

This instruction covers the set-up and safe use of the KLA-Tencor P7 Stylus Profiler. This machine is a stylus contact profiler capable of 150mm scan lengths with $\sim 10\text{\AA}$ resolution and $\sim 20\text{\AA}$ noise floor. It is capable of measuring step height, roughness, and waviness on sample surfaces.

The P7 Stylus profiler at Purdue is equipped with the standard head configuration:

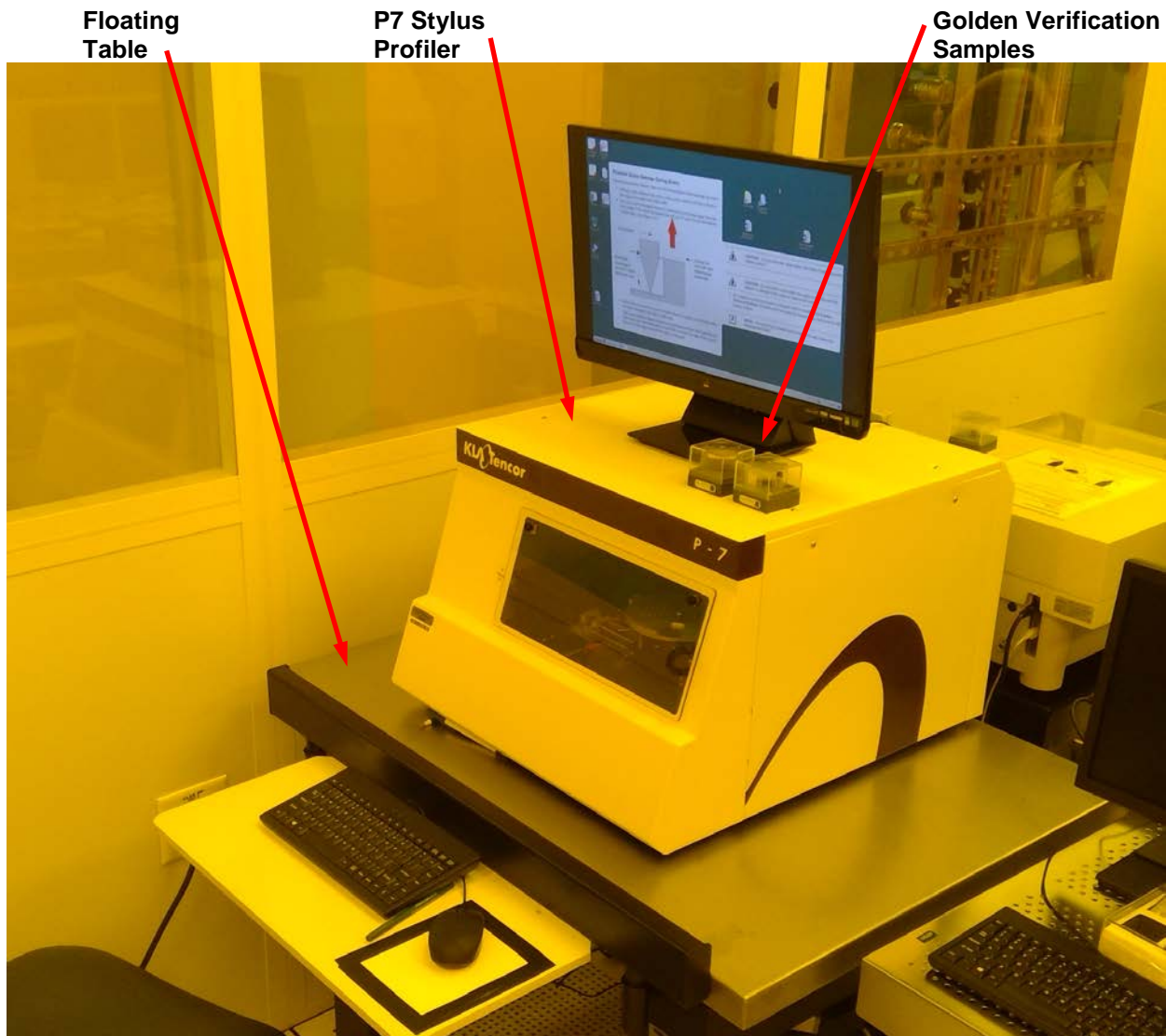
- The MicroHead V SR (standard range) has a vertical range of 327 μm , and is capable of scanning at forces between 0.5 and 50 mg.
- The WCAM unit has a 2 μm radius tip with a 60° angle installed that limits the maximum force to 2mg
- A manual theta stage with stops at 45° increments and a fine theta adjustment of $\pm 5^\circ$.

1. SAFETY REQUIREMENTS

- 1.1 Safety glasses must be worn whenever in the cleanroom, except when using a microscope or when wearing protective goggles.
- 1.2 Information regarding the hazardous materials used in the cleanroom may be found through MSDS documentation located in the gowning room.
- 1.3 Operate the P7 Stylus Profiler with all protective shields and doors in place.
- 1.4 Do not reach into the tool except to place your sample on the chuck. Do not put your hands under the scan head, or you may damage the stylus.

