STANDARD OPERATING PROCEDURE

FOR

DEKTAK XT

USC University of Southern California

DPS emergency number 213-740-4321

SPECIFICATION

The DektakXT stylus surface profiler is an advanced thin and thick film step height measurement tool with the following characteristics:

- equipment compatible with 2”, 4”, 6” and 8’’ wafers
- Selectable magnification, 1 to 4mm FOV
- Scan Length Range 55 mm with stitching option
- step-height repeatability of 5A
- N-Lite+ Low Force with 0.03 to 15mg
- 3D mapping

OPERATING PROCEDURES

Before Starting:

1. On arrival, the instrument should be off, and the cover to the isolation chamber should be closed.
2. The bottom of your sample must be clean (no Hg or Ga/In contaminated samples allowed!)
3. The sample must be dry.

POWERING ON THE SYSYTEM

1. Press the white ON button on the EMO Box. After you do this, the following events occur:
    - The white ON button on the EMO box illuminates (see Figure 1).

Figure 1: EMO Box with Illuminated On Button

2. Turn on the monitor and power up the computer.

3. Select Start > Vision64 or click the Vision64 application button on the desktop or task bar.

As the software launches, the following events occur:

- The tower assembly moves to its upper limit. The system stops with the stylus in the Tower Up position.
- The Vision64 Welcome screen appears, followed by the Vision64 Instrument tab, which includes the DektakXT Live Video Display (see Figure 2).

4. Allow the system to warm up for approximately 15 minutes before taking a scan measurement.

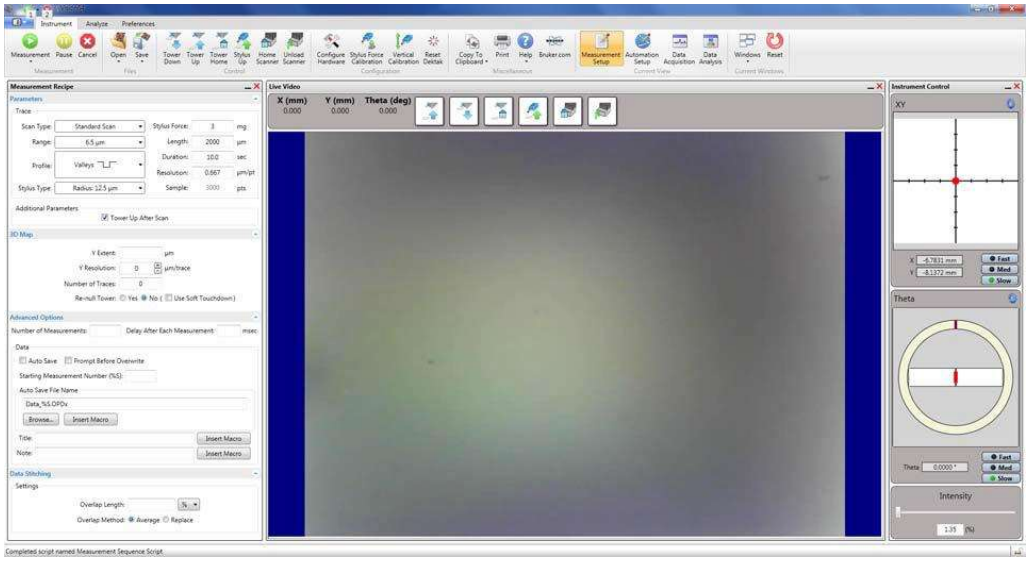


Figure 2: Vision64 Instrument Tab, Including the Live Video Display

LOADING AND UNLOADING THE SAMPLE

Loading the sample:

1. Click the **Unload Sample** button on the toolbar above the Live Video Display to move the scan stage forward 55mm (two inches). You can now conveniently place a sample on the sample fixture (see Figure 3) and remove it without risk of damage to the stylus or the sample.
2. Click the **Load Sample** button to move the scan stage backward its home position. Use the auto stage controls to fine-position the area of interest on the sample beneath the stylus.

Figure 3: Sample Loaded on the Theta Sample Fixture (Chuck)

Unloading the Sample:

When a scan routine is complete, the stylus automatically lifts off the surface. To remove the sample, from the fixture, click the **Unload Sample** button to make the system move the sample positioning stage forward. You can now lift your sample off the fixture.

