

Model and Update Machine Constants - ...ond Order Distortion Optimization Method
Operator:VLACER Machine:5633 Release:5.0.0 Date:02/02/2022 Time:22:00

OK: Test finished successfully

=====

Second Order Distortion Optimization Method

Exposure	: First	Second
Date	: 02 Feb 2022	02 Feb 2022
Time	: 21:31:11	21:40:21
Machine ID	: 5633	5633
Chuck ID	: 1	2
Cal. State ID	: ASML_4PAR	ASML_4PAR
Reticle ID	: 45559892C031	45559892C031
Reference Grid	:	
Lens Type	: 07	07
Lens ID	: 0130361z	0130361z
Elle ID	: 195154	195154
Energy [mJ/cm2]	: 12.0	12.0
Focus Offset [um]	: 0.000	0.000
Illumination Mode	: Annular	Annular
Blade ID	:	
Numerical Aperture	: 1.200	1.200
Sigma Inner	: 0.740	0.740
Sigma Outer	: 0.940	0.940
Clean-Up Aperture	: 0	0
Pol. changing ID	: 4	4
Pol. shaping ID	: 1	1
Meas chuck meander	: OFF	OFF
Temperature [degC]	: 22.00	22.00
Pressure [mbar]	: 1017.57	1017.35
Wavelength [nm]	: 193.379	193.379

Recipes:

Recipe Exposure First Layer	: FXY_16XPA_1700i_300WN_R6
Layer Exposure First Layer	: OV_NO_ID
Recipe Exposure Second Layer	: FXY_16XPA_1700i_300WN_R6
Layer Exposure Second Layer	: OV_NO_ID
Recipe Measure Mark Positions	: ASML/FXY_16XPA_1700i_300WN_R6
Layer Measure Mark Positions	: READ_REDUCED

Comments from:

'Exposure First Layer'	:
'Exposure Second Layer'	:
'Exposure Third Layer'	:

'Measure Mark Positions' :
'Modelling' :

Test Log Name : XYDSU_shiloh.tlg
Measurement Machine ID: : 5633
Measurement Chuck ID: : 1
Number of Wafers Measured : 1
Number of Fields per Wafer : 12
Number of Marks per Field : 91
Number of Failed Wafers : 0
Alignment Errors in Data : 0
Wafer Size [mm] : 300
Max Field Size X [mm] : 26.0
Y [mm] : 32.0

Settings used during readout
Global Align Timeout(seconds) : 100
Number of scans per mark SA : 1
Number of scans per mark WA : 1

Wafer/Field/Mark Selection : (*:*)
Align. Errors in Selection : 0
First to Nominal Overlay : TRUE
Second to Nominal Overlay : TRUE
Second to First Overlay : FALSE
Third to Nominal Overlay : FALSE
Third to First Overlay : FALSE
Third to Second Overlay : FALSE
Set Threshold : OFF

Reticle data used : Reticle data from database

Distortion parameters

	Current	After		Deltas		
		NEXZ	+SA	NEXZ	SA	Both
Max Lens Dx [nm]	2.88	N.A	0.70	N.A	N.A	3.29
Max Lens Dy [nm]	1.48	N.A	1.41	N.A	N.A	0.72

System Errors

	Current	After	Delta
Max System Dx [nm]	2.15	1.88	0.44
Max System Dy [nm]	1.69	1.45	0.39

Parameter error classification:

	Model Parameters		Max. Resulting Errors	
	Mean [nm/cm2]	Std. Dev. [nm/cm2]	Mean [nm]	Std. Dev. [nm]
Z2_2	1.509	0.140	2.1	0.2
Z3_2	-0.846	0.144	1.2	0.2

Maximum Effect Correctables

	Chuck1		Chuck2		Chuck2-Chuck1	
	X [nm]	Y [nm]	X [nm]	Y [nm]	X [nm]	Y [nm]
Batch	2.1	2.0	2.8	4.8	4.9	4.2
Wafer 1 - Batch	0.0	0.0	0.0	0.0	0.0	0.0

Maximum Position Error for this Batch:

Chuck ID: 1

	Corresponding Position in Field
--	---------------------------------

Nr	Max DX [nm]	Stdev [nm]	DY [nm]	X [mm]	Y [mm]
1	6.4	1.3	3.5	-12.720	-5.406
2	5.6	1.3	2.5	-10.600	-5.406
3	5.5	1.0	4.6	-10.600	-10.812
4	5.1	1.4	5.6	-10.600	-16.218
5	4.6	1.1	5.0	-12.720	-10.812

Nr	Max DY [nm]	Stdev [nm]	DX [nm]	Corresponding Position in Field	
				X [mm]	Y [mm]
1	6.8	1.6	0.8	4.240	16.218
2	6.7	1.6	2.9	12.720	16.218
3	6.6	1.5	2.2	12.720	-10.812
4	6.3	1.7	0.8	10.600	-5.406
5	6.2	1.9	1.0	10.600	16.218