2. EQUIPMENT

- 2.1 P7 Stylus Profiler
- 2.2 Floating optical table
- 2.3 Golden verification samples



3. TOOL LIMITATIONS

The performance of the tool is dependent upon proper operation by the user, and by not exceeding the tool capability.

- 3.1 Do not try to measure samples that are too thick and too big in size for the instrument.
- 3.2 Do not measure step heights that are beyond the range of the instrument.
- 3.3 Do not move the stage with the stylus lower than the top of the sample surface.
- 3.4 **Always scan left to right. This protects the stylus.**

Sample size requirements/restrictions

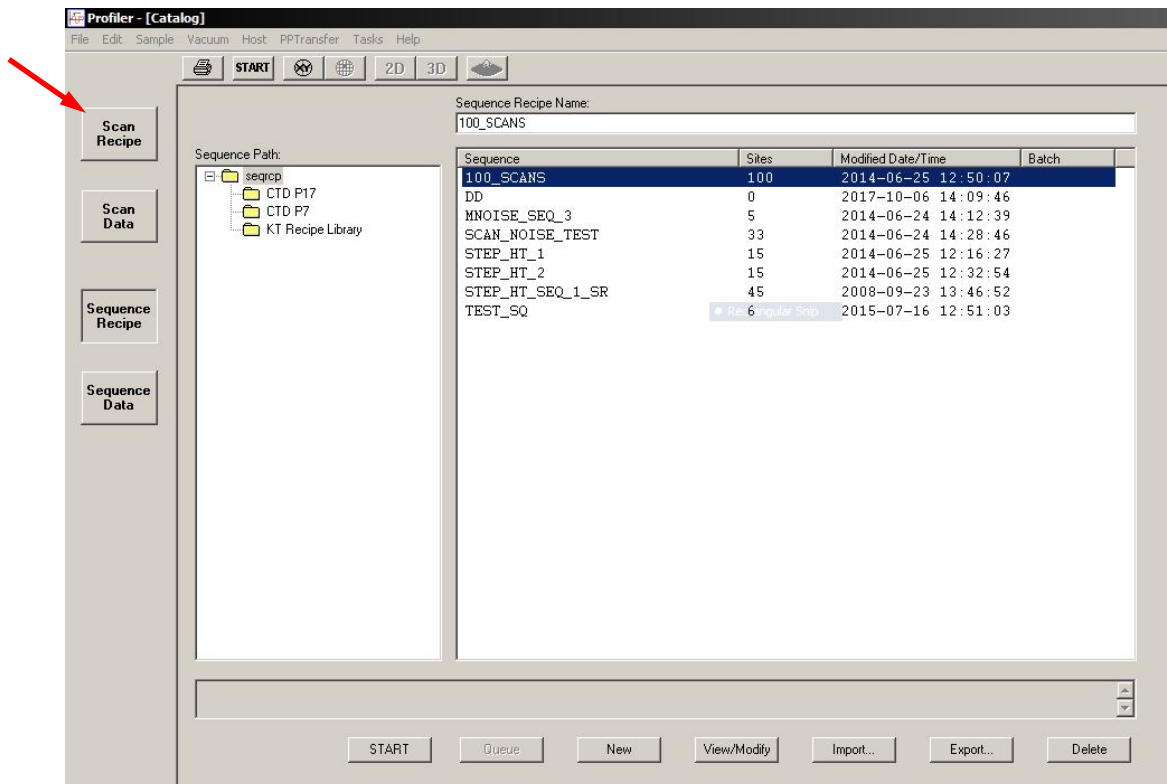
- o Vertical range **0 to 327 um**
- o Substrate sizes from **3mm x 3mm** up to **150mm** in diameter.
- o **2 um radius** diamond stylus with 60° cone angle
- o Maximum scan length of **150mm**

Material Limitations:

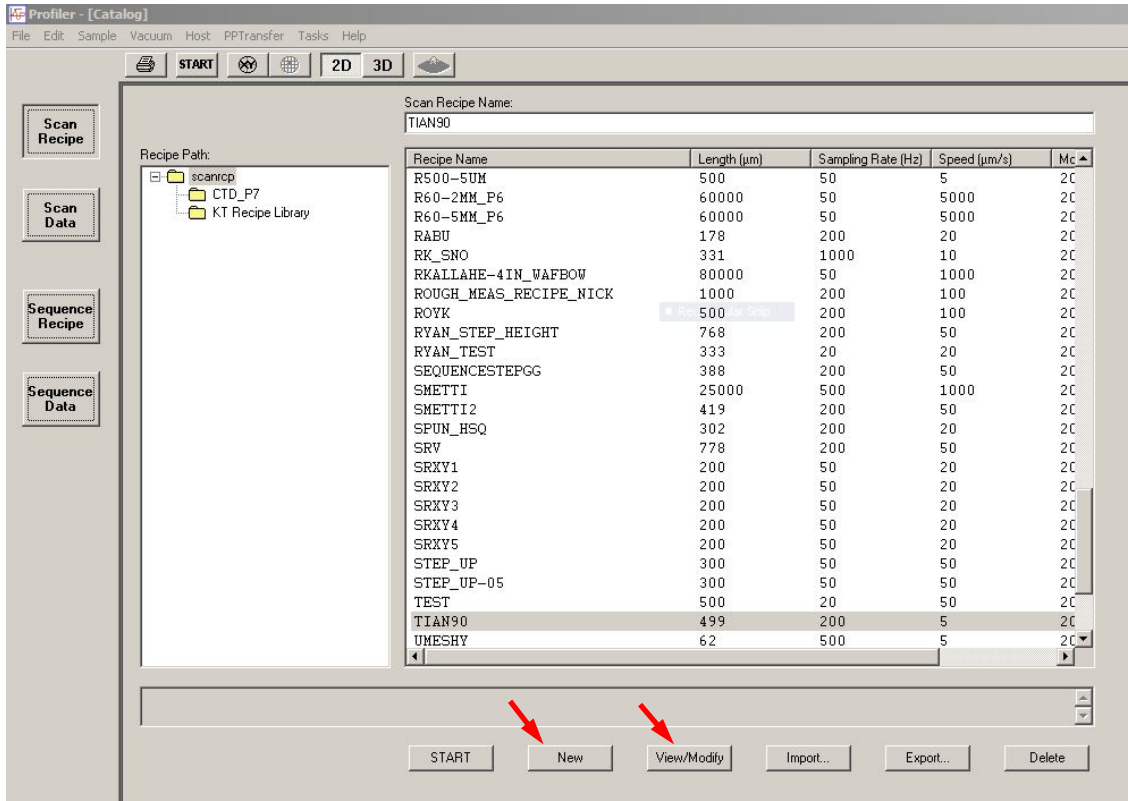
- o No uncured SU8
- o No uncured PDMS
- o No uncured photoresists
- o No soft materials that might stick to the stylus

4. CYCLE OF OPERATIONS

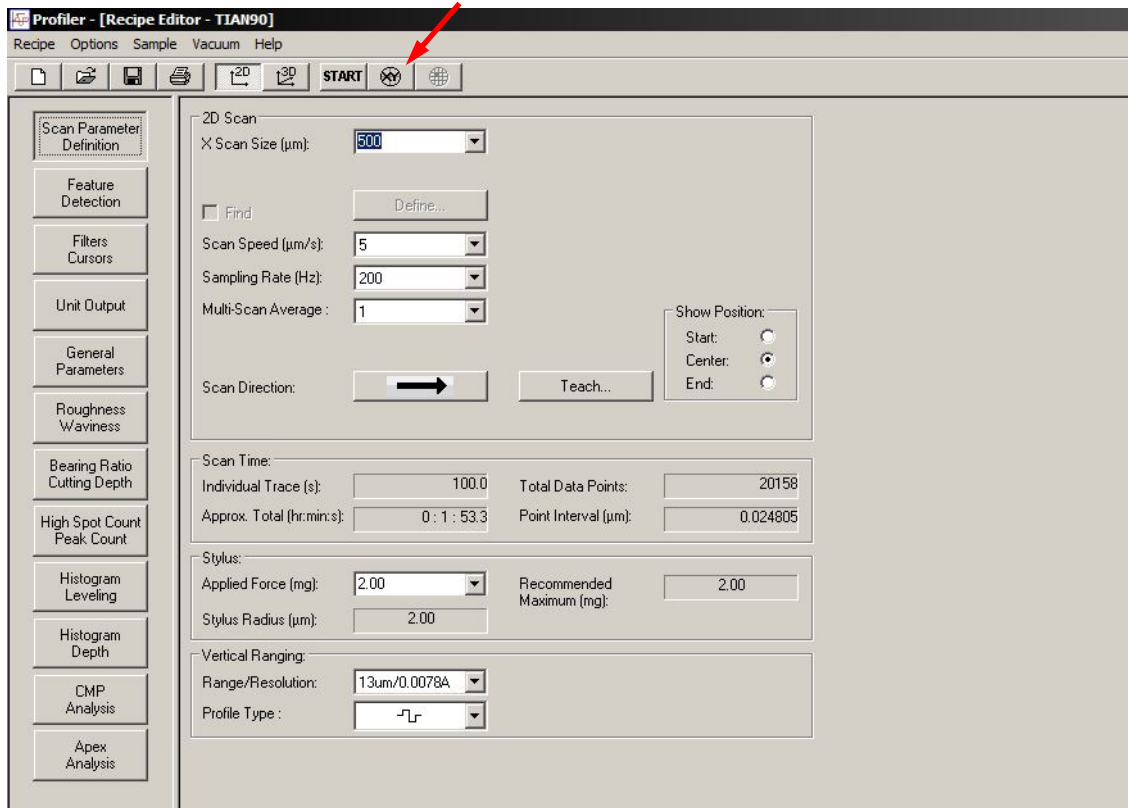
- 4.1 Start the software
 - o Doubleclick the **Profiler 8.0** icon.
 - o The software will open up to the Catalog page.
 - o Press the Scan Recipe button



