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Profiler-P16/P7- Standard Operating Procedure

Badger Name: K1 Surface Profiler P16
KLA-Tencor
Model:
Location: Keller-Bay 1, PAN-Bay 1

Revision: 2
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1. **Scope**
   - **1.1.** This document provides detailed instructions on how to properly operate the profiler-P16/P7.
2. **Tool description**
   - **2.1.** The KLA-Tencor P16/P7 Surface profiler provides leading edge surface measurement and analysis performance capability on a Windows XP operating system. Some of the key features of the P16/P7 are as follows:
     - **2.1.1.** Vertical range 0-327µm
     - **2.1.2.** 2µm diamond stylus with a 60 degree cone angle
     - **2.1.3.** Substrates sizes from 3mm x 3mm up to 200mm in diameter
     - **2.1.4.** Maximum substrate thickness of 3mm
     - **2.1.5.** Maximum scan length of 80mm
     - **2.1.6.** 2D scans
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     - **2.1.17.** Expandable data points

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Figure 1 *The P16 profiler, located in Keller Hall-Bay 1.*

3. **Safety**
   - **3.1.** Take care not to touch/bump the stylus.
4. **Restrictions**
   - **4.1.** Do not put your hands under the scan head, you could damage the stylus
   - **4.2.** Must be a qualified MNC user
   - **4.3.** Limitations substrate size and thickness. No samples greater than 200mm in diameter or smaller than 3mm x 3mm
   - **4.4.** Limitations on materials. No uncured SU8, no uncured photoresists, no soft material that might stick to the stylus
   - **4.5.** Sample thickness is between 150µm-3mm
   - **4.6.** Do not measure any cantilevers or thin membranes, you may damage stylus
5. **Tools and Equipment**
   - **5.1.** Compressed air 30 psi
   - **5.2.** 120 V/20A
   - **5.3.** 18” of vacuum
6. **Operating Instructions**
   - 6.1. There are three main windows –The top level is the Catalog Window, to return to the catalog window from either the X-Y or the Analysis, just close one or both windows.
     - 6.1.1. **Catalog Window**- This is where you would select your recipe.
     - 6.1.2. **X-Y Window** – This is where you would do your measurement.

6.1.3. **Analysis Window**- This is where you analyze your data.

6.1.4. **The trackball and trackball left mouse button** – to move cursor and select items.

6.2. Log in to badger.

6.3. Enable **Characterization and Testing>surface-prof-p16**

6.4. Log in user name –**user**, password-**nfc-1234**

6.5. Double click on **Profiler 7.1 icon**. It will take a minute for the system to start.

6.6. Press on **scan recipe** button. (Additional information in Catalog screen and recipe editor section in section 2.)

6.7. Open **user-scan's-2D** folder.

6.8. Make a new recipe with your_name as the title or go to step j.

6.9. Click the new button at the bottom of the catalog screen.

6.10. Using the pull down menus at the top of the recipe editor screen recipe>save as > Your_name.

6.11. Double click on your recipe. To modify your recipe see Recipe Editor section in section 2.

6.12. Press the **X-Y** button.

6.13. Load your sample by pressing the **man load** button.

6.14. Open door- **DO NOT OPEN DOOR BEFORE THE STAGE IS IN FRONT LOAD POSITION AND COMES TO A COMPLETE STOP.** If you do the system will give you an error. To clear the error select the **Clear status** button in the lower right hand corner of the X-Y window.

6.15. Load your sample onto the center of the stage. Sample size 3mmx3mm minimum and 8" diameter maximum. If your sample is smaller than 25mmx25mm cover the center hole with your sample.

6.16. Turn on the manual toggle switch to the left side of the door.

6.17. Close door.

6.18. Press **man load** button to move the stage in. Wait to stage to stop.

6.19. Press on **Focus** button.

6.20. To Move your sample with either with the buttons at the top of the X-Y screen, or arrow keys on the key board, or the pull down menus at the top of the X-Y screen. (Additional information in X-Y window section in section 2.)

6.21. Once your sample is positioned correctly, press the **start** button.

6.22. After the scan is complete the Analysis window will open automatically.

6.23. Press **level** button. (Additional information in Analysis section in section 2.)

6.24. Use the cursor to adjust the leveling bars. (inside the window-changes the bar length, outside the window-changes the bars position)

6.25. Press **level** button. This levels your scan and automatically switches to the measurement bars (inside the window-changes the bar length, outside the window-changes the bars position). Your measurement is an average of each area under each bar.

6.26. Use the measurement cursors to determine the height of your sample. On the left hand side at the bottom of the window there are a number of cursors.

6.26.1. L.Height- Left cursor height

6.26.2. R.Height- Right cursor height

6.26.3. St.Height- Step height

6.26.4. Width-distance between right and left cursors.

6.26.5. TIR-**Total Indicator Run Out** The difference between the highest and lowest points in the scan.

6.27. To save your graph of your data to a file select **file>export graph**. Export your graph to a folder in the following location c:\eagle\scandata\user_scan_data\your_folder. Use the USB port on the right side of the vibration table to get your graph to a flash drive.

6.28. To save your data to a file select file>save data. Save the data to the following folder c:\eagle\scandata\user_scan_data\your_folder. Use the USB port on the right side of the vibration table to get your data to a flash drive.

