GUIDE FOR SELF-CALIBRATION & TEST OF THE Digi-Pas® 2-AXIS PRECISION DIGITAL LEVEL UTILIZING SINE BAR

Model: DWL1900XY

Step 1: SELF-CALIBRATION

Preparation:

Part	Qty.	Specification
DWL1900XY Device	1	Accuracy: ±0.002˚ at 0.000˚ ~ ±0.500˚ ±0.004˚ at other angle Measurement range: X-axis: 0.000° ~ ±5.000° Y-axis: 0.000° ~ ±5.000°
Granite Table	1	Grade AA (Leveled to ≤1 arcsec.)

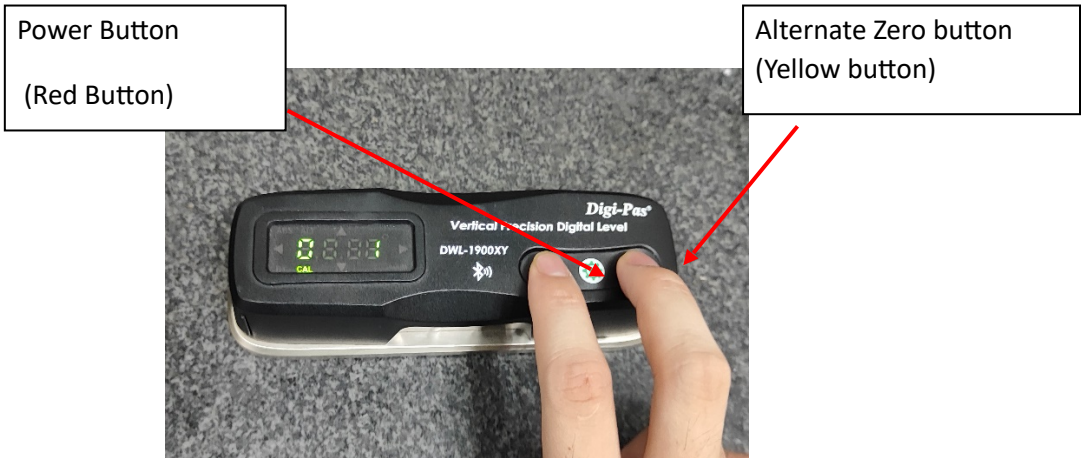
Method for Self-Calibrating the DWL1900XY (Note: Figure Illustration is using Model DWL1900XY) :

1. Ensure the DWL1900XY device is in power OFF condition before performing the following calibration procedure.

Figure 1.1.0

2. While pressing and holding the Alternate Zero button (Yellow button) as shown in the following figures, concurrently press the ON/OFF button (RED button) to enter the Calibration Mode. Release both buttons when “Calibration 0 1” displayed on LED screen (Figure 1.20b).

1.20a



1.20b

Precaution:

1. **When device is powered ON, allow 5 minutes prior starting calibration.**
2. **Before pressing the MODE button to initiate each calibration step, allow sufficient time to let the device settle down at each angle. Typically, 20 seconds are required for the device to get stabilized during calibration.**
3. **Ensure new batteries are being used.**

3. Place the device on the **leveled** granite table. The granite table should be leveled to ≤1 arcsec in order to allow proper calibration procedure to reset the device back to the factory preset accuracy.

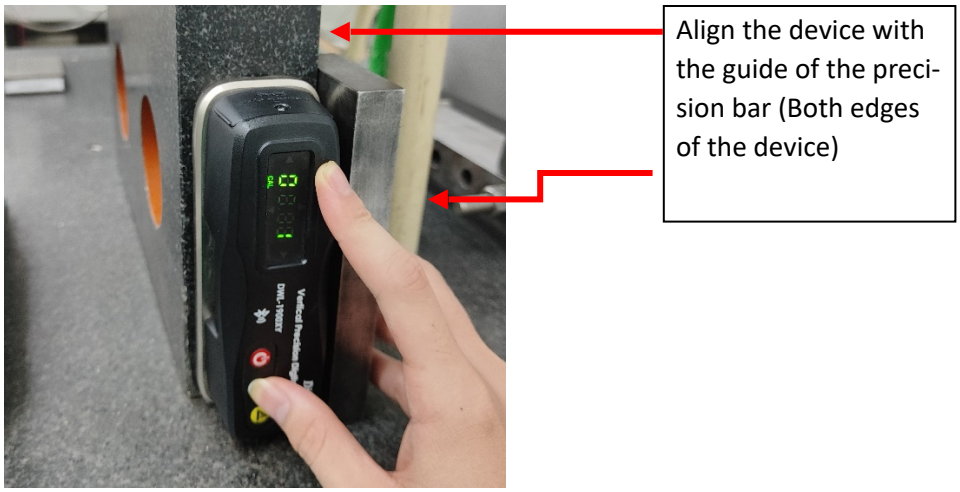


Figure 1.3.0

4. Press the MODE button once (Green button) and wait until the countdown to “0”. “Calibration with 0 2” will be displayed on the LED screen indicating to proceed to next step.

