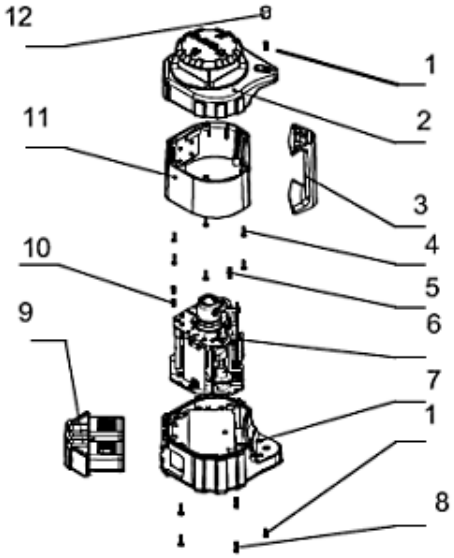
40-6537 Auto-leveling Rotating Laser Service Manual

1.0 Introduction

This rotating laser is a highly accurate instrument. Out side of a few customer adjustments (outlined in the owners manual), all 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 Assembly (40-6537)

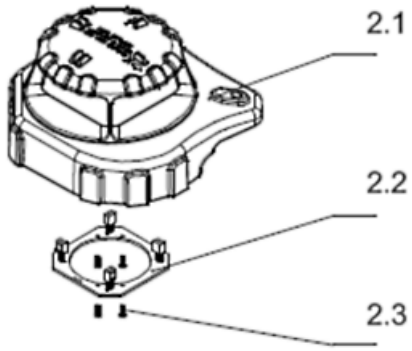
Item	JLT Part #	Description	Qty
1	AP1690	ST2.9 x 10 Cross Plate Tapping Screw	2
2	AP1939	Upper Cover Assembly	1
3	AP1940	Handle	1
4	AP1742	M2.5 x 12 Cross Plate Screw	6
5	AP1026	ST2.9 x 13 Cross Plate Tapping Screw	2
6	AP1941	Main Body Assembly	1
7	AP1942	Base Assembly	1
8	AP1565	M3 x 14 Cross Plate Screw	4
9	AP1943	Battery Case Assembly	1
10	AP1677	ST2.9 x 8 Cross Plate Tapping Screw	2
11	AP1944	Housing Assembly	1
12	AP1945	Stopper	1



1. Remove Rechargeable Battery Pack (9) by turning retaining screw counter clockwise.
2. Remove Upper Cover Assembly (2), and Housing Assembly (11), by removing retaining screws 8.
3. Carefully disconnect ribbon cable of Keypad PCB
4. Remove Handle (3) by removing rubber screw plug (12) and retaining screw (1).
5. Disassemble housing assembly (11) by removing retaining screws (4).
6. Remove Main Body Assembly by removing retaining screws (10) and (5).

2.1 Upper Cover Assembly (AP1939)

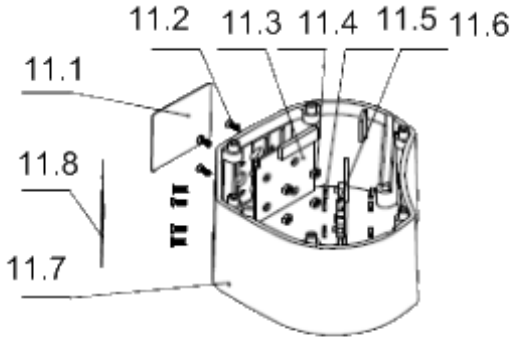
Item	JLT Part #	Description	Qty
2.1	AP1947	Upper Cover	1
2.2	AP1948	#11 Connecting PCB	1
2.3	AP1843	ST2.2 x 6.5 Cross Plate Tapping Screw	1



1. Remove Rechargeable #11 PCB (2-2) by removing retaining screws (2.3)

2.2 Housing Assembly (AP1944)

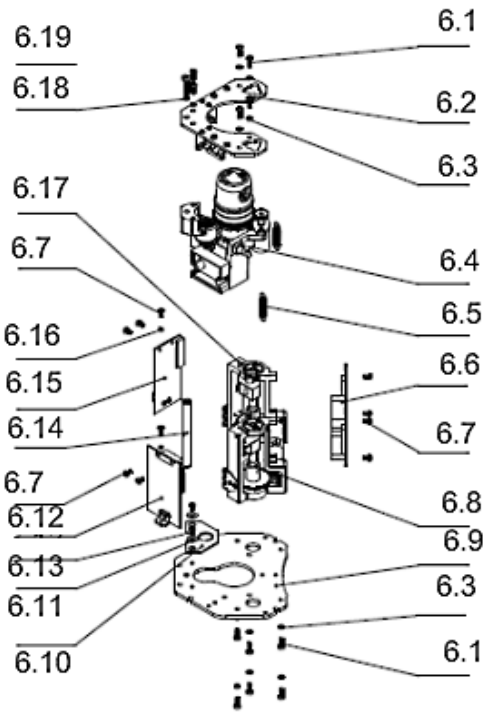
Item	JLT Part #	Description	Qty
11.1	AP1949	Keypad 2	1
11.2	AP1950	M2.5 x 8 Cross Sunk Screw	8
11.3	AP1951	#2 PCB Key Pad 2	1
11.4	AP1538	M2.5 Nut	8
11.5	AP1952	Connecting Nut	4
11.6	AP1953	#3 PCB Keypad 1	1
11.7	AP1954	Housing	1
11.8	AP1989	Keypad 1	1