6.29. To **export** your data to a **ascii file**.

6.29.1. At the catalog screen, highlight scan data button on the left side of the catalog screen.

6.29.2. Use the scan data path screen to navigate to the correct folder containing your data file.

6.29.3. Select your data file.

6.29.4. Select **import/export** button on the right hand side of the catalog screen, it is the fourth button down.

6.29.5. Select **export** button at the button of the catalog screen

6.29.6. Select ascii format

6.29.7. Navigate to the folder that you would like to put the data.

6.29.8. Click **OK**

6.29.9. Use the USB port on the right side of the vibration table to get your graph to a flash drive.

6.30. Close the **Analysis window** and discard changes. By click on the red X in the upper right corner of the analysis window.

6.31. Press the **X-Y** button. By click on the red X in the upper right corner of the x-y window.

6.32. To unload you sample Press **man load**.

6.33. Open sample window, turn off the vacuum, and unload your sample.

6.34. Close the sample window.

6.35. Press **man load** to unload sample. You can leave the system in the X-Y window and logout of badger at this point.

6.36. To close the **X-Y** window.

6.37. To close the **recipe editor**. By click on the red X in the upper right corner of the recipe editor window.

6.38. To close **Catalog** window. By click on the red X in the upper right corner of the Catalog window.

6.39. To Logout of the computer **Start button> the arrow button>log off**

7. Catalog Window

7.1. Pull down menus-catalog screen

7.1.1. File

7.1.1.1. **Start** –Starts the currently highlighted scan recipe and switches screens to the scan screen.

7.1.1.2. **Center Object**-Displays the center object in the XY view window.

7.1.1.3. **Teach Die Grid**-Opens the teach Die Grid procedure in the XY view screen.

7.1.1.4. **XY view**-Brings up the XY view screen, which is the typical scan screen.

7.1.1.5. **Print**-no print attached to system.

7.1.1.6. **Exit**-Exits the catalog screen. This sometimes prompts the display of dialog box asking if the current changes are to be saved.

7.1.2. Edit

7.1.2.1. **New** – The opens the recipe Editor screen with an untitled recipe. The recipe title is “UNTITLED” until the new recipe parameters are set and saved with a new name.

7.1.2.2. **View/ modify**-This opens the Recipe Editor screen displaying the parameters of the recipe that is highlighted on the catalog display area.

7.1.2.3. **2D**-This displays the 2D list of Scan Recipes in the catalog display area.

7.1.2.4. **3D**- This displays the 3D list of Scan Recipes in the catalog display area.

7.1.3. Sample

7.1.3.1. **Manual load**- This moves the sample stage to stage door of the system (manual load door) so a sample can be manually loaded onto the stage.

7.1.4. Vacuum

7.1.4.1. **Off**-This function is inactive for the P-16 profiler, because the vacuum switch is manual.

7.1.4.2. **On** -This function is inactive for the P-16 profiler, because the vacuum switch is manual.

7.1.5. Host

7.1.5.1. **Go Offline**-This takes the P-16 Profiler system offline. This is used to prevent the system from responding to a host during a user defined operation.

7.1.5.2. **Attempt Online**- This attempts contact with the host to open the system communication link. The system then operates according to its predetermined GEM parameters.

7.1.5.3. **Local**-This is an online state where there is communication with the host but in which the P-16 Profiler system controls the systems operation.

7.1.5.4. **Remote**- This is an online state where there is communication with the host and in which the host controls the P-16 Profiler system operation.

7.1.6. Diagnostic

7.1.6.1. Synthesize Data-Access restricted.

7.1.6.2. ARAMS-Selection sends you to ARAMS Diagnostics.

7.1.7. Tasks

7.1.7.1. **Configuration**- a short cut to configuration

7.1.7.2. **Calibration**-a short cut to calibration.

7.1.7.3. **Scan Catalog**- a short cut to scan catalog.

7.1.7.4. **Database Catalog**-a short cut to database catalog.

7.1.7.5. **Stress**-a short cut to Stress menu.

7.1.7.6. **Gem-secs**-a short cut to Gem-Secs menu.

7.1.7.7. **Defect review**- a short cut to the defect review menu.

7.2. Tool bar for the catalog screen

7.2.1. **Print**- No printer attached to system.

7.2.2. **Start**-Starts scan using highlighted recipe.

7.2.3. **X-Y screen**-Switches to X-Y view screen with the current recipe active, ready for a scan to be run.

7.2.4. **Stage Rotation**- Switches to X-Y view screen with the stage rotation (theta) buttons active.

7.2.5. **2D scan**-Displays 2D scan recipes in the list window.

7.2.6. **3D scan**- Displays 3D scan recipes in the list window.

7.2.7. **Apex shortcut**-Launches Apex application and sends the current file to Apex in a separate window.

7.3. The buttons at the left of the screen

7.3.1. **Scan Recipe**-This button displays the list of currently available Scan recipe folder.

7.3.2. **Scan Data**-This button displays the list of currently available Scan Data folder. e:\edgle\scandata\user_scan_data\<user_name>

7.3.3. **Sequence Recipe**-This button displays the list of currently available sequence Recipe folder.

7.3.4. **Sequence Data**- This button displays the list of currently available sequence data folder.

7.4. The button at the bottom of the catalog screen

7.4.1. **Print**- This prints the currently highlighted recipe. No printer attached to system.