CAUTION: Do not disturb the device during each count down period.

Figure 1.4

5. Turn the device to other side as shown in the Figure 1.5 Press the MODE button to start the calibration at the “Position 2” and wait until the countdown to “0”.

Figure 1.5

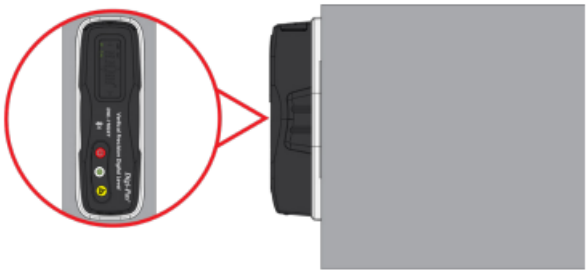
6. Turn the device to 180° as shown in the Figure 1.6 Press the MODE button to start the calibration at the “Position 3” and wait until the countdown to “0”.

Figure 1.6

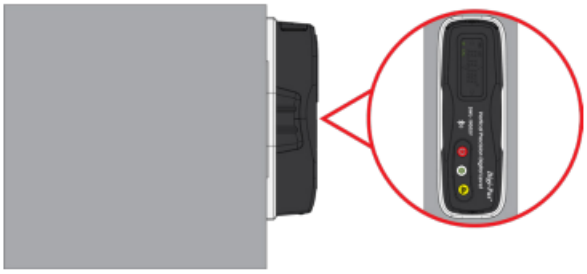
7. Turn the device to other side as shown in the Figure 1.7. Press the MODE button to start the calibration at the “Position 4” and wait until the countdown to “0”. The calibration process completed and device will automatic go to angle measuring mode.

Figure 1.7

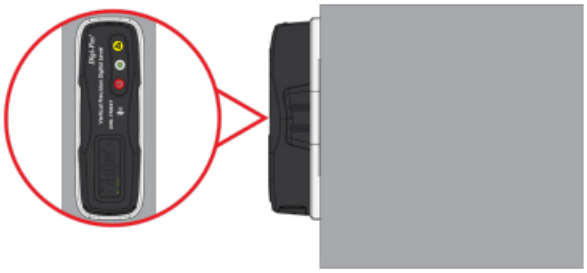
<u>Calibration step device orientation: Position 1 to Position 4</u>



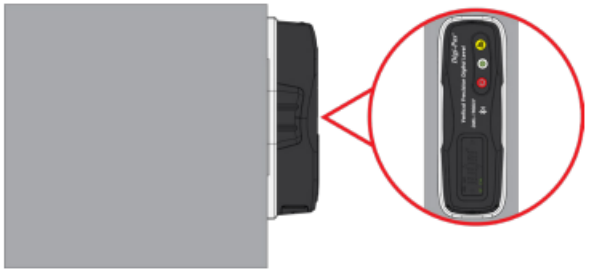
Position 1



Position 2



Position 3



Position 4

8. Quick check for the Calibration result (X-axis & Y-axis).

8.1. Place the DWL1900XY device on the **leveled** granite table and wait a few seconds for the digit to stable and the LED display would display **0.000**°. Turn the device to the side and wait a few seconds till the digit display is **stable**. Compare the current and previous readings. The value should be **0.000**