Maximum Position Error for this Batch:

Chuck ID: 2

Nr	Max DX [nm]	Stdev [nm]	DY [nm]	Corresponding Position in Field	
				X [mm]	Y [mm]
1	6.5	1.7	2.5	-12.720	-5.406
2	5.1	1.7	1.5	-10.600	-5.406
3	4.8	1.7	3.3	-10.600	-10.812
4	4.4	2.0	3.0	-12.720	5.406
5	4.4	1.5	3.4	-12.720	-10.812

Nr	Max DY [nm]	Stdev [nm]	DX [nm]	Corresponding Position in Field	
				X [mm]	Y [mm]

	[nm]	[nm]	[nm]	[mm]	[mm]
1	5.5	2.7	0.5	4.240	16.218
2	5.4	2.2	0.3	12.720	-10.812
3	5.1	2.1	1.5	4.240	-16.218
4	5.0	2.7	1.4	10.600	-5.406
5	4.8	2.4	0.4	6.360	-5.406

Position Error Classification:

Chuck ID: 1

	Model Parameters		Max. Resulting Errors	
	Mean	Std. Dev.	Mean [nm]	Std. Dev. [nm]
INTRAFIELD PARAMETERS				
Translation in X [nm]	-0.000	1.105	0.0	1.1
Translation in Y [nm]	0.000	0.926	0.0	0.9
Magnification [ppm]	0.066	0.020	1.4	0.4
Asymm. magnification [ppm]	0.069	0.028	1.4	0.6
Rotation [urad]	0.044	0.050	0.9	1.0
Asymm. rotation [urad]	-0.063	0.031	1.3	0.6
Linear rotation Y [urad/m]	2.400	1.159	0.5	0.2
RS curv. in Y at WL [nm/cm2]	0.248	0.234	0.6	0.6
2nd-order Dist. X [nm/cm2]	-1.230	0.112	2.1	0.2
2nd-order Dist. Y [nm/cm2]	0.735	0.133	1.2	0.2
3rd-order Dist. X [nm/cm3]	-0.185	0.170	0.4	0.4
INTERFIELD PARAMETERS				
Translation in X [nm]	-1.581	0.000	1.6	0.0
Translation in Y [nm]	3.790	0.000	3.8	0.0
Wafer Rotation [urad]	-0.003	0.000	0.5	0.0
Nonorthogonality [urad]	0.002	0.000	0.3	0.0
Scaling in X [ppm]	-0.007	0.000	1.0	0.0
Scaling in Y [ppm]	-0.018	0.000	2.8	0.0

Position Error Classification:

Chuck ID: 2

	Model Parameters		Max. Resulting Errors	
	Mean	Std. Dev.	Mean [nm]	Std. Dev. [nm]
INTRAFIELD PARAMETERS				
Translation in X [nm]	-0.000	1.092	0.0	1.1
Translation in Y [nm]	-0.000	1.261	0.0	1.3
Magnification [ppm]	0.088	0.022	1.8	0.5
Asymm. magnification [ppm]	0.111	0.027	2.3	0.6
Rotation [urad]	0.050	0.047	1.0	1.0
Asymm. rotation [urad]	-0.050	0.037	1.0	0.8
Linear rotation Y [urad/m]	1.370	1.027	0.3	0.2
RS curv. in Y at WL [nm/cm2]	0.355	0.156	0.9	0.4
2nd-order Dist. X [nm/cm2]	-1.285	0.120	2.2	0.2
2nd-order Dist. Y [nm/cm2]	0.674	0.103	1.1	0.2
3rd-order Dist. X [nm/cm3]	-0.047	0.160	0.1	0.4
INTERFIELD PARAMETERS				
Translation in X [nm]	-0.440	0.000	0.4	0.0
Translation in Y [nm]	2.468	0.000	2.5	0.0
Wafer Rotation [urad]	-0.025	0.000	3.7	0.0
Nonorthogonality [urad]	0.027	0.000	4.0	0.0
Scaling in X [ppm]	0.021	0.000	3.1	0.0
Scaling in Y [ppm]	-0.044	0.000	6.6	0.0

Maximum Position Error after proposed Corrections are carried out:

Chuck ID: 1

Nr	Max DX [nm]	Stdev [nm]	DY [nm]	Corresponding Position in Field	
				X [mm]	Y [mm]
1	2.1	0.5	0.2	-12.720	-0.000
2	1.8	0.5	0.1	12.720	16.218
3	1.5	0.5	1.2	-12.720	10.812
4	1.4	0.7	0.9	-10.600	-10.812
5	1.4	0.5	1.1	-10.600	-5.406

