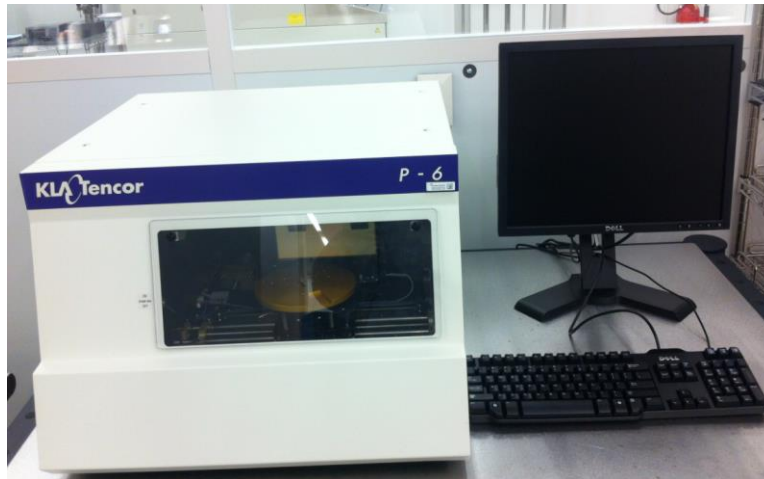


Operation Instructions for the KLA Tencor P-6 Surface Profilometer

**University of Notre Dame
Department of Electrical Engineering**



General Precautions

Contacts

For problems, clarification of procedures, or general information pertaining to this machine please contact lab staff at staff-ndnf-list@nd.edu.

**In Case of Emergency, Please Contact Notre Dame Security at
911**

Description:

The P-6 offers complete high resolution 2D analysis of surface topography in a versatile platform. The system is capable of scanning up to 150 mm wafers. The process recipes allow users to select one of three vertical ranges that best match the profile to be measured. The system is equipped with a 2 μm radii tip for measurement applications. The P-6 is routinely calibrated onsite with 4700, 900 and 160 Angstrom VLSI reference standard to ensure system performance. The system has adjustable scan speeds and stylus force settings which allow for flexibility with any surface to be measured.

The P-6 can be used to measure film stress (tensile or compressive) by measuring changes in the radius of curvature before and after a film has been deposited. The system requires a special chuck to perform these measurements. If interested please contact lab staff as this is not normally covered in the P-6 training.

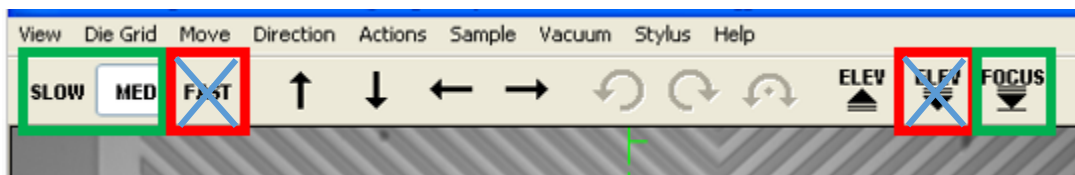
CAUTION:

1 - The P-6 is a contact measurement system that can be easily damaged. The stylus (tip) and sensor are extremely delicate and can be damaged easily.

Users MUST always know the location of the tip prior to moving the stage.

2 – **NEVER use the Elevator down Button** – ONLY Use the Auto FOCUS. Elevator down will move the elevator down this complete disregard to the location of the stylus. Damage WILL result.

3 – **NEVER use FAST for stage speed**, Medium is fast enough



4 – The software does not like to multitask - Do not use multiple programs while in operation as it causes the system to lockup. If scanning – let the system scan. Please practice patience when changing between screens. Allow the system to complete its action before changing services/software.

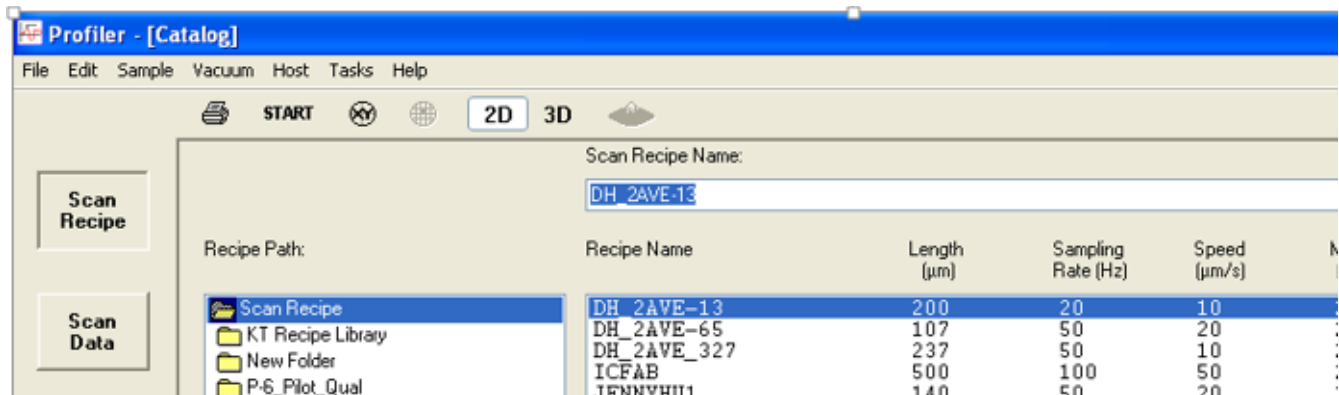
5 – Always Scan From HIGH To LOW to prevent shock to the stylus when possible.