TOWERING UP AND DOWN

You must slowly lower the tower assembly to bring the feature that you want to measure into focus in the Live Video Display. To do this, click the **Tower Down** button on the toolbar above the Live Video Display.

To raise the tower assembly, click the **Tower Up** button

To bring the tower all the way up to its home position, click the **Tower Home** button

ADJUSTING THE ILLUMINATION

After lowering the tower to focus the camera on your sample, you must adjust the illumination level of the video image displayed on the monitor. To do this, move the slider on the Intensity Bar at the bottom of the right pane of the Live Video Display (see Figure 4). Move it to the right to increase the illumination and to the left to decrease it. The feature that you want to scan should be clearly illuminated.

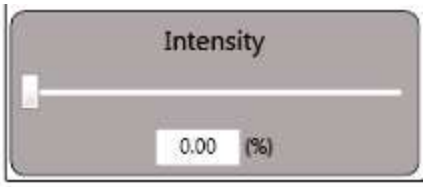


Figure 4: Intensity Bar

USING THE AUTO-STAGE POSITIONING CONTROLS

When you open Vision64, the Live Video Display appears by default. On its right-hand side, it contains two instrument control panels—the X/Y Control Panel and the Theta Control Panel.

X-Y Control Panel

Prior to a taking measurement, you must position the area of interest on the sample under the stylus by adjusting the X-Y position of the motorized sample-positioning stage.

To set the X-Y position of the motorized sample-positioning stage:

1. In the X-Y Control Panel in the Live Video Display (see Figure 5), click the blue Gear icon in the upper right corner to enter the select the units as well as the speeds for Fast, Medium, and Slow (see Figure 6). If you select the **Grab Circle to Move** check box, you must grab the red circle in the middle of the X-Y Control Panel before you can adjust the X/Y position of the motorized stage. When your settings are complete, click **OK**.

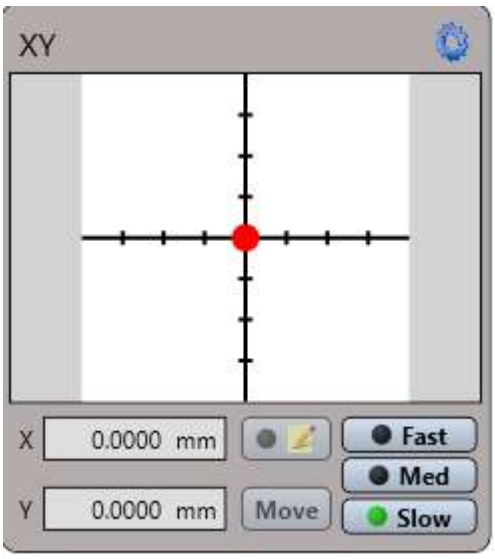


Figure 5: X-Y Stage Control Panel

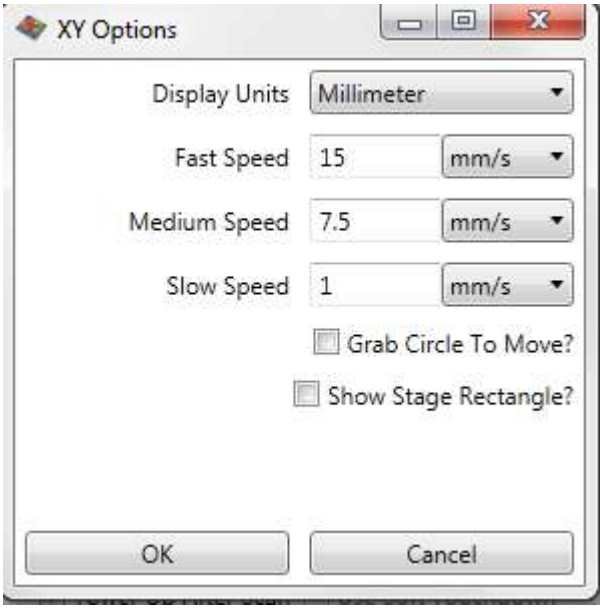


Figure 6: X/Y Options Dialog Box

2. In the lower right corner, click the speed at which you want the stage to travel.
3. Do one of the following:
    - Holding down the left mouse button, drag the red dot in the center of the cross hairs. The dot becomes an arrow that you can drag with the cursor. The real time X and Y positions of the stage appear in the boxes at the lower left. Click and drag to move the stage to another area of interest and display it in the Live Video Pane. When you have obtained the correct stage position, release the mouse button.
    - Click the **Edit Mode** button . Either type your locations in the **X** and **Y** fields or click the **Move** button to move the stage to those locations.

