



## REPORT OF CALIBRATION

NIST Test No. 821/271639-05

For: MetroBoost  
1750 Halford Avenue, Suite 218  
Santa Clara, CA 95051

Item: MetroCal Standard Pattern  
SN: 001

The horizontal and vertical long gratings on this 20mm x 20mm poly-silicon sample was calibrated with the NIST Line Scale Interferometer (LSI). The LSI consists of a scanning electro-optical line detector, a high precision one-axis motion system, and a high accuracy heterodyne interferometer for determining the displacement of the test artifact beneath the line detector. The wavelength of a stabilized helium-neon laser corrected for temperature, humidity and atmospheric pressure is used as the length standard. The instrument is housed in an environmental chamber in which all environmental properties are carefully monitored. The complete description of the design and operation of the NIST LSI is given in the Journal of Research of the National Institute of Standards and Technology Volume 104, Number 3, May-June 1999, "*The NIST Length Scale Interferometer*".

Results of the calibration are given on the following pages of this report. The length values are the mean of eight measurements and the expanded uncertainty in each value is

$$U = k u_c$$

where the combined standard uncertainty

$$u_c = \sqrt{u_i^2 + u_j^2}$$

where  $u_i$  is the standard uncertainty arising from random effects and  $u_j$  is the standard uncertainty arising from systematic effects in the measurement process. The coverage factor  $k=2$  was used which

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gives for the reported value a level of confidence of approximately 95 percent. During measurement the 20mm x 20mm wafer chip was placed on a flat surface. Only the horizontal and vertical Long Gratings were measured on this standard as indicated on the supplied drawings on page 3 in this report.

On both gratings measurements were made from line center to line center using an approximately 0.09 mm long segments of the graduation lines, centered around the alignment lines. The zero line was chosen the second line at the left on the 6 micrometer gratings, as indicated on the supplied drawings.

The environmental chamber and the artifact temperature were held within  $\pm 0.005$  °C of 20 °C during the calibration process. The length is reported at a temperature of 20 °C (68 °F). A coefficient of linear thermal expansion of  $2.5 \times 10^{-6}/^{\circ}\text{C}$  was used in normalizing the length to 20 °C.

Certified correct by William B. Perzes  
William B. Perzes

For the Director,

John A. Kramer for MTP

Dr. Michael T. Postek, Group Leader  
Nano-Scale Metrology Group  
Precision Engineering Division  
Manufacturing Engineering Laboratory

Purchase Order No.: 120326  
Internal Control No.: M-8161  
Date: July 12, 2005

An image from the CAD drawing of the center of Fig. 6 and the left portion of Fig. 5 is shown in Fig. 7 below. A horizontal line is drawn at the end of the grating. This line, together with its mirror image on the opposite end of the grating can assist with proper angular placement of the sample. Also, there are longer vertical lines that extend by 10 microns per side from the grating. The upper end of the long lines are in contact with lines extending down from the 0.3 micron pitch ruler. These longer lines have a spacing of 120 microns. There are 38 such lines along the length of the grating. These lines are 200 microns long. The bulk of the grating consists of lines that are 180 microns long.

