operation

In this mode of operation, the instrument is self-leveling, where by a major factor of accuracy is how well the leveling compensator is balanced. Different types of errors require different methods of calibration. These errors are easily characterized by placing the instrument on a flat surface following the guidelines below, and running the instrument with the rotating head continuously rotating 360°.

4.1.1. Quantifying Accuracy Error

Establish the set up shown in the following drawing.

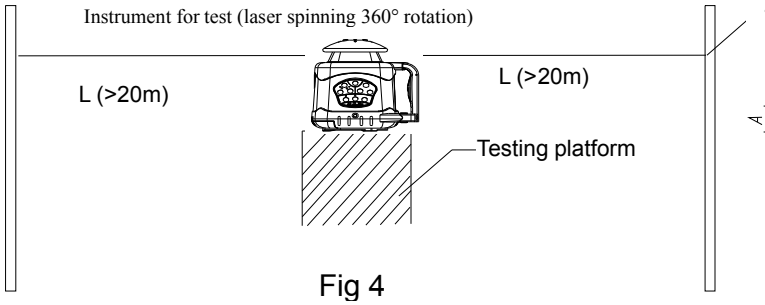
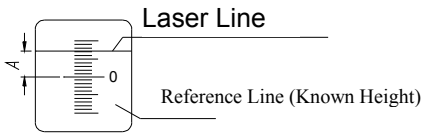


Fig 4

Near Target placed within 0.3m (12") of instrument. Note that "0" of the target corresponds to the height of laser line at the aperature of the instrument.

Far Target placed on wall at least 10m (33ft) from Test Stand, where "0" corresponds to them same height as "0" on the target next to the aperature of the instrument.