1. Remove keypads 1 and 2 (11-1) and (11-7) respectively, by peeling off of housing.
2. Remove #2 PCB (11-3) by loosening retaining nuts (11-4).
3. Remove #3 PCB (11-6) by loosening retaining nuts (11-4) and (11-5), respectively.

2.3 Main Body Assembly (AP1941)

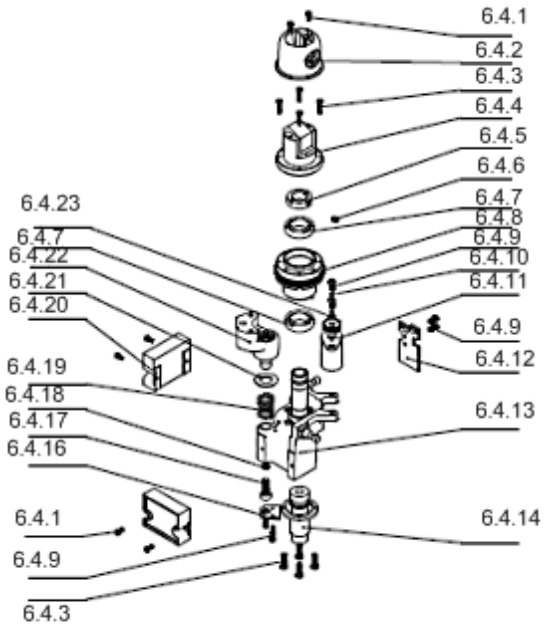
Item	JLT Part #	Description	Qty
6.1	AP1513	M3 x 8 Cross Plate Screw	12
6.2	AP1955	Top Plate Assembly	1
6.3	AP1883	3MM Elastic Gasket	12
6.4	AP1956	Core Assembly	1
6.5	AP1957	Tension Spring	2
6.6	AP1958	#1 Main PCB	1
6.7	AP1616	M2.5 x 5 Cross Plate Screw	10
6.8	AP1959	Frame Part 1	1
6.9	AP1960	Bottom Plate	1
6.10	AP1961	#8 Alarm PCB	1
6.11	AP1962	Spacer	2
6.12	AP1493	M2.5 x 8 Cross Plate Screw	2
6.13	AP1963	#4 PCB	1
6.14	AP1964	Connecting Staff Part	1
6.15	AP1965	#5 PCB	1
6.16	AP1915	2.5MM Elastic Gasket	2
6.17	AP1966	Frame Part 2	1
6.18	AP1967	4MM Elastic Gasket	1
6.19	AP1968	M4 x 14 Cross Plate Screw	1



1. Remove #4 PCB (6-13) and #5 PCB (6-15) by loosening/removing retaining 6 screws (6-7) and 2 elastic gaskets (6-16) respectively.
2. Remove #1 PCB (6-6) by loosening/removing 4 retaining screws (6-7).
3. Disassemble top plate assembly (6-2) by removing retaining screw (6-19) and respective elastic gasket (6-18) as well as 6 retaining screws (6-1) and respective elastic gaskets (6-3).
4. Remove Core Assembly (6-4) from Frame Parts 1 and 2 (6-8 and 6-17, respectively) by removing 2 tension springs (6-5).
5. Disassemble Frame Parts 1 and 2 (6-8 and 6-17, respectively) by removing 6 retaining screws (6-12) and they're respective elastic gaskets (6-3).
6. Disassemble #8 Alarm PCB (6-10) by removing 2 retaining screws (6-12) and they're respective spacers (6-11)