Theta Control Panel

Prior to a taking measurement, you must place the area of interest on the sample under the stylus by adjusting the position of the motorized theta sample-positioning stage. Instructions for doing this appear after the figure.

To set the position of the motorized theta sample-positioning stage:

1. In the Theta Control Panel in the Live Video Display (see Figure 7), click the blue Gear icon in the upper right corner to enter the units as well as the speeds for Fast, Medium, and Slow on both the R Axis and the Theta Axis (see Figure 8). When your settings are complete, click **OK**.
2. Holding down the left mouse button, drag the red bar in the center of the ring. The bar becomes an arrow that you can drag with the cursor. The real time theta position of the stage appears in the box below the ring. This position is graphically depicted by the moving red indicator on the yellow ring.
3. When you have obtained the correct stage position, release the mouse button.

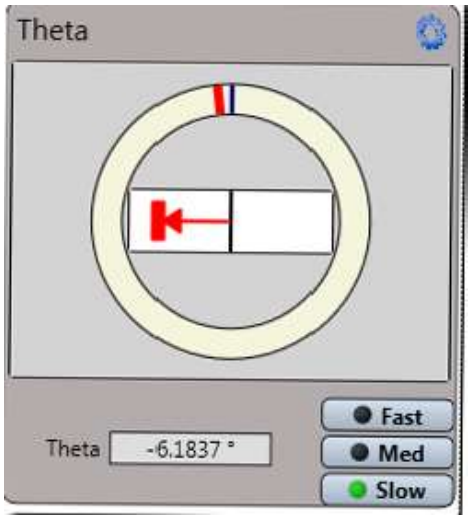


Figure 7: Theta Stage Control

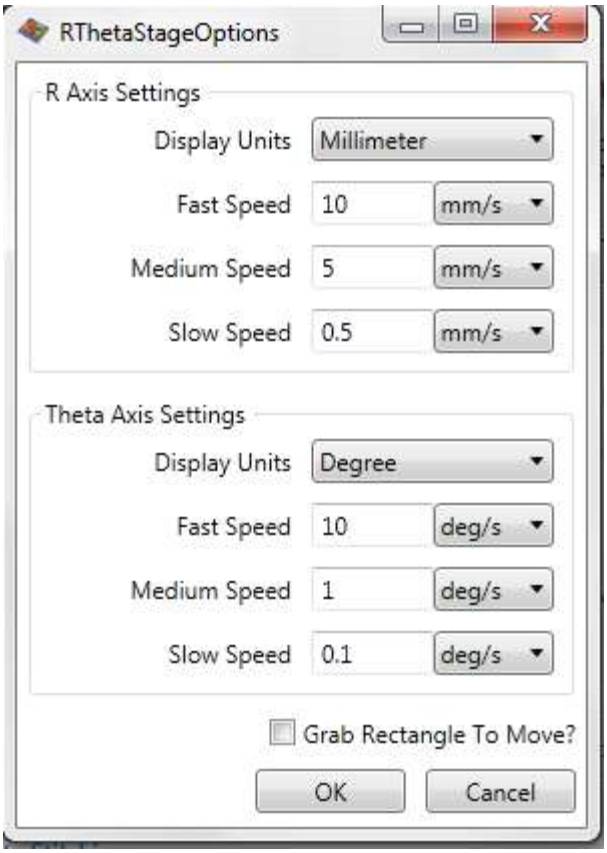


Figure 8: RTheta Stage Options Dialog Box

SETTING UP MEASUREMENT OPTIONS

Before taking a manual measurement or an automated series of measurements, you must make selections in the **Measurement Setup** window (see Figure 9). If you save these selections as a Vision recipe that you designate as the default, the system will automatically apply them to every future measurement. (NOTE – If the Measurement Options window does not appear, click the **Measurement Setup** button on the Ribbon or select it from the Windows drop-down list.)