Nr	Max DY [nm]	Stdev [nm]	DX [nm]	Corresponding Position in Field	
				X [mm]	Y [mm]
1	2.3	0.4	0.5	4.240	16.218
2	2.1	0.4	0.1	12.720	5.406
3	1.8	0.8	1.3	-10.600	-16.218
4	1.8	0.4	0.4	4.240	-16.218
5	1.7	0.8	0.6	-12.720	-16.218

Maximum Position Error after proposed Corrections are carried out:

Chuck ID: 2

Nr	Max DX [nm]	Stdev [nm]	DY [nm]	Corresponding Position in Field	
				X [mm]	Y [mm]
1	1.9	0.4	0.4	-12.720	-0.000
2	1.9	0.5	0.2	12.720	16.218
3	1.6	0.5	0.0	-12.720	-5.406
4	1.5	0.7	0.5	-8.480	10.812
5	1.4	0.3	1.2	-12.720	10.812

Nr	Max DY [nm]	Stdev [nm]	DX [nm]	Corresponding Position in Field	
				X [mm]	Y [mm]
1	2.7	0.8	0.6	4.240	16.218
2	1.9	0.7	0.6	2.120	16.218
3	1.9	0.5	0.5	12.720	5.406
4	1.9	0.4	0.4	4.240	-16.218
5	1.5	0.5	0.6	4.240	-5.406

Chuck ID: 1

	Value
Max(DX - RES X) [nm]	4.9
Max(DY - RES Y) [nm]	6.8

Chuck ID: 2

	Value
Max(DX - RES X) [nm]	5.0
Max(DY - RES Y) [nm]	4.9

THE FOLLOWING CORRECTIONS SHOULD BE APPLIED TO THE MACHINE CONSTANTS:

	Reference	Correction	New
LENS-RELATED MCs			
IMAGE QUALITY (KI) MCs			
Wavelength shift [pm]	11.342	0.034	11.376
Reticle-stage height [um]	0.000	-0.000	0.000
Lens element 1 [um]	7.419	0.290	7.709
NEXZ Element 1 Rx tilt [urad]	21.951	0.712	22.663
NEXZ Element 1 Ry tilt [urad]	9.923	0.163	10.085
Lens element 2 [um]	3.009	-0.006	3.003
NEXZ Element 2 Rx tilt [urad]	2.007	-0.067	1.940
NEXZ Element 2 Ry tilt [urad]	2.418	0.444	2.863
Lens element 3 [um]	14.268	0.501	14.769
NEXZ Element 3 Rx tilt [urad]	27.943	0.524	28.468
NEXZ Element 3 Ry tilt [urad]	40.146	1.317	41.463
Lens element 4 [um]	0.913	-0.371	0.543
NEXZ Element 4 Rx tilt [urad]	16.745	0.196	16.941
NEXZ Element 4 Ry tilt [urad]	5.337	-0.117	5.220
Lens element 5 [um]	7.456	0.154	7.610
NEXZ Element 5 Rx tilt [urad]	23.617	0.020	23.637
NEXZ Element 5 Ry tilt [urad]	-13.762	-0.536	-14.298
Lens element 6 [um]	-0.294	0.027	-0.268
NEXZ Element 6 Rx tilt [urad]	-4.810	0.174	-4.636
NEXZ Element 6 Ry tilt [urad]	0.017	0.032	0.049
Adaptive lens element 1 [bar]	0.201	-0.005	0.196
Adaptive lens element 2 [bar]	-0.095	0.002	-0.093