7.4.2. **New**-The opens the Recipe Editor for the creation of a new recipe. In the recipe editor, the title is “UNTITKED” until the recipe is named. The recipe contains the default parameters.

7.4.3. **View/modify**-This opens the recipe Editor allowing modification of the currently highlighted recipe.

7.4.4. **Start**-This opens the X-Y view screen and begins the scan procedure associated with the currently highlighted scan recipe.

7.4.5. **X-Y screen**-This opens the X-Y view screen with the currently highlighted recipe in place to perform a scan.

8. Recipe Editor Window

8.1. Pull down menus-Recipe editor

8.1.1. Recipe

8.1.1.1. open

8.1.1.2. Start scan

8.1.1.3. Diagnostic information

8.1.1.4. Print

8.1.1.5. Exit recipe editor

8.1.2. Options

8.1.2.1. 2D scan

8.1.3. Scan

8.1.4. Sample

8.1.4.1. Manual load

8.1.5. Vacuum

8.1.6. Help

8.1.6.1. About Profiler

8.2. Parameter buttons on the left

8.2.1. Scan Parameters Definition- 2D and 3D

8.2.2. Feature Detection
8.2.3. Filters cursors
8.2.4. Unit Output
8.2.5. General Parameters
8.2.6. Roughness/Waviness
8.2.7. Bearing ratio cutting Depth
8.2.8. High Spot Count Peak Count
8.2.9. Set Up Analysis Tools

8.3. Scan parameters-2D-Information display-Button

8.3.1. **X scan size** (um) 1um-5000um (normal scan length 50um-200um) Remember, if you increase your scan length, this increase your scan time.
8.3.2. **Scan speed** (um/s) 1-50(normal scan speeds 10 um/s) Remember, if you decrease your scan speed, this increase your scan time. Do not exceed 50 um/s. For soft materials (Cu, Al, gold, Photo resist, and Su8) do not scan faster than 10um/s.
8.3.3. **Sample rate** (Hz) 1-2000 number of points per second of scan. Remember the stylus in our system is 2um in diameter. Optimum data collection is determined by scan speed, scan length, and stylus diameter.
8.3.4. **Multi-scan average** 1-10 (Scans the same area from 1 to 10 times and averages the result.
8.3.5. **Scan direction**
8.3.5.1. Scan direction; please do not change the scan direction. If you need to measure the other direction please rotate your sample 180 degrees.
8.3.6. Teach
8.3.7. Scan time/data points
8.3.8. **Stylus/force/radius** (applied force 1mg-2mg/2um diamond stylus) do not exceed 5 mg of force.
8.3.9. **Vertical range** 13/65/327um (normal range is 13um)

8.4. Scan Parameters-3D-Information Display-Button

8.4.1. X scan size (um) 1um-5000um (normal scan length 50um-200um) Remember, if you increase your scan length, this increase your scan time.
8.4.2. Y scan size (um) 1um-5000um (normal scan length 50um-200um) Remember, if you increase your scan length, this increase your scan time.
8.4.3. Scan speed (um/s) 1-200(normal scan speeds 20 um/s) Remember, if you decrease your scan speed, this increase your scan time. Do not exceed 50 um/s. For soft materials (Cu, Al, gold, Photo resist, and Su8) do not scan faster than 10um/s.
8.4.4. Sample rate (Hz) 1-20 number of points per second of scan. Remember the stylus in our system is 2um in diameter. Optimum data collection is determined by scan

speed, scan length, and stylus diameter. Therefore, for a 100um scan length and a scan speed of 10 um/s the sampling rate should be 20 Hz. This gives you

8.4.5. Scan direction ☾ (Scan direction; please do not change the scan direction. If you need to measure the other direction please rotate your sample 180 degrees.

8.4.6. Teach

8.5. Feature detection-Button

8.5.1. Feature

8.5.1.1. None- No feature detection is being used.

8.5.1.2. Up Edge-At the trailing edge of a feature rise, it is the point at which the trace begins the plateau.

8.5.1.3. Up Base-At the trailing edge of a plateau, it is the point at which begins to turn upward.

8.5.1.4. Down Edge-At the trailing edge of a feature decline, it is the point at which the trace begins the plateau.

8.5.1.5. Down Base-At the trailing edge of a feature decline, it is the point at which the trace begins the plateau.

8.5.1.6. Convex-This is the point at the apex of a convex feature.

8.5.1.7. Concave- This is the point at the apex of a convex feature.

8.5.2. Feature Number-If there are multiple edges detected in the scan, feature number provides a way to select a specific edge for detection.

8.5.3. Slope Threshold-This factor sets the value at which any rise or fall in a trace is considered to be a slope, not just part of the roughness or noise. This means that the slope threshold defines a point at which the system recognizes a trace line as following or preceding an edge, convex or concave point. Use values between 0-50.00 the default value is 10.000 for a step and 1.000 for an apex point. These values are sufficient for most scans above 200 A in height.

8.5.4. Plateau Threshold-This factor affects the precise horizontal location calculated for an edge or an arc point. This parameter allows for the positional adjustment of the point to the left or right. Use values between 0-50.000 the default value is 10.000 for a step and 0.000 for an apex point. These values are sufficient for most scans above 200 A.