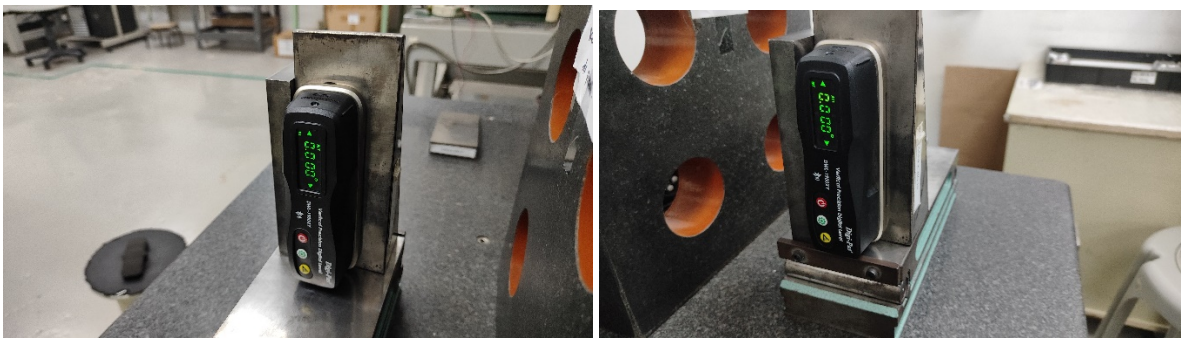


Figure 1.8.1

8.2. Turn the DWL1900XY device 180°on the **leveled** granite table and wait a few seconds for the digit to stable and the LED display would display **0.000**°. Turn the device 180° and wait a few seconds till the digit display is **stable**. Compare the current and previous readings. The value should be **0.000**

Figure 1.8.2

8.3. Switch the display value to **Y-axis** direction by pressing the MODE button.

The arrow indicator will switch direction to UP DOWN position to indicate the Y-axis measurement. Record the display value. The value should be **0.000**°. Turn the device 180° and wait a few seconds till the digit display is **stable**. Compare the current and previous readings. The value should be **0.000**

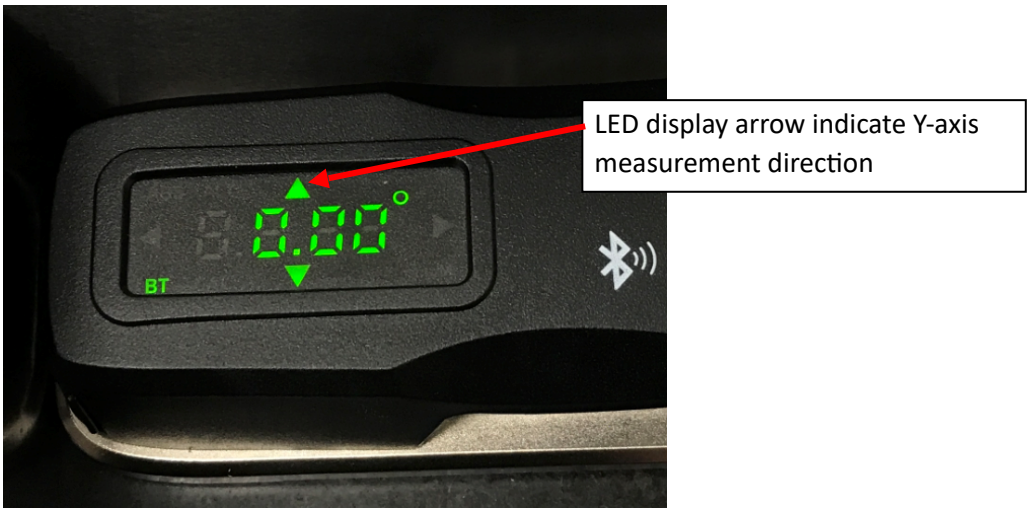


Figure 1.8.3a

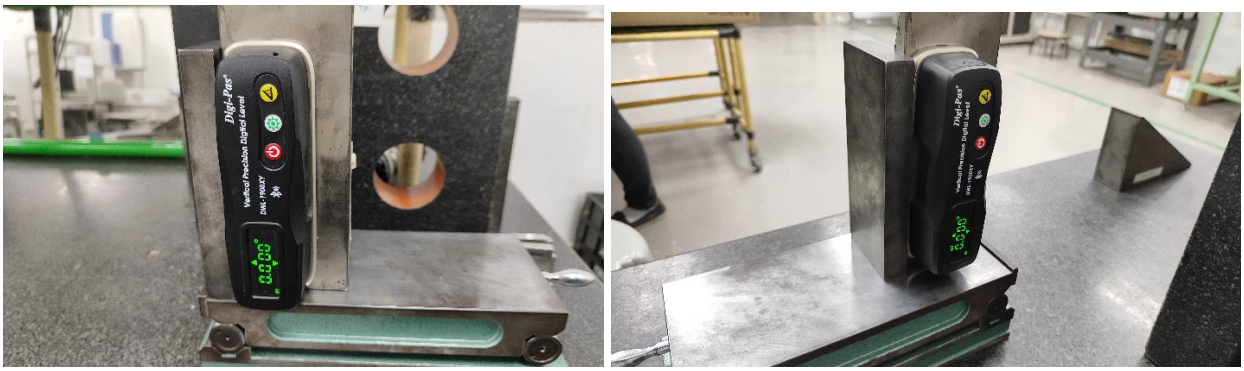


Figure 1.8.3b

8.4. Turn the DWL1900XY device 180°on the **leveled** granite table and wait a few seconds for the digit to stable and the LED display would display **0.000**°. Turn the device 180° and wait a few seconds till the digit display is **stable**. Compare the current and previous readings. The value should be **0.000**