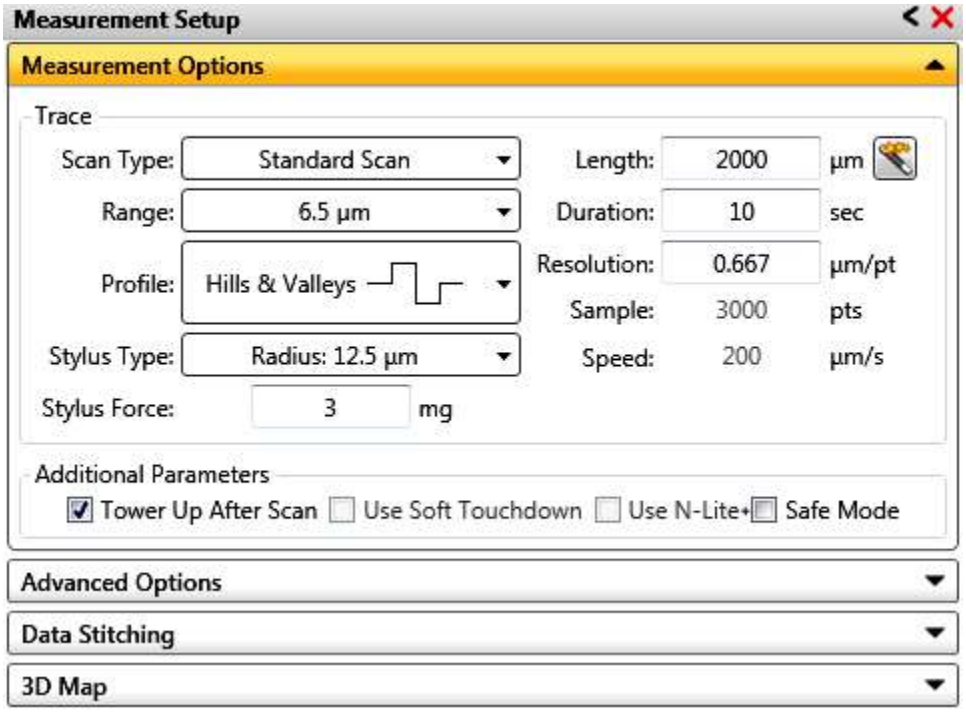


Figure 9: Measurement Options Tab of the Measurement Setup Window

Settings on the Measurement Options Tab

Scan Type: Select from the following:

- **Standard Scan**: A normal scan type in which the scan is performed across the surface of a sample. Because the tower is nulled before each scan, each successive scan has its own reference point.
- **Static Tower Scan**: A special scan type in which the scan is performed across the surface of a sample, but the tower is nulled before only the first scan. Each successive scan therefore uses the same initial reference point.
- **Static Scan**: A special scan type in which the scan is performed at the same point. (The scan stage does not move.) The tower is nulled before the scan. This scan type is primarily used for determining the noise and drift of the system.
- **Map Scan**: If your system includes the 3D Mapping Option, select this scan type to measure, analyze, and view surface contour data in three dimensions (X, Y, and Z)

Range: Enter a value that indicates vertical resolution of the scan. When measuring extremely fine geometries, the 6.5 um range provides a vertical bit resolution of 0.1 nm. For general applications, the 1.0 nm vertical resolution of the 65.5 um range is usually adequate. When

measuring thick films or very rough or curved samples, select the 524 um range with 8.0 nm resolution.

Vertical Scan Range	Vertical Resolution
µm	nm
6.5	0.1
65.5	1.0
524	8

Profile: Select from the following:

- **Valleys**: Provides 90% of the measurement range below the zero horizontal grid line. This option is used primarily for measuring etch depths.

- **Hills and Valleys**: Provides 50% of the measurement range above the zero horizontal grid line and 50% below. This option is used in most applications, especially if the surface characteristics of the sample are not well known, or if the sample is out of level.

