APPENDIX A - SPECIFICATIONS

MEASUREMENTS

Roughness

R_a, Arithmetic Average
Max R_a, Maximum of 19 overlapping sections
R_q, Root-Mean-Square (RMS)
R_p, Maximum Height
R_v, Maximum Depth
R_t, Maximum Peak-to-Valley
R_z, Ten-Point Height
R_{3z}, Six-Point Height

Waviness

W_a, Arithmetic Average
W_q, Root-Mean-Square
W_p, Maxixum Height
W_v, Maximum Depth
W_t, Maximum Peak-to-Valley

Topography

TIR Total Indicator Run-out

Height Height between two points (Step Height)

Average Height Average height of all data points between the measurement cursors relative to the leveled baseline (Delta Average Mode).

Cut Off Filter

mm	inch	mm	inch
.0045	.0002	0.45	.018
.008	.0003	0.8	.03
.014	.0006	1.4	.055
.025	.001	2.5	.1
.045	.002	4.5	.18
.08	.003	8.0	.3
.14	.006	14.0	.55
.25	.01	25.0	1.0

PROFILING PERFORMANCE

	Metric	English
Scan Length	210 mm	8.2 in. maximum.
Scan Speed	1 µm/s to 25 mm/s	0.04 mil/s to 1 in./s

Sampling Rate	50, 100, or 200/s nominal	
Vertical Range		
At 1Å (0.004 μin.) Resolution:	± 6.5 μm	± 0.25 mil maximum.
At 25Å (0.1 μin.) Resolution:	± 150 μm + 20/-280 μm + 280/-20 μm	± 6 mil maximum + 0.8/-11 mil or + 11/-0.8 mil
Vertical Linearity, entire range	± 0.5%	± 0.5%
Horizontal Resolution	**Metric**	**English**
At 1 μm/s scan speed	0.01 μm (100Å)	0.4 μin.
Scan Method	Moving stage, stationary stylus	
Stylus Control	Programmable Force:	
	Range	1.0 - 100 mg
	Resolution	0.1 mg
	Full retract between scans	
	Programmable descent rate	

REPEATABILITY AND STABILITY

Step Height Repeatability	
13 μm (± 6.5 μm) range	0.001 μm (10Å) maximum standard deviation
300 μm (± 150 μm) range	0.005 μm (50Å) maximum standard deviation
	Note: The Step Height Repeatability has been verified using step height standards from VLSI Standards with a sequence of fifty 10 s measurements at a single position.
Base Line Stability	
Time	0.02 μm (200Å) maximum TIR for a 100-s scan.
Distance	0.2 μm (2000Å) maximum TIR on a profile length of 130 μm verified on a l/20 optical flat.
Measurement Environment	Floor vibration below 0.2 mG
	Audio noise below 80 dB
	Ambient temperature range 16-26° C
	Maximum rate of change 2° C/hour

MEASUREMENT CONTROL

Manual/Single Scan Mode

Continuous or segmented scan, from recipe.

Keylock with three Modes

Position 1: Run a single recipe or sequence without modification.
Position 2: Run any recipe or sequence without modification.
Position 3: Unlocked. All functions available including interlock setting.

Repeat and Average Mode

Scan repeated up to ten times and averaged.

Automatic Sequence Mode

Up to 100 recipes and locations combined into a sequence of recipes (optional).

SAMPLE HANDLING

Motorized X-Y

Two programmable locations (Standard Config.)
Unlimited programmability (Automatic Config.)

Manual Control

Via trackball or keyboard

Maximum Sample Size

Metric	English
254 x 254 mm	10 x 10 in.

Note: 355 x 355 mm (14 x 14 in.) with side panel removed
Note: Stylus can access any part of a 210-mm (8.2-in.) round sample without sample repositioning.

Open Frame Configuration

Without Removable Isolation Hood:

480 x 480 mm	19 x 19 in.

With Removable Isolation Hood:

430 x 430 mm	17 x 17 in.

Note: Inside space of hood is 743 mm (29.25 in.) X, 556 mm (23.1 in.) Y. A 480-mm (19-in.) sample has full 210 mm (8.2 in.) of scan or positioning motion in the X direction but only 100 mm (4 in.) in the Y direction.