8.5.5. Minimum Plateau Width-Defines the minimum horizontal distance between rising and falling edges (or falling and rising edges). This is used in feature detection to identify true features. Use values between 0.005-1000.00 um the default is 10um.

8.5.6. Apply Gaussian Noise Filter before Detection-This is only used to filter out unwanted noise so the feature detection can more easily detect designated

features. It does not apply the result to scan data. For use of the Gaussian filter with scan data, see filters.

8.5.7. Filter cutoff-This option is only activated when there is a check in the Apply Gaussian Noise Filter before Detection check box. The number to be entered is in microns. This determines the noise level that is filtered out. The filter cutoff range is from 0.25-800um.

8.6. Filter Cursors

8.6.1. 2D filters-Filter option-Gaussian filter or RC filter. The Gaussian filters noise out of a scan data, during the scan or after the scan is complete, but before the data is saved. The RC filter is an older version noise filter.

8.6.2. 2D filter-Noise filter-Is a short wavelength cutoff filter. This is an adjustable software filter used to reject short wavelength components of scan data. When used with the Waviness filter, it also isolates band passes for wavelengths.

8.6.3. 2D filters-Waviness filter- This is an adjustable software filter used to separate long wavelength components of scan data.

8.6.4. Cursors-Cursors are used for two general purposes:

8.6.4.1. Measurement cursors are used to gather data either between the two sets of cursors or within the boundaries of the cursor itself.

8.6.4.2. Leveling cursors are used to level the data points in the trace so the trace features fairly represent the actual scanned surface.

8.6.5. Relative to feature detected-When this is checked, the cursor limits are set relative to the feature that is defined in the Feature Detection parameters window in the recipe editor. The feature becomes the 0 point (the origin of the new coordinate system), with the points to the left being negative and those to right being positive.

8.6.6. Fit to level- This option is designed to remove a secondary curvature from the overall trace of a curved surface. Features should then appear relative to a flat surface.

8.6.7. Median Filter for 2D and 3D data- This filter can e chosen as part of the recipe to help filter out spikes from environment noise and particulate contamination. A median filter can be turn on before the scan, allowing the system to filter the data before the first viewing. It also can be used on saved data. With the data open in the Analysis Screen, the saved data from a single scan can be changed by opening the recipe used to create the scan from the analysis screen, and changing the filter size in that recipe. The median filter is used for both 2D and 3D recipes. When the filter is applied before the scan, the data is filtered and permanently changed.

8.6.8. Y lead Screw Filter-This filter can be used only with large 3D scans. The Y lead screw filter is designed to remove the Y lead screw noise present in die level 3D scan data.

8.7. Unit Output Button- Unit Output is designed to give the user an opportunity to determine units output for parameters calculated and set to an automatic crossover values for unit changes.

8.8. 2D General Parameters (Normal Trace)

8.8.1. Step height (StpHt) - The difference in height the left and right measurement cursors positions. Each cursor position is an average of the area between the cursor boundaries. The difference is between these averages.

8.8.2. Total Indicator Run Out (TIR) - The difference between the highest and lowest points in the scan.

8.8.3. Average Height (Ave) - The average height of all data point between the measurement cursors relative to the leveled baseline. (ANSI)

8.8.4. Slope- The ratio of the difference in vertical positions to the difference in horizontal positions of the measurement cursors. The slope is reported as an angle in degrees.

8.8.5. Radius-The distance from the center of curvature of the profile arc to the profile.

8.8.6. Area of Peaks (Area +) - The total area bounded by the leveled baseline and the profile where it rises above the baseline. (ANSI)

8.8.7. Area of Valleys (Area -) -The total area bounded by the leveled baseline and the profile where it descends below the baseline. (ANSI)

8.8.8. Total Area (Area) – The sum of area of the peaks and area of the valleys. The delta cursors are not used. (ANSI)

8.8.9. Peak (Pp) - Maximum Z value, measured relative to the leveled reference line, between the left and right measurement cursors.

8.8.10. Valley (Pv) – Minimum Z value, measured relative to the leveled reference line, between the left and right measurement cursors.

8.8.11. Profile Length (ProfL) – The length that would be obtained from drawing out the profile in a straight line. (ANSI)

8.8.12. Distance to Edge (Edge)- Depending on the parameters settings in Feature Detection, this distance is either:

8.8.12.1. The distance between the beginning of the scan and first rising or falling edge of a profile feature: or

8.8.12.2. The distance between the beginning of the scan and first concave or convex arc of a profile feature.

8.8.13. Step Width (StpWt) - The distance between the first rising edge of an upward step and falling edge that follows, or the first falling edge of a downward step and the rising edge that follows.

8.9. 3D General Parameters (Normal Trace)

8.9.1. Total Indicator Run Out (TIR3D) - This is the 3D Total Indicator Run Out. TIR3D is the difference between the highest and lowest point in the scan.

8.9.2. Slope X- Slope X refers to the slopes for lines in the plane. The slope X is the slope along the X-direction. For the data set in any rectangular area (either a box or the entire area), a plane can be established using the least squares method.

8.9.3. Slope Y- Slope Y refers to the slopes for lines in the plane. The slope X is the slope along the Y-direction. For the data set in any rectangular area (either a box or the entire area), a plane can be established using the least squares method.

