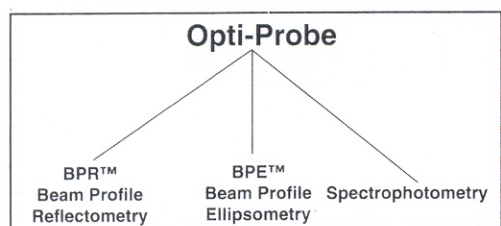


Opti-Probe™ 2100/2600

Film Thickness Measurement System Specifications

Opti-Probe
Integrates 3 Technologies into 1 Tool...



... for Superior Performance
and Cost-Effectiveness

Precision and Repeatability

One Parameter Measurements

Film(s)	Thickness Ranges	Parameters Measured	Precision*	
			Repeatability**	
Oxide/Si, Nitride/Si, & Oxynitride/ Si	0-100Å	t	0.1Å	0.2Å
	100-1,000Å	t	0.2Å	0.4Å
	1,000-10,000Å	t	0.5Å	0.8Å
	10,000-50,000Å	t	0.8Å	0.02%
	50,000-150,000Å	t	1.5Å	0.03%
Photoresist/ Si	100-1,000Å	t	0.2Å	0.4Å
	1,000-5,000Å	t	0.5Å	1.0Å
Polyimide/ Si	5,000-50,000Å	t	0.8Å	0.02%
Nitride/ Oxide/Si & Oxide/ Nitride/ Si	0-100Å	t	0.1Å	0.2Å
	100-1,000Å	t	0.2Å	0.4Å
	1,000-10,000Å	t	0.5Å	0.8Å
	10,000-50,000Å	t	0.8Å	0.02%
	50,000-150,000Å	t	1.5Å	0.03%
Polysilicon/ Oxide/Si & Amorph. Ox/ Si	200-10,000Å	t _{Si}	0.50Å	1.0Å
	75-5,000Å			
Photoresist/ Oxide/Si	400-40,000Å	t _{Resist}	0.8Å	1.5Å
	100-10,000Å			or 0.02%
Oxide/ Poly/ Oxide/Si	100-10,000Å	t _{Oxide}	0.5Å	0.8Å
	200-10,000Å			
Oxide/ TiN/Al	2,000-35,000Å	t _{Oxide}	1.0Å	2.5Å
	200-600Å			or 0.02%
Oxide/Al	3000-35,000Å	t _{Oxide}	2.0Å	3.0Å
				or 0.02%

Two Parameter Simultaneous Measurements

Film(s)	Thickness Ranges	Parameters Measured	Precision*	
			Repeatability**	
Oxide/Si, Nitride/Si, & Oxynitride/ Si	200-500Å	t	0.5Å	0.8Å
		n	0.002	0.003
	500-1,000Å	t	1.0Å	1.5Å
		n	0.002	0.003
	1,000-50,000Å	t	0.03%	0.1%
		n	0.0008	0.0015
Photoresist/ Si	500-1,000Å	t	2.0Å	4.0Å
		n	0.002	0.006
	1,000-10,000Å	t	2.0Å	0.06%
		n	0.0006	0.001
	10,000-35,000Å	t	0.03%	0.06%
		n	0.04%	0.10%
Polysilicon/ Oxide/Si, Amor. Si/ Oxide/Si	200-10,000Å	t _{Si}	1.0Å	2.0Å
	50-5,000Å	k _{Si}	0.0015	0.004
Oxide/ Nitride/	50-6,000Å	t _{Oxide}	0.9Å	2.5Å
	70-2,000Å	t _N	0.5%	1.5Å
Oxide/ Poly/ Oxide/	200-10,000Å	t _{Oxide}	2.0Å	4.0Å
	500-10,000Å	t _{Poly}	2.0Å	4.0Å
Oxide/ TiN/Al	2000-35,000Å	t _{oxide}	1.0Å	2.5Å
	200-600Å	t _{TiN}	1.0Å	2.5Å
TiN/Al	200-600Å	t _{TiN}	0.8Å	3.0Å
		k _{TiN}	0.05	0.07