6 – **Scan Speeds ($\mu\text{m}/\text{sec}$) should never exceed 20 $\mu\text{m}/\text{sec}$** unless measuring wafers for film stress measurements.

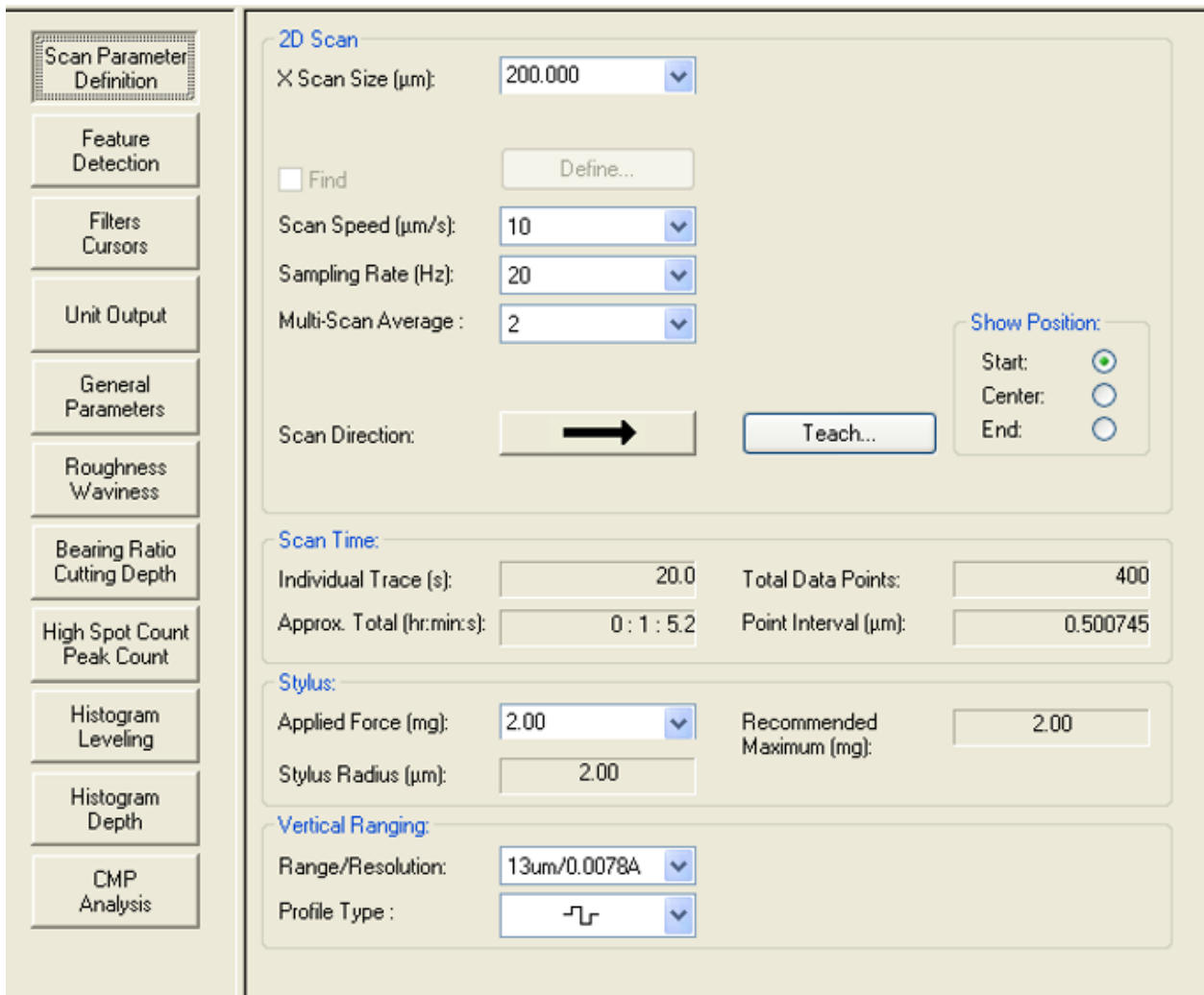
7 – Bumping the table or platform that the system is located on can transfer noise to the system. This can cause spikes in the data collected. While the system is scanning – please keep hands/feet/chairs off of the system and table.

Recipe Configuration:

1. X out of the XY screen until the scan recipe catalogue is shown

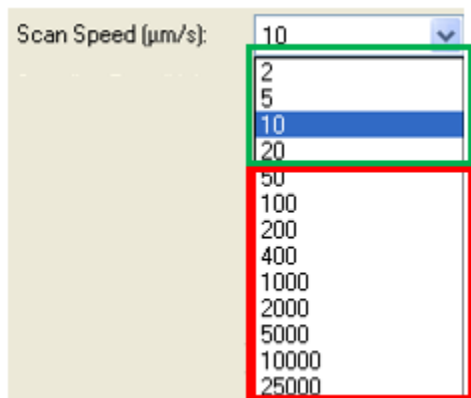


2. Select the recipe you wish to edit – this will bring the user to the Scan Definition Parameters tab



3. Adjust the Scan parameters as needed

- a. X-Scan Speed = Length of Scan (um)
 - i. May be changed on the XY screen
- b. Scan Speed
 - i. DO NOT EXCEED 20 um/sec
 - ii. Shock to the tip can result in damage



- iii.
- c. Sampling Rate = Number of data points per second
 - i. This will affect the point interval between data points as shown in the Point Interval cell.