2.4 Core Assembly (AP1956)

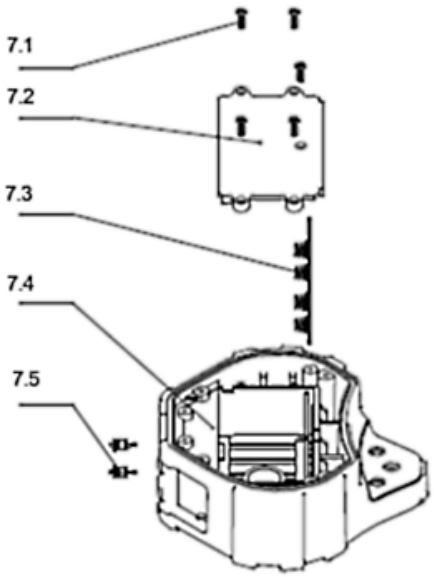
Item	JLT Part #	Description	Qty
6.4.1	AP1647	M2x 5 Cross Plate Screw	6
6.4.2	AP1969	Rotary Head Part	1
6.4.3	AP1696	M2x 10 Cross Plate Screw	12
6.4.4	AP1970	Prism Assembly	1
6.4.5	AP1971	Locking Nut	1
6.4.6	AP1592	M3 x 4 Inner Hexagon Tightening Screw	1
6.4.7	AP1972	12MM Bearing	2
6.4.8	AP1973	Big Gear Assembly	1
6.4.9	AP1449	M2.5x 6 Cross Plate Screw	4
6.4.10	AP1915	M2.5 Elastic Gasket	2
6.4.11	AP1974	Electric Motor	1
6.4.12	AP1975	#6 PCB	1
6.4.13	AP1976	Base Assembly	1
6.4.14	AP1977	Indicator	1
6.4.16	AP1978	#9 Connecting PCB	1
6.4.17	AP1979	M4 x 12 Inner Hex Column Screw	1
6.4.18	AP1967	M4 Elastic Gasket	1
6.4.19	AP1980	Compression Spring	1
6.4.20	AP1981	Sensor Assembly	2
6.4.21	AP1982	Spacer	1
6.4.22	AP1983	Ball Gimbal Assembly	1
6.4.23	AP1984	M2.5 flat spacer	2



1. Disassemble Ball Gimbal Assembly (6-4-22) and Compression Spring (6-4-19) by removing retaining screw (6-4-17) and respective elastic gasket (6-4-18).
2. Disassemble 2 Sensor assemblies (6-4-20) by removing 4 retaining screws (6-4-1).
3. Disassemble #6 PCB (6-4-12) by removing 2 retaining screws (6-4-9).
4. Disassemble #9 PCB (6-4-16) by removing 2 retaining screws (6-4-9).
5. Disassemble Electric Motor (6-4-10) by removing 2 retaining screws (6-4-9), 2 elastic gaskets (6-4-10), and 2 flat spacers (6-4-23).
6. Disassemble Rotary Head (6-4-2) by removing 2 retaining screws (6-4-1).
7. Disassemble Prism Assembly (6-4-4) by removing 4 retaining screws (6-4-3).
8. Disassemble 12mm Bearing (6-4-7), Big Gear Assembly (6-4-8), and second 12mm Bearing (6-4-7) by loosening retaining screw (6-4-6) and turning locking nut (6-4-5) counter-clockwise until it is removed.
9. Disassemble Indicator (6-4-14) by removing 4 retaining screws (6-4-15).

2.5 Base Assembly (AP1942)

Item	JLT Part #	Description	Qty
7.1	AP1690	ST2.9 x 10 Cross Plate Tapping Screw	5
7.2	AP1985	Cover	1
7.3	AP1986	#10 Connecting PCB	1
7.4	AP1987	Bottom Seat Assembly	1
7.5	AP1988	Feeler Part	2



1. Disassemble Cover (7-2) by removing 5 retaining screws (7-1)
2. Remove #10 Connecting PCB (7-3) by sliding it out of the guide slot of the Bottom Seat Assembly (7-4).
3. Disassemble Bottom Seat Assembly (7-4) by desoldering the wires of 2 Feeler Parts (7-5). Press out Feeler Parts as required.

3.0 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 40-6537. Each item discussed is shown below.

3.1 Horizontal Mode Operation

3.1.1 Quantifying Accuracy Error
3.1.2 Characterize the type of error
3.1.2.1 Oblique Error
3.1.2.2 Taper Error
3.1.2.3 Wave Error