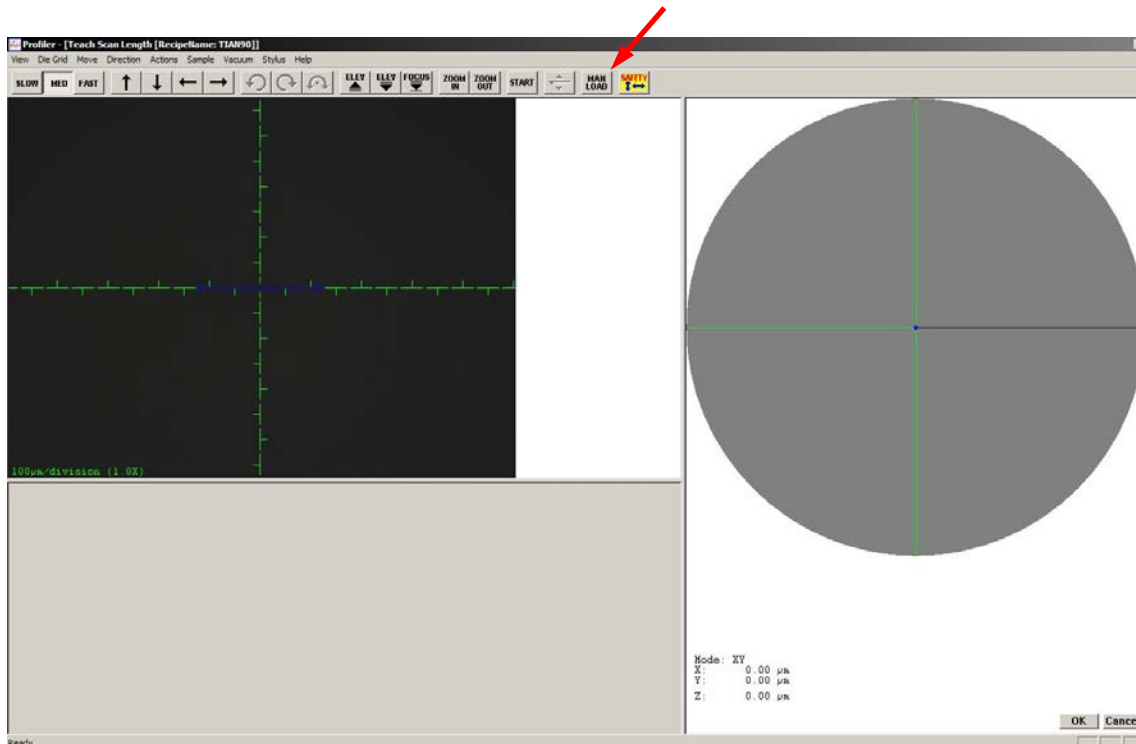
- 4.2 Choose an existing recipe by selecting a recipe then pressing **View/Modify** button
 Or make a new recipe by pressing **New** button



- 4.3 Press **XY** button to switch to camera mode



- 4.4 Press the **MAN LOAD** button
 This will move the stage towards you.
 Once the stage has stopped, open the door.



- 4.5 Observe the 5 small vacuum ports near the center of the chuck, then:
- o Load your sample with extreme care, and place it in the **exact center** of the chuck.

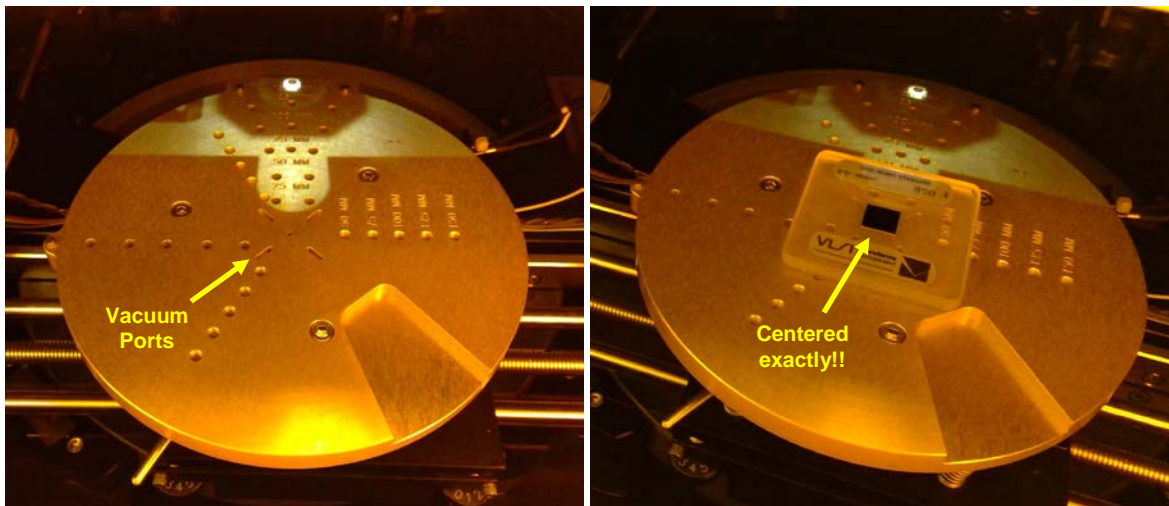
Note: Keep your hand away from the stylus head to avoid damage to the instrument.