Example: a 200 um scan at 10 um/sec scan speed at 5 Hz will give a point every 2 um

Total Data Points:	101
Point Interval (um):	1.999878

While the same 200 um scan at 10 um/sec scan speed with 20 Hz will give a point every 0.5 um

Total Data Points:	400
Point Interval (um):	0.500745

- d. Multi-Scan Average = Number of scans to be averaged
- e. Scan Direction – Left to Right or Right to Left
 - i. Always Scan from HIGH to Low when possible
- f. Applied Force = Downward force applied to the tip
 - i. Do not exceed 2 mg unless necessary
- g. Vertical Range/Resolution = Half Distance above/below that the system can measure

Vertical Ranging:

Range/Resolution: 13um/0.0078A

Profile Type :

327um/0.1953A
65um/0.0391A
13um/0.0078A

- i. 13 um setting – 6.5 um above/below contact point
- ii. 65 um setting – 32 um above/below contact point
- iii. 327 um setting – 163 um above/below contact point
- h. If Line Roughness calculations are desired – Select the “Roughness Waviness” tab shown below

Scan Parameter Definition

Feature Detection

Filters Cursors

Unit Output

General Parameters

Roughness Waviness

Bearing Ratio Cutting Depth

High Spot Count Peak Count

Histogram Leveling

Histogram Depth

CMP Analysis

2D Roughness Parameters

☐ Average (Ra)

☐ Maximum Ra (MaxRa)

☐ RMS (Rq)

☐ Peak (Rp)

☐ Valley (Rv)

☐ Peak/Valley (Rt)

☐ Height 10pt (R5z)

☐ Height 6pt (R3z)

☐ Mean Ht Sampling Lengths (Rz)

No. of Sampling Lengths: 5

☐ Max Ht Sampling Length (Rmax)

☐ Roughness Height (Rh)

☐ Mean Peak Height (Rpm)

☐ RMS Slope (Dq)

☐ RMS Wavelength (Lq)

☐ Std. Dev. Height (SD)

2D Waviness Parameters

☐ Average (Wa)

☐ RMS (Wq)

☐ Peak (Wp)

☐ Valley (Wv)

☐ Peak/Valley (Wt)

☐ Waviness Height (Wh)

Select All Roughness

Remove All Roughness

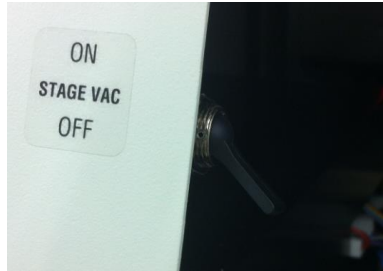
Select All Waviness

Remove All Waviness

- i. Select the roughness/waviness parameters
- j. Return to the “Scan Parameter Definition” tab and select “Recipe” then “Save As” to save the recipe. Coral ids must be used to identify the scan recipe.

Operation Instructions:

1. Enable the system in Coral
2. Open Door and Load sample onto center of stage
3. Turn Vacuum on to secure sample



4. Close Door
5. Select "Man Load" to position the stage centrally under the microscope/stylus

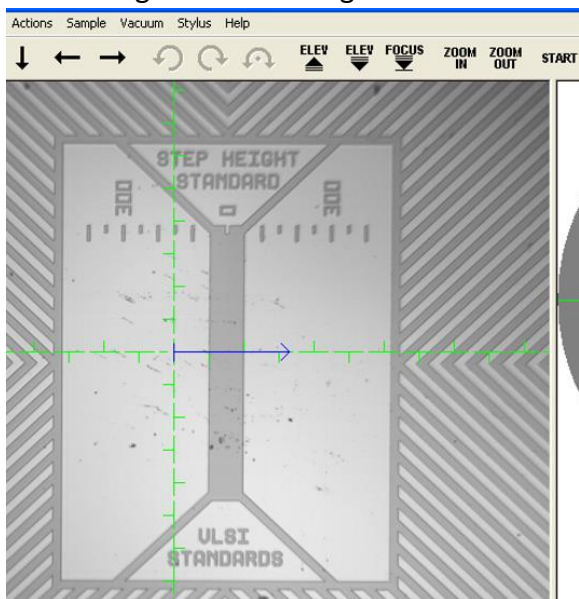


- a.
6. Select "Focus" to lower the elevator

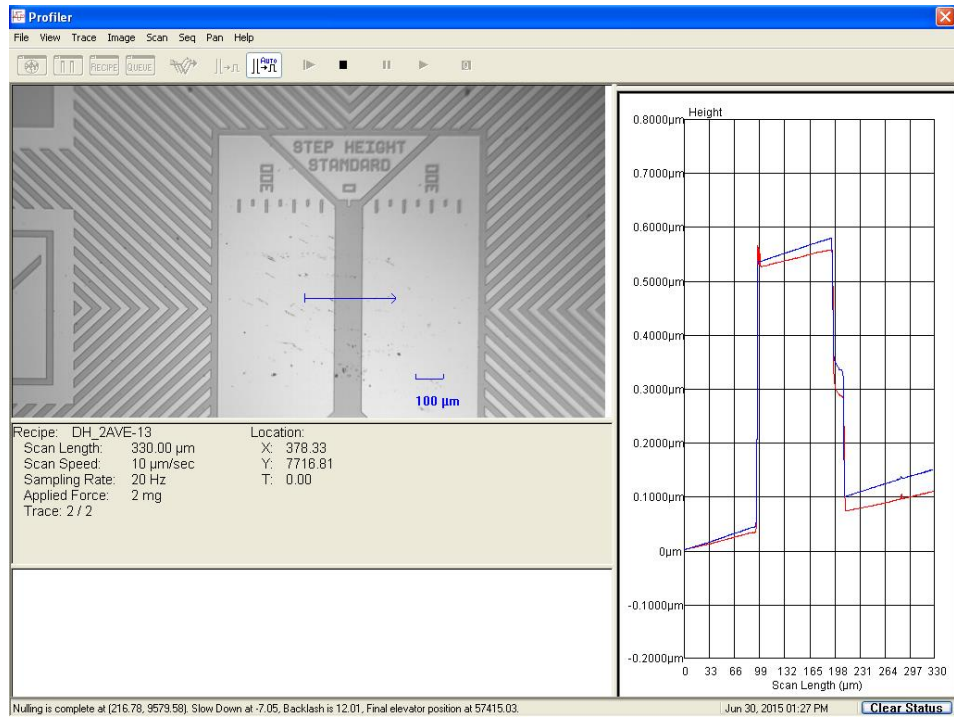


- a.
 - b. NEVER USE THE ELEVATOR DOWN BUTTON
7. Verify Stylus has clearance before moving the stage
 8. Move the stage to the desired measurement location

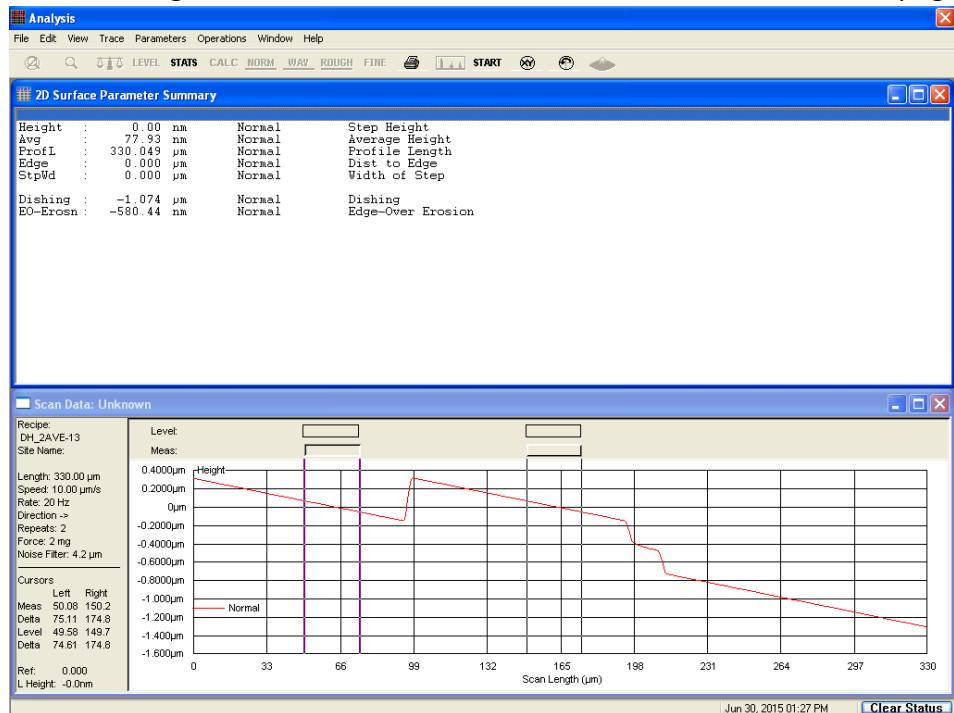
- c. Scan length can be changed on the screen



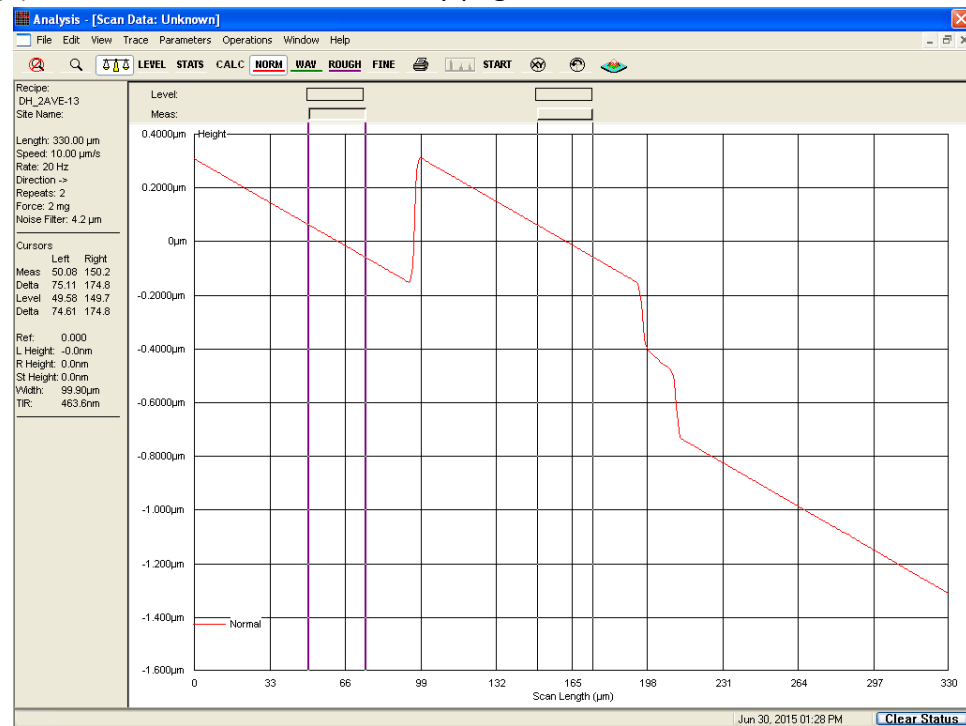
9. Select "Start" to start scanning
10. Scan screen will show data as it is being collected