3.2 Vertical Mode Operation

3.3 Leveling Range Alarm Calibration

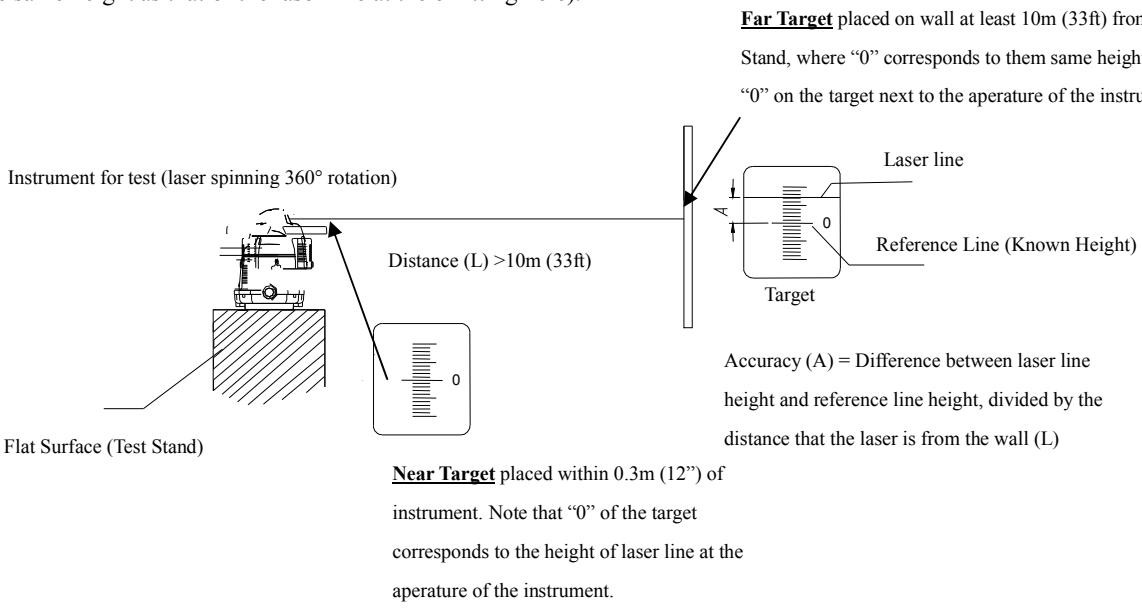
3.1. Horizontal Mode Operation

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°.

3.1.1. Quantifying Accuracy Error

Establish the test set-up shown in the following illustration and confirm that it meets the following requirements:

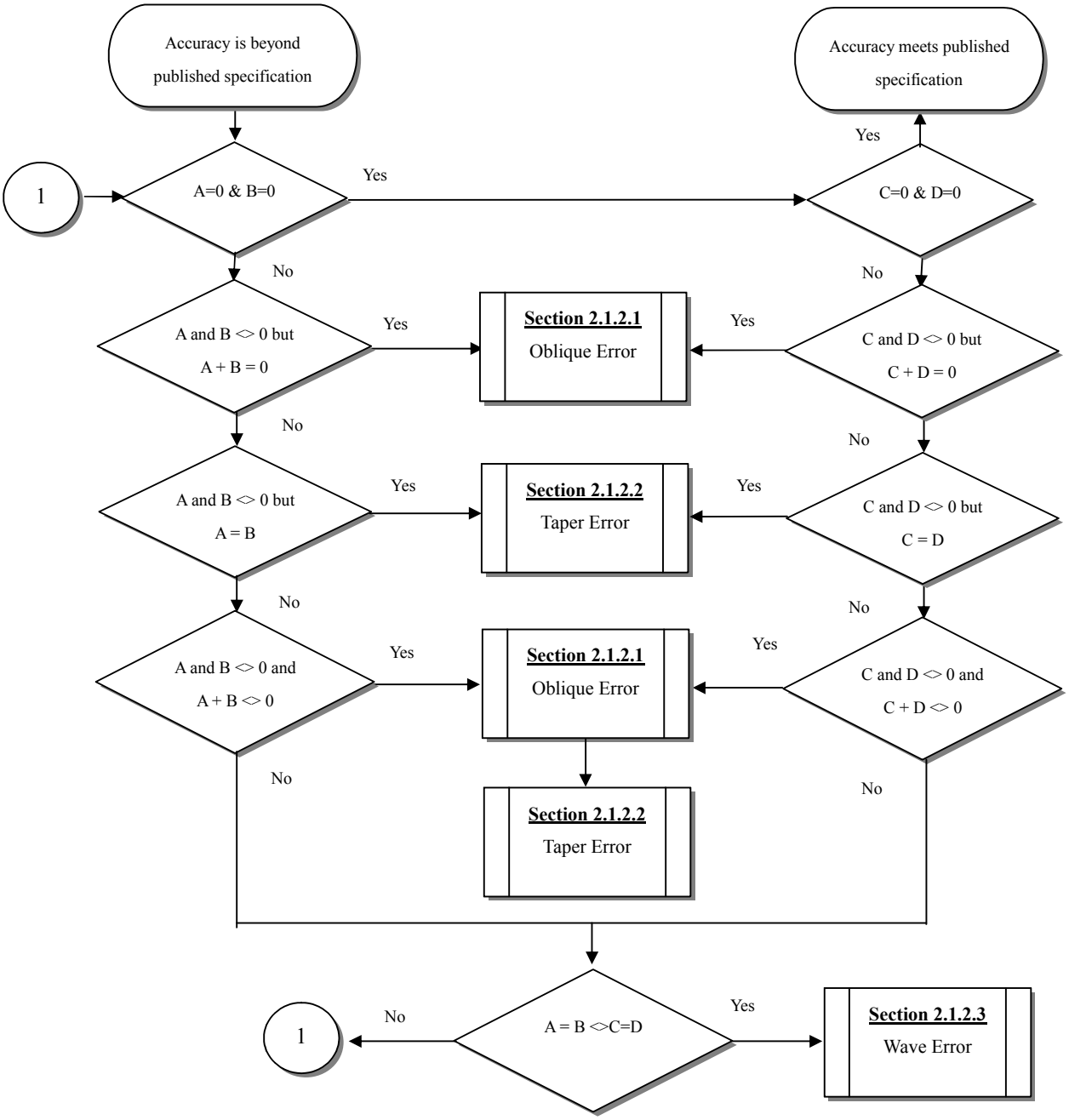
1) The debugging platform should be horizontal with a error less than 0.1°(6′);
2) The distance L from the center of the debugging clamp to the wall should be L≥10m;
3) The accuracy of the reference marking is no less than 0.05mm/m;
4) The adjacent-light ruler should be put within 0.3m (12”) of the instrument (the zero position of the ruler should be located at the same height as that of the laser line at the emitting hole).