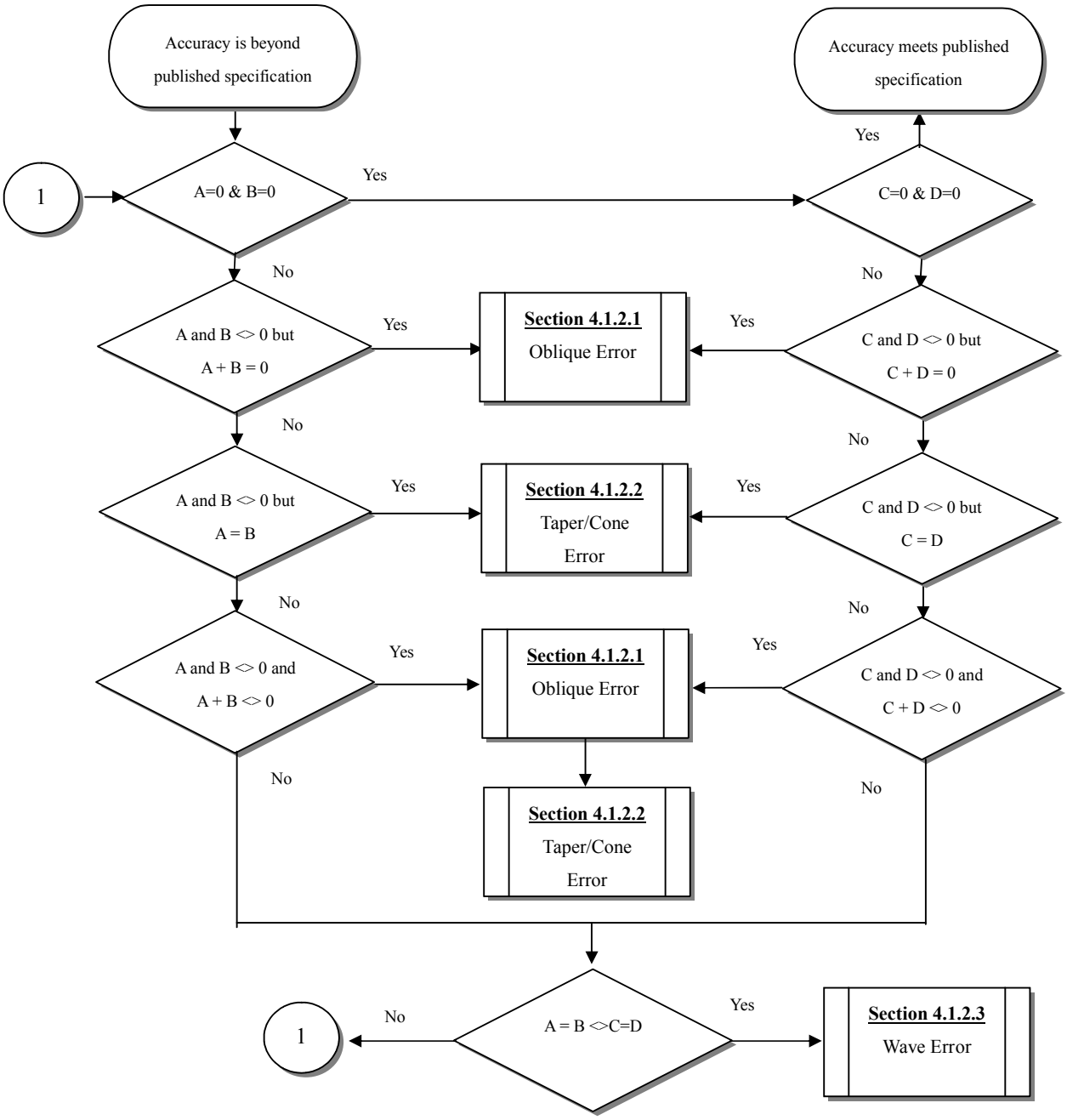


Accuracy (A) = Difference between laser line height and reference line height, divided by the distance that the laser is from the wall (L)

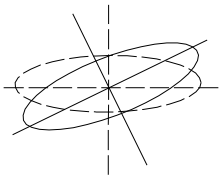
1. Place the instrument for test on the test stand (preconfigured from the illustration above) with handle facing the far target .
2. Power the laser and function in full rotation mode (head rotates 360°)
3. Note the errors in all four quadrants of the instrument as read on the far target (i.e. x axis A = 0° and B = 180°, y axis C = 90° and 270°)
   - You should end up with 4 numbers
     A (0°) = _____
     B (180°) = _____
     C (90°) = _____
     D (270°) = _____
4. Since all of the errors are referenced against "0" on the far target, essentially the largest number from the data collected (A – D) / the distance should be equal to or less than the published specification for the product. If not, characterize the error and determine method of calibration as defined by section 4.1.2 of this document.

4.1.2. Characterize the type of error

Use the following rules to determine what type of accuracy error the instrument for test has, and reference the stated section to adjust for it. Note that the unit my have a combination of different types of errors to adjust for, in which case, multiple calibration must be performed.



4.1.2.1 Oblique/Inclination error



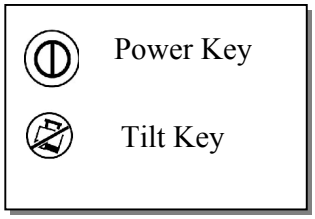
This type of error occurs when leveling compensator does not hang straight (as illustrated to the right), i.e. is not properly balanced. When the laser spins, it actually rotates on a plain that is not level, i.e. perfectly horizontal whose rotating axis is not plumb. So value A on the left target does not has the same sign as that on the right target, like, $A_{0°}$=+2, $A_{180°}$= -2. A number of factors can cause this situation to exist.

- Normal use – Depending upon how careful the user is with the instrument, finely tuned adjustments can be altered by very large changes in temperature, vibrations (due to handling and transportation)
- Shock – The instrument was dropped and components of the leveling system have either been damaged or came out of alignment. If defective components are present, they will need to be repaired or replaced prior to the calibration procedures defined below being initiated.

Depending upon the magnitude of the error (±5mm or 0.2”), only fine adjustments need to be made. Larger errors (>5mm or 0.2”) require coarse adjustment to get close, the fine adjustment to bring the unit within specification.