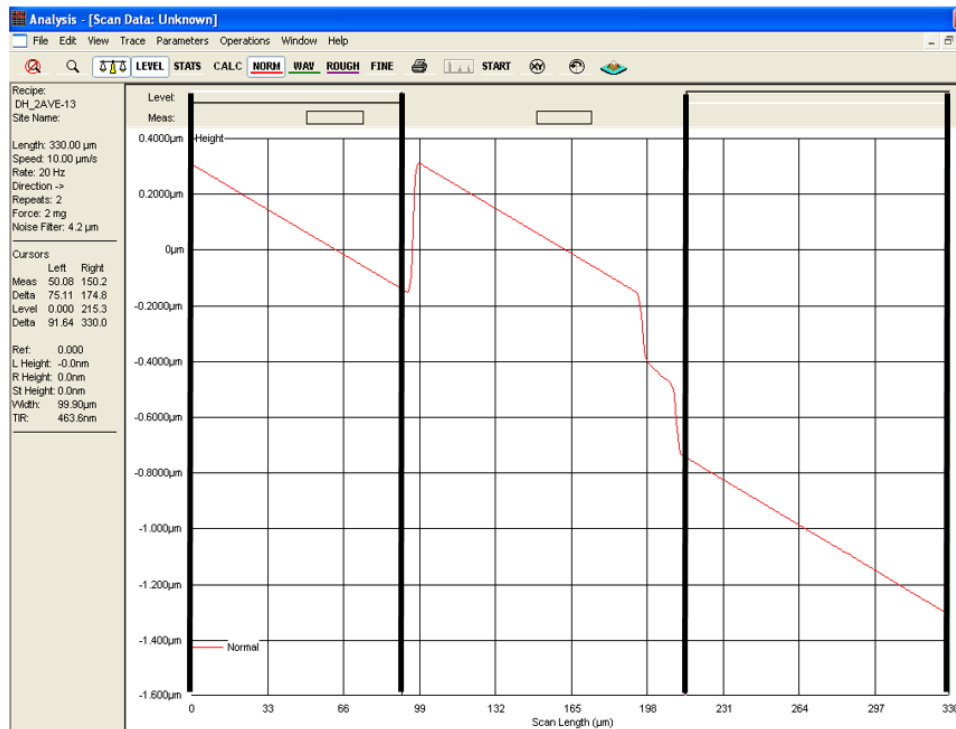
11. Once complete
 - a. Scan Data tab will be displayed
 - b. 2D Surface Parameter Summary will be displayed
 - i. If roughness/waviness data was selected – it will show in this page



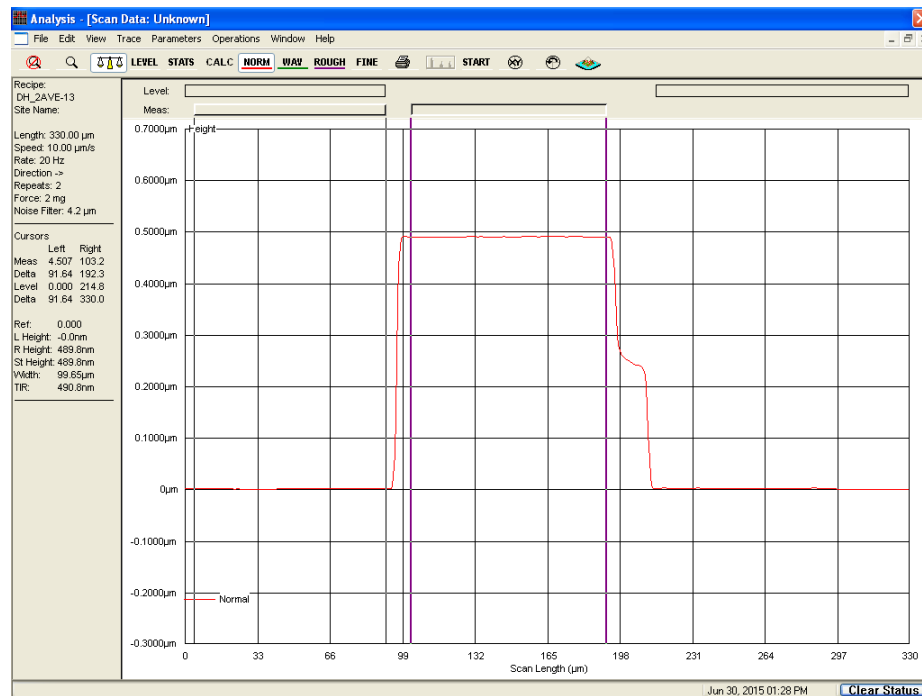
12. Close (X) 2D Surface Parameter Summary page to view full scan data



13. Select "Level" tab and adjust top Level Bars to encompass desired data to level
 - a. Widths are adjustable
 - b. Select data which is known to be at same height on the sample

