alpha·step

Thin Film & Surface Profile Measurement

- **AUTOMATIC LEVELING**—No time-consuming manual adjustments.
- **FAST**—Measurements completed in less than 1 minute.
- **SENSITIVE**—1,000 Å full-scale.
- **ACCURATE**—Exclusive features eliminate interpretation errors.
- **USE ANYWHERE**—No shock isolation required. Exceptional mechanical, electronic and thermal stability.

DESCRIPTION

Tencor Instruments' Alpha-Step is a compact, portable instrument designed for accurate mapping of surface profiles and for precise measurement of thin-film thickness. Unlike other instruments of its type which require tedious zeroing and substrate leveling adjustments before a meaningful measurement can be performed, the Alpha-Step incorporates advanced electronic logic which performs these operations automatically within 15 seconds. Total time required for zeroing, leveling and recording of surface profile is less than 1 minute — even for an untrained operator.

The Alpha-Step has a unique built-in analog computer which processes data from the stylus sensor, vastly improves signal-to-noise ratio on high sensitivity ranges and automatically operates the strip chart recorder with the trace always starting at a point selected by the operator. The result of the automatic leveling and analog data processing is output which is not subject to interpretation errors so common with other instruments.

Alpha-Step has exceptional mechanical, thermal and electronic stability, allowing its use in production environments. The instrument incorporates a three-stage momentum-decoupled mounting (pat. pend.), making it possible to use on ordinary tables and benches without special shock isolation. The basic sensitivity is 1,000 Å full-scale with 10 Å resolution. Even at this range, Alpha-Step is stable and has negligible thermal drift.

All instrument controls are conveniently grouped on one control panel.

APPLICATIONS

Alpha-Step is designed to meet the specific profile measurement needs of the microelectronics industry. Its automatic leveling and recording capability makes Alpha-Step ideally suited for on-line thin film thickness measurements in the production area. Examples of the measurements Alpha-Step can perform include: thin film components of integrated circuits, roughness characteristics of samples, dimensional characteristics of etched oxide patterns and photoresist masks, and flatness of masks and substrates. In addition, Alpha-Step's range of measurement (1,000 Å to 1,000 KÅ full-scale deflection), automatic leveling and zero-setting features, and the ability to accept samples up to 11 mm (.46") in thickness, lend it to a wide variety of uses besides those in the microelectronics industry. These range from measurements of recording surfaces on tapes and discs to surface characteristics of optical elements.

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OPERATION

Alpha-Step scans the sample surface with a diamond stylus and displays the surface profile on a strip chart. The stylus tracking force is adjustable, but is factory set between 15 and 18 mg. An optional variable stylus tracking force adjustment provides a means of setting force between 1 and 20 milligrams (see Technical Bulletin No. 103). Light-emitting diodes on the control panel and in the microscope eyepiece indicate direction of stylus movement.

Substrate Insertion and Set-Up

The sample to be measured is placed on the substrate stage and inserted under the stylus. The cam lever is rotated clockwise until the zero needle falls within the broad green null band. Any of three scanning modes may be selected by depressing the appropriate switch.

Automatic Leveling and Scan

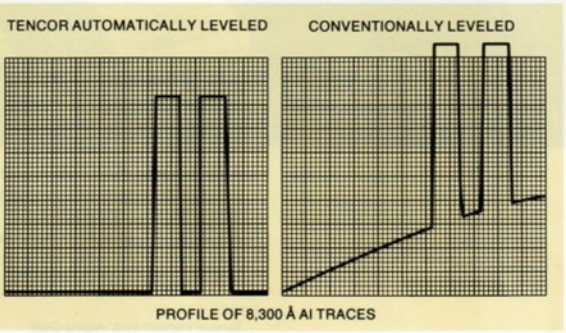
This mode eliminates the need for manually setting up. Alpha-Step will automatically determine any deviation between the stylus plane of travel of the stylus and the plane of the sample surface. A C-MOS logic circuit will adjust the plane of travel so that it is co-planar with the sample surface. This is accomplished within 2 to 5 arc-seconds, depending upon the smoothness of the surface. The stylus then returns to the center point (zero) and automatically performs a 3-mm scan profile measurement, recording the data on the strip chart. The 3-mm scan is completed in 30 seconds. When the scan is completed, the logic circuitry turns off the strip chart recorder and returns the stylus to the center point. The stylus signal is electronically processed to distinguish between micro-features of the measured surface and substrate bow and taper to provide precise step-height measurement.

Manual Leveling and Scan

This mode is used if the sample surface is very rough or bowed so that leveling must be adjusted to accommodate the bow. It may also be used to record all of the surface variations. The recorder and scan both start when the Start button is depressed. Leveling is done by pressing the Up and Down leveling buttons. In this mode, the analog computer does not process the signal to remove residual slopes.

Automatic Leveling and Manual Scan

This mode is used to record all features of the scanned surface, including bow and warpage — especially in the 1,000 Å and 2,500 Å ranges. The instrument is started in the fully automatic mode, allowed to complete the automatic leveling and then switched to Manual for the scan.



PROFILE OF 8,300 Å Al TRACES

SPECIFICATIONS

Measurement Ranges (full-scale deflection): 1,000 Å, 2,500 Å, 5,000 Å, 10 KÅ, 25 KÅ, 50 KÅ, 100 KÅ, 250 KÅ, 500 KÅ, 1,000 KÅ.