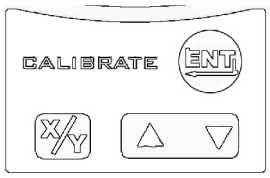
Note: Only fine adjustments are discussed in this document. Coarse adjustments are integral to the core module and are factory adjusted. Units that have defective core modules, or core modules that need coarse calibration should be replaced by the service technician and the defective part sent back to the factory for repair/recalibration.

4.1.2.1.1. Fine Calibration via Remote Control



1. Access calibration mode by simultaneously pressing the “**Power**” key and the “**Tilt**” key.
2. While continuing to hold the “**Tilt**” key, release the “**Power**” key.
   - When releasing the “**Power**” key, all red LED’s on the unit’s keypad display with light up. After about 10 seconds, all LED’s, except the power LED will go off.
3. Release the “**Tilt**” key.
   - Note that the rotating head of the laser is not rotating but the laser is flashing. The unit is now in calibration mode and all other operations will be performed with the unit’s remote control.

4. Open the lower cover of the remote control to access the operation panel for the calibration.



   - Multiple presses of the **"X/Y"** key toggles calibration control between the X-axis, Y-axis, and Z-axis (as indicated via the x, y, and z Calibrater LED's located on the instruments keypad. See below

Status Indicator

   - Once the desired axis has been selected, the "**UP Arrow**" and "**Down Arrow**" keys are used to adjust the position of the laser plane.

X-axis Calibration

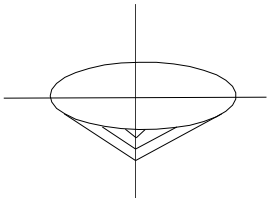
1. Place the unit into calibration mode as discussed above.
2. Position the unit so that the X axis directing to the two targets.
3. Press **"X/Y"** key on the remote control to toggle calibration control to the X-axis
4. Press the "**UP Arrow**" and "**Down Arrow**" keys, respectively to adjust the laser height to coincide with the zero position of the target
5. Press the "**Enter**" key on the remote control to accept the calibration value, noting that the status indicator goes "off"
6. After calibration is completed, make sure to power off the unit and then power on again to activate the calibration.

Y-axis Calibration

1. Place the unit into calibration mode as discussed above.
2. Position the unit so that the Y axis directing to the two targets.
3. Press **"X/Y"** key on the remote control to toggle calibration control to the X-axis
4. Press the "**UP Arrow**" and "**Down Arrow**" keys, respectively to adjust the laser height to coincide with the zero position of the target
5. Press the "**Enter**" key on the remote control to accept the calibration value, noting that the status indicator goes "off"
6. After calibration is completed, make sure to power off the unit and then power on again to activate the calibration.

Once calibration is complete re-verify accuracy as directed in sections 4.1.1 and 4.1.2, and repeat as necessary.

4.1.2.2 Taper/Cone error



Taper error results when the prism base module does not reflect the laser light exactly 90° (i.e. non-perpendicularity between the rotating line and the rotating axis). The end result is a laser rotating surface that is not a plane, but a tapered one as shown in the figure to the right. The value A in the left target shares the same symbol as the one in the right target during the check, that is, $A_{0°}$=+2 and $A_{180°}$= +2. The error is removed by adjusting the optical wedge of the laser output window to make the rotating laser beam and rotating axis plumb beam. The details are listed as follows:

a. Remove the top cover as discussed in section 1 of this document
b. Screw the wedge out of its base with special spanner as shown in the figure to the right.
c. Adjust the laser to the zero position of the target.

Note: Only one direction (X or Y) is necessary for the adjustment.