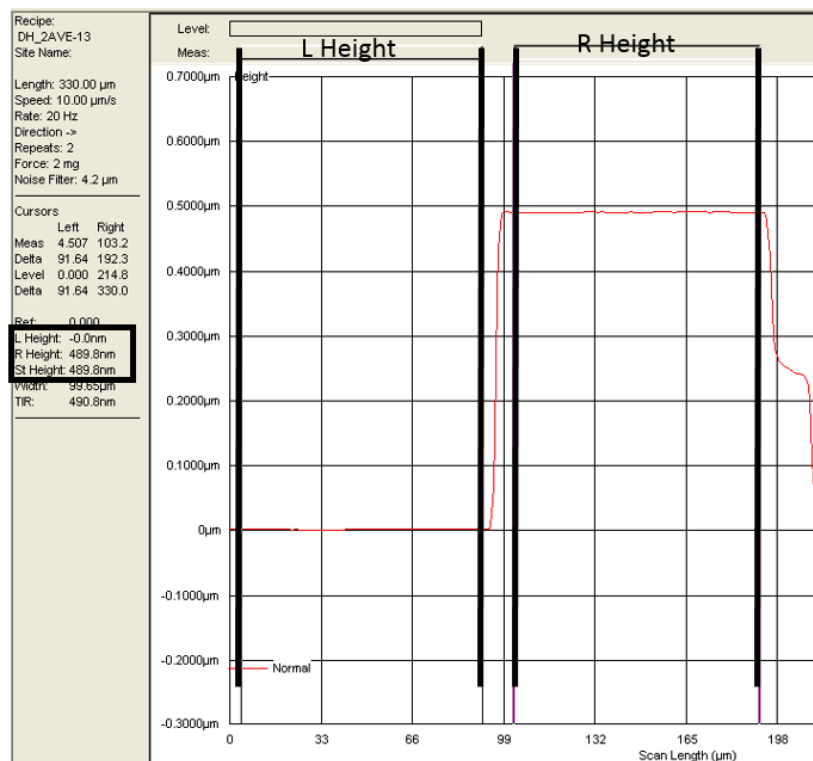


14. Select “Level” once again to have the system level the scan data based on the selected level Points. Corrected data will now be shown.

