

Veeco Dektak 6M Profilometer



System Ranges/Resolutions

Range (Å)	Resolution (Å)
50 (5nm) to 65K	1
0.5K to 655K	10
2K to 2620K	40
8K to 10000K (1mm)	160

Maximum sample thickness: 31.75mm

Scan range: 50 to 30,000um (30mm)

Scan time: 3 to 100 seconds

Data points: 300 pts/sec

Note: This unit uses a 12.5 micron diamond stylus, which will scratch softer surfaces. The stylus is also very expensive, please be careful.

Under no circumstances should any user attempt any repairs or modifications to the machine. Please see a staff member if you have any questions, or desire any special processing not covered in these instructions.

1. Starting up:

- A. Log on to the instrument using the equipment log on computer
- B. Sign into the Dektak computer as user "Dektak6M", using the password listed on the computer monitor.
- C. Click on the Dektak32.exe icon to start the program. Wait for 1 minute while the instrument is initialized.

2. Setting up scan parameters:

- A. Go to "**Window**" > "**Scan Routines**". Click on the "**Scan Parameters**" box to change the scan variables.


The screenshot shows the 'Scan Parameters' dialog box with the following settings:

- ID: 0
- Length: 2000 μm
- Duration: 13 seconds
- Sample: 3900 points
- Resolution: 0.513 $\mu\text{m}/\text{sample}$
- Stylus Force: 15 mg
- Measurement Range: 1mm
- Profile: Hills&Valleys (selected)


- B. Variables depend on your sample and preferences:

1. **ID**: Arbitrary number used to identify your sample, if desired.
2. **Length**: Scan length desired, in microns (50-30,000 microns). Longer baseline measurements are usually more accurate.
3. **Duration**: Time taken to run the scan (3-100 s). Values of 10-30 seconds are typical, and longer durations lead to increased accuracy in measurements.

4. **Sample:** Number of data points taken per scan (300 points per second duration).
5. **Resolution:** Dependent upon Length and Duration.
6. **Stylus Force:** Force exerted by stylus (1-15 mg). Photoresist measurements should be taken with a stylus force of 1- 3 mg to avoid damaging the photoresist.
7. **Measurement Range:** Describes the vertical resolution of the sample. (650 nm to 1 mm) 655 kÅ is typical. Higher values are appropriate for very deep or rough structures.
8. **Profile:** Select “Hills”, “Valleys”, or “Hills and Valleys” depending on the topography of your sample. Select “Hills and Valleys” if you are unsure.

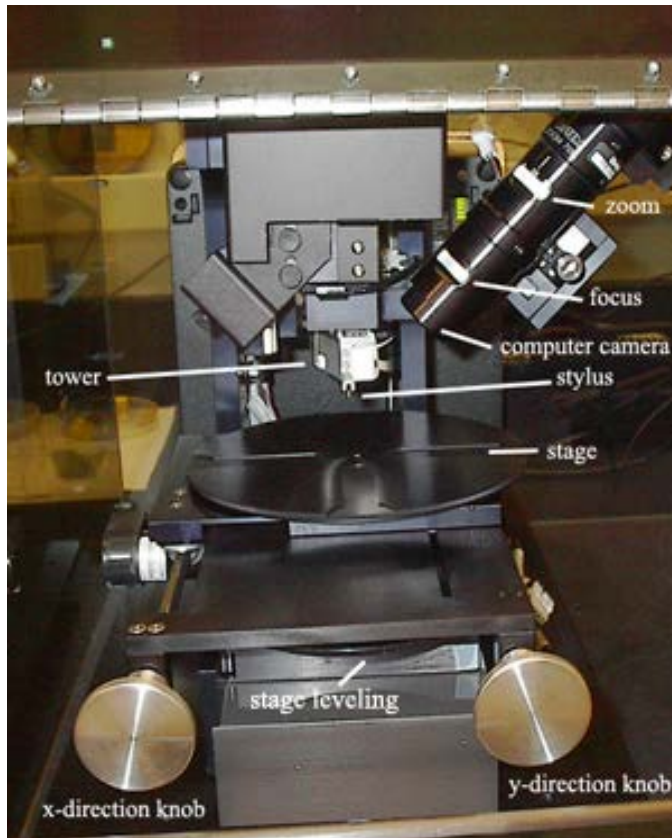
- C. When the variables have been set, click OK, then the “**Sample Positioning**”  button.