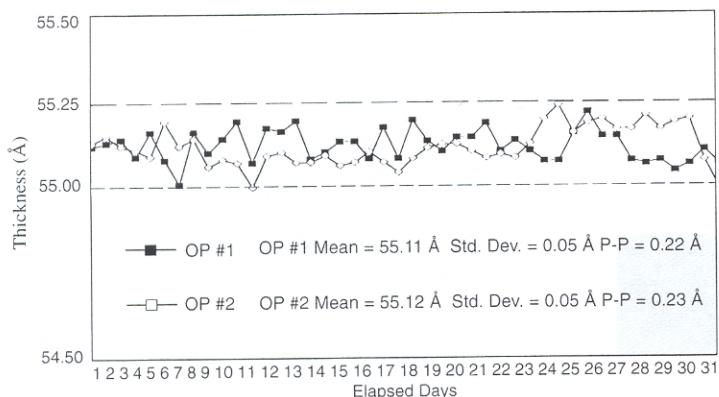
Three Parameter Simultaneous Measurements

Nitride/ Oxide/Si	1,000-10,000Å	t _{Nitride}	2.0Å	4.0Å
	200-5,000Å	t _{Oxide}	2.0Å	4.0Å
		n _{Nitride}	0.001	0.003
Nitride/ Oxynitride/ Si	1,000-5,000Å	t _{Nitride}	2.0Å	4.0Å
	1,000-10,000Å	t _{Oxynitride}	2.0Å	4.0Å
		n _{Oxynitride}	0.001	0.003

* 1 sigma standard deviation of 50 static measurements on one site. Actual results could be different depending on sample condition and film properties.

** 1 sigma standard deviation on one site load/unload, three times a day over a five day period using a saturated uniform sample. Actual results could be different depending on sample condition and film properties.

Unparalleled Opti-Probe Matchability and Repeatability



Accuracy

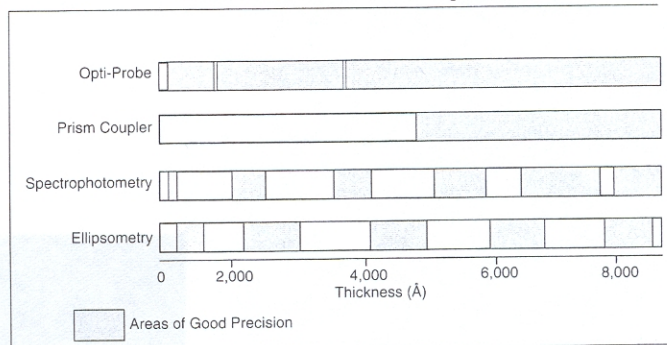
± 3 Å at 500 Å, 1,000 Å, and 2,000 Å nominal thicknesses
 ± 1 Å at 100 Å nominal thickness.
 SiO₂ on Si NIST (formerly NBS) standards

System Specifications

- Throughput*
 - 74 monitor wafers per hour, pre-alignment performed
 - 60 product wafers per hour, global alignment
 - 46 product wafers per hour, site-by-site alignment, 10 X 10 μm measurement area
 - (*5 points per wafer, 500 Å oxide thickness measurement typical)
- Particle Specification < 0.01 particles/cm²/wafer pass (>0.3 μm)
- Uptime >96%
- MTBF 1500 hours
- Measurement System
 - Spot Size (at 1/e² point): 0.9 μm
 - Source: 675nm thermoelectrically cooled diode laser (typical lifetime, 100,000 hours)
- Autofocus:
 - Proprietary high-speed, laser-based subsystem designed for product wafer topography
 - Time for initial focus on wafer: 3 seconds
 - Time for refocusing on wafer: 10-100 milliseconds
- Controller:
 - MS-DOS compatible, 80486/DX2, 66MHz-based PC
 - 16 Mb DRAM memory
 - 270 Mb hard disk drive
 - 3.5 inch floppy disk drive
 - 120 Mb streaming tape backup
 - VGA and color video monitors
 - Color graphics printer
- Calibration:
 - Fully automatic, with calibration interval user-definable
 - Internal reference utilized
 - Calibration time: 30 sec

Continuous Refractive Index Measurements

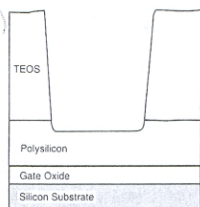
Ranges for Simultaneous Nitride Thickness and Index Measurement for Film Measurement Technologies