- **Hills**: Provides 90% of the measurement range above the horizontal grid line. This option is used primarily for measuring step heights.

Stylus Type: Select the currently installed stylus type from the drop-down list.

Stylus Force: Enter a value between 1 mg and 15 mg.

Length: Enter a scan length between 50 um and 55,000 um (55 mm) for a non-stitched measurement.

Duration: Enter amount of time it will take to complete a given scan. Scan duration, in conjunction with
scan length, determines the horizontal resolution of a scan. For most applications, a 10 – 20 second scan provides adequate resolution and throughput.
Resolution: Enter the horizontal resolution for the scan length and scan duration. The scan resolution is expressed in um/sample, indicating the horizontal distance between data points.

Sample: Indicates the number of data points that the system should take on the sample during a measurement.

Speed: Indicates the scan speed in units of um/s.

Tower Up After Scan: Select this check box to make the DektakXT stylus profiler automatically raise the tower to a safe position after each scan.

Use Soft Touchdown: If your system includes the 3D Mapping Option, select this check box to make the DektakXT stylus profiler increment the stylus force up to the specified value. This causes the stylus to descend more slowly, thus minimizing the possibility of scratching the sample.

TAKING A STANDARD MANUAL 2D MEASUREMENT

1. In the Vision64 Measurement Setup window, if your system includes the X-Y or theta auto stage, click **Unload Sampl**e in the Live Video Display. The tower moves to its full upward position, and the stage moves to its full front (unload) position.
2. Place the sample on the sample fixture (chuck). If you are measuring a wafer, this will be the vacuum wafer chuck.
3. In the Live Video Display, click the **Load Sample** button. The scan stage moves back to its home position, ready for a measurement.
4. Click **Tower Down** in the Live Video Display. The tower lowers to the measurement position with the stylus down, and the stylus makes brief contact with the sample. The stylus then moves to its Up position.
5. If necessary, adjust the Intensity slider in the Live Video Display so that the sample is clearly illuminated.
6. Adjust the position of the X-Y or theta stage until you find the location of interest on your sample.
7. Fine-position the location of interest in the center of the Live Video Display.

8. On the Measurement Options tab of the Measurement Setup window, select Standard Scan (see Figure 10).

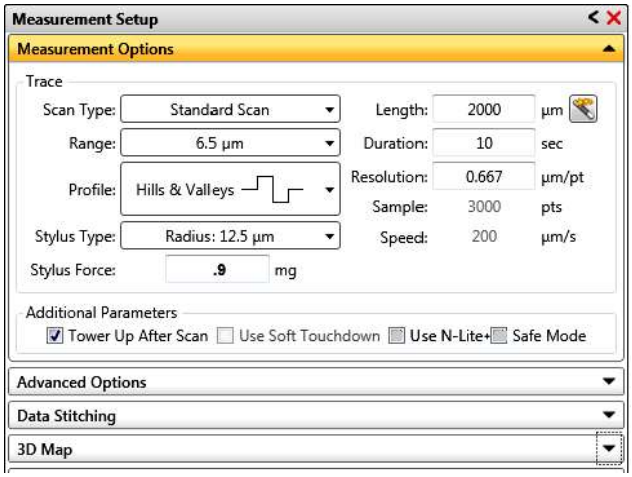


Figure 10: Measurement Options Window

9. If you do not want to use the default Measurement Options settings that are stored in your Vision recipe, change any other settings on the Measurement Options tab of the Measurement Setup window.

10. Click the Advanced Options tab and make sure that the Number of Measurements is set to 1.

11. Click the Measurement button on the Ribbon (see Figure 11) and then select Measurement.

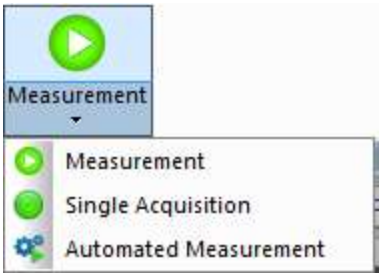


Figure 11: Measurement Buttons

12. Observe the measurement in real-time in the Data Acquisition window. If the scan hits or exceeds the top or bottom border of the Data Acquisition window, do the following:
    - Increase the Scan Range value in the Measurement Options window.