- o Turn on the vacuum switch to keep your sample from sliding around.

Note: If your sample is so small that it does not fully cover all 5 vacuum ports, you will need to get creative:

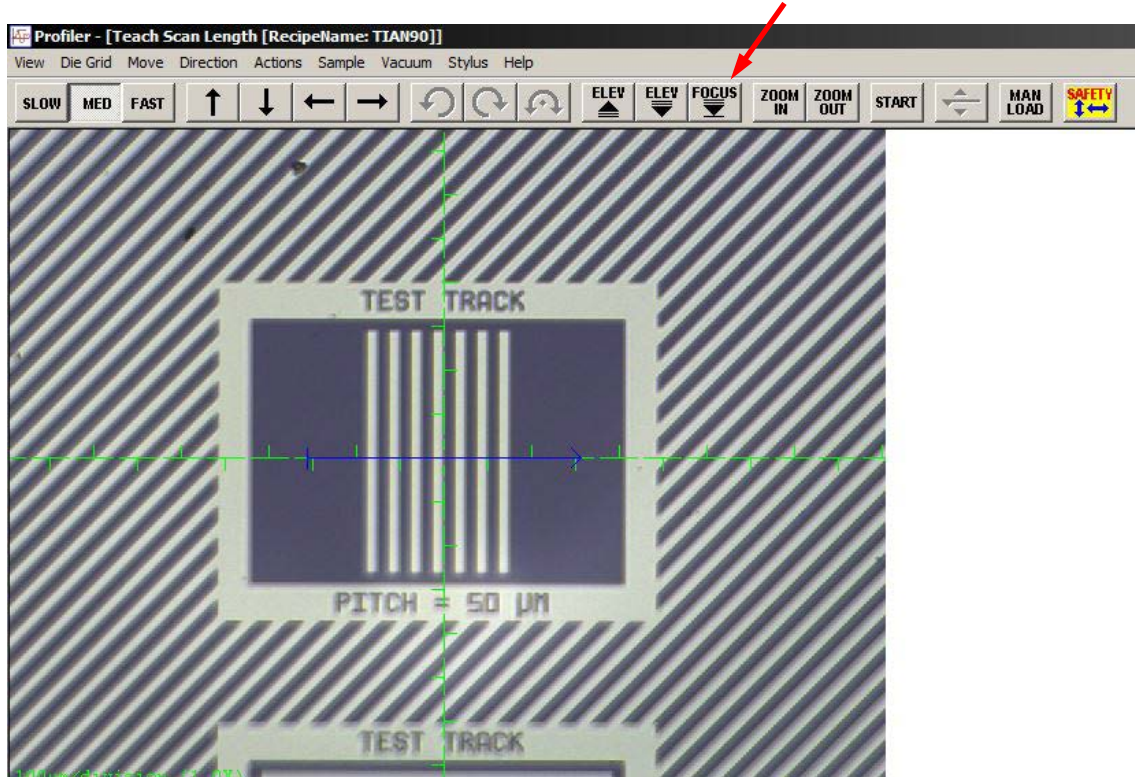
1. You can cover the unused vacuum ports with small pieces of silicon or glass.
2. You can mount your small sample to a larger carrier wafer that covers all the vacuum ports

- o Close the door
- o Press **MAN LOAD** again to move the chuck into the measurement position.



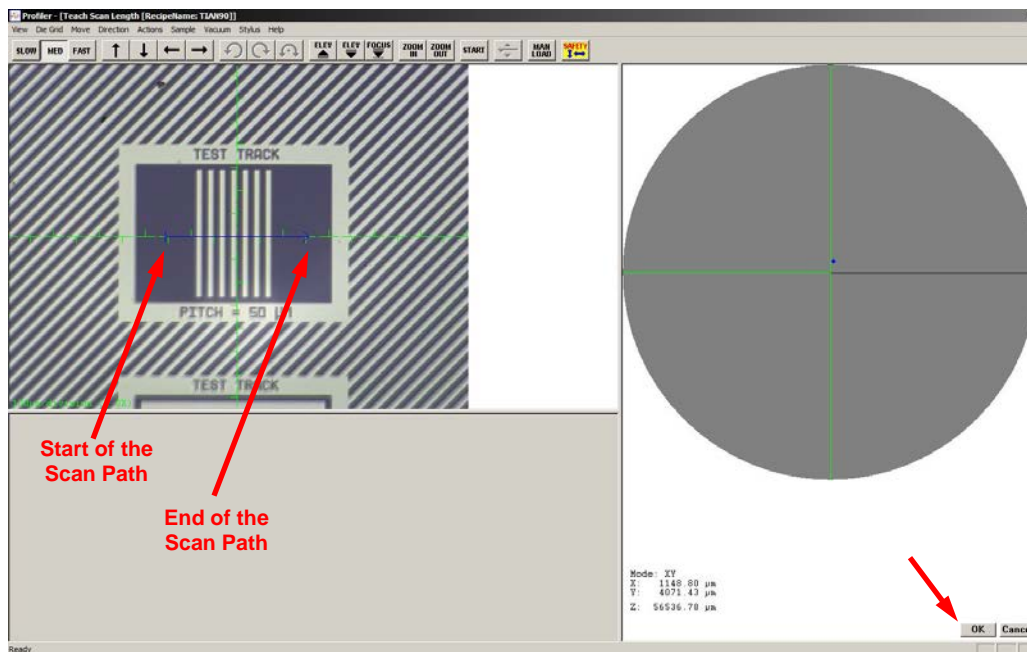
- 4.6 Double check to make sure the sample is in the center of the stage.
- 4.7 Press **FOCUS**
This will move the stylus head down to the surface of the sample.

