Tencor Alphastep 200 Automatic Step Profiler

The Alphastep 200 is a computerized step profiler with a manual X-Y stage, and a 9" video monitor which displays a magnified view of the sample and stylus during the scan, as well as scan profiles and a summary of scan data. The system has the capability of "manual" single scans only. The system allows the operator to set, and store if desired, a variety of scan parameters such as scan direction, scan length/sampling rate and vertical units (kA vs. Mm). Measurement cursors are used to level plots, obtain a variety of data, and/or to zoom in on a particular section of a scan profile. A printer is built into the system for hard copies of screen scan profiles and data.

This machine is to be used by authorized personnel only. For training & consultation contact Lab Manager or Engineer.

Schedule and start a session in iLabs

1.0 System Description

General

The figure in the hard copy manual shows the main features of the system.

The top half of the system houses the printer, video monitor and its controls. The lower half has the sample chuck and the keyboard, by which the sample and data are manipulated.

Specifications of mechanical profilometer

Scanning Stylus: 12.5-micron radius Zoom Video Microscope 40x to 120x Magnification 5 Angstrom Vertical Resolution 400 Angstrom Horizontal Resolution Tracking Force - User adjustable 1 to 25 mg Maximum Sample Dimensions
- 16.5 mm thickness, 162 mm diameter

Data Display:

The Alphastep 200 digitizes measurement data and stores it in memory during the scan. When the scan has been completed, a plot of the scan is displayed along with pertinent data and information on the scan characteristics. The cursors displayed on the plot are positioned by the operator to level the plot and/or obtain the desired data.

The following describes the data display as read from top to bottom:
ID# Optional identifier (up to 7 characters) for sample assigned by the user. Pressing # when the system is NOT in "Enter Mode" (see below) will allow the user to enter a number. Pressing ENT, PRINT or initiating a scan will terminate the entry. VERT Total vertical scale on plot in kA or Mm (specified by operator) Profile height at intersection with left cursor. R Profile height at intersection with right cursor. Highlighted Value Calculated
difference between heights at cursors. Avg. Average profile height between cursors measured relative to the baseline.

TIR	Total Indicator Runout - difference between maximum and minimum profile heights for section of plot between measurement cursors.
R	Arithmetic Average Roughness, see a manufacturer's manual for details.
Area	Cross-sectional area of a profile above the base line, displayed in Mm2. The base line is that line which extends between the intersections of the two measuring cursors and the profile. Only those parts of the profile above the line are included in the measurement. See section 2.3 for details on how to display the area and the baseline.
HORIZ	Total horizontal scale on plot (scanlength) Position at left cursor on horizontal scale
R	Position at right cursor on horizontal scale

Highlighted Value Difference between horizontal positions.

Directly under the data described above are the chosen scan length/sample density specifications, scan time, scan direction, stylus force, and the vertical units.

Keyboard

There is a figure showing the keyboard in the hard copy manual. A brief description of key functions follows. For further information on using the keyboard, see the detailed operating procedures in Section 3 and Appendix 2 Reference Guide..

ENT	"Enter" Pressing this button will initiate/terminate "Enter Mode" in which the operator can change parameters in the scan menu.
VID	"Video" Toggles the screen between the sample display and the scan menu.
O	Moves the stage out from under the stylus to the "home" position, for loading or unloading of samples.
-	Holding this key down when a plot is on the video screen displays the cross sectional area of the profile as described under Area in Section 2.2 (Data Display) above.
.	Holding this key down when a plot is on the video screen displays the baseline of the profile as described under Avg in Section 2.2 (Data Display) above.
RESET	If pressed prior to a scan, will return measurement cursors to their position during the previous scan. Used for other miscellaneous operations, such as setting the time clock.
RANGE	Allows the user to set the scan length/sample density. The highlighted values change as either the ^ or "down arrow" key is pressed.
PLOT	Used to zoom in on a section of a profile between the measurement cursors, or to level a profile.
CUR	This key and its associated <- and -> keys allow the operator to set scan

direction and place the measurement cursors.

LEVEL   Used to level the baseline of a profile.

TABLE   The ^ and "down arrow" keys will move the sample chuck up and down respectively.

FEED   Printer paper feed.

START/STOP   Starts/stops the scan.