3. Loading a sample:

- A. Click on “**Window**” → “**Sample Positioning**” to open the control screen, or use the sample positioning button on the left side of the screen.
- B. Verify that the tower is in the “up” position before loading your sample, and whenever you are removing or touching the sample. The stylus needle should be about 1 inch from the stage. If not, press the “**Tower Up**”  button.
- C. Load your sample onto the stage roughly in position under the stylus (you will be able to see your sample in the monitor to fine tune the position later).

NOTE: The sample should be arranged such that a front-to-back scan yields the desired information. The image on the computer monitor is rotated 90 degrees counter-clockwise relative to the view as you face the instrument.

Profilometer Controls





4. Taking a measurement:

- A. When your sample has been roughly positioned, click the **“Tower Down”**



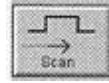
button. The stylus will slowly move towards your sample, touch the sample briefly, and rise back up a small (~1mm) amount. If the stylus does not retract, click “Release stylus”.


- B. A video image of the needle and stage should be visible. If not, adjust the lighting using the **“Increase Light Intensity”**  button or **“Decrease Light Intensity”**  (shaded) button.

- C. Zoom and focus can be adjusted using the lower and upper focus rings on the microscope, respectively.

- D. The green crosshairs show approximately where the stylus will touch down on the sample. Adjust the stage using the knobs in front of the stage and/or rotating the top of the stage until the sample is located under the crosshairs.

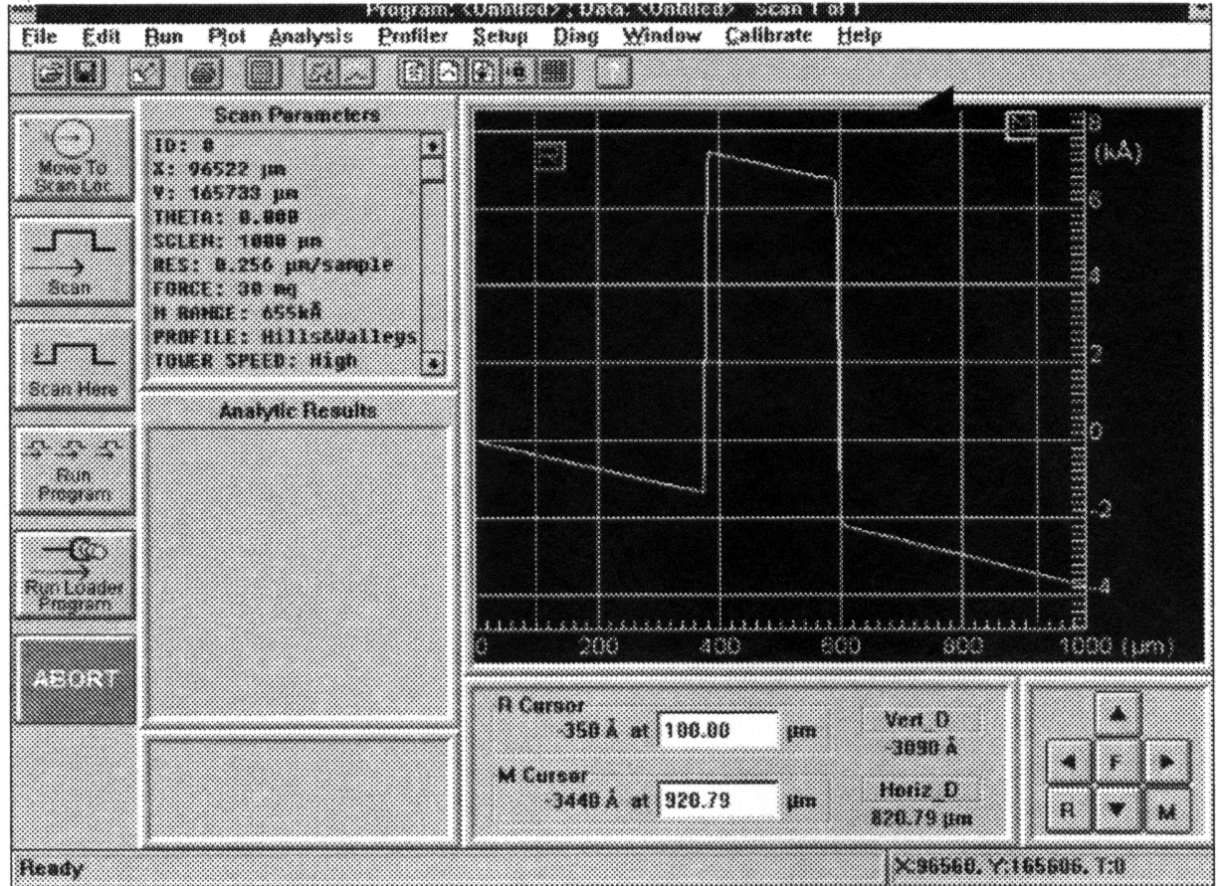
(The scan moves from left to right on the screen, front to back on the sample from the perspective of the user.)