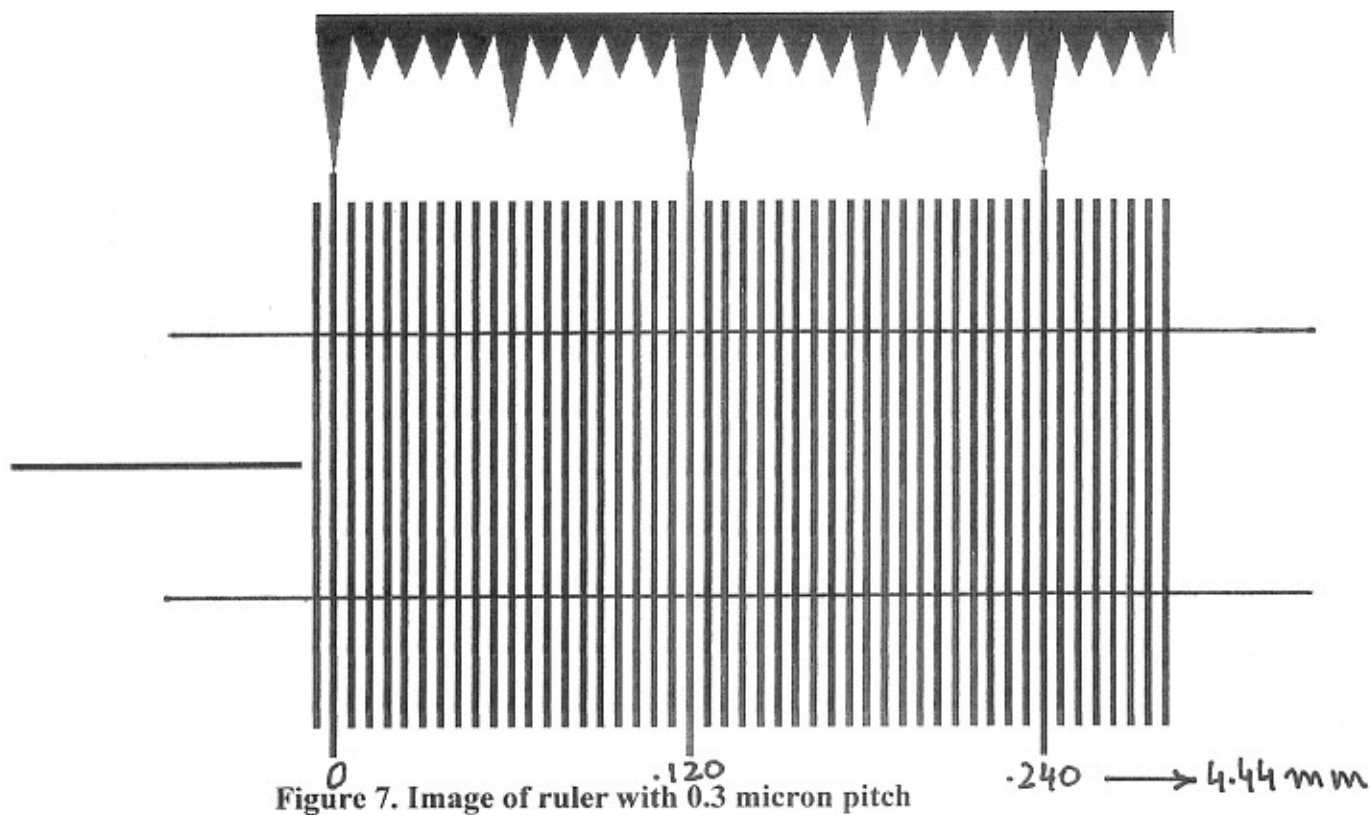


Figure 7. Image of ruler with 0.3 micron pitch

SEM images of the upper left portion of the grating where a line from the 0.3 micron ruler touches the extended line from the grating are shown in images below:



Figure 8. SEM image, 64 micron FOV



Figure 9. SEM image, 8 micron FOV

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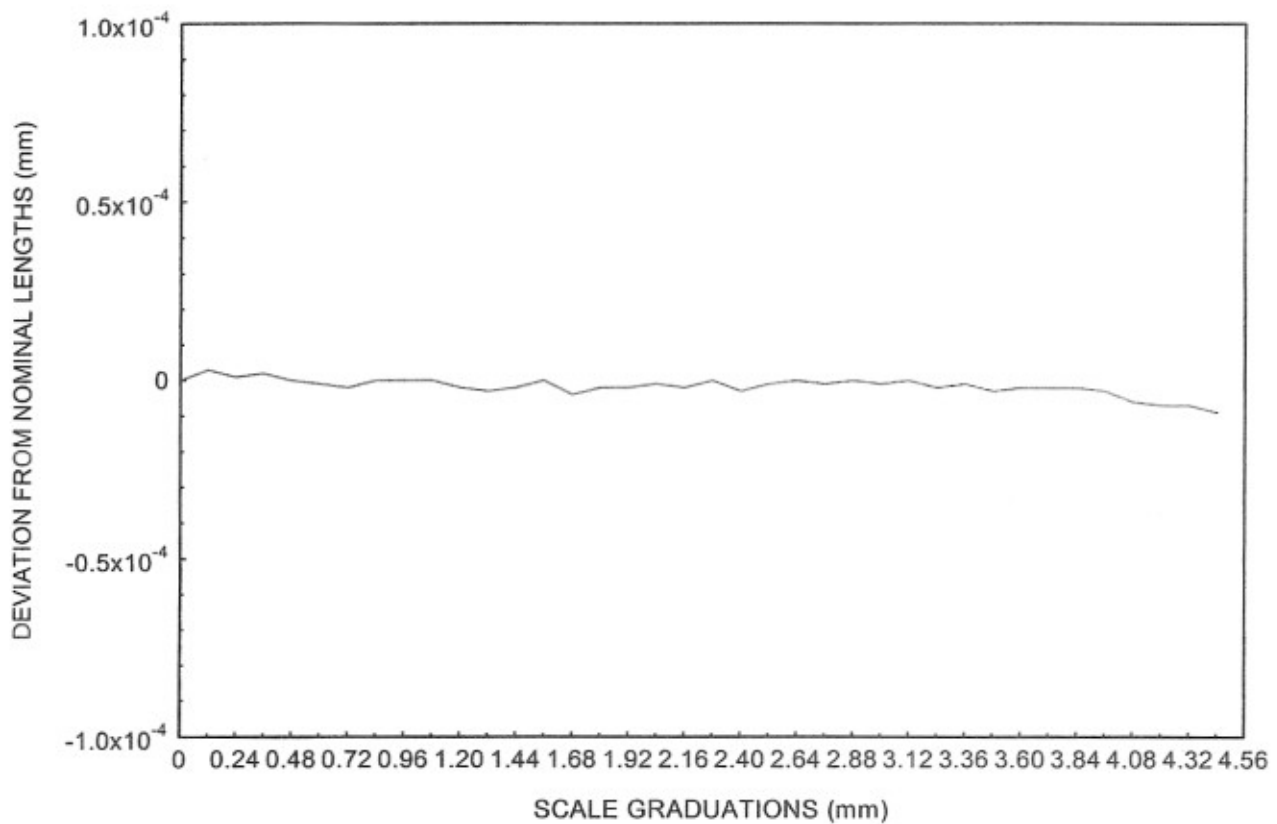
INTERVAL (MILIMETERS)	LENGTH (mm)	CORRECTION (mm)	$u_i$ (mm)	$u_j$ (mm)	$U$ (mm)
0.00 TO 0.12	0.120003	0.000003	0.000001	0.000000	0.000003
0.00 TO 0.24	0.240001	0.000001	0.000002	0.000000	0.000003
0.00 TO 0.36	0.360002	0.000002	0.000001	0.000000	0.000003
0.00 TO 0.48	0.480000	0.000000	0.000001	0.000000	0.000003
0.00 TO 0.60	0.599999	-0.000001	0.000002	0.000000	0.000004
0.00 TO 0.72	0.719998	-0.000002	0.000001	0.000000	0.000002
0.00 TO 0.84	0.840000	-0.000000	0.000002	0.000000	0.000004
0.00 TO 0.96	0.960000	-0.000000	0.000002	0.000000	0.000003
0.00 TO 1.08	1.080000	-0.000000	0.000002	0.000000	0.000003
0.00 TO 1.20	1.199998	-0.000002	0.000002	0.000000	0.000004
0.00 TO 1.32	1.319997	-0.000003	0.000002	0.000000	0.000004
0.00 TO 1.44	1.439998	-0.000002	0.000002	0.000000	0.000004
0.00 TO 1.56	1.560000	-0.000000	0.000003	0.000000	0.000006
0.00 TO 1.68	1.679996	-0.000004	0.000003	0.000000	0.000006
0.00 TO 1.80	1.799998	-0.000002	0.000003	0.000000	0.000005
0.00 TO 1.92	1.919998	-0.000002	0.000002	0.000000	0.000005
0.00 TO 2.04	2.039999	-0.000001	0.000002	0.000000	0.000004
0.00 TO 2.16	2.159998	-0.000002	0.000003	0.000000	0.000005
0.00 TO 2.28	2.280000	-0.000000	0.000003	0.000000	0.000006
0.00 TO 2.40	2.399997	-0.000003	0.000004	0.000000	0.000008

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INTERVAL (MILIMETERS)	LENGTH (mm)	CORRECTION (mm)	$u_i$ (mm)	$u_j$ (mm)	$U$ (mm)
0.00 TO 2.52	2.519999	-0.000001	0.000004	0.000000	0.000008
0.00 TO 2.64	2.640000	-0.000000	0.000004	0.000000	0.000008
0.00 TO 2.76	2.759999	-0.000001	0.000005	0.000000	0.000010
0.00 TO 2.88	2.880000	-0.000000	0.000005	0.000000	0.000010
0.00 TO 3.00	2.999999	-0.000001	0.000005	0.000000	0.000010
0.00 TO 3.12	3.120000	-0.000000	0.000005	0.000000	0.000010
0.00 TO 3.24	3.239998	-0.000002	0.000005	0.000000	0.000010
0.00 TO 3.46	3.359999	-0.000001	0.000005	0.000000	0.000010
0.00 TO 3.58	3.479997	-0.000003	0.000005	0.000000	0.000010
0.00 TO 3.60	3.599998	-0.000002	0.000005	0.000000	0.000010
0.00 TO 3.72	3.719998	-0.000002	0.000005	0.000000	0.000010
0.00 TO 3.84	3.839998	-0.000002	0.000005	0.000000	0.000010
0.00 TO 3.96	3.959997	-0.000003	0.000005	0.000000	0.000010
0.00 TO 4.08	4.079994	-0.000006	0.000005	0.000000	0.000010
0.00 TO 4.20	4.199993	-0.000007	0.000005	0.000000	0.000010
0.00 TO 4.32	4.319993	-0.000007	0.000005	0.000000	0.000010
0.00 TO 4.44	4.439991	-0.000009	0.000005	0.000000	0.000010