Operating Procedure

Setting Scan Parameters

Up to 9 scan menus containing scan parameters can be stored in the system. It is usually convenient, however, to simply bring up the default menu and modify it to suit your needs, as follows.

1. Make sure the power is on.
2. Press VID to bring up a menu.
3. Press ENT to initiate "Enter Mode". You will see a message at the bottom of the screen "SCAN MENU may now be changed".
4. Use the RANGE keys to select the desired scan length and sampling rate. Note how the scan time changes as you move through the options.
5. Use the CUR (cursor) arrow keys to indicate desired scan direction. Note: this is the direction in which the stylus will move, not the substrate.
6. Use the CUR key to toggle the vertical units (MODE) between kA and Mm.
7. Once all the parameters are set as you want them, press ENT to leave "Enter Mode". Press VID to toggle the screen display back to the sample. You are now ready to start your scan.

Scanning a Sample

8. Press the TABLE key to lower the substrate table. Make sure that there is enough room for your sample to clear the stylus housing when it is mounted on the chuck.

9. Use the stage positioning knobs on the left hand side to move the stage out from under the stylus.
10. Place your sample on the chuck.
11. Move your sample under the stylus
12. Press TABLE ^ key and watch the screen. You should see your sample come into view, and the stylus lower and come to rest on the surface of your substrate. If you continue to press TABLE ^, the stylus will retract. Thus the TABLE ^ button toggles the stylus between its fully retracted and lowered position. Always retract the stylus when moving the sample.
13. Move to your sample measurement location.
14. With the sample in position and the desired Scan Menu parameters set, press START/STOP to initiate the scan. The sample table will automatically rise if it is not already in the up position. If it must rise more than the amount it lowered after the last scan, it will stop and START/STOP must be pressed again.
15. The stylus will first make a short pass "away" from the section of the sample to be scanned. It will then reverse direction so that it is traveling in the direction specified in the Scan Menu. Data collection will begin when the stylus passes thepoint where it was positioned prior to starting to scan. When finished, move the table all the way down and out from under the stylus before removing the sample.
16. To interrupt a scan, press START/STOP. The data collected to that point will be displayed in the usual manner.

Data Processing

After the scan, the profile is plotted on the screen with a summary of the data displayed next to it. For many applications, this initial display will contain all required information. When further analysis is needed, it can be performed in the instrument's computer without having to re-scan. If the profile appears tilted, proceed to Section 4.3 before taking any measurements.

Overriding Vertical Auto-Ranges

To change the vertical range after the scan, press the RANGE ^ or "down arrow" key. The range is indicated in the data summary, next to the label VERT. When the desired range is selected, press PLOT to redraw the image. The profile will be centered vertically where it intersects the left cursor. Some of the profile may spill of the screen at higher magnifications.

Measurement Cursors - Measuring Profile Features

On the edges of the profile are two dashed vertical lines. These are the measurement cursors, used to make horizontal and vertical measurements off the plot. Cursor-derived measurement data is continuously displayed in the data summary on the left side of the screen.

The CUR button selects the cursor to be moved. You can see the active cursor indicator appear over each cursor in turn, and then over both as you repeatedly press this button. When both cursors are active, they will remain a fixed distance apart as they move simultaneously. The arrow buttons will move the cursor(s) in the direction indicated. Holding down these buttons causes the cursors to automatically speed up for long moves.

The cursors can be returns to the ends of the scan by pressing CUR followed by ABT. This also undoes all zooming (see below), returning to the plot displayed immediately after the scan.

Vertical measurements are shown in the data summary under the heading VERT. Profile heights at the cursors appear directly beneath the label. The highlighted area directly below shows the difference between the heights.
Thus to measure a step height, simply position one cursor so that it intersects the substrate at the base of the step. Position the other so that it intersects the profile on top of the step. The vertical difference shown in the highlighted area under VERT is the step height.

Horizontal measurements are shown in the data summary under the heading HORIZ. Scan positions at the cursors appear directly beneath the label.
The highlighted area directly below shows the distance between the cursors. To measure the width of a feature, position on cursor on each side of it and read the horizontal distance shown in the highlighted area under HORIZ.

Once positioned, the cursors will retain those positions for subsequent scans. They will not move unless forced to do so by a change in scan length or they are moved by the operator. If a batch of similar samples is to be tested, the cursors can be left in position and the measurement can be read directly from the data summary with minimum operator intervention.