Resolution:
10 Å (minimum detectable step)

Auto Zero:
Recorder automatically starts at any preset level.

Horizontal Magnification/ Scan Speed/ Recorder Speed:

50 X	0.1 mm/sec	5 mm/sec
500 X	0.01 mm/sec	5 mm/sec
2500 X	0.01 mm/sec	25 mm/sec

Scan Length:
3 mm in either direction (6 mm total).

Stylus:
Diamond 12.5 μ radius standard. Other radii on request (see Technical Bulletin No. 103).

Tracking Force:
Factory-set 15–18 mg (1 mg minimum).
Variable stylus tracking force option (see Technical Bulletin No. 103).

Sample Stage Dimension:
190 mm (7.5") W x 127 mm (5") deep

Sample Stage Movement:

x-axis	3 mm (.12")
y-axis	48 mm (1.9")
z-axis	11 mm (.46") plus (vertical) stylus lift

Throat Depth:
65 mm (2.54") allowing measurement anywhere on a 125-mm (5") dia. wafer.

Maximum Acceptable Sample Thickness:
11 mm (.46")

Operational Modes:
Automatic Leveling and Scan
Manual Leveling and Scan
Automatic Leveling and Manual Scan

Optics:
Non-inverted Image, 22X magnification. 45X Optics also available as an option (see Technical Bulletin No. 103)

Illumination:
Light-emitting diodes.

Chart Recorder:
Type: thermal printing
Chart Speeds: 5 and 25 mm/sec
Chart Size: 5 cm (2") continuous roll
Linearity: ±1% full-scale
Max. Drift vs Temp.: 0.5 division/10°C
Max. Drift vs Time: 0.1 division/8 hrs.

Dimensions:
Scan Unit, 208 mm (8.2") W x 226 mm (8.9") H x 422 mm (16.6") D
Control Unit, 216 mm (8.5") W x 124 mm (4.9") H x 394 mm (15.5") D

Weight:
Scan Unit, 7.7 kg (17 lb); Control Unit, 6.4 kg (14 lb)

Electrical:
100 V ±10%, 50 or 60 Hz
117 V ±10%, 50 or 60 Hz
220 V ±10%, 50 or 60 Hz

ORDERING INFORMATION

ALPHA-STEP	MODEL NO.
Scan Unit	10-00020
Control Unit (117 V, 60 Hz)	10-00030
Control Unit (220 V, 50 Hz)	10-00040
Control Unit (100 V, 50 Hz)	10-00050
Control Unit (100 V, 60 Hz)	10-00060

NOTE: Accessories are fully described in Technical Bulletins No. 103 and 104.

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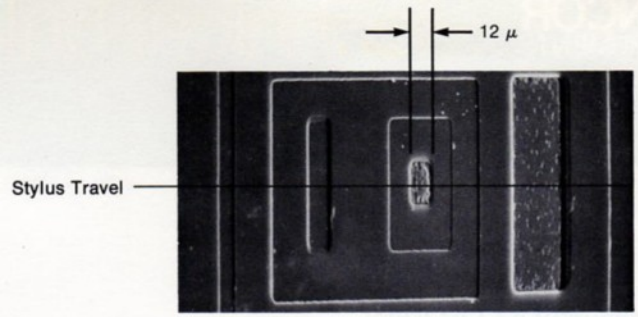
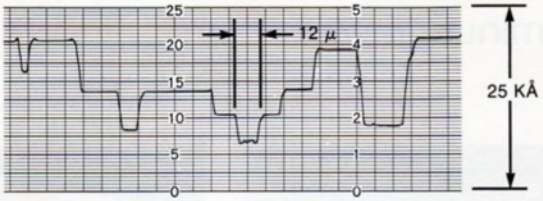
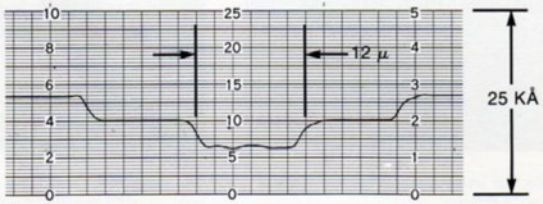


The Stylus Travel: The 5 μ-radius stylus scanned from left to right across the transistor. The emitter is shown in the center, dimensioned according to its original design width.



The First Trace: After insertion of the sample and automatic leveling, this trace was made at a horizontal magnification of 500×. Elapsed time from insertion of sample: 60 seconds.



The Second Trace: Immediately after the first trace was completed, the stylus automatically returned to its starting point, the operator switched to a horizontal magnification of 2500×, and this second trace was produced. Total elapsed time for set-up both traces: 90 seconds.

The ALPHA-STEP profiler delivers unsurpassed performance in the measurement of micro-surface profiles. Its unique closed-loop servo speed control and leveling mechanism are combined with exceptional ease of use and ruggedness to deliver these important benefits:

- Automatic leveling
- Very fast set-up
- Use on normal workbench (no shock isolation)
- Repetitive accuracy
- Use by unskilled operators
- Difficult profiles become routine

The ALPHA-STEP profiler eliminates the tedious and intricate set-up that other instruments require. It saves considerable time and makes it possible to routinely test samples from your production line.

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