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20MM x 20MM Polysilicon MetroCal Standard Pattern, SN 001, Horizontal.Scale, 7/15/05



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INTERVAL (MILIMETERS)	LENGTH (mm)	CORRECTION (mm)	$u_i$ (mm)	$u_j$ (mm)	$U$ (mm)
0.00 TO 0.12	0.119998	-0.000002	0.000002	0.000000	0.000004
0.00 TO 0.24	0.239996	-0.000004	0.000002	0.000000	0.000004
0.00 TO 0.36	0.359990	-0.000010	0.000001	0.000000	0.000003
0.00 TO 0.48	0.479994	-0.000006	0.000002	0.000000	0.000005
0.00 TO 0.60	0.599991	-0.000009	0.000002	0.000000	0.000004
0.00 TO 0.72	0.719988	-0.000012	0.000002	0.000000	0.000004
0.00 TO 0.84	0.839983	-0.000017	0.000002	0.000000	0.000003
0.00 TO 0.96	0.959984	-0.000016	0.000002	0.000000	0.000003
0.00 TO 1.08	1.079982	-0.000018	0.000001	0.000000	0.000003
0.00 TO 1.20	1.199986	-0.000014	0.000002	0.000000	0.000004
0.00 TO 1.32	1.319985	-0.000015	0.000002	0.000000	0.000003
0.00 TO 1.44	1.439985	-0.000015	0.000002	0.000000	0.000003
0.00 TO 1.56	1.559982	-0.000018	0.000002	0.000000	0.000003
0.00 TO 1.68	1.679983	-0.000017	0.000001	0.000000	0.000003
0.00 TO 1.80	1.799982	-0.000018	0.000002	0.000000	0.000004
0.00 TO 1.92	1.919979	-0.000021	0.000002	0.000000	0.000004
0.00 TO 2.04	2.039978	-0.000022	0.000002	0.000000	0.000003
0.00 TO 2.16	2.159979	-0.000021	0.000002	0.000000	0.000003
0.00 TO 2.28	2.279981	-0.000019	0.000002	0.000000	0.000005
0.00 TO 2.40	2.399979	-0.000021	0.000002	0.000000	0.000003



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INTERVAL (MILIMETERS)	LENGTH (mm)	CORRECTION (mm)	$u_i$ (mm)	$u_j$ (mm)	$U$ (mm)
0.00 TO 2.52	2.519980	-0.000020	0.000002	0.000000	0.000004
0.00 TO 2.64	2.639976	-0.000024	0.000002	0.000000	0.000004
0.00 TO 2.76	2.759979	-0.000021	0.000002	0.000000	0.000005
0.00 TO 2.88	2.879976	-0.000024	0.000002	0.000000	0.000004
0.00 TO 3.00	2.999982	-0.000018	0.000002	0.000000	0.000005
0.00 TO 3.12	3.119982	-0.000018	0.000002	0.000000	0.000005
0.00 TO 3.24	3.239981	-0.000019	0.000003	0.000000	0.000005
0.00 TO 3.36	3.359984	-0.000016	0.000003	0.000000	0.000005
0.00 TO 3.48	3.479984	-0.000016	0.000002	0.000000	0.000005
0.00 TO 3.60	3.599984	-0.000016	0.000002	0.000000	0.000005
0.00 TO 3.72	3.719979	-0.000021	0.000003	0.000000	0.000006
0.00 TO 3.84	3.839978	-0.000022	0.000003	0.000000	0.000006
0.00 TO 3.96	3.959977	-0.000023	0.000003	0.000000	0.000007
0.00 TO 4.08	4.079983	-0.000017	0.000003	0.000000	0.000007
0.00 TO 4.20	4.199978	-0.000022	0.000003	0.000000	0.000006
0.00 TO 4.32	4.319978	-0.000022	0.000004	0.000000	0.000007
0.00 TO 4.44	4.439978	-0.000022	0.000003	0.000000	0.000007



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20MM x 20MM Polysilicon MetroCal Standard Pattern, SN 001, Vertical Scale, 7/15/05