Leveling the Plot

When the profile is plotted after a scan, a leveling program aligns the trace to the two axes to facilitate accurate measurement. Leveling cursors, vertical lines normally invisible to the user, are used to indicated two points on the profile whose heights are equal. The leveling program re-computes the measurement data to make these heights equal on the display. The rest of the profile is displayed relative to these points.

The leveling cursor are normally located at the ends other scan. If one cursor is on a surface feature higher or lower than the other cursor, the substrate will appear tilted when the program makes both cursor heights equal.

The condition described above can be corrected by moving the leveling

cursors to places on the profile where the heights are equal. Ideally, these should both be on the substrate, near the ends of the scan, although any equally high points may be used.

If the message "SCAN MENU may now be changes" is displayed, press ENT to terminate "Enter Mode".

1. Press the orange LEVEL key. The screen will show the leveling cursors which are dotted vertical lines, instead of the dashed lines used for measurement cursors. The following message will appear at the bottom of the screen: "MANUAL LEVELING may now be changed".
2. Position the cursor so the actual profile height is the same at each cursor. Ignore the indicate profile height. The leveling cursor are moved using the <- and -> keys in conjunction with CUR as described in Section 4.2.
3. Press the PLOT or ENT key. The profile will be redrawn with the points under the cursors at equal heights. The horizontal positions of the leveling cursors are shown in the lower left corner of the screen.
4. Plotting Individual Profile Features - Zoom Any portion of a profile can be magnified for close examination. Using the procedures of the previous section, position the cursors so that they bracket the feature of interest. Press the yellow PLOT button. The display will zoom in on the bracketed region. The horizontal and vertical scales will each auto- range to provide the greatest magnification that the feature's size will allow.

The cursors will still be located at the same points on the profile after the image is re-plotted. The profile will be positioned to place the left cursor at the left edge of the screen. The right cursor will appear in the right half of the screen after the zoom.

To return to the previous magnification after zooming, press PLOT again without moving the cursors. The cursors will remain in their most recent position. Pressing PLOT again will not cause zooming until a cursor has been moved.

To return to the screen showing the entire profile, press ABT. This undoes all zooming but leaves the cursors at their most recent positions on the profile.

Pressing CUR then ABT undoes all zooming and returns the cursors to the ends of the scan.

Average Difference Mode

In Average Difference mode, the system computes the difference between average height measurements. When this mode is entered the

displayed average is stored as a reference reading. The instrument displays the difference between this reference and all subsequent average height measurements. This mode remains in effect until it is exited, even if another scan is taken.

5. Level the plot if necessary (see Section 4.3).
6. Position the measurement cursors on the section of the profile to be stored as the reference reading.
7. Press ENT, then the "dot" key [+].

The vertical height field will be re-labeled "dAv" for average difference. It will read "0" until the cursors are moved.

The difference between cursor heights is not shown in this mode, since the cursors are typically placed at the same profile height when an average is being taken. The reference profile section is marked with vertical lines called the average reference cursors. These cursors are drawn with large dashes and connected by bars at the top and bottom of the screen to distinguish them from the other cursors.

1. Position the measurement cursors on the profile section to be compared to the reference.

   The field labeled "Avg." will show the average profile height between the measurement cursors. The field labeled "dAv" will now show the difference between this value and the reference reading.

   When the measurement cursors are moved, the average height and average difference will be updated.

2. To exit Average Difference mode, press CUR then ABT. The vertical height field will now display the difference between the cursor heights. See the hard copy manual for a figure showing the Average Difference Mode display.

To transfer data to a text file that could be imported into a spreadsheet see notes in Appendix 1:

1. Log into the computer next to the alpha step. This computer is also shared with the Signatone probe station:

   · User name: **user**
   · Password: **MFCguest$**
   · Domain: **this computer**

2. Run the alphastep 200 connection program and wait for the hyperterminal screen.
3. On the hyperterminal screen click on Transfer on the top menu bar
   1. Select Capture Text and wait for the dialog box
   2. Click Browse on the dialog box and choose a location for the text file to be saved. Click on the desktop as the save location.
   3. Select a file name
   4. Press Save
   5. Under Transfer click Start to initiate capture
   6. Go back to the alpha step and press the white PRINT key
   7. Wait for the transfer to complete

8. Under Transfer click capture text and then choose Stop
9. The text file should now appear on the desktop under the name you chose earlier.
4. Delete your saved data file after either transferring it to your memory disk or emailing it to yourself.