- E. When the sample is in position, lower the lid and click the “**Scan**” button.
- F. If there is a problem with the scan, or the stylus is about to run off of the sample, click the red “**ABORT**” button on the left side of the screen. If after aborting the stylus is touching the sample, press the “**Stylus Up**”  button.
- G. The scan will display in real-time, then it will automatically redraw/rescale it and trace analysis screen will come up.
- H. To manually level the stage (when the plot goes diagonally off the screen):
 1. Turn the large horizontal black dial at the front of the stage (between the knobs) as you scan a flat portion of your sample.
 2. Try to level the trace, turn Clockwise to raise the trace, turn Counter-Clockwise to lower the trace.
Note: moving the wheel 1cm will raise the trace about 3Å per micron traveled—i.e., for a 2000 micron trace, moving the wheel by 1cm will raise or lower the trace by about 0.6 microns.

5. Data trace adjustments:

- A. The stylus trace will appear in the dataplot window, and parameters can be adjusted after about 30 seconds (while the stylus returns to its original position).



- B. The cursors labeled “R” and “M” refer to Reference and Measurement, respectively. The sampling width of the cursors can be adjusted by clicking “Plot” → “Band Width”. The values in this window are in microns.
- C. To “Level” the graph to your substrate:
1. Select the “R” cursor (lower right panel), move it with the arrows keys, click on the “F” button to switch to fine tuning mode; or enter a um value directly in the display box (lower center panel) to select a point on your reference surface.
 2. Select the “M” cursor, move it to the other side of your feature on the same reference surface.
 3. Click the “Plot Level”  button.

- D. To “Zero” the graph to your substrate:
 1. Select the “**R**” cursor, move it with the arrow keys to your reference surface.
 2. Go to “**Plot**” > “**Zero**” to redraw the graph.

- E. To “Zoom In” on a portion of the graph:
 1. Click on the graph and drag a box around the area to be magnified.
 2. Go to “**Plot**” > “**Replot**” to redraw the graph.
 3. To “Zoom Out” to the original settings, click on “**Plot**” > “**Replot**” again.

6. Analytic data functions:

- A. The height of a step can be determined by moving ‘**R**’ and ‘**M**’ to the desired locations and looking at the vertical distance between them (**Vert_D** at the bottom of the screen). A more accurate determination can be made by averaging over a section at the top and bottom of a step. To do this:
 - a. Click “**Analysis**” → “**Analytical Functions**”.
 - b. In the menu, select the box labeled “**ASH**” (Average Step Height)
 - c. Choose the length of the trace you wish to average over, for “**R**” and “**M**”, in the pop-up box, and click OK.
 - d. Select the “**Measure**” box at the bottom of the menu, and click “**Compute**” to calculate the step height. “**R**” and “**M**” can be further adjusted if desired.
 - e. Note: Each time you “Compute”, it will add the new value(s) to the “Analytic Results” box.


- B. Other measurement features:
 1. Area under the curve between the “**R**” and “**M**” cursors with respect to the zero grid line.
 - a. Position the “**R**” and “**M**” cursors.
 - b. Go to “**Analysis**” → “**Analytical Functions**” select the box labeled “**Area**” from the menu, and click “**Compute**”.

 2. “**R_a**” (Average Roughness) of the surface between the “**R**” and “**M**” cursors with respect to a mean line drawn through the surface trace.
 - a. Position the “**R**” and “**M**” cursors.
 - b. Go to “**Analysis**” → “**Analytical Functions**”, select the box labeled “**R_a**” from the menu, and click “**Compute**”.



 3. “**AvgHt**” (Average Height) of the surface between the “**R**” and “**M**” cursors with respect to the zero grid line.
 - a. Position the “**R**” and “**M**” cursors.
 - b. Go to “**Analysis**” → “**Analytical Functions**”, select the box labeled “**AvgHt**” from the menu, and click “**Compute**”.

4. Other measurements can be made from the Analytical Functions menu. See the “Help” menu for detailed instructions. (Relevant Help sections that may be useful are listed under the “Index” tab: “Roughness Parameters,” “Waviness Parameters,” “Height Parameters,” “Geometry Parameters.”)


