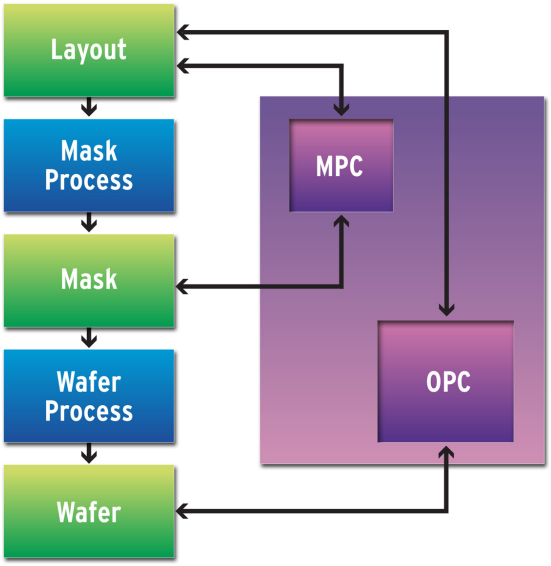
# Calibre nmMPC

D A T A S H E E T




*Improve overall lithography results for 32/22nm ICs with dedicated OPC for the mask making step. Calibre nmMPC complements the existing OPC flow with model-based mask correction optimized for mask writers to achieve the most accurate correction and highest silicon quality.*

Calibre® nmMPC (Mask Process Correction) provides dedicated model-based correction for issues associated with mask variations at the 32/22nm process nodes. Mask process correction with Calibre nmMPC improves mask critical dimension linearity and uniformity for advanced nodes, especially for smaller feature sizes such as SRAFs.

At the 32/22nm process nodes, mask writing requires the same corrections for lithographic variability that has affected wafers since the 130nm node. Calibre nmMPC addresses areas of particular sensitivity: narrow features and corners, across-mask variability, residual proximity and linearity effects due to the mask etch process, and corner rounding in contact layers and on line ends.

Rather than lumping mask errors into the overall OPC model, Calibre nmMPC uses more accurate dedicated models specific to the mask writing process, which results in better fidelity of critical features and superior silicon quality.

Build on the experience of the well established Calibre nmOPC tool for optical process correction, Calibre® nmMPC addresses the specific needs of mask manufacturing at advanced process nodes.

## Correction of Etch Effects

Mask etching imperfections can be categorized in terms of their range of influence as proximity, mid-range, and long-range effects. Proximity effects have a range of

## Key Benefits

- Improved mask CD linearity and uniformity for advanced nodes, especially for smaller feature sizes such as SRAFs.
- Improved correction accuracy for both 1D and 2D effects.
- Oasis-based for easier flow development and interoperability with other tools.

For the Mask house/IDM:

- Change mask writer without recalibrating the entire manufacturing flow.
- Match proximity characteristics of an old mask process to allow process retirement.
- More accurate mask representation on inspection input.
- Extend existing mask writers to the next technology node.
- Extend the use of laser writers to more layers.

## Major Product Features

- Long and medium range correction using density-based bias models.
- Short range correction using a calibrated Variable Etch Bias (VEB) model.
- Etch loading correction with Gaussian density model.
- Uniformity correction using a polynomial model.
- Test pattern creation and model calibration provided by Calibre Workbench



Mentor Graphics®

influence from zero to few micrometers and are caused by finite patterning resolution, resist develop, and etch loading.

Long-range effects have a range of influence from tens of micrometers to tens of millimeters. The most significant contribution to long-range mask CD errors can be expressed as process non-uniformity and pattern density loading effects.

Calibre nmMPC improves long and medium range correction using density-based bias, transition smoothing between densities, line widening or narrowing, and line extensions. Short range proximity correction uses a Variable Etch Bias (VEB) model calibrated with physical mask measurements.

For etch loading correction, Calibre nmMPC uses a Gaussian density model, and includes the ability to correct fogging It performs uniformity correction using a polynomial model.