Note: Stage Table: 243 x 243 mm (9.57 x 9.57 in.) with switchable vacuum to handle wafer sizes of 100 mm (4 in.) to 200 mm (8 in.). Accomodates

	Tencor P-2 sample locators. Note: The stylus can access, without sample repositioning, one 210-mm (8.2-in.) diameter area or a 145-mm (5.7-in.) square area. Also, the stylus can access 86% of a 355-mm (14-in.) or 73% of a 430-mm (17-in.) square sample when the sample is moved to each of four or five positions respectively.	
Maximum Sample Weight	2.2 kg	5 lb
Throat Depth	228 mm	9 in.
Throat Height, incl. Rotary Stage	63.5 mm	2.5 in.
X,Y Maximum Travel	210 mm	8.2 in.
Stylus and Sample Programmed Position Repeatability (1 σ)	2 μm	0.08 mil
X,Y Positioning Speed	Variable up to: 25 mm/s	 1 in./s
Manual Stage Rotation	Unlimited rotation. Can be set with six detents (four at 90^{o}, two at ± 45^{o})	
Motorized Stage Rotation		
Angle Resolution	0.001 degrees	
Position Repeatability (1 σ)	4 μm (at 4 in. from center)	0.16 mil
Leveling	Electronic leveling of traces is standard. Automatic mechanical leveling of sample with Motorized Level and Rotation Option	
Vacuum Hold-Down of Sample	Standard with either of the rotating stages	
Custom Fixturing Interface	Six mounting holes, 8-32 on 3.6-in. diameter B. C.	
Standard Precision Locator	(See Appendix F, "Ordering Information.")	

DATA STORAGE

Hard Disk	40 Mbytes. Stores up to 6000 scans at 1000 points each.
Diskette	1.4 Mbyte, 3.5 in. Data storage limited to approximately 100 recipes and 200 scans at 1000 points each. (300 scans per diskette dedicated to data.)
Storage Requirements	DOS Operating System: approx. 80 Kbytes Tencor P-2 Program: approx. 500 Kbytes Recipe: approx. 140 bytes Scan Data (incl. graphs): Approx. 240 bytes + 250 bytes/s of scan time (e.g., 20 s scan time: 4240 bytes).

DATA ANALYSIS

Interactive Graph	Two cursor read-out. Cursors move independently or in tandem.
Delta Average Mode	Each cursor is expandable into a region for measurement or leveling.
Zoom Box Data Expansion	Portion of a graph can be magnified.
Data Catalog	Immediate data retrieval and display from catalog.
Database Manager Option	For each recipe in a given sequence: data table with statistics of mean, standard deviation, minimum, maximum, and range for up to 20 surface analysis parameters. Recall or purge data saved on disk using up to seven user-labeled identifiers in addition to recipe and sequence identifiers, dates. Data can be formatted for PC-AT compatible programs.
Metric/English Units	Parameters displayed in preprogrammed metric or English units; independent selection of horizontal and vertical parameters.

EQUIPMENT SPECIFICATIONS

Processor	8038620-MHz controller, PC/AT compatible, runs MS-DOS Operating System, version 3.3.
Screen	Displays magnified image of the sample or output data. Initial data trace or cross-hair identification of stylus location relative to stage can be superimposed on sample image. 33 cm (13 in.) diagonal High resolution: 640 x 350 pixels Color data display, user-selectable colors Variable image magnification: 150 - 600X standard. 60 - 240X optional, factory only. Motorized zoom with keyboard control Filtered illumination of sample (Yellow-red wavelength only)
Console	Built-in keyboard and trackball to program and operate instrument.
Remote Keyboard	Removable keyboard enabling use of PC/AT software (Automatic Configuration only).
Real Time Clock	Battery-backed clock provides date and time of day.

PHYSICAL SPECIFICATIONS

Tencor P-2 without Wafer Handler

Dimensions	**Metric**	**English**
Width	57 cm	22.5 in.
Height	75 cm	29.3 in.
Depth	78 cm	30.6 in.
Open Frame Configuration		
Width (with hood)	75 cm	29.3 in.
(without hood)	57 cm	22.5 in.
Depth	90 cm	35.6 in.
	Note: Feet will fit on a 76-cm (30-in.) deep table.	
Hood Door Opening	55 cm	21.9 in.
Overall Width (with hood)	75 cm	29.3 in.
(without hood)	57 cm	22.5 in.

Weight		
Instrument	118 kg	260 lb
Shipping Weight	197 kg	435 lb
Open Frame Configuration		
Instrument Weight	127 kg	280 lb
Tencor P-2 with Wafer Handler		
Dimensions	**Metric**	**English**
Width	117 cm	46.0 in.
Height	154 cm	61.0 in.
Depth	78 cm	30.6 in.
Weight		
Instrument	231 kg	510 lb
Shipping Weight	354 kg	780 lb

Electrical

90-130 V, 50/60 Hz
180-260 V, 50/60 Hz
Power requirements: 150 VA