8.9.4. Peak 3D (Sp) - Maximum Z value, measured relative to the leveled reference plane.

8.9.5. Valley 3D (Sv) - Minimum Z value, measured relative to the leveled reference plane.

8.10. 2D Roughness Parameters

8.10.1. Average (Ra)-This is the arithmetic average deviation of the absolute values of the roughness profile from the mean line or center line. This is also known as the centerline average roughness. The centerline divides profiles such that all areas above it are equal to all areas below it. (ANSI)

8.10.2. Maximum Ra (Max Ra)-The trace within the cursors is divided into nineteen overlapping sections. Each section is one tenth of the sampling length. The Ra of each section is calculated, and the maximum is displayed. (ANSI)

8.10.3. RMS (Rq) - The Root Mean Squared or geometric average deviation of the roughness profile from the mean line in the sampling length. (ANSI)

8.10.4. Peak (Rp) - The distance between the mean line and the highest peak within the sampling length. (ANSI)

8.10.5. Valley (Rv) - The distance between the mean line and lowest valley within the sampling length. (ANSI)

8.10.6. Peak/Valley (Rt) - The vertical distance between the highest peak and lowest valley in the sampling length leveled in the mean line. (Also known as Rmax, Ry, Maximum peak to Valley Roughness.) (ANSI)

8.10.7. Height 10pt (Rz) - The average height difference between the five highest peaks and the five deepest valleys within the cursors measured from a line parallel to the mean line. (ANSI)

8.10.8. Height 6pt (R3z) - The average height difference between the three highest peaks and the three deepest valleys within the cursors measured from a line parallel to the mean line. (ANSI)

8.10.9. Roughness Height (Rh) - The difference in height in the roughness profile between the left and right cursor positions.

8.10.10. Mean Peak Height (Rpm) - The mean value of the local peak heights relative to the mean line of the roughness trace within the sampling length.

8.10.11. RMS Slope (Dq) - The root mean squared (RMS) value of the roughness trace slope. The delta cursors are not used.

8.10.12. RMS Wavelength (Lq) - is a measure of the spacing of local peaks and local valleys, taking into account their relative amplitudes and individual spatial frequencies. (ISO)

8.10.13. Std. Dev. Height (SD) - The standard deviation of the local peak heights about the mean peak height relative to the mean line within the sampling length.

8.11. 2D Waviness Parameters

8.11.1. Average (Wa) - This is the arithmetic average deviation of the absolute values of the waviness profile from the mean line or center line. This is also known as the centerline average waviness. The centerline divides profiles such that all areas above it are equal to all areas below it. (ANSI)

8.11.2. RMS (Wq) - The Root Mean Squared or geometric average deviation of the waviness profile from the mean line in the sampling length. (ANSI)

8.11.3. Peak (Wp)-The distance between the mean line and the highest peak within the sampling length. (ANSI)

8.11.4. Valley (Wv)-The distance between the mean line and lowest valley within the sampling length. (ANSI)

8.11.5. Peak/Valley (Wt) - The vertical distance between the highest peak and lowest valley in the sampling length leveled in the mean line. (Also known as Wmax, Wy, Maximum peak to Valley Waviness.) (ANSI)

8.11.6. Waviness Height (Wh) - The difference in height in the waviness profile between the left and right cursor positions.

8.12. 3D Roughness Parameters

8.12.1. RMS Deviation (Sq) - Root mean Squared Deviation of the surface. The root mean squared value of the surface departures within the sampling area.

8.12.2. Arithmetic Mean Deviation (Sa) - Arithmetic mean deviation of the surface. The arithmetic mean of the absolute values of the surface departures above and below plane within the sampling area.

8.12.3. Skewness (Ssk) - The measure of asymmetry of surface deviations about the mean plane. It effectively describes the shape of the height distribution.

8.12.4. Kutosis (Sku) - A measure of the peakedness or sharpness of the surface height distribution. It characterizes the spread of the height distribution.

8.12.5. RMS slope (S delta q) - The root mean squared value of the surface slope within the sampling area. It characterizes the spread of the height distribution.

8.12.6. Ten Point Height (Sz) - The average value of the absolute heights of the five highest peaks and the depths of the five deepest pits or valleys within the sampling area.

8.12.7. Density of Summit (Sds) - The number of summits of a unit sampling area.

8.12.8. Interfacial Area Ratio (Sdr) - The ratio of the increment of the interfacial area of a surface over the sampling area. The interfacial area ratio reflects the hybrid property of surface.

8.13. Bearing Ratio Cutoff Depth Button (tp) - The bearing ratio is ratio of the bearing length to the sampling length.

8.14. High Spot Count Peak Count Button- is the number of profile peaks per unit of length projecting through a reference line parallel to a given height above, a line drawn parallel to the mean line through the lowest point of he roughness trace.

8.15. Setup Analysis Tools Button-This tool has two purposes that are used in the Analysis of the gathered data. The first is leveling the data is accomplished based on a choice of data to be used as a leveling basis. The second is the data is complied as a histogram for comparison of feature depth in the scan.

8.16. 3D Cursors Button- The 3D Cursors screen is designed to allow the user to view the cursor coordinates, and manipulate the cursor position and boundaries by coordinate.

9. X-Y window

9.1. Pull down menus

9.1.1. Focus- Using the current magnification settings, this button causes the system to focus on the sample that is on the stage at the same time that the stylus is nulled on the sample surface.