Note: Please make sure you have a sample in the center of the stage prior to lowering the stylus head with the focus button. If there is no sample, damage to the stylus will occur.

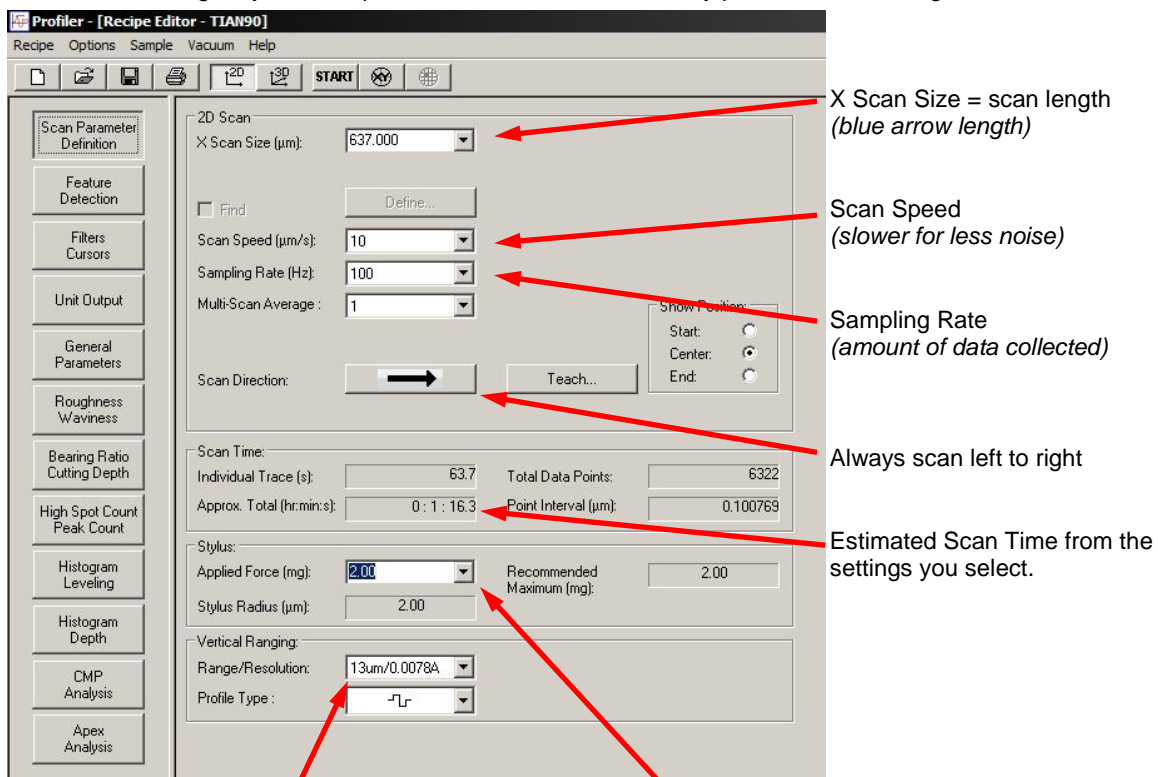


- 4.8 Find your feature of interest:
 - o You may click on the camera screen to drive the field of view, or you may press the arrow keys in the top menu bar to pan around.

- 4.9 Once your feature is in view, click and drag (from **left to right**) to define your scan path.
 - o This shows up as a blue arrow.
 - o Press OK when you are satisfied.



- 4.10 Review and configure your scan parameters. There are a few key parameters to change:



X Scan Size = scan length
(blue arrow length)

Scan Speed
(slower for less noise)

Sampling Rate
(amount of data collected)

Always scan left to right

Estimated Scan Time from the
settings you select.

Ensure the step height maximum
of your feature of interest
is within this range.

Use 1 mg force for soft metals or polymers.
Use 2 mg force for metals and semiconductors.