Figure 1.8.4

8.5. If the device fail the calibration verification process (Symmetrical check) with the error display between front and back **≥ 0.001°** . Please repeat the calibration process (1-7) until pass the symmetrical check.

Step 2: Angle Verification

Preparation:

Part	Qty.	Specification
DWL1900XY Device	1	Accuracy: ±0.002˚ at 0.000˚ ~ ±0.500˚ ±0.004˚ at other angle Measurement range: X-axis: 0.000° ~ ±5.000° Y-axis: 0.000° ~ 5.000°
Sine Bar	1	Center distance of round bars : 200.000mm ± 2.0μm Ground square & parallel : ≤ 2.0μm Surface Flatness : ≤ 2.0μm Roll roundness : ≤ 1.0μm
Granite Table	1	Grade AA (Leveled to ≤1 arcsec.)
Gauge Block Set	1set	Grade Zero or above (Specified by DIN861, BS4311 and JIS B 7506)
Metal Block	2pcs	Surface flatness : ≤ 5.0μm Parallelism : ≤ 5.0μm

Methodology for Testing the DWL1900XY:

1. Place the Sine Bar on the leveled granite table. The granite table should be leveled to ≤1 arcsec in order to allow proper calibration procedure to reset the device back to the factory preset accuracy.

NOTE: Do not use the Alternate Zero function to 'force' the device to **0.000**° on an un-leveled granite table to perform calibration and testing the device. Instead, use a leveled granite table.

Results from the application can be further compared to the table on Appendix B to ensure that the both values are the same.

2. Using the **Digi-Pas Machinist Level App**, The app must first sync with the device (ON)

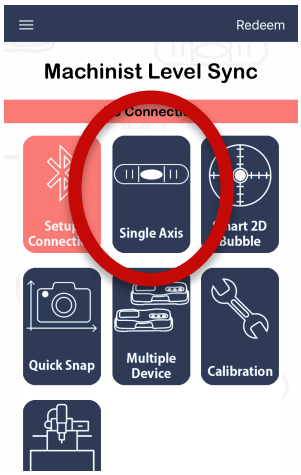


Figure 2.2.1

3. The device should be shown on the Setup Connection page as shown in the image below.

Figure 2.3.1

4. After clicking the selected device, The application will show that both the app and the device is now sync. Next is to select the Single Axis option.

Figure 2.4.1

Figure 2.4.2

5. The device under test should be calibrated in accordance to the Digi-Pas® calibration procedure stated above in **Step 1: 1-7** . Place the **calibrated** DWL1900XY on the Sine bar to confirm the initial value is **0.000**° i.e. completely leveled to the plane (Check the parallelism and surface flatness of the Size bar). Take note on precaution required in Appendix A which explains the effect on the device positioning (i.e. Device positioned parallel to Sine Bar) for **correct method of angle test/measurement**.

6. When device is set to the respective angle on the machine at 0.0057, 0.2063 and 3.4336, check what the result is on the app and enter the details onto Appendix B “reading data” column.

7. Once selected, This screen will be displayed. In this screen, the Degree and the (µm/50mm) must be the same as the stated value in Appendix B. When App degree is set to the set standard degree, compare the with the value in the app and fill the reading data column. As shown on Figure 2.7.1, The placement of device should be flushed parallel to the side and the end of the sine bar.

X-Axis

Description	Set Standard (°)	Set Standard (µm/50mm)	Lower Limit (µm/50mm)	Upper Limit (µm/50mm)	Reading data (°)	Reading data (µm/50mm)
(+) Slope	0.000	0 µm/50mm	2 µm/50mm	2 µm/50mm	0	0
	0.0057	5 µm/50mm	3 µm/50mm	7 µm/50mm	0.006	5
	0.2063	180 µm/50mm	178 µm/50mm	182 µm/50mm	0.206	180
	0.9167	800 µm/50mm	796 µm/50mm	804 µm/50mm	0.917	800
	3.4336	3000 µm/50mm	2996 µm/50mm	3004 µm/50mm	3.434	3000

Figure 2.7.1

8.After the positive X Axis direction is done, Flip the device to the as shown on Figure 2.7.2 parallel to end of the sine bar and record the findings the same as point 7.