9.1.2. View

9.1.2.1. Video controls- Displays the video display dialog box. You can change brightness and contrast.

9.1.2.2. Save image –Displays the dialog box which sets up the location of where the image is to be saved. Please save you images to the following location. c:\eagle\scandata\user_scan_data\(your_name). Data which is not in this directory will be deleted.

9.1.2.3. Print image-Displays the dialog box for printing the image in the video portion of the screen.

9.1.2.4. Display Center object View- The puts the center of the object being scanned at the screen crosshair.

9.1.2.5. Align sample-Displays the dialog box used for setting up the angular rotation of the sample on the sample stage and initiates the automated procedure for aligning the sample to the video display. This command will align the sample to a datum.

9.1.2.6. Zoom in- Causes the optics to zoom in to higher magnification.

9.1.2.7. Zoom out- Causes the optics to zoom in to a lower magnification.

9.1.2.8. Reset Zoom- Resets the zoom position to "0" when the zoom is active (position not saved).

9.1.2.9. Save Zoom Position- Displays a dialog box where the zoom position is set and locked so that it cannot be changed by the Zoom In and Zoom Out buttons.

9.1.2.10. Show Start of Feature- Displays, at the crosshair of the video display, the starting point of the scan.

9.1.2.11. Show Center of Feature- Displays, at the crosshair of the video display, the center of the scan on the sample surface.

9.1.2.12. Show End of Feature-Displays, at the crosshair of the video display, the end of the scan on the sample surface.

9.1.3. Die Grid

9.1.3.1. Load- Displays the dialog box used to load a die grid pattern.

9.1.3.2. Save As… Saves the die grid pattern.

9.1.3.3. Clear Die Grid- Removes any die grid pattern ion the video display window.

9.1.3.4. Clear Dropout Dies- Blocks the dies from being scanned when a mouse cursor is placed over the die on the Sample Positioning Window and the SHIFT+LEFT+MOUSE BUTTON is pressed.

9.1.3.5. Clear Associated Dies- Removes dies which were previously associated in a sequence recipe.

9.1.3.6. Pattern Rec. Options … - The displays the Load Die Grid dialog box.

9.1.3.7. Display Numbers- Display the number on the Sample Positioning Window.

9.1.3.8. Font… - Displays the font dialog box used to change the screen fonts.

9.1.3.9. Move to Partial Dies- Scan the partial die the edge of the wafer perimeter, only when this feature is enabled.

9.1.4. Move

9.1.4.1. Slow- Sets the XY stage to move in the slowest or smallest increment, speed as defined in the Move Extents.

9.1.4.2. Medium- Sets the XY stage to move in medium or intermediate increment, speed as defined in the Move Extents.

9.1.4.3. Fast- Sets the XY stage to move in fast or largest increment, speed as defined in the Move Extents.

9.1.4.4. Move extends-Sets the increment (Slow, Medium, and Fast) for the stage movement. Enter the um per click distance in each field for X/Y movement and the degrees in the Theta fields.

9.1.4.5. Precision Move- Takes out nay backlash in the lead screws.

9.1.4.6. To position- The displays the Move to Position dialog box. Enter the coordinates the stage is to move to. If rotational move is used to reorient a feature already in the view so it can be scanned in a different, also choose Rotate about Camera Position. Click OK to make the move.

9.1.5. Direction

9.1.5.1. Up – Moves the stage in the + Y direction away from the front door by one increment per click. Click and hold the button for continuous movement.

9.1.5.2. Down- Moves the stage in the - Y direction towards the front door by one increment per click. Click and hold the button for continuous movement.

9.1.5.3. Left- Moves the stage in the –X direction toward the left by one increment per button click. Click and hold the button for continuous movement.

9.1.5.4. Right - Moves the stage in the +X direction toward the right by one increment per button click. Click and hold the button for continuous movement.

9.1.5.5. Fast Z up- Raises the scan head away from the stage by one increment per button click. Click and hold the button for continuous movement.

9.1.5.6. Fast Z down (focus) - Lowers the scan head and sensor to the null position, and focuses the video image. The measurement head automatically lowers to the correct distance from the sample for real-time video. This is the same as click the focus button.

9.1.5.7. Rotation CCW- Rotates – Rotates the stage in theta counterclockwise direction by one increment per button click. Click and hold the button for continuous movement.

9.1.5.8. Rotation CW- Rotates the stage in theta clockwise direction by one increment per button click. Click and hold the button for continuous movement.

9.1.6. Action

9.1.6.1. Start scan- Starts the scan process.

9.1.6.2. View Scan-Changes to the view scan window.

9.1.7. Sample

9.1.7.1. Manual load- Moves the stage towards the front door. This is used for loading and unloading wafers.

9.1.7.2. Change configuration- This brings up the Safe Area configuration box.

9.1.8. Vacuum

9.1.8.1. Off-Not applicable for P-16 profiler systems. The vacuum status is set using a manual switch next to the door.

9.1.8.2. On- Not applicable for P-16 profiler systems. The vacuum status is set using a manual switch next to the door.

9.1.9. Stylus

9.1.9.1. Drop/lift- Causes the stylus to pivot up. A check mark is visible while it is in the UP position. Click it to release it back to its normal scanning position.