Data Analysis

The red reference (**R**) cursor and green measurement (**M**) cursor in the Data Analysis Display define the portion of the profile trace on which to calculate analytical functions on the measurement results (see Figure 12). You can adjust the bandwidth at each cursor to average

the data points within that cursor's bandwidth. This is especially useful for average step height measurements.

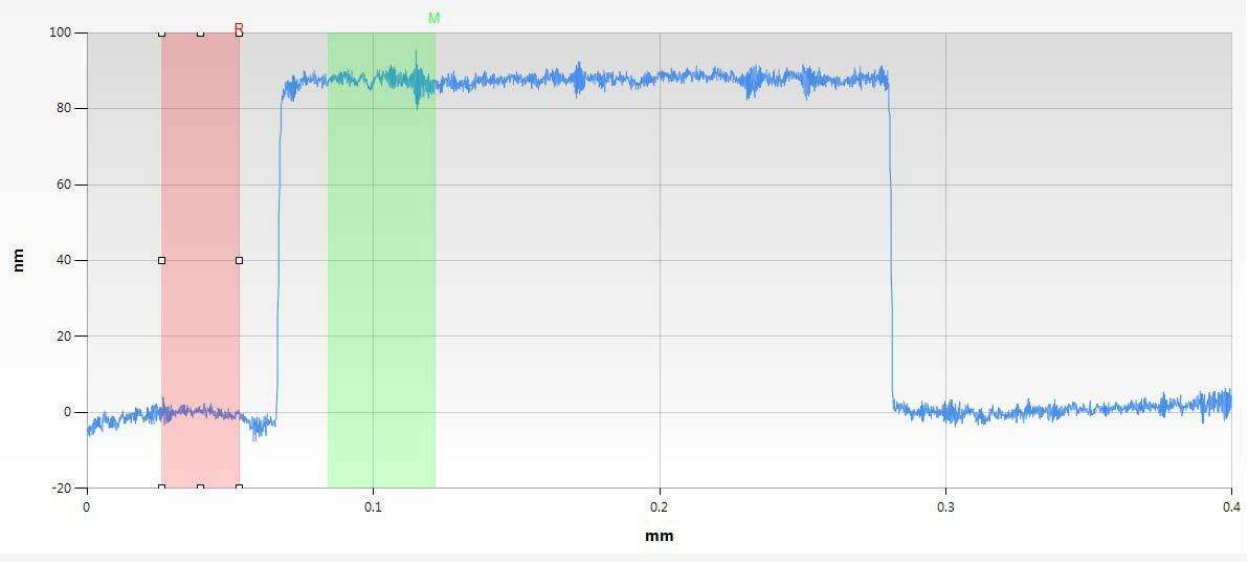
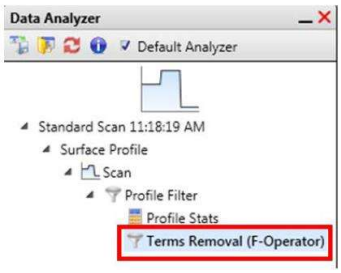


Figure 12: 2D Profile of the Data Analysis Display Showing the R and M Cursors

1. To change the position of each cursor on the measurement data, click on it and then drag it with the mouse.
2. To change the bandwidth of a cursor, click it to display small boxes that you can then drag.
3. To reposition the cursors while maintaining the same distance between them, click on one of the cursors, and then hold down the Alt key while dragging that cursor. The second cursor moves along with it.
4. The locations of the **R Cursor** and **M Cursor** and their bandwidths appear in a box at the bottom of the Data Analysis window (see Figure 13). To change these settings, type in new values and press **Enter**.
5. To software level the results, click on **Terms Removal (F-Operator)** under the Analysis Toolbox window.



Cursor Status

Label	Position (mm)	Total Profile (µ	Width (mm)
R	0.5362	0.0223	0.0000
M	1.4182	0.0372	0.0000
Δ	0.8821	0.0149	

USING THE QUICK ANALYZER

For all of the operations in the Quick Analyzer, you can open a setup menu by left-clicking the mouse while hovering over the button.