Description	Set Standard (°)	Set Standard (µm/50mm)	Lower Limit (µm/50mm)	Upper Limit (µm/50mm)	Reading data (°)	Reading data (µm/50mm)
(-) Slope	0.000	0 µm/50mm	2 µm/50mm	2 µm/50mm	0	0
	0.0057	5 µm/50mm	3 µm/50mm	5 µm/50mm	0.006	5
	0.2063	180 µm/50mm	178 µm/50mm	182 µm/50mm	0.206	180
	0.9167	800 µm/50mm	796 µm/50mm	804 µm/50mm	0.917	800
	3.4336	3000 µm/50mm	2996 µm/50mm	3004 µm/50mm	3.434	3000

Figure 2.8.1

9. To being with the Y Axis, Toggle Y axis can be found at the bottom of the app

Figure 2.9.1

Repeat the process from the X Axis onto the Y Axis. Ensure that the Device is perpendicular to the end of the sine bar as shown on Figure 2.9.2

Y- Axis:

Description	Set Standard (°)	Set Standard (µm/50mm)	Lower Limit (µm/50mm)	Upper Limit (µm/50mm)	Reading data (°)	Reading data (µm/50mm)
(+) Slope	0.000	0 µm/50mm	2 µm/50mm	2 µm/50mm	0	0
	0.0057	5 µm/50mm	3 µm/50mm	5 µm/50mm	0.006	5
	0.2063	180 µm/50mm	178 µm/50mm	182 µm/50mm	0.206	180
	0.9167	800 µm/50mm	796 µm/50mm	804 µm/50mm	0.917	800
	3.4336	3000 µm/50mm	2996 µm/50mm	3004 µm/50mm	3.434	3000

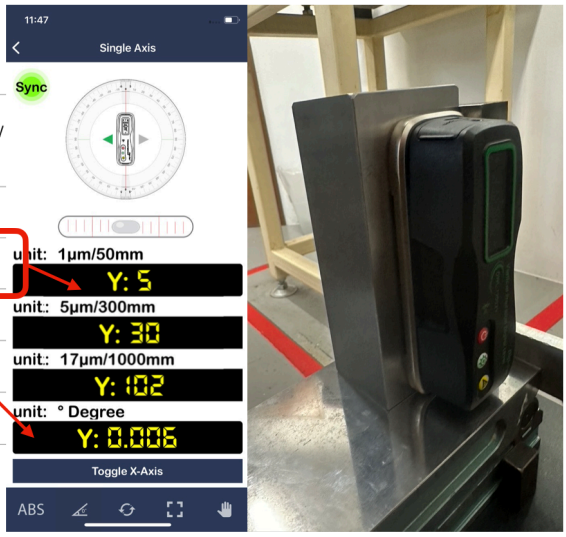


Figure 2.9.2

10. After the Y Positive axis, next is the Y Negative axis. Bring the device to the other end of the block gauge. And repeat the process. Ensure that the device position is flush perpendicular to the end of the sine bar the same as the figure below.

Description	Set Standard (°)	Set Standard (µm/50mm)	Lower Limit (µm/50mm)	Upper Limit (µm/50mm)	Reading data (°)	Reading data (µm/50mm)
(-) Slope	0.000	0 µm/50mm	2 µm/50mm	2 µm/50mm	0	0
	0.0057	5 µm/50mm	3 µm/50mm	5 µm/50mm	0.006	5
	0.2063	180 µm/50mm	178 µm/50mm	182 µm/50mm	0.206	180
	0.9167	800 µm/50mm	796 µm/50mm	804 µm/50mm	0.917	800
	3.4336	3000 µm/50mm	2996 µm/50mm	3004 µm/50mm	3.434	3000