9.1.9.2. Distance- Displays the distance from sample dialog box. This is the distance from the stylus to the sample surface during scan positioning. Set the number in um and click OK. The distance remains in effect until changed by the user.

9.1.10. Blob- Edit Binarization Threshold- Activates the blob Analysis capability when the display center object view feature is selected from the view menu. This allows the user to draw a box around an object visible in the video image, and the stage moves to the center of that object using the image contrast to locate the object. The contrast value can be set from 0 to 255 with a typical range 60-100.

9.2. X-Y Window Buttons at the top (left to right)

9.2.1. Slow –Sets the XY stage to move in small increments as set in Move Extents.

9.2.2. Med - Sets the XY stage to move in moderate increments as set in Move Extents.

9.2.3. Fast - Sets the XY stage to move in large increments as set in Move Extents.

9.2.4. Up-Moves the in the +Y direction (away from the door) by one increment per button click. Click and hold the button for continuous movement.

9.2.5. Down- Moves the in the -Y direction (towards the door) by one increment per button click. Click and hold the button for continuous movement.

9.2.6. Left- Moves the in the -X direction (towards the left) by one increment per button click. Click and hold the button for continuous movement.

9.2.7. Right- Moves the in the +X direction (towards the right) by one increment per button click. Click and hold the button for continuous movement.

9.2.8. Counterclockwise-Rotates the stage in the theta counterclockwise direction by one increment per button click. Click and hold the button for continuous movement.

9.2.9. Clockwise- Rotates the stage in the theta clockwise direction by one increment per button click. Click and hold the button for continuous movement.

9.2.10. Elev- Raises the measurement head away from the stage by one increment per button click. Click and hold the button for continuous movement.

9.2.11. Focus-Lowers the scan head containing the sensor assembly to the null position, with the stylus just above the surface, and focuses the video image.

9.2.12. Zoom in- Changes to higher magnification with each click.

9.2.13. Zoom out- Changes to lower magnification with each click.

9.2.14. Start- Starts the scan process.

9.2.15. Down/Lift-A toggle that lifts and drops the stylus.

9.3.

10. 2D-Analysis window

10.1. Pull down menus

10.1.1. File

10.1.1.1. Start scan- Starts the scan process.

10.1.1.2. View scan- Switches to the view scan window.

10.1.1.3. Save data- Saves the current data to file.

10.1.1.4. Export graph-Exports the current data to file.

10.1.1.5. Print -no printer attached.

10.1.1.6. Print preview-no print attached.

10.1.1.7. Print setup-not printer attached.

10.1.1.8. View Simple Binary File-

10.1.1.9. Load Workspace-The option allows the user to choose a specifically designed work space from a drop down menu the select work space dialog box.

10.1.1.10. Save Workspace-This option presents a dialog box that allows the user to establish a named work space.

10.1.1.11. Origin Information-

10.1.1.12. Apex Analysis- Activates the Apex Analysis software.

10.1.1.13. Exit- This options Exits the Analysis screen.

10.1.2. Edit

10.1.2.1. Recipe – Switches to the Recipe Editor window.

10.1.3. View

10.1.3.1. Change Z graph limits -

10.1.3.2. Log 10 x axis –

10.1.3.3. Log 10 z axis -

10.1.3.4. Normal data -

10.1.3.5. FFT… -

10.1.3.6. PSO -

10.1.4. Trace

10.1.4.1. Normal trace - Toggles, ON/OFF, the waviness trace graph.

10.1.4.2. Waviness trace - Toggles, ON/OFF, the waviness trace graph.

10.1.4.3. Roughness - Toggles, ON/OFF, the roughness trace graph.

10.1.4.4. Auto scale – Toggles, ON/OFF, the auto scale function.

10.1.5. Parameters

10.1.5.1. N/A

10.1.6. Operation

10.1.6.1. Level Trace- levels the trace according to cursor settings and activates the measurement cursors.

10.1.6.2. Fine movement - Activates Fine Cursor Movement mode of measurement and leveling cursors.

10.1.6.3. Zoom - Activates the zoom capability. To focus on a certain part of the graph, use the cursor boundaries to define the zoom in area.

10.1.6.4. undo zoom - Displays the graph view in the original view size.

10.1.6.5. Extents -

10.1.6.6. Recal. / unzoomed cursors - This initiates a recalculation of the data using newly placed measuring cursor.

10.1.6.7. Remove glitches within cursors – The 2D glitch removal is designed to remove erroneous data caused by environmental noise.

10.1.6.8. Procedure

10.1.6.8.1. Move the left cursor to the next position to the left of the glitch that models the trace where the glitch occurs. Place the cursor’s left and right borders to include the data set that is to be used to remove the glitch.

10.1.6.8.2. Move the right cursor to the next position to the right of the glitch that models the trace where the glitch occurs. Place the cursor’s left and right borders to include the data set that is to be used to remove the glitch.

10.1.6.8.3. Move the cursor over Remove Glitches Within Cursors to display its menu.

10.1.6.8.4. Click on the required filter.

10.1.7. Window

10.1.7.1. Cascade

10.1.7.2. Tile vertical

10.1.7.3. Tile horizontal

10.1.7.4. arrange icons

10.1.8. Help

10.2. Tool bar buttons (left-right)

10.2.1. Undo zoom- Displays the graph view in the original view size.

10.2.2. Zoom-Activates the zoom capability. To focus on a certain part of the graph, use the cursor boundaries to define the zoom in area.