Appendix 1

Data Send Option

This option may be used to collect data from the alphastep using the PC located next to the alphastep.

1. Go To C:\ ALPHASTEP folder and delete DATA.TXT and OUT.TXT files

2. Choose HYPERTERMINAL from the desktop

   -Select DATA.HT

   -Choose CONNECT under CALL menu

   -Choose CAPTURE TEXT under TRANSFER menu

   -Click on START

3. Go To the alphastep unit and press PRINT . The data will be sent to the PC

4. Go To the PC

   -Choose CAPTURE TEXT under the TRANSFER menu

   -Select STOP

   -Choose DISCONNECT under CALL menu

   -Close HYPERTERMINAL window

5. Go To C:\ALPHASTEP Folder

   -Click on COLUMN.SWAP.EXE

   -Enter "DATA.TXT", then hit ENTER

   -File "OUT.TXT" will be created

6. Go To EXCEL

   -Open C:\ALPHASTEP\OUT.TXT File

   -Choose FINISH on the Import Wizard

   -Highlight the data

   -Select CHART under the INSERT menu

   -Select XY(SCATTER)

   -Choose FINISH

After you finish plotting, you may save it to your disk or print it out. You may also FTP the file to your account.

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FUNCTION	INPUT SEQUENCE	DESCRIPTION/ COMMENTS

DELTA AVERAGE

1. Position Reference Cursors	[←] or [→]	Define reference page.
2. Enable Software	[ENT] [•]	Second set of cursors will appear.
3. Position Measurement Cursors	[←] or [→]	Mode will remain with subsequent scans unless the menu is changed or mode is exited. Reference Cursors cannot be moved.
4. Exit Delta Average Mode	[CUR] [ABT]	Cursors will be returned to ends of graph. Only one set of cursors remains.

SLOPE MEASUREMENT

1. Access Set Up Menu	[RESET] [ENT] [VID]	
2. Enable Software	[LEVEL]	Field will change from Area to Angle.
3. Initiate Scan	[START/STOP]	Parameters must be set at 80 μm, 25 s/μm.

REPEAT AND AVERAGE

1. Position Cursor	[←] or [→]	Delta Average Mode can be used if desired.
2. Enable Software	[ENT] [TABLE ↑]	
3. Input no. of repeats	[X]	Scan will be repeated X (0–9) times.
4. Initiate Scan	[START/STOP]	

STYLUS FORCE ADJUSTMENT

1. Lower Stylus	[TABLE ↑]	Table must be fully raised.
2. Enable Software	[ENT] [VID]	
3. Adjust Stylus Force	Adjust setscrew	Location of setscrew and complete instructions in Alpha-Step 200 Manual. Turn CW to increase, CCW to decrease.
4. View Stylus Force	[TABLE ↑]	Actual Stylus Force will be displayed. Also after each scan.