Additional Scan tips:

- If you scan too fast, you may miss out on some roughness data, and might overshoot some step heights on the trailing edge of travel.
- For short scans, 2mm and smaller, the general rule of thumb is to keep the scan time between 5 and 10 seconds.
- The General Parameters tab, and the Roughness Waviness tab may be used to determine slope, area, roughness, and other parameters from your scan analysis.
- If you need to adjust the scan path, you may press the XY button.

4.11 Once all your scanning parameters are set, press the **START** button in the top menu bar.

5. Analyze the scan

After the scan completes, your data will display in the Analysis Window

5.1 Leveling your scan.

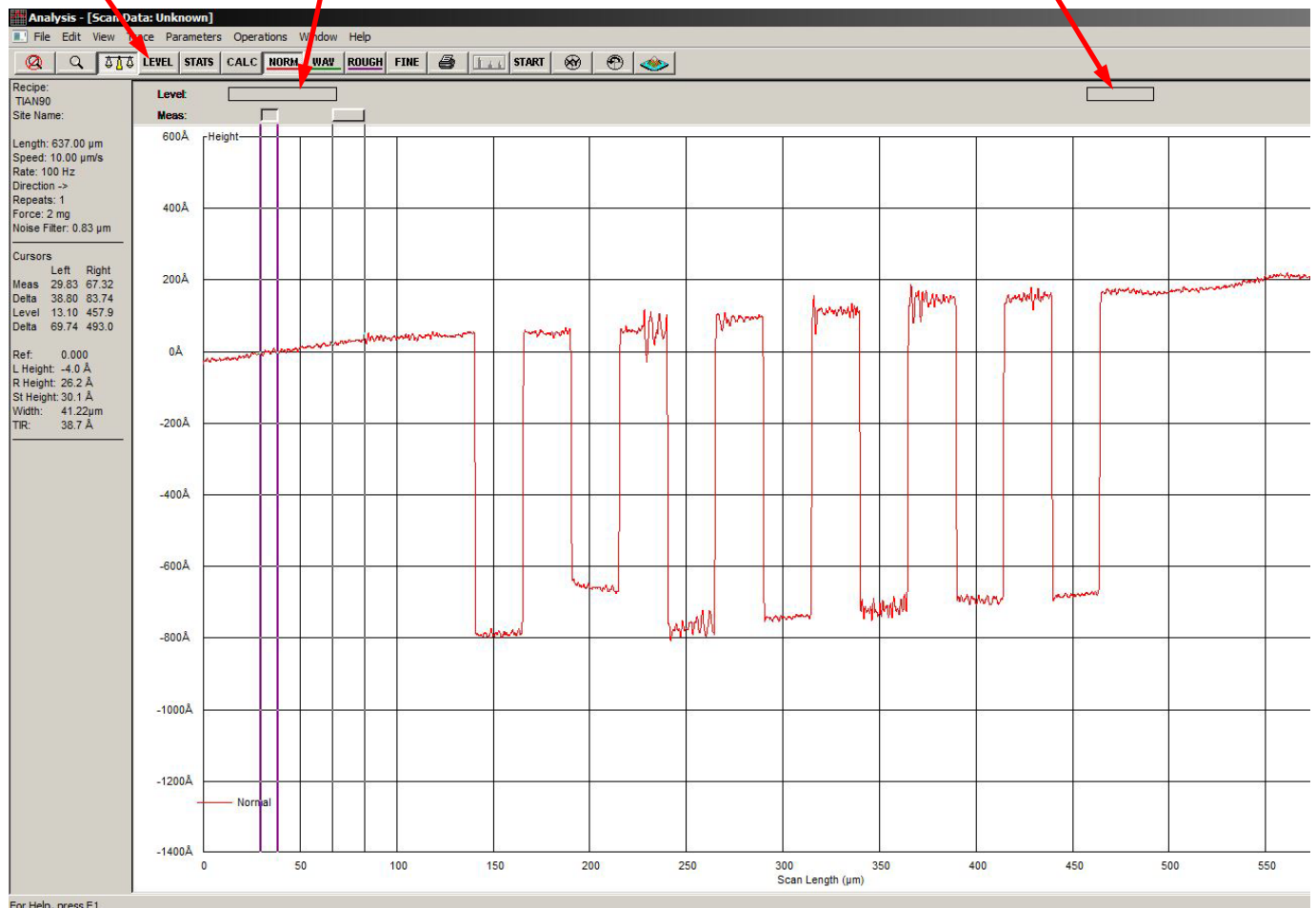
If your data is not level, you may level it and define a flat plane in the software

- Press the Level button.
- Drag, pull, and manipulate the left and right Level cursors to define flat and even planes.
- Press Level button again to flatten the selected planes.