10.2.3. Auto scale on/off- Enables and disables zooming in X only or zooming in X and Z.

10.2.4. Level data on/off- First click activates the level cursors. The second click levels the trace according to cursor settings and activates the measurement cursors.

10.2.5. Open Statistics- Opens the surface parameters summary window. If the surface Parameter Summary window is currently minimized, it appears maximized upon clicking this button.

10.2.6. Recalculate statistics- This initiates a recalculation of the data using newly placed measuring cursor.

10.2.7. Normal trace on/off-Toggles, ON/OFF, the normal trace graph.

10.2.8. Waviness Trace on/off- Toggles, ON/OFF, the waviness trace graph.

10.2.9. Roughness trace on/off- Toggles, ON/OFF, the roughness trace graph.

10.2.10. Fine cursor movement-Activates Fine Cursor Movement mode of measurement and leveling cursors.

10.2.11. Start Scanning- Starts the scan process.

10.2.12. Print- Prints the Analysis graph and surface parameters summary.

10.2.13. Apex Analysis- Activates the Apex Analysis software.

10.3. The left side of the Analysis window displays the basic data taken from the leveling and measurement cursors. These values are updated instantaneously with positioning of the cursors.

10.3.1. Meas (um) - Displays the X-axis value of the left vertical line of the left and right measurement cursors.

10.3.2. Delta (um) - Displays the X-axis value of the right vertical line of the left and right measurement cursors.

10.3.3. Level (um) - Displays the X-axis value of the left vertical line of the left and right measurement cursors.

10.3.4. Ref (um) - Displays the Feature detection reference point within the trace.

10.3.5. L Height – Displays the Average height of the scan region marked by the left measurement cursor.

10.3.6. R Height – Displays the Average height of the scan region marked by the right measurement cursor.

10.3.7. St Height – Displays the difference between the R Height and the L Height.

10.3.8. Width – Displays the difference between the average X value of the scan region marked by the right measurement cursor, and the average X value of the scan region marked by the left measurement cursor.

10.3.9. TIR – Displays the difference between the highest and the lowest points on the scan between the measurement cursors. Stands for Total Indictor Run out.

10.4.

11. View Scan Window

11.1. Pull down menus

11.1.1. File

11.1.1.1. XY View-Returns to the XY View screen.

11.1.1.2. Analysis-Returns to the Analysis screen with the current data displayed.

11.1.1.3. Edit Recipe-Open the recipe screen for the current scan.

11.1.1.4. Exit Scan- Closes the current screen.

11.1.2. View

11.1.2.1. Toggle video or wafer view (CTRL-W). Provides choice of view between live video as the system scans in the video overlay or view a representation of the wafer and the scanning position on the video overlay.

11.1.2.2. Auto scroll Statistics (CTRL-T) Drop done option displays the statistics in a statistics in a statistics pane of the live scan page.

11.1.3. Trace

11.1.3.1. Rescale-Resizes the trace to fit the graph. Requires operation initiation.

11.1.3.2. Auto scale –Scales the trace as it is being created.

11.1.3.3. AC/DC –not available.

11.1.4. Mode

11.1.4.1. Background subtraction- Appears active but is not available for use with the P-16 Profiler system.

11.1.5. Image

11.1.5.1. Zoom in-not available

11.1.5.2. Center Anchor-not available for single 2D scans.

11.1.5.3. Corner Anchor-not available for single 2D scans.

11.1.5.4. Edit Scan Parameters- Use the file/recipe menu item for this function.

11.1.6. Scan

11.1.6.1. Start – Starts the scan after it has been stopped mid process. This is the same as the start button in the tool bar. The grayed out options the currently active one.

11.1.6.2. Stop – Stops the scan during a scan without canceling the procedure.

11.1.7. Seq

11.1.7.1. Pause-Used in Scan Sequences only.

11.1.7.2. Resume- Used in Scan Sequences only.

11.1.8. Pan

11.1.8.1. Slow-Small size stage movement's increments. The slow movement is defined in the Move Speeds dialog box.

11.1.8.2. Medium- Medium size stage movement's increments. The medium movement is defined in the Move Speeds dialog box.

11.1.8.3. Fast- Large size stage movement's increments. The large movement is defined in the Move Speeds dialog box.

11.1.8.4. Move Speed –Opens the dialog box to define the stage movement increments.

11.1.8.5. Left-Not available on P-16.

11.1.8.6. Right- Not available on P-16.

11.1.8.7. Up- Not available on P-16.

11.1.8.8. Down- Not available on P-16.

11.1.9. Debug-unavailable for this application

11.1.10. Help

11.2. Buttons at the top (left-right)

11.2.1. XY screen- Returns to the XY View screen.

11.2.2. Go to Analysis screen- Returns to the Analysis screen with the current data displayed.

11.2.3. Rescale trace- Resizes the trace to fit the graph. Requires operation initiation.

11.2.4. Auto scale- Scales the trace as it is being created.

11.2.5. Start scanning- Starts the scan after it has been stopped mid process.

11.3.

12. Problems/Troubleshooting

12.1. Errors

12.1.1. The P-16 program sometimes stops running. If this happens, end the 7.1 Profiler program and restart the tool.

12.1.2. Flash drive- please tell window to stop the drive before removing it.