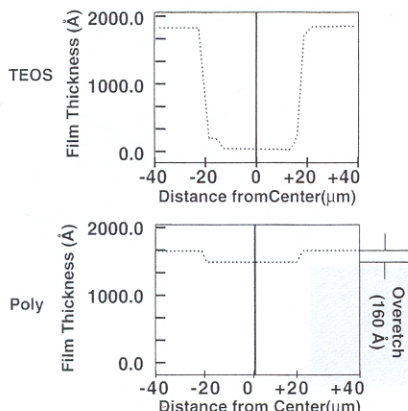
- Friendly graphical user Interface
 - Light pen for all user input including menu control and data entry
 - Trackball for manual stage positioning. Hidden keyboard for diagnostic use
- Data Presentation and Analysis
 - Point Measurements
 - Single Point Measurements: Manual or auto positioning
 - Area Scans for uniformity mapping with user-definable parameters including:
 - Density:
 - Low (21 points)
 - Medium (52 points)
 - High (137 points)
 - Very High (481 points)
 - Size: 10 μm to 200mm diameter
 - Location: Manually selectable with trackball, or Automatically selectable by entering X, Y coordinates
 - Area Scan Displays
 - 2-D Contour Maps:
 - Measurement sites marked by +, -, or □ to signify values >, <, or within 0.25% of mean wafer value, respectively
 - Bold contour line indicates average value
 - User-definable color contour intervals
 - Summary of outlier-excluded wafer statistics
 - 3-D Maps:
 - User-definable parameters:
 - Color contour intervals
 - Viewing angle above wafer plane, from 0°-90°
 - Wafer rotation angle from flat, from 0°-360°
 - Summary of outlier-excluded wafer statistics.

Improved Process Control

Product Wafer Overetch Measurement



- TEOS etched to clear
- Slight overetch into Poly required
- Need to measure amount of overetch into Poly on product wafer.



Line Scans, including Diameter Scans, with user definable parameters including:

Density: 2-625 points

Size: 10 μ m to 200mm

Location: Manually selectable with trackball, or Automatically selectable by entering X, Y coordinates

Orientation: Horizontal or vertical

Template Measurements, including six SEMI and ASTM standard patterns, also provide the following user definable parameters:

Density: Variable for product or monitor wafers

Size: 10 μ m to 200mm

Location: Manually selectable with trackball, or Automatically selectable by entering X, Y coordinates

SPC

Full functionality package allows application of any or all of the five Western Electric rules indicating a process exceeding limits. Any combination of average, sigma, and/or range for one, two, and/or three measured parameters can be displayed. For example, X bar and R charts can be displayed for all three measured parameters.

Both Control Limits and Specification Limits user-selectable

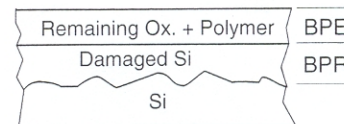
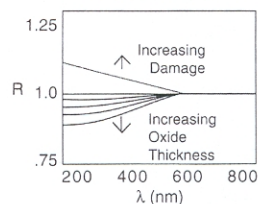
Indexed data base allows rapid storage and retrieval of measurement data

Output: Color graphics printer
VGA monitor display

Measure Damaged Silicon & Remaining Oxides Independently

Spectrometer

OP-2600



Spectrometry: Damage layer causes artificially low oxide reading.

Opti-Probe: BPR +BPE technologies measure damaged silicon and oxide thicknesses independently

• Pattern Recognition

Vision Tools:

Search using normalized correlation along with edge-detection and other image procession tools provide sufficient capability to perform robust pattern recognition at all stages of wafer fabrication (including etch and chemical mechanical polishing, CMP, processes).

Vision Processor:

25 MHz, 68020-based processor
256 gray levels

Spot Placement:

$\pm 2.5 \mu$ m measurement area with site-by-site alignment
 $\pm 12 \mu$ m measurement area with global mask alignment

Resolution (site-by-site):

User selectable down to 0.5 μ m

• Wafer Handling

Wafer Sizes:

100, 125, 150, and 200mm

Wafer Transport:

Cassette size automatically sensed: no additional time required for change of wafer size
3-axis, random-access robot
2 cassette stations standard
Wafer transfer < 8 seconds
Wafer status automatically sensed
Automated user-defined cassette and wafer sequencing

Stage:

X and Y Resolution: 0.2 μ m
Theta Resolution: 0.005°
X and Y Travel: 200 X 200mm
X and Y Speed: Up to 4 inches/sec.
Theta Speed: Up to 30 RPM
Control: 80486-based PC (automatic mode)
Trackball (manual mode)

Wafer Pre-Alignment:

Repeatability:	Notch:	$\pm 0.2^\circ$
	Flat:	$\pm 0.4^\circ$
	Centering :	$\pm 100\mu\text{m}$
Technology:	Non-contact transmission sensor	
Detection:	One major flat	
	Two minor flats	
	Notches	