LENS FINGERPRINT				
RMS Z2 - Z3	[nm]	0.908	0.390	1.298
RMS Z4 - Z5	[nm]	0.719	0.004	0.723
RMS Z5 - Z37	[nm]	1.207	0.002	1.209
Std Z2 - Z3	[nm]	2.959	-0.104	2.855
Std Z5 - Z37	[nm]	2.076	-0.022	2.054
SYCO REFERENCES				
RMS Z2 - Z3	[nm]	10.953	-0.678	10.275
RMS Z4 - Z5	[nm]	21.208	-0.156	21.052
RMS Z5 - Z37	[nm]	2.090	-0.019	2.071
SYCO TOTAL DRIFT				
RMS Z2 - Z3	[nm]	1.785	-1.785	0.000
RMS Z4 - Z5	[nm]	0.595	0.000	0.595
RMS Z5 - Z37	[nm]	0.000	0.000	0.000
MEAS. SYS. INTERFEROM. (MI) MCs				
Reticle-stage height	[um]	-9.695	-0.086	-9.781
Reticle-stage Rx tilt	[urad]	-64.955	-0.306	-65.261
Reticle-stage Ry tilt	[urad]	77.669	1.209	78.877
Reticle-stage Y curv.	[nm/cm2]	-0.302	-0.075	-0.378
METROLOGY GENERIC (ME) MCs				
3rd-order Dist. X	[nm/cm3]	-38.080	0.119	-37.961
Linear rotation Y	[urad/m]	-8.826	1.885	-6.941
NON-LENS-RELATED MCs				
METROLOGY GENERIC (ME) MCs				
Blue Alignment Offsets Chuck: 1				
Translation in x	[nm]	0.906	-1.152	-0.246
Translation in y	[nm]	8.656	4.633	13.289
Sym. Magnification	[ppm]	-0.241	0.030	-0.212
Sym. Intrafield Rotation	[urad]	0.113	0.030	0.143
Asym. Magnification	[ppm]	-0.313	0.034	-0.279
Asym. Intrafield Rotation	[urad]	-0.029	-0.049	-0.078
Wafer Rotation	[urad]	0.126	-0.003	0.122
Nonorthogonality	[urad]	-0.030	0.001	-0.029
Scaling in x	[ppm]	-0.070	-0.007	-0.077
Scaling in y	[ppm]	0.185	-0.019	0.166
Blue Alignment Offsets Chuck: 2				
Translation in x	[nm]	14.722	-0.046	14.676
Translation in y	[nm]	29.241	3.272	32.514
Sym. Magnification	[ppm]	-0.160	0.060	-0.101
Sym. Intrafield Rotation	[urad]	0.055	0.036	0.091

Asym. Magnification	[ppm]	-0.199	0.083	-0.116
Asym. Intrafield Rotation	[urad]	0.004	-0.036	-0.033
Wafer Rotation	[urad]	0.142	-0.025	0.117
Nonorthogonality	[urad]	-0.063	0.027	-0.036
Scaling in x	[ppm]	-0.250	0.021	-0.230
Scaling in y	[ppm]	0.157	-0.045	0.112
HEIGHT AND TILT EXPOSURE (KU) MCs				
Chuck: 1				
Image Height	[um]	0.927	0.018	0.945
Image Tilt Ry	[urad]	-148.998	-1.028	-150.026
Chuck: 2				
Image Height	[um]	1.181	0.018	1.198
Image Tilt Ry	[urad]	-176.481	-1.028	-177.509

THE FOLLOWING ADJUSTMENTS SHOULD BE APPLIED TO THE SEMI-ACTIVE ELEMENTS:

Item	Adjustment
SAXY 1x	[um] -0.089
SAXY 1y	[um] -0.037
SAXY 2x	[um] 0.070
SAXY 2y	[um] 0.019
SAXY 3x	[um] 0.003
SAXY 3y	[um] 0.003
SAXY 4x	[um] 0.042
SAXY 4y	[um] -0.008
SAXY 5x	[um] 0.002
SAXY 5y	[um] -0.004
SAXY 6x	[um] -0.035
SAXY 6y	[um] 0.025
(W)ELLE element X	[um] 0.021
(W)ELLE element Y	[um] 0.026
(W)ELLE element Z	[um] 0.017
(W)ELLE element Rx	[urad] 0.048
(W)ELLE element Ry	[urad] -0.131
HDM element 1X	[um] -0.192
HDM element 1Y	[um] -0.122
HDM element 1Z	[um] 0.083
HDM element 1Rx	[urad] -0.050
HDM element 1Ry	[urad] 0.229
HDM element 2X	[um] -0.156
HDM element 2Y	[um] -0.135
HDM element 2Z	[um] 0.067
HDM element 2Rx	[urad] 0.047

HDM element 2Ry	[urad]	0.116
-----------------	--------	-------

New Machine Constants Saved : Y

Overlay Error for this Batch:

Before correction

	Overlay Error		
	X [nm]	Y [nm]	Vector [nm]
Mean	1.2	-1.4	
St. Dev.	1.8	1.8	
Maximum 3 Sigma	6.5	6.7	
Maximum 99.7%	6.0	6.0	6.7

	Filtered Overlay Error		
	X [nm]	Y [nm]	Vector [nm]
Mean	1.2	-1.4	
St. Dev.	1.6	1.7	
Maximum 3 Sigma	6.2	6.4	
Maximum 99.7%	5.5	5.1	5.8

After correction

	Overlay Error		
	X [nm]	Y [nm]	Vector [nm]
Mean	-0.0	0.0	
St. Dev.	0.9	1.0	
Maximum 3 Sigma	2.6	3.0	
Maximum 99.7%	2.3	3.0	3.3

	Filtered Overlay Error		
	X [nm]	Y [nm]	Vector [nm]
Mean	-0.0	0.0	
St. Dev.	0.6	0.7	
Maximum 3 Sigma	1.8	2.2	
Maximum 99.7%	1.7	2.0	2.2