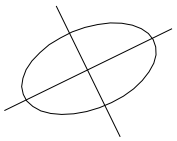
1. Place the instrument for test on the test stand (preconfigured from the illustration above) with handle facing the far target .
2. Power the laser and function in full rotation mode (head rotates 360°)
3. Note the errors in all four quadrants of the instrument as read on the far target (i.e. x axis A = 0° and B = 180°, y axis C = 90° and 270°)
    - You should end up with 4 numbers
        i. A (0°) = _____
        ii. B (180°) = _____
        iii. C (90°) = _____
        iv. 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.

3.1.2. Characterize the type of error

Use the following rules to determine what to 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.



3.1.2.1. Oblique error



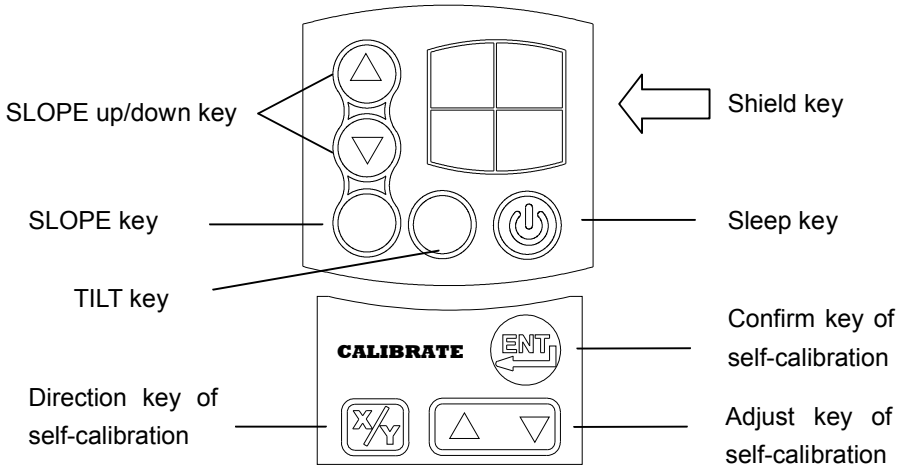
This type of error occurs when leveling compensator does not hang straight (as illustrated to the right), i.e. is not properly balanced. When the laser spins, it actually rotates on a plain that is not level, i.e. perfectly horizontal whose rotating axis is not plumb. So value A on the left target does 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.

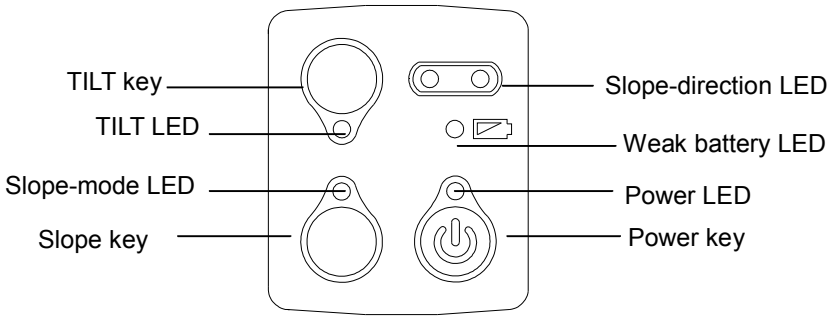
- Normal use – Depending upon how careful the user is with the instrument, finely tuned adjustments can be altered by very large changes in temperature, vibrations (due to handling and transportation)
- Shock – The instrument was dropped and components of the leveling system (gimbal, compensator weight and shaft., screw adjustments) 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 0.0005”/in), only fine adjustments need to be made, i.e. calibration via the remote control. Larger errors (>.5mm/m or 0.0005”/in) require coarse adjustment to get close, then fine adjustment to bring the unit within specification. Both adjustments are defined below

Fine Adjust - Calibration via The Remote Control

If the error is within the range of ±0.5mm/m, it only needs to make calibration with the aid of remote control. The details are as follows:

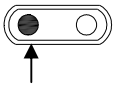




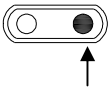
1. Enter self-calibration mode

- Power off the instrument and direct the X-axis towards wall.
- Press the key and key simultaneously. While continuing to hold the key, remove finger from the key. While continuing to hold the key, observe the main display's LED's flash 3 time. Once this happens, remove finger from the key and observe that the rotating head of the laser continuously rotates. The laser is now in calibration mode.