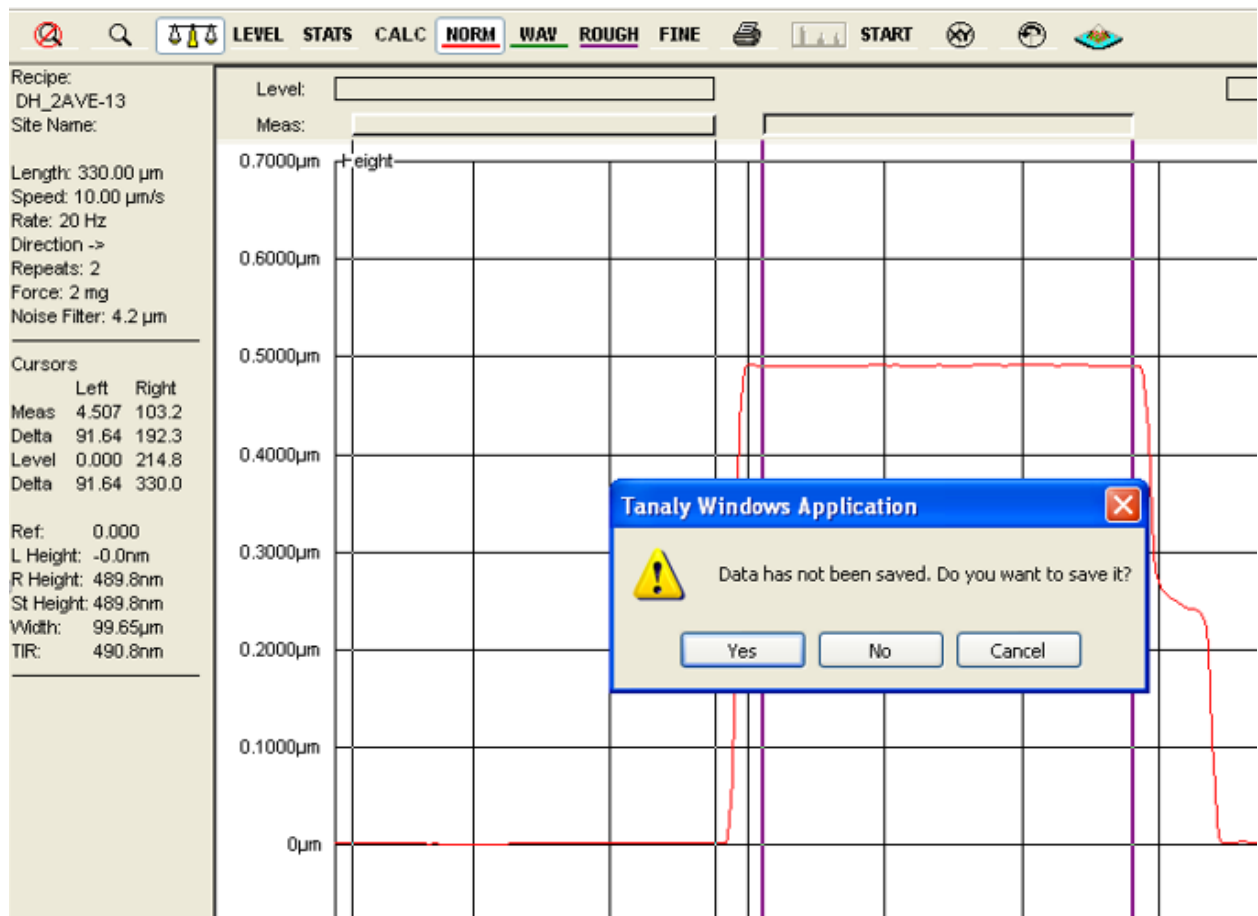


15. Adjust “Meas” tab width and location to show average for all data in range.

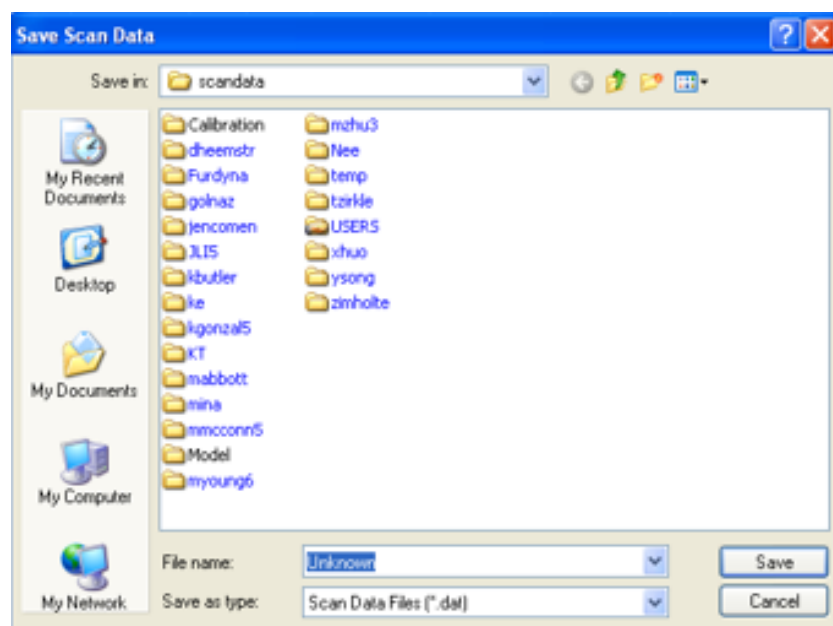
- Left and Right measurement tabs will show
- Step height will also be displayed



16. Select the “XY” button to measure another location



17. Save data if needed. System data must be saved in the “users” folder in the “scandata” file location and then exported to the desktop.



- a. See Exporting Data Section for additional details
- 18. The system will then ask if you want to save the modified recipe.
 - a. This will only change the Length of the scan if it was changed in step 8(c)

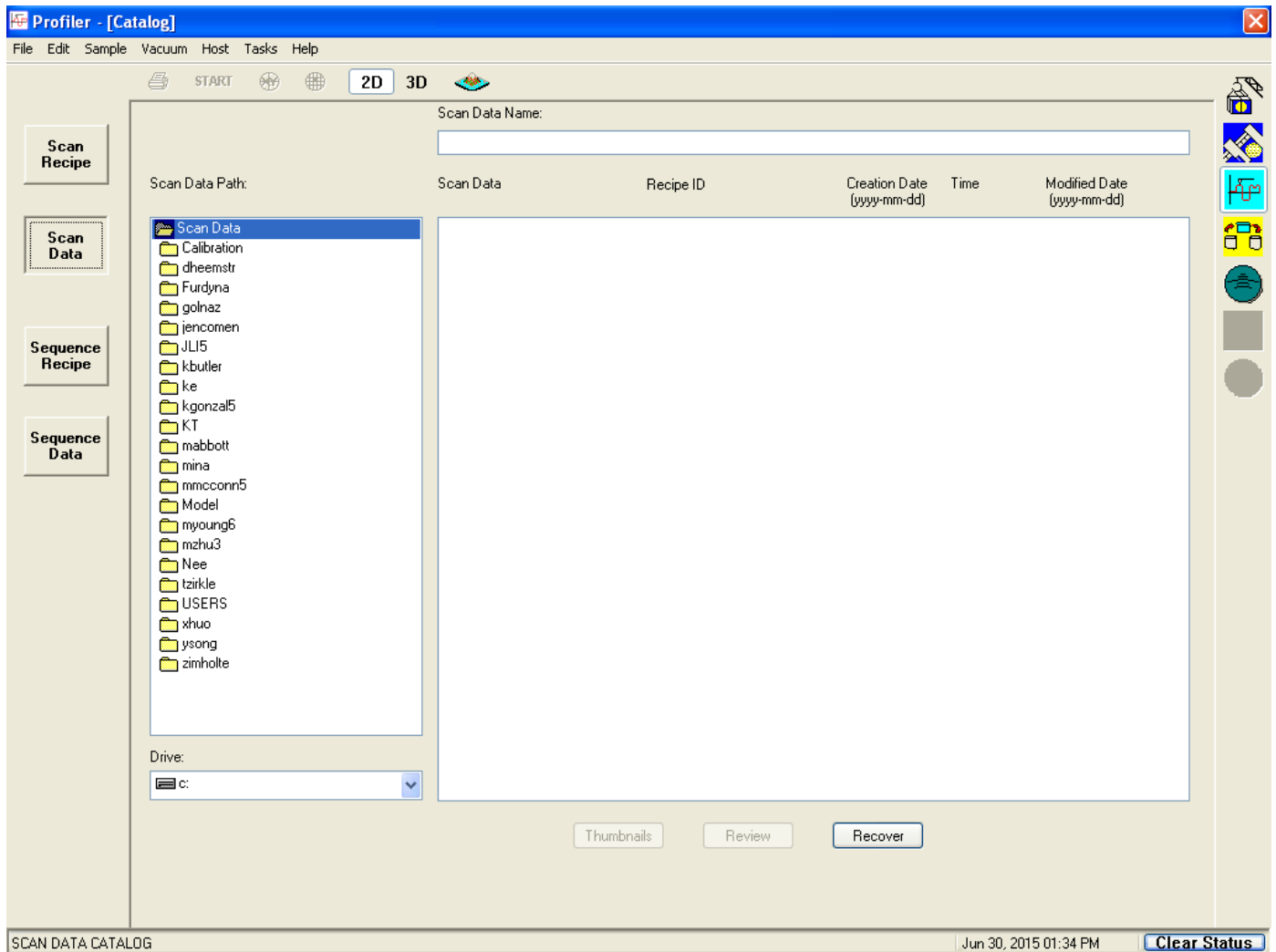


- 19. When measurements are completed – Select the “LOAD MAN” button again
 - a. This will raise the elevator
 - b. Then return the stage to the Load Position nearest to the door
- 20. Open Door – Turn Off Vacuum – Remove Sample and Close the Door
- 21. Disable system in CORAL