7. Exporting Data and/or Photos:

- A. Click **File**→**Export** to save the settings and data to a *.txt file. This file can then be opened in Excel for further processing.
- B. Click on the “**Sample Positioning**”  button, click “**File**” > “**Save Video Image**” to save the image as a *.jpg, *.bmp, *.tif, or *.tga image file.
- C. Take a screen shot: Ctrl+Print Screen, then paste the copied screen shot into MS Paint.

8. Taking another measurement:

- A. To return to the sample to make another measurement or remove the sample, click on the “**Sample Positioning**”  button. If the wafer needs to be moved, click the “**Stylus Up**”  button and wait for the stylus to move completely upwards.

9. Removing the sample:

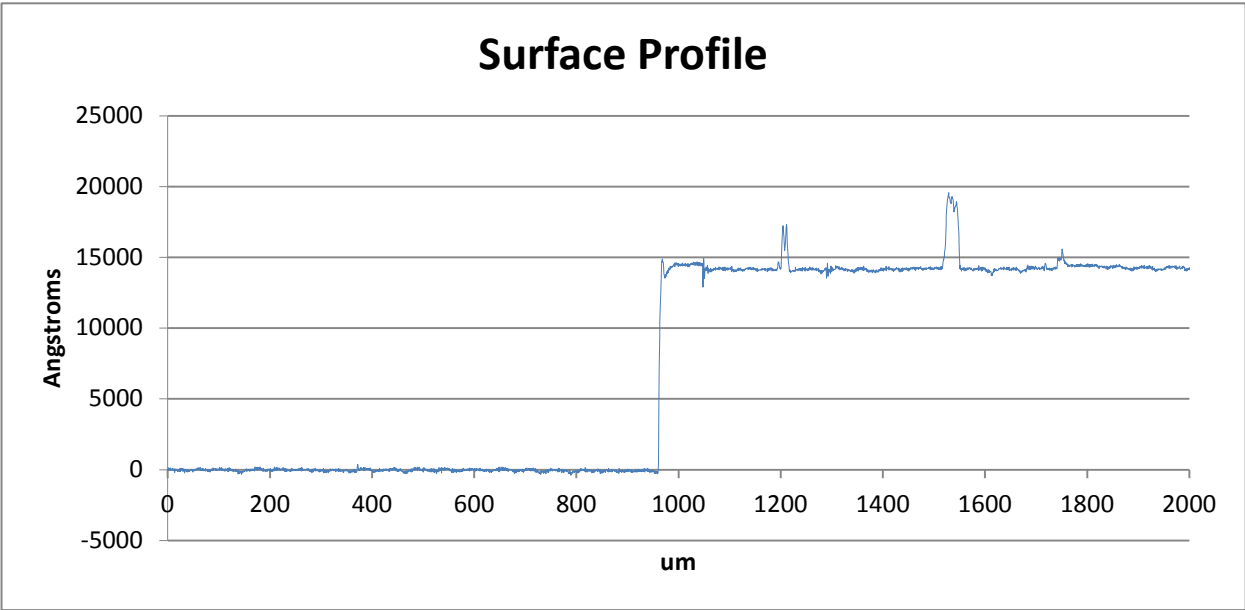
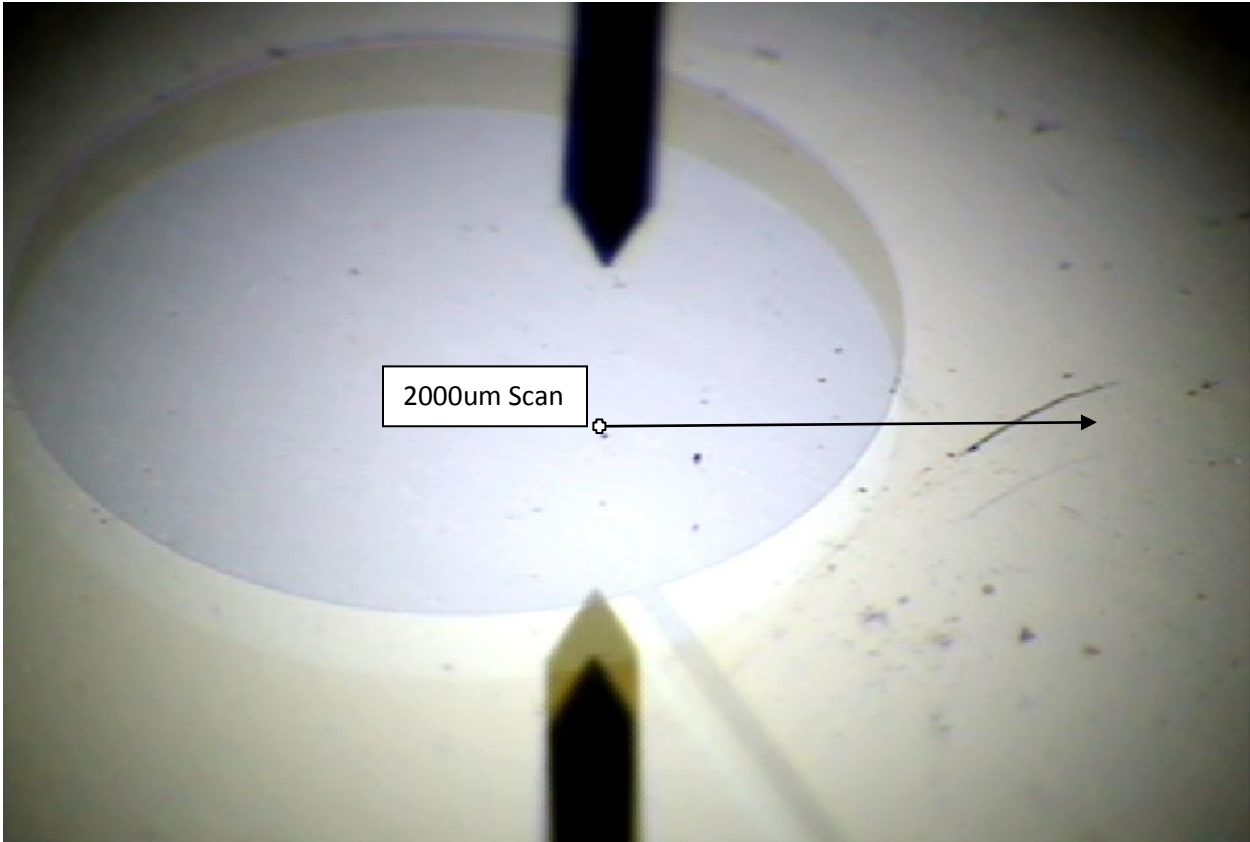
- A. Click the “**Tower Up**”  button and wait for the tower to move completely upwards.
- B. Remove the sample, and return the stage to a location roughly centered beneath the stylus using the X and Y knobs.