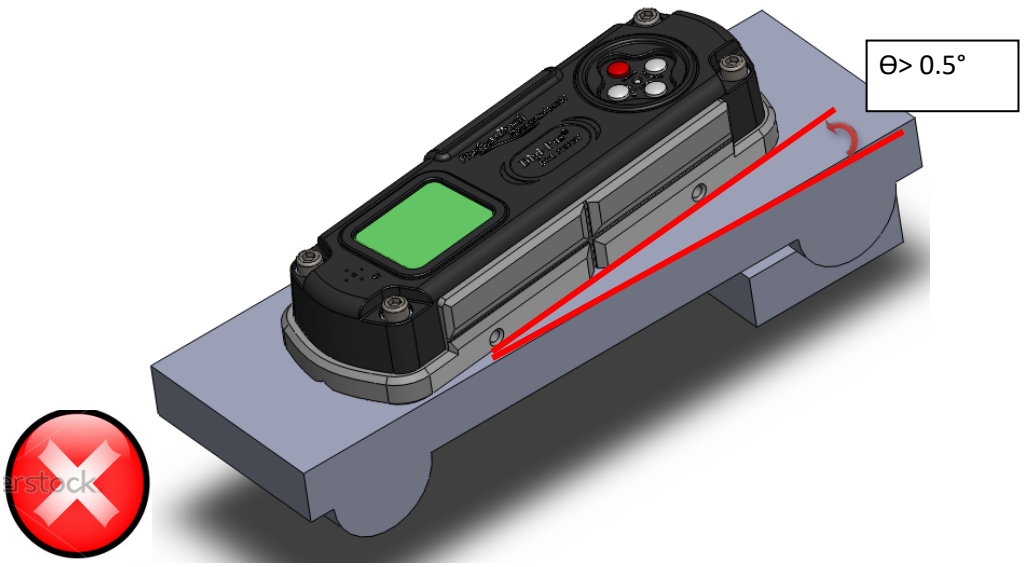
Figure 2.10.1

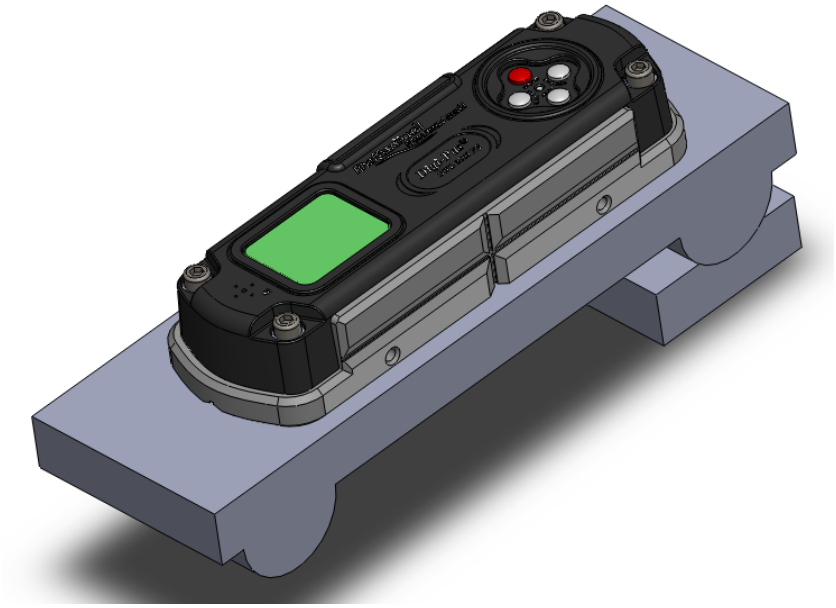
Appendix A

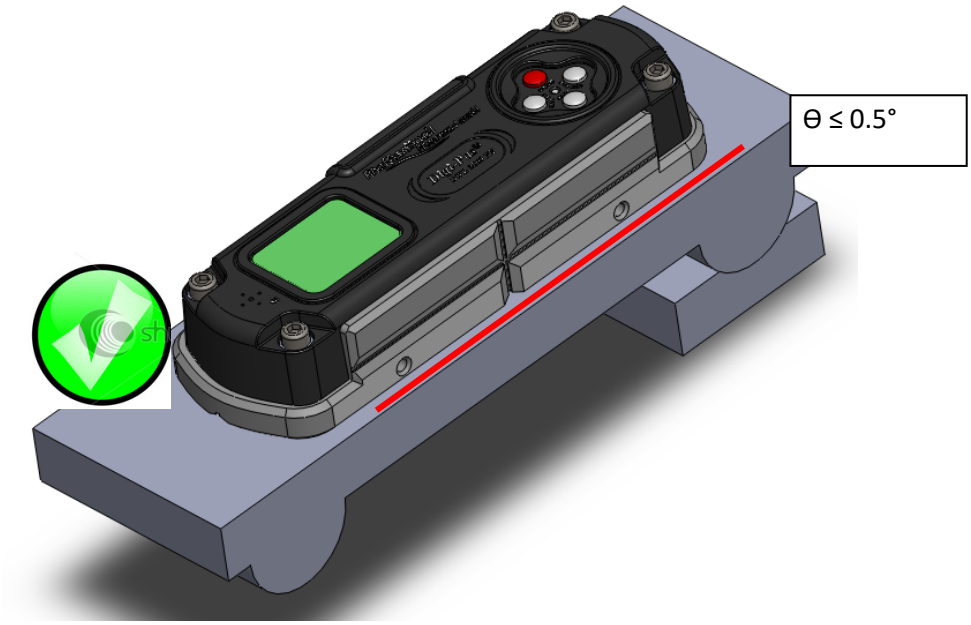
A.1 Precaution on Device Setting Position:

1. Device Setting Position on a Sample of Calibration Jig/Fixture. E.g. Sine Bar.

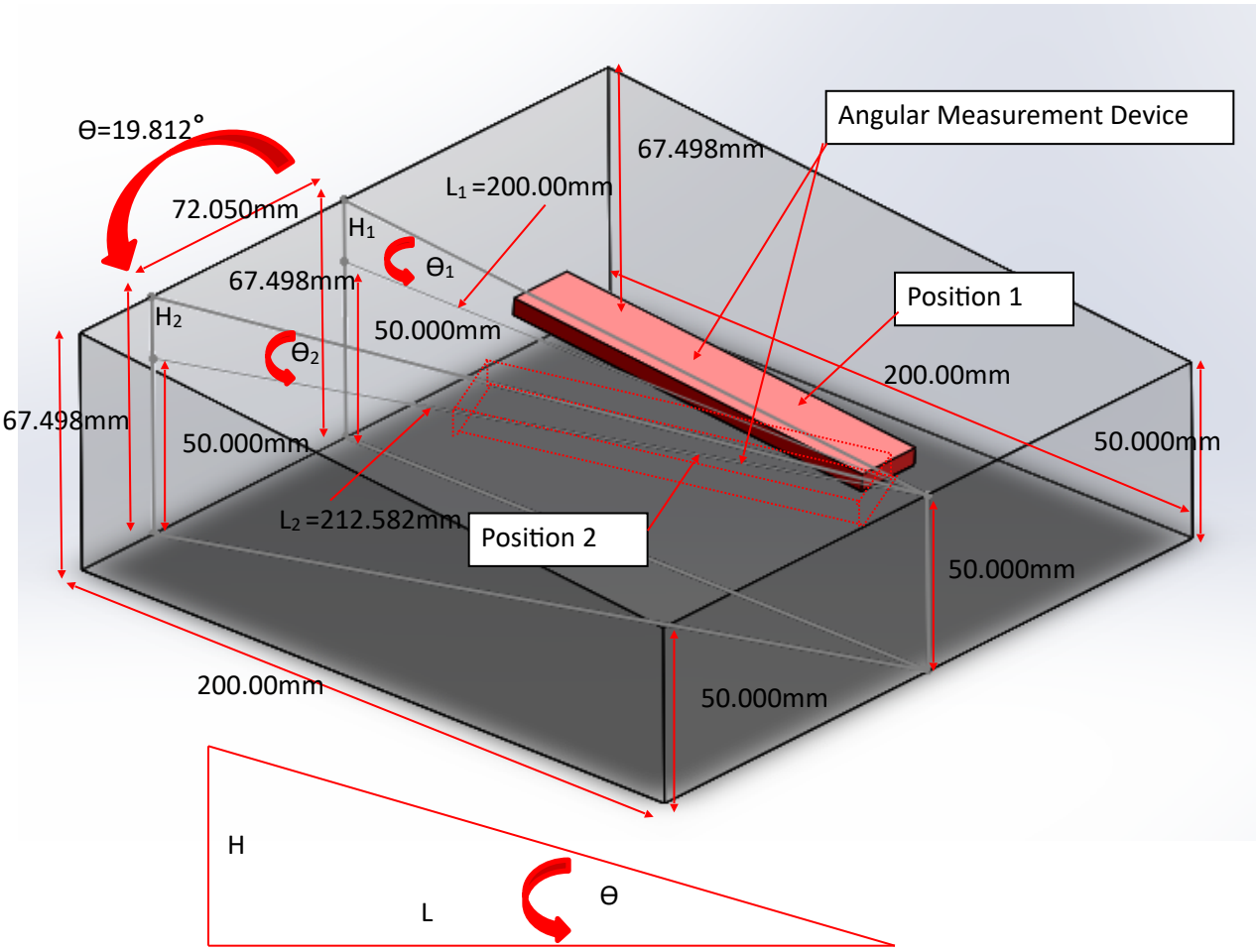
   The device must be placed **parallel** with testing Jig/Fixture as shown below.