ALPHA-STEP 200 KEYBOARD
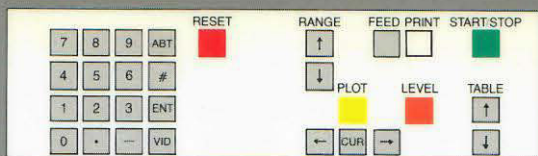
FUNCTION	INPUT SEQUENCE	DESCRIPTION/ COMMENTS

GRAPHICAL ANALYSIS

FUNCTION	INPUT SEQUENCE	DESCRIPTION/ COMMENTS
Cursor Movement: Select Cursor	CUR	Symbol (▶) will appear above the cursor(s) selected for movement.
Move Cursor(s)	← or →	Cursors can be moved independently or in tandem.
Assign I.D. # 123 to Plot	# 1 2 3	
Rescale Vertical Axis: Increase Scale	RANGE ↑ PLOT	New range is displayed next to the VERT label in the data summary section of the screen.
Decrease Scale	RANGE ↓ PLOT	
Display Baseline	•	
Display Area	—	Cross-Sectional Area will be shown.
Toggle Display	VID	Toggle video between camera image and graphical plot.
Expand Trace:	PLOT	Section of trace between cursors will be replotted to fill the screen.
Return to *Previous* Trace	PLOT	Note: if cursors unchanged.
Return to *Original* Trace: Cursors Unchanged	ABT	Cursors will remain at current position.
Cursors Returned	CUR ABT	Cursors will be returned to ends of graph.
Print Graphical Display	PRINT	
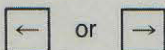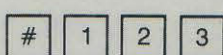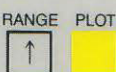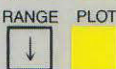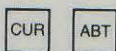
LEVELING

FUNCTION	INPUT SEQUENCE	DESCRIPTION/ COMMENTS
Manual Leveling: 1. Enable Software	LEVEL	New set of cursors will appear.
2. Position Cursors	← or →	Move cursors to desired level endpoints.
3. Relevel Plot	PLOT	Only current plot will be releveled. Endpoints will be recorded on Summary but not on Scan Menu.
Auto-leveling: 1. Enable Software	ENT LEVEL	New set of cursors will appear.
2. Position Cursors	← or →	Move cursors to desired level endpoints.
3. Relevel Plot	PLOT or ENT	Current scan menu will contain new level endpoints. Current and subsequent plots will be releveled.
Disable Auto-leveling	LEVEL ABT	
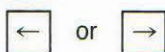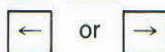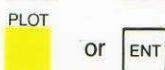
TENCOR
INSTRUMENTS

| FUNCTION	INPUT SEQUENCE	DESCRIPTION/ COMMENTS
STYLUS POSITION		
Raise Stage	TABLE ↑	Table rises. Video image will focus.
Lower Stage	TABLE ↓	
Move Stylus Up/Down	TABLE ↑	Table must be fully raised.
SCAN		
Initiate Scan	START/STOP ▇	Begin new scan. Erase previous scan.
Stop Scan	START/STOP ▇	Stop scan in progress. Scanned region will be plotted.
Stop Scan	RESET ▇	Stop scan in progress. Previous scan will be erased.
Toggle Display	VID	Toggle between camera image and graphical plot.

TEST SET UP MENU   Access it to turn filter on/off, set the clock, display angle or area.

Access Menu	RESET ▇ ENT VID	Erase previous scan. Follow prompts on screen to make changes.

SCAN MENU (Press ENT before and after making changes)

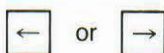|		
Change Scan Range	RANGE ↑ or ↓	Change scan length & sampling density.
Change Scan Length	1 2 3	Highlighted scan length will become 123. (Must be less than preprogrammed length.)
Scan Direction	← or →	
Vertical Units	CUR	Mode field will change: kÅ or μm.
Select Menu # X	# X	Change to Scan Menu X (1–9).
Select Print Mode	PRINT ▢	Print Screen or Summary or Data Send.
Default Parameters	ABT	Return to original scan parameters.
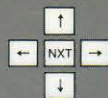
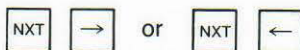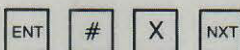| STAGE MOVEMENT	MANUAL STAGE	PROGRAMMABLE STAGE
Move Left/Right:	Turn rear knob	
Slow Speed		[←] or [→]
Fast Speed		[NXT] [→] or [NXT] [←]
Move Forward/Back:	Turn front knob	
Slow Speed		[↓] or [↑]
Fast Speed		[NXT] [↓] or [NXT] [↑]
Move to Home Position		[0]
Rotate	Turn theta wheel	Turn theta fine adjust knob and rotate vacuum chuck against stop.
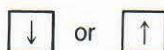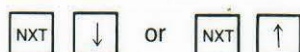
PROGRAM LOCATIONS

Program Location in Menu X   [ENT] [#] [X] [NXT]

Erase Location in Menu X   [ENT] [#] [X] [—]

MOVE TO LOCATION IN MENU X

[X]

AUTOMATIC SCAN SEQUENCE

[0]   START/STOP ■

All programmed locations
will be executed in order of
increasing menu numbers,
skipping over non-programmed
locations if any.

TOGGLE AUTOPRINT ON/OFF

RESET ■ [ENT] [VID] [•]