10. Shutting down:

- A. Make sure that:
 - a. the tower is UP.
 - b. the Dektak32.exe program is closed.
 - i. When asked “Do you wish to save your current changes to the current automation program?” answer NO!
 - ii. When asked “Do you wish to save the current scan data and analytical function results?” answer YES if desired (and you haven’t already), and follow the instructions. Save your file as *.txt if you want to open it in EXCEL.
 - c. you are logged off of the instrument at the central LogOn computer.

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Sample *.JPG Image and Excel Data



2009-09-24-10:52:22

DATA FILE: Default.001
Date: 9/24/2009 10:41
AUTO PROG: Default.mp
Units: SCI
ScID: test5
ScLen: 2000
Stitch: NO
#Stchs: 1
Speed: Select
Mrange: 65kÅ
Prof: H & V
Tspeed: High
Force:4.44659e-3231073741824
Drnge-: 0
Drnge+: 0
Rcur: 1109
Rwidth: 50
Mcur: 1917
Mwidth: 25
RVTI: 14029
MVTI: 14169
Disp: Raw
Smthed: NO
Wavfed: NO
Ruffed: NO
Smdeg: 1
Smband: 0
HPF: 0
LPF: 0
BP: NO
Calib: NO
VSF: 1.00E+00
VCF: 9.97E-01
Levpt: 7.50E+01
Levslp: -1.11E+01
Zeropt: 3.39E+04
Horzpt: 0.00E+00
NumPts: 18000
Hsf: 1.11E-01

Function	Result	R.Cur	M.Cur	R.Width	M.Width
Ash	14224	851	1148	50	25
Ra*	376	1109	1917	50	25
Maxdev*	5160	1109	1917	50	25
Ash	67	1109	1917	50	25

SCALED DATA:
Surface Profile

27	-4	-130	-197	-138
-55	-73	-163	-177	-42
124	146	20	-87	-75
-23	-65	-175	-195	-52
126	171	66	-39	-37
18	16	-56	-99	-41
56	74	-10	-100	-102
-49	-38	-100	-156	-124
-26	44	50	45	75
123	118	51	-11	-5