Facility Requirements (non bulkhead)

Electrical Power:	100-200 or 200-240VAC, 50/60Hz, 15Amp breaker 120VAC, 15A, 60Hz Standard for U.S.A.
Electrical Receptacle:	NEMA 5-15R (for 100-120VAC installations) NEMA 6-15R (for 200-240 VAC installations)
Vacuum Req.	20"-24" (50.8-61cm) Hg, .6 SCFM min. (2 independent lines)
Vacuum Fitting:	1/8" (3.175mm) I.D. hose barb
Air or N ₂ :	80 psi (5.6 kg/cm ²), filtered to 1.5 μm , H ₂ O vapor < 5%, 4 cu.ft./hr
Air Fitting:	1/8" (3.175mm) I.D. hose barb
Exhaust Vent and Fitting:	4" (100mm) diameter, flexible hose 350 SCFM min.
Target Room Temp.:	20° \pm 4°C
Temp. Variation 24 hrs:	Target room temperature $\pm 1^\circ\text{C}$
Room Humidity:	30%-70%, $\pm 2\%$ maximum change in 1 hour
Floor Vibration:	< 2mils peak amplitude @ > 10Hz, < 0.5mil peak amplitude @ < 10Hz

Machine Dimensions and Weight

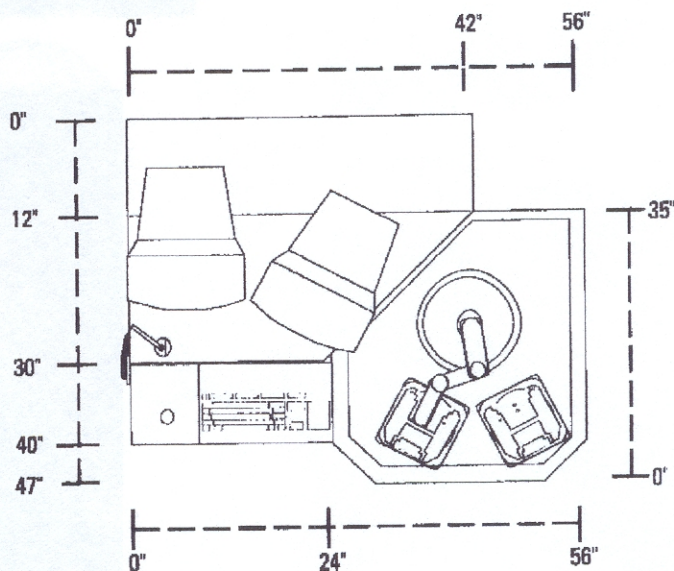
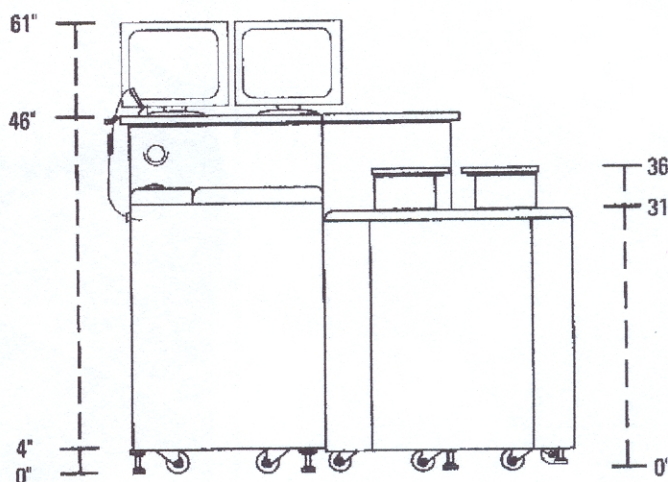
Width:	56" (142.2cm)
Depth:	46" (116.9cm)
Height:	61" (70" service access) (154.94cm, 177.8cm service access)
Weight:	1275lb. (318kg)

Safety Compliance

- Meets National Electrical Code
- Uses UL-approved parts
- Meets applicable CDRH regulations
- Complies with IBM corporate safety standards

Options

- SECS II interface for host computer communication
The optional SECS II interface complies fully with the GEM (SEMI E30-93) specification. It provides bidirectional communication (data upload and recipe download) with a host processor.
- Bulkhead option available
- SMIF Indexer

Opti-Probe Top View**Opti-Probe Front View**

Specifications subject to change without notice.



1250 Reliance Way, Fremont, CA 94539
(510) 490-3663 FAX (510) 656-3852
<http://www.thermawave.com>