2. X-axis calibration

- Press the key one time and verify that the X-direction LED on the keypad of the 40-6537  flashes, indicating that it has entered the self-calibration mode on the X-direction.
- Press the key to adjust the laser beam up or down to coincide with the reference line.

3. Y-axis calibration

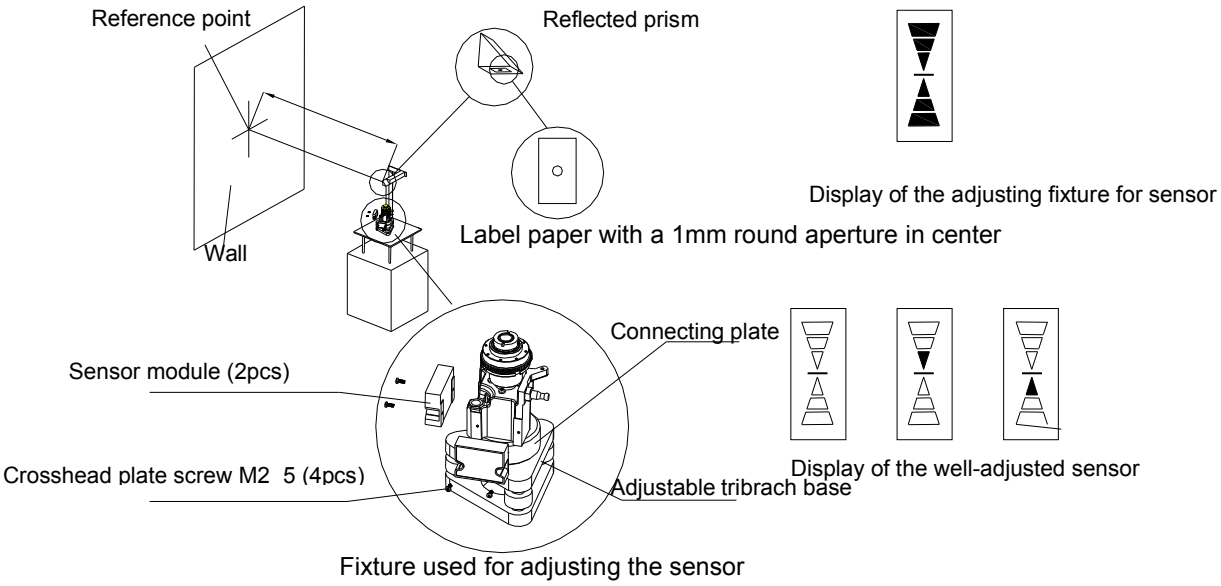
- Rotate the 40-6537 90° so that the Y-axis is now facing the wall.
- Press the key one time and verify that the Y-direction LED on the keypad of the 40-6537  flashes, indicating that it has entered the self-calibration mode on the Y-direction.
- Press the key to adjust the laser beam up or down to coincide with the reference line.

4. Self-calibration confirmation

- Press the key after finishing self calibration on both the X and Y axis and verify that the Self Calibration LED extinguishes. The instrument will exit the self-calibration mode automatically after finishing self-calibration.
- Power off the unit to store the calibration values into the 40-6537's memory.
- Repower the 40-6537 and confirm the units accuracy. Repeat procedure as required.

Coarse Adjust - Calibration via Internal Leveling Sensors

If the error is more than 0.5mm/m, it will need to make calibration by adjusting the sensor. The details are as follows:



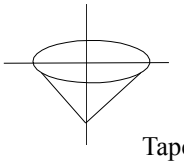
Fixture Setup (See Above)

1. Fix a square reflected prism on the debugging platform, and affix a label paper that having a light-emitting aperture in center on the prism (the diameter of the aperture is about 1mm). Put an auto-leveling rotating laser that having plumb-up point on the platform. Power on the unit and the plumb-up point will pass through the prism and the light-emitting aperture of the label paper, and then to reflect on the wall. Take the center of the reflected laser point on the wall as a point A.
2. Turn the unit by 90°, and take the center of the laser spot on the wall as points B, C, D in turn. The center of internally tangent circle of these four points A, B, C, D is used as the reference point.

Core Module/Leveling Sensor Calibration

1. Fix the core part on the special clamp. By supplying the laser source with a power of DC 3V, the laser spot will pass through the aperture on the laser paper and to reflect on the wall. Adjust the three leveling knob on the tribrach base (shown above), in order to make the center of the reflected laser spot coincident with the reference point.
2. Fix the sensors of X & Y direction to the proper positions on the core part using 2 crosshead plate screw M2×5.
3. Adjust the position of the sensors by connecting a specially designed instrument developed for sensor levelling position, and adjusting until the signal shows that sensor is level, i.e. the upper & lower arrows occupy no more than one grid. And then tighten the screws on leveling sensor, securing it to the core module.
4. After the sensors of both X & Y directions have been calibrated, loc-tight the heads of the tightening screws to the sensors so that they cannot come loose.

