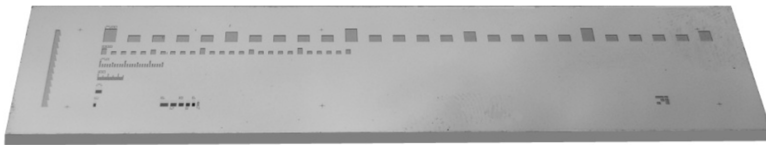
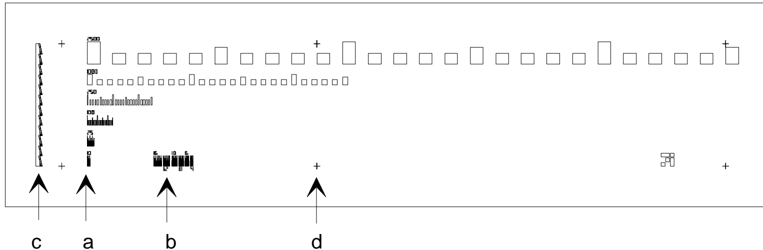


Line Scale
LS

1. Structure



For the calibration of profiling instruments in view of the length of a profile (scan length) a line scale standard is available that contains periodically arranged grooves. The lateral distances inside the periodic profile are defined very precisely by sharp edges of grooves:

(a) 6 scales each with 25 pitches as line scale standard with the following lengths of periods (µm): 10, 25, 100, 250, 1000, 2500
or lengths of scales (µm): 250, 625, 2500, 6250, 25000, 62500

(b) 5 scales each with 50 pitches (gratings) for assessment of the stylus tip with the following lengths of periods (µm): 16, 12, 10, 8, 6
or lengths of scales (µm): 800, 600, 500, 400, 300

(c) Deepening with a saw tooth shaped border for the assessment of an increment perpendicular to the scan direction

(d) 6 cross-shaped marks as a support of the adjustment of the standard

The line scales are standardly realized by orientation dependent wet etching The etch mask of the scales contains rectangular windows which are periodically arranged in the distance approximately equal to their width. The sidewalls of the deepenings are inclined 54.74° against the surface.
Because of the very small but noticeable underetching the resulting width of the grooves is larger than the distance between them. The underetching is increased by the crystallographic misalignment leading to variations between standards produced from different wafers. In each case the lengths of periods (signed at the beginning of a scale) are not influenced by this effect.

2. Calibration Procedure

The certification is performed according to the European Standard EN ISO 5436-1 (Type C3).
At first the line scale standard must be adjusted in the direction of the scan using the cross-shaped marks (d) or the baseline of the scale intended for calibration. After profiling across a scale of group (a) the overall length of 25 periods can be determined (for example the distance between the left edge of the 1st groove and the left edge of the 25th groove).
If the determination of the parameters RS_m or PS_m (ISO 4287) is possible then these values represent the measured length of a period.
Special attention must be given to the definition of the begin of a groove. Because of the depiction of the stylus tip during profiling a sharp edge a rounded profile results. Consequently equivalent points of the edge profiles must be included in the evaluation (for example the respective first point deviating clearly from the upper level outside of its peak-to-valley height).
The minimum distance between two points detectable by the used profiling instrument limits the accuracy of the calibration.

The standard is available with a calibration certificate of the PTB (PTB: Physikalisch-Technische Bundesanstalt, the national metrology institute of Germany). The scale for certification can be chosen.

3. Packaging, Handling and Cleaning

For a better handling the line scales are mounted on borosilicate glass with a size of 10 cm x 10 cm as substrate. Further sizes are possible on request. The chips are mounted by an epoxy resin adhesive.
The standards are stored in a box. The scales for measuring and calibration do not come into contact with the box.
Do not touch the silicon chip especially the regions determined for measuring and calibration. Use suitable (plastic) tweezers for handling.
For cleaning the dimensional standards the following procedures are recommended:
• Removing of particles of dust: blowing off by pure nitrogen or by compressed air.
• Removing of tightly sticking particles: ultrasonic cleaning in deionised water, rinsing with deionised water, blowing dryly by pure nitrogen or by compressed air.
• Removing of organic deposits: rinsing with ethanol (analytic-grade), rinsing with deionised water, blowing dryly by pure nitrogen or by compressed air.
If none of these methods is successful please contact SiMETRICS for a cleaning process.

J. Frühauf, S. Krönert, U. Brand:Tiefen- und Längennormale aus Silizium, tm – Technisches Messen 68, 7-8, 2001, p. 326
J.Frühauf, H. Trumpold: Silicon Standards for Assessment and Calibration of Stylus Probes, Annals of the CIRP, Vol. 51/1/2002, p. 475
R. Krüger-Sehm, W. Häßler-Grohne, J. Frühauf: Traceable Calibration Standard for the Lateral Axis of Contact Stylus Instruments, Wear, Vol. 257 No. 12, 2004, p. 1241

4. Assortment and Specification

Type	Scale	Length (µm)	Certified uncertainty (typical) of the length (nm)	Pitch (µm)	Number of pitches	Certified uncertainty (typical) of the pitch (nm)
LS	250	250	50	10	25	2.5
	625	625	50	25	25	2.5
	2500	2500	70	100	25	2.5
	6250	6250	100	250	25	5
	25000	25000	100	1000	25	5
	62500	62500	200	2500	25	10

Scale	Length (µm)	Pitch (µm)	Number of pitches
800	800	16	50
600	600	12	50
500	500	10	50
400	50	8	50
300	300	6	50

Ra surface < 5 nm.
Standard etch depth 5 µm, at this etch depth the cross sections of the very narrow windows (width < 7 µm, length of period < 14 µm) are V-shaped. Other depths are possible on request.
Chip size 75 mm x 20 mm.

All scales are situated on one standard.

Besides the standards with 54,7° inclined sidewalls line scales with vertical sidewalls are also possible. Please contact SiMETRICS for further information.