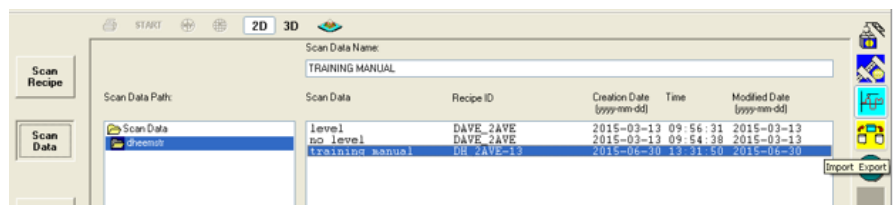
Exporting Data:

Users can export data that has been saved in the “scandata” folder (.dat data type).

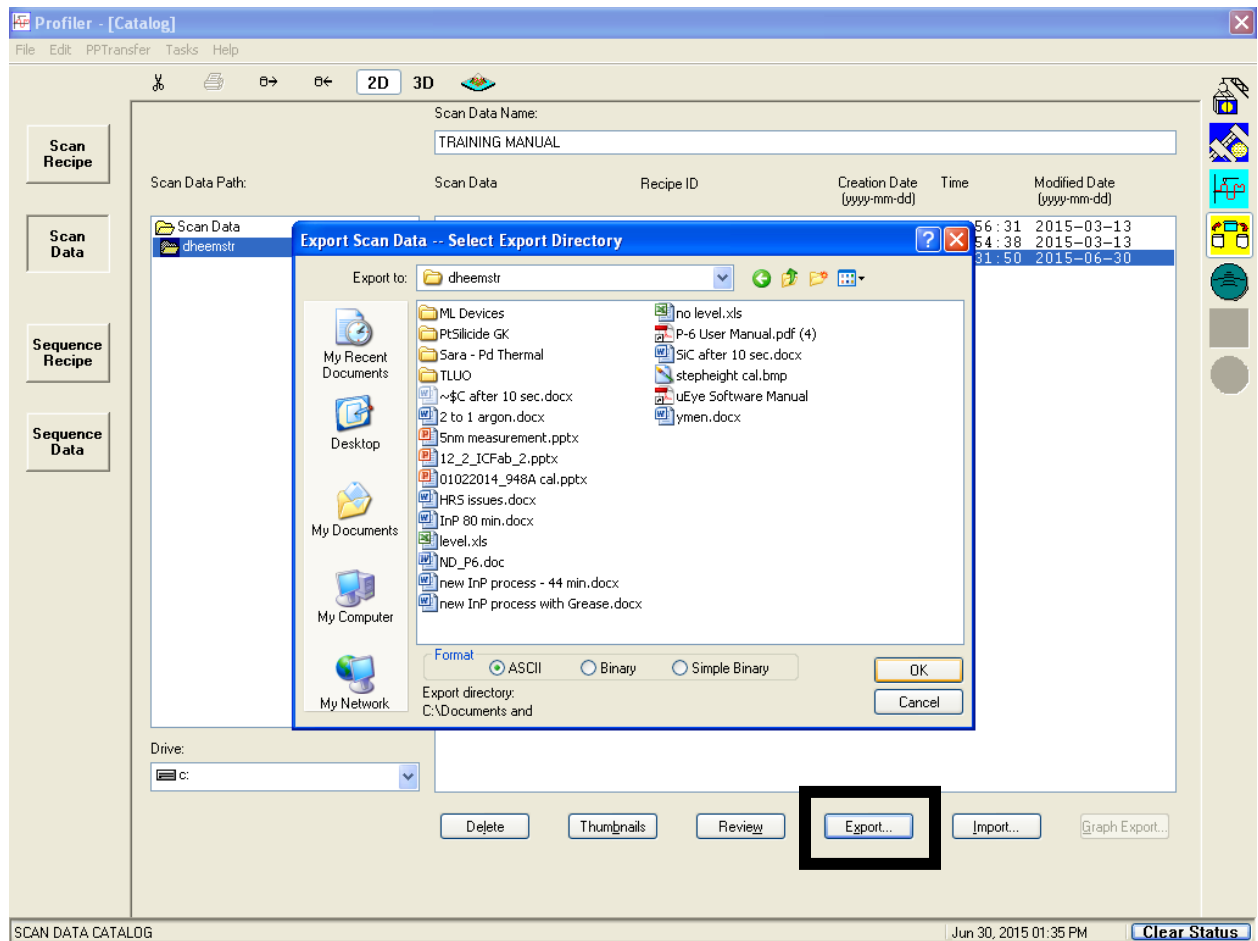
1. Close (X) windows until reaching the Scan Recipe List
2. Select The “Scan Data” tab on the left
3. Find the user specific file



4. Select the “Import Export” tab on the right side



5. Select the File to Export and then select “Export” at the bottom



6. Save the Exported file as ASCII in the Desktop → Users → User Specific Folder

7. Data can then be saved (USB) and opened in Excel using Tab Delimited