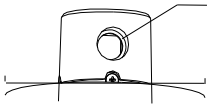
3.1.2.2 Taper Error



Taper error

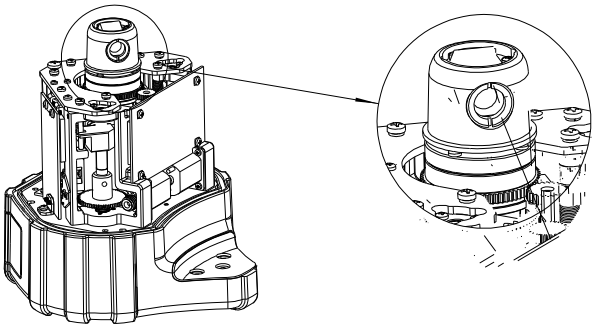
Taper error results when the prism base module (discussed in section 2.4, item 6.4.4) does not reflect the laser light exactly 90° (i.e. non-perpendicularity between the rotating line and the rotating axis). The end result is a laser rotating surface that is not a plane, but a tapered one as shown in 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.
d. Loc-tight adjust after it has been set.

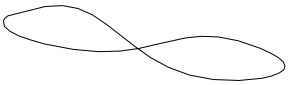


Optical wedge

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



3.1.2.3 Wave Error



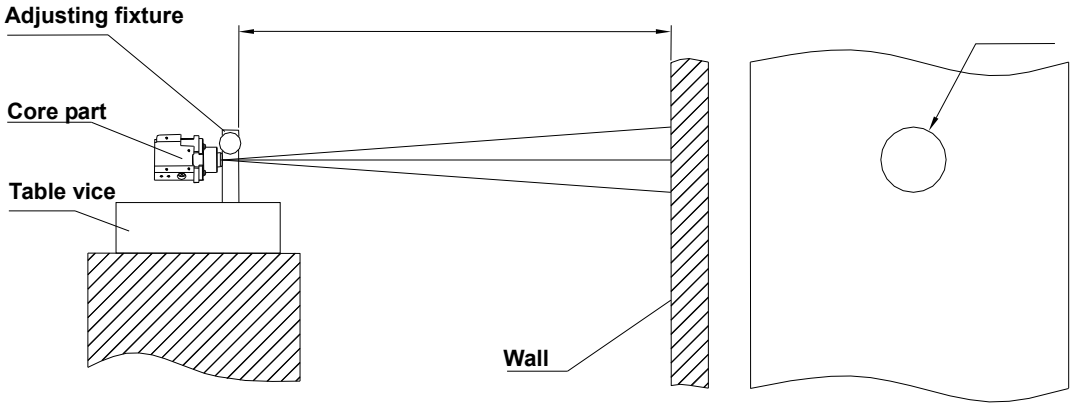
Wave error

This error occurs when the rotating laser surface is not a plane, but a turn up one as shown in the figure to the right. The rotating beam projected on the wall is crooked, similar to waviness, which is caused by the unbalance of rotating head. The value A checked in the X-direction deviates upwards while the one in the Y-direction downwards, or the value A in the Y-direction upwards while the one in the X-direction downwards. Meanwhile, you can see the laser point above the head is mobile and its orbit is inclined to be a circle.

The error can be removed by adjusting the balance block of the Rotating head as follows:

a. Remove the top cover as discussed in section 1 of this document.
b. Regulate the adjusting screws on the four balance block as shown in the figure to the right, until the laser point above the head becomes stable, namely, the laser point projected on the ceiling being a stable one.

1) As shown in the figure below, put the table vice on the debugging platform;
2) Fix the core part without prism on the adjustment fixture, and Install the adjustment fixture on the table vice, to make the laser spot towards the wall;
3) Turn the core part, to make the laser revolve around the rotary axis. Adjust the 4pcs of adjustment crews which are used for fixing the laser indicator, in order to make the diameter of the laser spot circle no more than 1cm;
4) Spread the screw and laser source part with shellac;



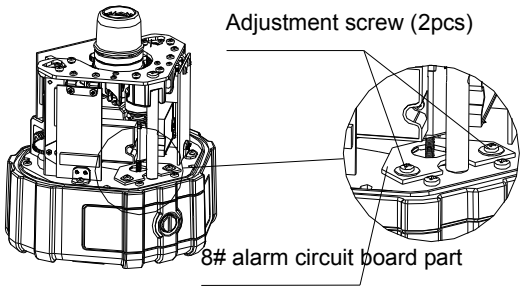
3.2. Vertical Mode Operation

In this mode of operation, the rotating laser surface is a plumb plane, while the laser line projected from the top is in projecting horizontal. While in this mode, the instrument is manually level, meaning that accuracy is a function of how accurately the vial is calibrated. The 40-6537 is not designed for Vertical Mode Operation.