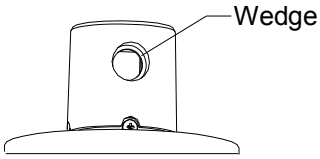
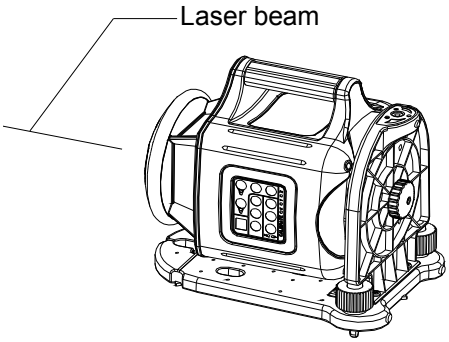


Fig 13

4.2 Vertical Mode Operation

In this mode of operation, rotating laser surface is a plumb plane, and meanwhile the laser line projected from the top is in horizontal situation. To check whether the plane is plumb, we just need to check whether the beam is horizontal. This is done by doing the following:

a) Put the unit in horizontal mode. Power on the unit and have it self-leveled.
b) Check whether the laser beam is horizontal by using auto level.
c) If the horizontal accuracy exceeds the range, it needs the calibration.



4.2.1. Z-axis Calibration

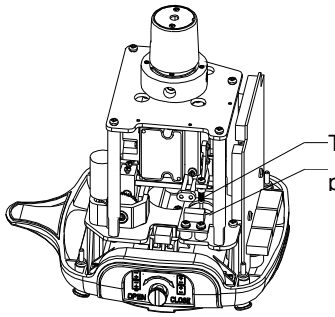
1. Place the unit into calibration mode as discussed above.
2. Position the unit so that the Z axis directing to the two targets.
3. Press **"X/Y"** key on the remote control to toggle calibration control to the X-axis
4. Press the "**UP Arrow**" and "**Down Arrow**" keys, respectively to adjust the laser height to coincide with the zero position of the target
5. Press the "**Enter**" key on the remote control to accept the calibration value, noting that the status indicator goes "off"
6. After calibration is completed, make sure to power off the unit and then power on again to activate the calibration.

4.3. Calibration for sound alarming range

If the alarm range is obviously biased, one side exceeds 4.5 degree and other side is much less than 4.5 degree, it needs the calibration.

Calibration method is as following:

a) Remove the top cover and the shell module
b) Put the unit on the leveling platform, turn on the unit to have it self-leveled and turn it off then.
c) Adjust the touching staff to the circle center of the touching ring on the alarming part.
d) Assemble the housing and the top cover on.



5.0. Troubleshooting Guide

No.	Symptom	Cause	Repair method
1	Cannot power on	Low battery	Replace batteries or charge NiMH battery-pack
		Damaged power adapter	Replace power adapter
		Damaged on/off switch	Key pad PCB
		Defective outlet or battery PCB	Replace outlet or battery PCB
2	Cannot power off	Defective 2# PCB	Replace 2# PCB
3	No response of remote control	Low battery for remote control	Replace remote control battery
		Damaged receiving tube	Replace receiving tube
4	No Laser	Damaged laser driving	Replace Main Control PCB
		Damaged laser diode	Send back to factory for maintenance
5	Cannot rotate Low rotating speed	Defective Main Control PCB	Replace Main Control PCB
		Loose/defective motor gear	Service motor gear
6	Cannot self-leveled after powered on	Too big or too small clearance between worm wheel and worm	Adjust clearance between worm wheel and worm
		Loosen adjustment part	Replace adjustment part
		Out-of-range without alarm	Wipe alarm staff and alarm ring by alcohol
		Damaged motor driving	Replace 1# PCB
7	Unlighted panel LED	Damaged LED	Replace Keypad PCB
8	Cannot self-leveled but alarm	Memorization error	1 Turn on the unit 2 Press keys of ⏻ and ▭ at the same time 3 Release the key ⏻ but keep pressing key ▭ until power indicator LED turn off. 4 Turn on the unit again to take precision calibration
9	Lighted charging LED all the time (without adaptor)	Damaged charging socket	Replace Outlet PCB
10	No alarm if titled beyond tolerance	Alarm board is loose	Re-adjust the alarm board
		The connecting line of the alarm board is loose	Re-weld or replace the connecting line
		1# main circuit board is broken	Replace 1# main circuit board
11	No buzzer if titled beyond tolerance.	The beeper is broken	Replace the beeper
		1# main circuit board is broken	Replace1# main circuit board