Level Button

Left Level cursor

Right Level cursor



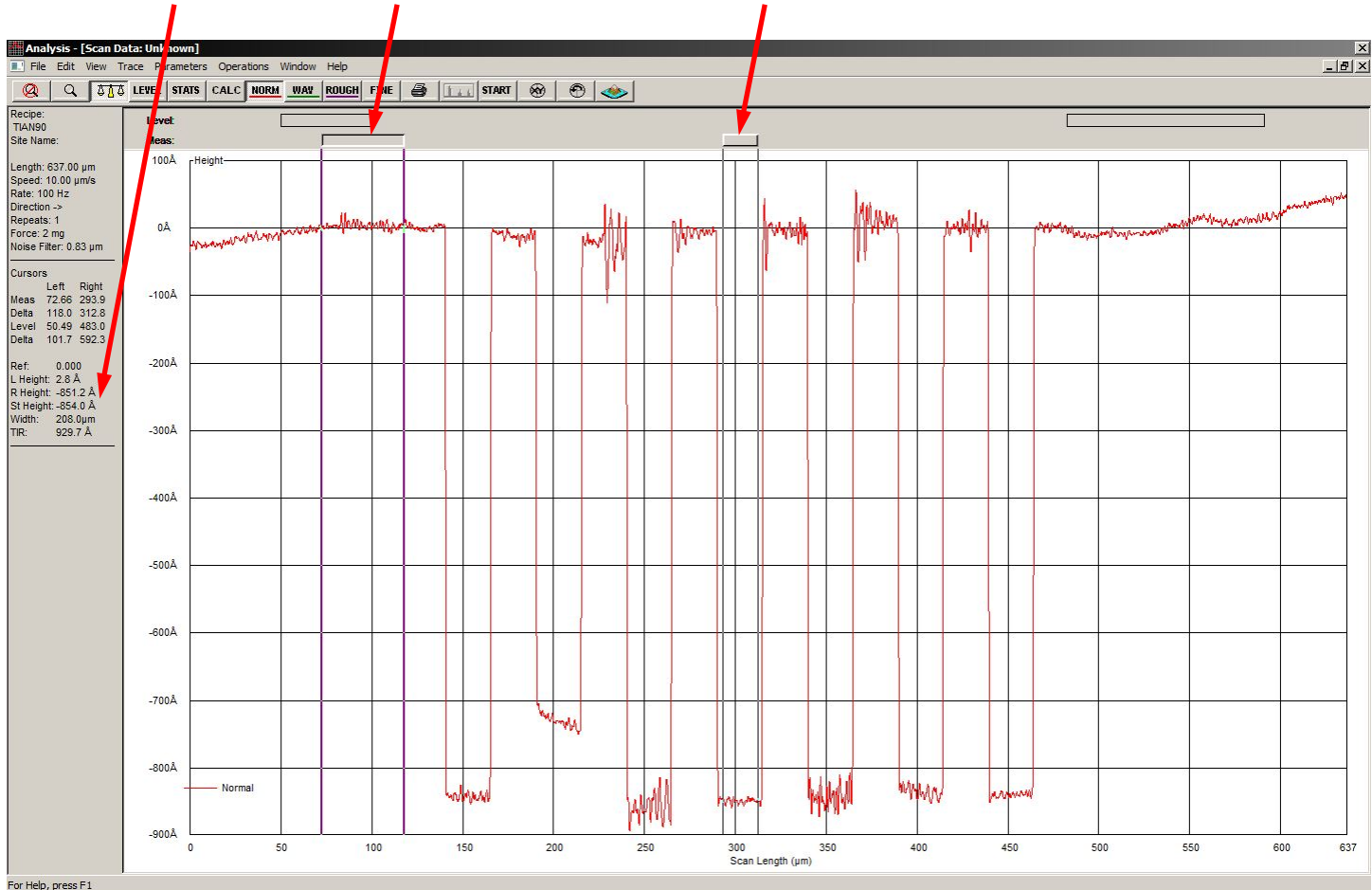
5.2 Measuring your step height

- o Drag, pull, and manipulate the left and right Measure cursors to define the differential step
- o Read the difference in height between the two cursors with the St Height value at the left

St Height Value

Left Measure cursor

Right Measure cursor



5.3 Further Analysis

- o Press Stats button on the top menu bar to view General, Roughness, and Waviness parameters selected from the recipe editor. Press Calc to recalculate these for a different selection.
- o Press the Apex Analysis button at the far left of the menu bar to use this powerful software. From there, you may save your measurement as a plaintext or jpg/png file.

5.4 To measure another area different from the first:

Press the XY button in the menu bar
 Reselect your scan path with your blue area. Press OK in the bottom right corner
 Confirm all your scan settings.

6. Unload Your Sample

- 6.1 Press the **MAN LOAD** button
This will raise the stylus head, and move the stage towards you.
- 6.2 Open the door once the stage has stopped moving.
- 6.3 Turn off the vacuum switch, and carefully remove your sample from the stage.
- 6.4 Close the door.
- 6.5 Press the **MAN LOAD** button again to return the stage to its home position.
- 6.6 Exit out of the software at the end of your session.
- 6.7 Disable use of the machine within i-Labs.

7. REVISION RECORD

Reason for Revision	Date of Revision	Person Responsible
Initial Release	January 2018	Sean Rinehart
Significant revisions and changes	November 9, 2018	Dan Hosler