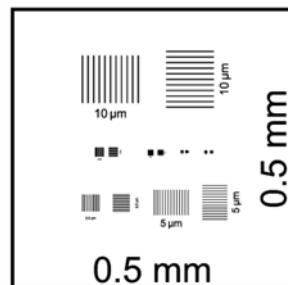
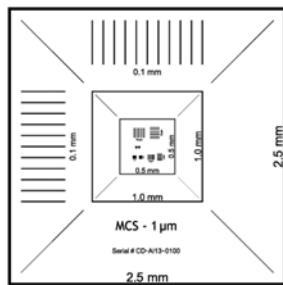


Wafer Level Certificate of Traceability for EM-Tec MCS-1 XY Magnification Calibration Standard



Product Numbers: 31-T31020-U, 31-T31020-1, 31-T31020-2, 31-T31020-6, 31-T31020-8

Product Description: EM-Tec MCS-1 XY Magnification Calibration Standard 2.5mm to 1μm in both X- and Y-direction on 4x4mm chip.

Wafer Identifier: CD-A13-xxxx

The accuracy of these products was determined by reference comparison to working standards traceable to the National Institute of Standards and Technology (NIST), Test No. 861/280822-11.

X-Direction

Line	Average pitch of wafer	Average pitch uniformity (1 σ uncertainty)	Total expanded uncertainty (3 σ) average pitch for wafer*
2.5 mm	2.50 mm	$\pm 2.5 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 8.75 \mu\text{m}$ ($\pm 0.35\%$)
1.0 mm	1.00 mm	$\pm 1 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 3.5 \mu\text{m}$ ($\pm 0.35\%$)
0.5 mm	0.500 mm	$\pm 0.5 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 1.75 \mu\text{m}$ ($\pm 0.35\%$)
0.25 mm	0.250 mm	$\pm 0.25 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 0.9 \mu\text{m}$ ($\pm 0.35\%$)
0.1 mm	0.100 mm	$\pm 0.10 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 0.35 \mu\text{m}$ ($\pm 0.35\%$)
10 μm	10.00 μm	$\pm 0.01 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 0.035 \mu\text{m}$ ($\pm 0.35\%$)
5 μm	5.01 μm	$\pm 0.01 \mu\text{m}$ ($\pm 0.20\%$)	$\pm 0.035 \mu\text{m}$ ($\pm 0.70\%$)
2.5 μm	2.50 μm	$\pm 0.005 \mu\text{m}$ ($\pm 0.20\%$)	$\pm 0.0175 \mu\text{m}$ ($\pm 0.70\%$)
1 μm	1.00 μm	$\pm 0.002 \mu\text{m}$ ($\pm 0.20\%$)	$\pm 0.007 \mu\text{m}$ ($\pm 0.70\%$)

Y-Direction

Line	Average pitch of wafer	Average pitch uniformity (1 σ uncertainty)	Total expanded uncertainty (3 σ) average pitch for wafer*
2.5 mm	2.50 mm	$\pm 2.5 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 8.75 \mu\text{m}$ ($\pm 0.35\%$)
1.0 mm	1.00 mm	$\pm 1 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 3.5 \mu\text{m}$ ($\pm 0.35\%$)
0.5 mm	0.500 mm	$\pm 0.5 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 1.75 \mu\text{m}$ ($\pm 0.35\%$)
0.25 mm	0.250 mm	$\pm 0.25 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 0.9 \mu\text{m}$ ($\pm 0.35\%$)
0.1 mm	0.100 mm	$\pm 0.10 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 0.35 \mu\text{m}$ ($\pm 0.35\%$)
10 μm	10.00 μm	$\pm 0.01 \mu\text{m}$ ($\pm 0.10\%$)	$\pm 0.035 \mu\text{m}$ ($\pm 0.35\%$)
5 μm	5.01 μm	$\pm 0.01 \mu\text{m}$ ($\pm 0.20\%$)	$\pm 0.035 \mu\text{m}$ ($\pm 0.70\%$)
2.5 μm	2.50 μm	$\pm 0.005 \mu\text{m}$ ($\pm 0.20\%$)	$\pm 0.0175 \mu\text{m}$ ($\pm 0.70\%$)
1 μm	1.00 μm	$\pm 0.002 \mu\text{m}$ ($\pm 0.20\%$)	$\pm 0.007 \mu\text{m}$ ($\pm 0.70\%$)

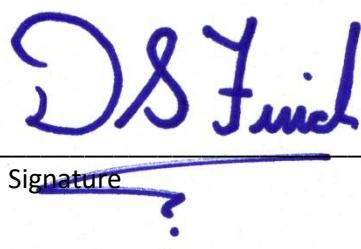
* The 3 σ uncertainty (95% confidence interval) average pitch is determined using a minimum of five die per production wafer. Each average pitch is determined using 100+ measurements on each die averaged over the stated number of lines. The total expanded uncertainty includes both Type A and Type B uncertainties corrected for sample size using an appropriate Student t-factor.

Equipment used:

Instrument	Model number	Serial #	NIST Certified CD	Resolution	Repeatability
FE-SEM	FEI Apreo 2	9958357	CD-PG01-0211	0.9nm	0.03%

Dudley S Finch

Certified by



Signature

 November 22nd 2023

Date

This certificate shall not be reproduced without the permission of Micro to Nano.

The EM-Tec MCS-1 XY traceable magnification calibration standard is manufactured on a silicon wafer with Cr and Au lines. All materials are deemed inert under normal working conditions. Under normal operation there would be no mechanical contact with the surface and the calibration features. When this calibration standard is stored and used in a clean environment, it can be used for at least 5 years.

TSB 31-T31020 Global Certificate of traceability 2023-10-08 CD AI13 Revision 2