Figure 14: Quick Analyzer

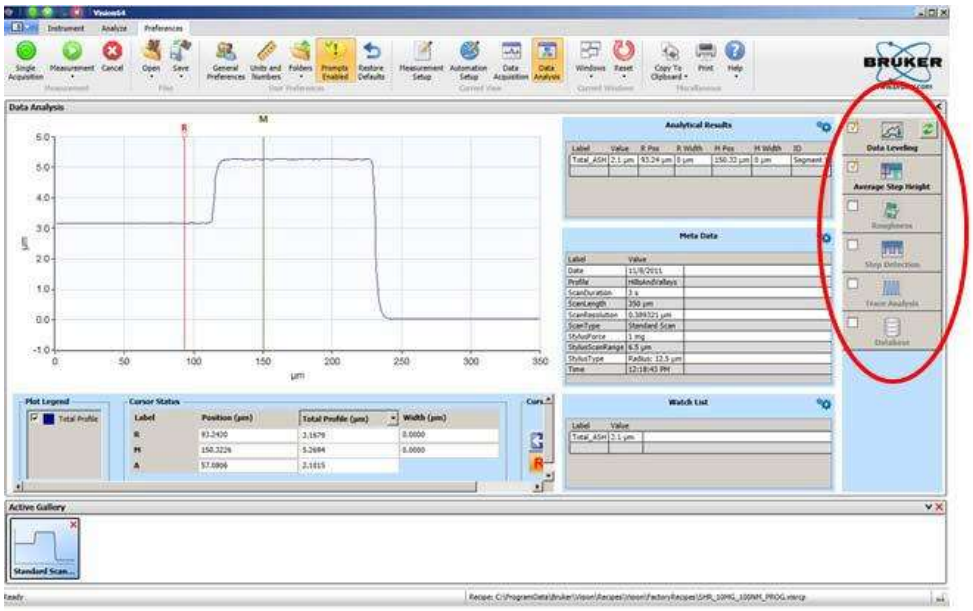


Figure 15: Quick Analyzer Shown as Part of Full Screen

Data Leveling

Figure 16: Data Leveling Section of the Quick Analyzer

Data Leveling allows you to level the data set using various software algorithms. After positioning the R and M cursors on the section of the displayed data set that is to be used for the operation, complete the leveling by doing one of the following:

- Right-click the mouse on the Data Analysis window and select the menu option Level – Two Point Linear.
- Left-click the mouse while hovering over the Data Leveling button on the right side of the screen. This activates a menu with various leveling options available (see Figure 17).

Left-click the Re-use button within the Data Leveling button. This reapplies the previous dataleveling option selected at the current cursor positions.

The Data Leveling Settings dialog box is shown on the next page. For explanations of its options, see your Vision64 Online Help.

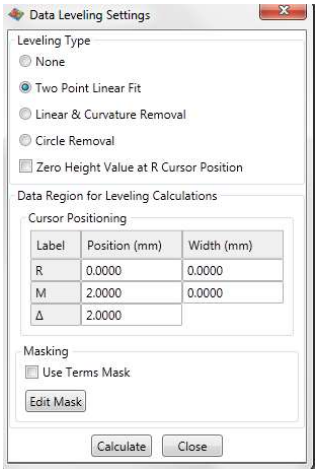


Figure 17: Data Leveling Settings Dialog Box

Average Step Height

Figure 18: Average Step Height Section of the Quick Analyzer

Average Step Height (ASH) allows you to quickly ascertain the step height at the cursor positions. There are two ways to complete this operation:

- Set the cursors to the desired position (and width) and then left click the mouse while hovering over the Average Step Height button.
- While hovering over the Analytical Results window, right click the mouse and select Add ASH.

POWERING DOWN THE SYSTEM

To power down the DektakXT system:

1. Close the Vison64 software as described in Closing Vision64 on page 6-1.

2. Press the black OFF button on the EMO Box (see Figure 19). This shuts off power to all system devices but the computer, monitor, power supply adapter, and 24 VDC control circuit in the EMO Box.

Figure 19: Red EMO and Black Off buttons on the EMO box

3. Select Start > Shut Down from the Windows 7 Start menu, and then click Shut Down in the dialog box that appears.

4. Turn off the monitor.