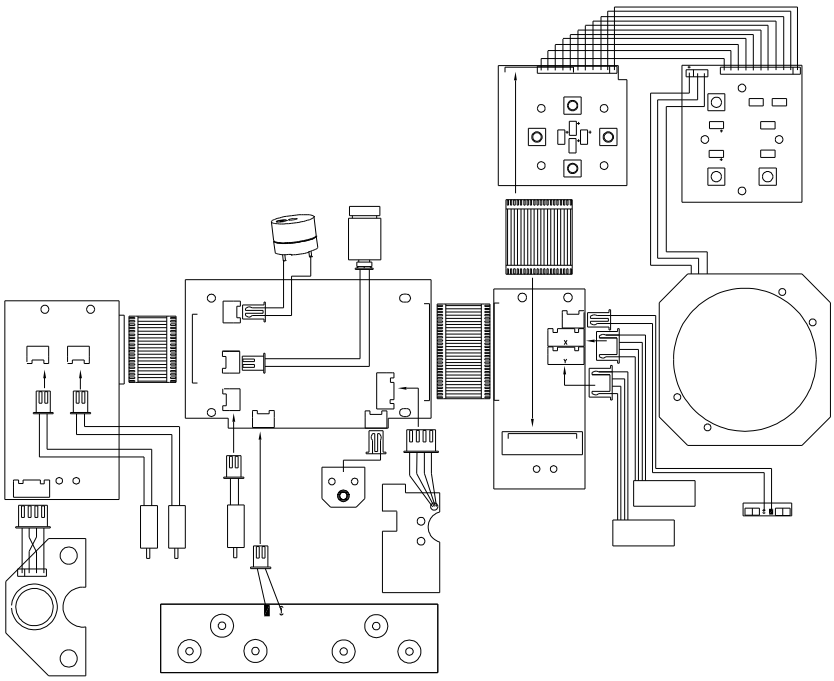
3.3. Alarm Calibration

The alarm function is made up of 3 components, the 2 alarm PCB's (7-15-17, 7-14-13) and the buzzer (10-3). Calibrating it is a matter of centering the contact ring of 7-14-13 to the spring post of 7-15-17. When the spring post makes contact with the contact ring of 7-14-13, the buzzer (10-3) sounds. Centering the post between the ring offers equal angular alarming in all directions. Adjustments are made as follows:

a. Remove the Upper housing assembly as shown in section 2.1.
b. Locate the adjustment screws 6-10 (reference section 2.3).
c. Loosen the adjustment screws 6-11and 6-12 to manually center the contact ring to the spring post.
d. Tighten the adjustment screws and reassemble the upper housing assembly to the base assembly.



4.0. Electrical Connections



5.0. Troubleshooting Guide

No.	Symptom	Cause	Corrective Action
1	Unit doesn't turn on	Battery case is loose	Change battery box
		1# control board is defective	Change 1# control board
		Battery is low	Charge/Change Battery
		Power switch is defective	Change Power Switch
		Cabling between PCB #1, PCB #3, and PCB #5 is loose/defective	Change/repair cabling
		Cabling between PCB #1 and PCB #10 is loose/defective	Change/repair cabling
2	Remote control does not work	PCB #1 is Defective	Repair/Replace PCB
		PCB #11 is Defective	Repair/Replace PCB
		Cabling between PCB #1, PCB #3, and PCB #5 is loose/defective	Change/repair cabling
		Cabling between PCB #3 and PCB #11 is loose/defective	Change/repair cabling
3	Alarm Sounds when power comes on.	Cabling from #12 PCB is defective	Change/repair cabling
		Ball switch from #12 PCB is defective	Repair/Replace PCB /Switch
4	Indicators don't light upon key press	Cabling between PCB #1, PCB #3, and PCB #5 is loose/defective	Change/repair cabling
		PCB #1 is defective	Repair/Replace PCB
		PCB #2 is defective	Repair/Replace PCB
		PCB #3 is defective	Repair/Replace PCB
5	Incorrect Quadrant Shield/incorrect rotating speed	PCB #6 is defective	Repair/Replace PCB
		Cabling from PCB #6 is defective	Change/repair cabling
		Reflective Plane is Dirty	Clean Reflective Plane
6	No Alarm when tilted beyond tolerance	Cabling between PCB #5 and PCB #12 is loose/defective	Change/repair cabling
		Cabling between PCB #4 and PCB #81 is loose/defective	Change/repair cabling
		Cabling between PCB #1 and PCB #9 is loose/defective	Change/repair cabling
7	alarm when tilted beyond tolerance but no sound	Buzzer is defective	Repair/Replace Buzzer
		Cabling from Buzzer is defective	Change/repair cabling
8	Unit powers, but no laser	Cabling to laser is defective	Change/repair cabling
		Laser is defective	Repair/Replace Laser
9	Unit doesn't auto level	Cabling between PCB #1, PCB #4, and PCB #5 is loose/defective	Change/repair cabling
		Core Spring is loose/spring is tightened	Adjust spring