A.2 Differential Angular Effect on Measurement Device Setting Position:



According Trigonometry theorem:

Tan Θ = $\frac{H}{L}$, therefore, Θ = $\tan^{-1}(\frac{H}{L})$

From the figure above:

$H_1 = H_2$ = (67.498mm - 50.000mm) = 17.498mm

Since (L_1=200.00mm) ≠ (L_2=212.582mm) i.e. from 3D drawing measurement $L_2 > L_1$)

Hence, **Θ_1** = $\tan^{-1}(\frac{H1}{L1}) = 5.000^\circ$ and **$\Theta_2 = 4.706^\circ$,** also, **($\Theta_2 \neq \Theta_1$)** and **($\Theta_2 < \Theta_1$)**

In Conclusion, the measurement device MUST be always positioned to align (see positioned 1, i.e. Θ_1) with test equipment to measure the intended (targeted) slope or angle. Other-

Appendix B

Digi-Pas® DWL1900XY Digital Machinist Level Calibration Checking Points:

X- Axis:

Device Display Unit:

1) 1µm/50mm:

X-Axis

Description	Set Standard (°)	Set Standard (µm/ 50mm)	Lower Limit (µm/ 50mm)	Upper Limit (µm/ 50mm)	Reading data (°)	Reading data (µm/ 50mm)
(+) Slope	0.000	0 µm/ 50mm	2 µm/50mm	2 µm/50mm		
	0.0057	5 µm/ 50mm	3 µm/50mm	7 µm/50mm		
	0.2063	180 µm/ 50mm	178 µm/ 50mm	182 µm/ 50mm		
	0.9167	800 µm/ 50mm	796 µm/ 50mm	804 µm/ 50mm		
	3.4336	3000 µm/ 50mm	2996 µm/ 50mm	3004 µm/ 50mm		
Description	**Set Standard (°)**	**Set Standard (µm/ 50mm)**	**Lower Limit (µm/ 50mm)**	**Upper Limit (µm/ 50mm)**	**Reading data (°)**	**Reading data (µm/ 50mm)**
(-) Slope	0.000	0 µm/ 50mm	2 µm/50mm	2 µm/50mm		
	0.0057	5 µm/ 50mm	3 µm/50mm	5 µm/50mm		
	0.2063	180 µm/ 50mm	178 µm/ 50mm	182 µm/ 50mm		

	0.9167	800 µm/ 50mm	796 µm/ 50mm	804 µm/ 50mm		
	3.4336	3000 µm/ 50mm	2996 µm/ 50mm	3004 µm/ 50mm		

Y- Axis:

Description	Set Standard (°)	Set Standard (µm/ 50mm)	Lower Limit (µm/ 50mm)	Upper Limit (µm/ 50mm)	Reading data (°)	Reading data (µm/ 50mm)
(+) Slope	0.000	0 µm/ 50mm	2 µm/50mm	2 µm/50mm		
	0.0057	5 µm/ 50mm	3 µm/50mm	5 µm/50mm		
	0.2063	180 µm/ 50mm	178 µm/ 50mm	182 µm/ 50mm		
	0.9167	800 µm/ 50mm	796 µm/ 50mm	804 µm/ 50mm		
	3.4336	3000 µm/ 50mm	2996 µm/ 50mm	3004 µm/ 50mm		
Description	**Set Standard (°)**	**Set Standard (µm/ 50mm)**	**Lower Limit (µm/ 50mm)**	**Upper Limit (µm/ 50mm)**	**Reading data (°)**	**Reading data (µm/ 50mm)**
(-) Slope	0.000	0 µm/ 50mm	2 µm/50mm	2 µm/50mm		
	0.0057	5 µm/ 50mm	3 µm/50mm	5 µm/50mm		
	0.2063	180 µm/ 50mm	178 µm/ 50mm	182 µm/ 50mm		
	0.9167	800 µm/ 50mm	796 µm/ 50mm	804 µm/ 50mm		
	3.4336	3000 µm/ 50mm	2996 µm/ 50mm	3004 µm/ 50mm		