Calibre nmMPC provides highly scalable processing while maintaining the highest data quality required for low-tolerance mask fabrication.

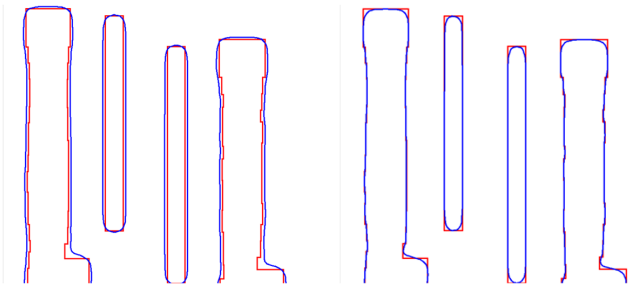
## Extend the Life of Mask Writers

Before the 32/22 process node, mask correction was included in the general OPC model. With Calibre nmMPC, mask correction and wafer imaging are treated separately. Aside from allowing for more accurate, model-based corrections, disaggregating mask correction from the overall wafer OPC model has notable benefits for the mask flow:

- It extends the useful life of existing mask writers without the need to adopt more expensive blanks or using hard mask etch processes.
- It extends the use of laser writers to more layers.
- It allows you to move to new mask making equipment without having to recalibrate the entire OPC flow.
- It allows for easier process retirement by matching proximity characteristics of an old mask process.

*Mask contours before correction.*

*Mask contours after correction with nmMPC.*



*Before correction, the mask data simulation shows how the actual contours (in blue) differ from the ideal (in red). After correction with nmMPC, the mask data conforms better to the ideal contours.*

## Calibre: The Design-to-Silicon Platform

As part of the Calibre design-to-silicon platform, Calibre nmMPC runs on the fully integrated Calibre hierarchical geometry engine, enabling an integrated mask data preparation flow. It is easy to use and fits easily into existing flows. It also includes tools for mask model building and customization integrated into Calibre Workbench.

Each tool in the Calibre nm Platform is an excellent point tool on its own, but in combination with other Calibre tools, the handoff from design to manufacturing is greatly simplified.

Calibre nmMPC supports common command languages and file formats, including

- Control languages including Calibre SVRF, Tcl, and TVF
- Litho and metrology APIs.
- Industry standard OASIS file format

With Calibre nmMPC, the mask, OPC, and tapeout engineers can use the same familiar toolset, and can build a flow that does correction and fracturing at the same time, resulting in faster turnaround.

**Visit our website at www.mentor.com**

Copyright © 2008 Mentor Graphics Corporation. Mentor products and processes are registered trademarks of Mentor Graphics Corporation.
All other trademarks mentioned in this document are trademarks of their respective owners.

**Corporate Headquarters**
**Mentor Graphics Corporation**
8005 S.W. Boeckman Road
**Wilsonville, Oregon 97070-7777**
Phone: 503-685-7000
Fax: 503-685-1204

**Sales and Product Information**
Phone: 800-547-3000

**Silicon Valley**
**Mentor Graphics Corporation**
1001 Ridder Park Drive
San Jose, California 95131 USA
**Phone: 408-436-1500**
Fax: 408-436-1501

**North American Support Center**
Phone: 800-547-4303

**Europe**
**Mentor Graphics Deutschland GmbH**
Arnulfstrasse 201
80634 Munich
Germany
Phone: +49.89.57096.0
Fax: +49.89.57096.400

**Pacific Rim**
**Mentor Graphics Taiwan**
Room 1001, 10F,
International Trade Building
No. 333, Section 1, Keelung Road
Taipei, Taiwan, ROC
Phone: 886-2-87252000
Fax: 886-2-27576027

**Japan**
**Mentor Graphics Japan Co., Ltd.**
Gotenyama Garden
7-35, Kita-Shinagawa 4-chome
Shinagawa-Ku, Tokyo 140 -0001
Japan
Phone: 81-3-5488-3033
Fax: 81-3-5488-3004

3-09-MGC 5829:080930