DIGITAL INDUSTRIES SOFTWARE

Calibre Multi-Patterning

Comprehensive multi-patterning support

Benefits

- Easy and efficient multi-patterning error debug and correction
- Industry-leading performance and quality
- Universal tool integration supports any use model and flow
- Calibre signoff quality

Features

- Supports all major foundry multi-patterning processes
- Supports all major multi-patterning design methodologies
- Seamless coding, execution, and results viewing within the Calibre platform
- Integrated with all major custom and P&R design and layout editing tools

Multi-patterning technology and process support

Multi-patterning solutions impose additional layout, physical and electrical verification, and debugging requirements on the designer. These requirements vary, depending on the design methodology used and the foundry's multi-patterning process.

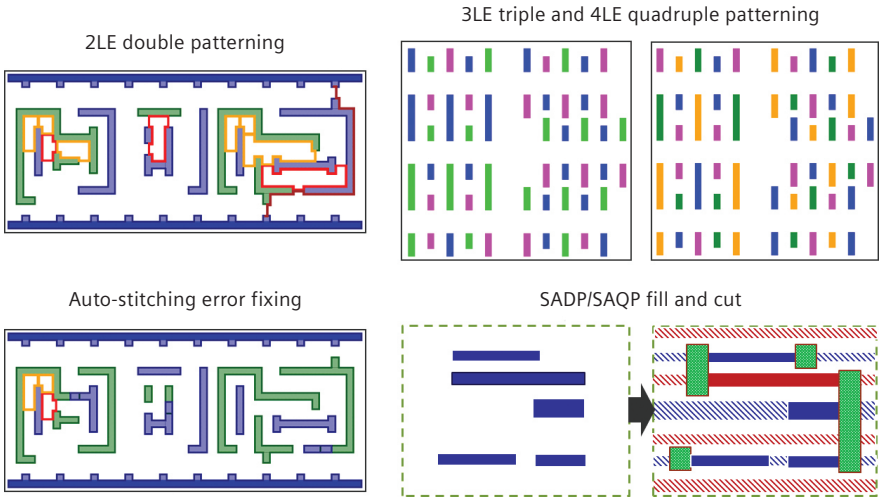
The Calibre® Multi-Patterning solution supports all major foundry design and verification methodologies and processes used to implement multi-patterning, while also adding unique tool integrations and debug capabilities that ensure a Calibre signoff-quality clean multi-patterned design. And, because it does all this within the signoff Calibre nmDRC rule deck, your multi-patterning implementation time is minimized, while your productivity is maximized and your time to market optimized.

Design methodology support

The Calibre Multi-Patterning functionality supports design decomposition and verification for all multi-patterning processes, including double, triple, and quadruple patterning pitch splitting (with or without cuts), and self-aligned double patterning (SADP) or sidewall image transfer (SIT). Depending on the

Features *continued*

- Fully integrated with Calibre RealTime tool for multi-patterning in custom design
- Fully integrated with Calibre InRoute functionality into Olympus-SoC tool for automated multi-patterning during P&R
- Support for manual, automated, and mixed decomposition
- Innovative multi-patterning error checking and debug
- Multi-patterning color control through anchoring
- Automated density balancing during decomposition
- Automated or manual error correction through stitching
- Supports colorless and colored design flows



Calibre Multi-Patterning provides comprehensive support for an extensive range of multi-patterning methodologies and processes, including automated mask decomposition and advanced debugging guidance.

foundry's requirements, designers can use the Calibre Multi-Patterning technology for a variety of multi-patterning approaches:

Colorless design and verification – the designer draws a traditional single layer. The Calibre Multi-Patterning functionality automatically verifies that the design can be legally decomposed by the foundry, or highlights regions that are invalid and provides visual feedback to help the designer correct the errors without having to know the colors.

Fully automated decomposition – the designer draws a single layout, and the Calibre Multi-Patterning functionality automatically decomposes it into multiple masks, flagging any non-decomposable layout constructs.

Full Manual Decomposition – the designer manually decomposes the layout into multiple masks, and then uses the Calibre Multi-Patterning solution for verification.

Mixed Decomposition – the designer manually decomposes part of the layout into multiple masks, or includes some content (such as intellectual property) that is already decomposed, and then uses Calibre Multi-Patterning functionality to automatically decompose the rest of the layout.

The Calibre Multi-Patterning technology is available for use at all major foundries for all advanced production nodes.

Foundry Process Support

The Calibre Multi-Patterning functionality supports design decomposition and verification for all major multi-patterning foundry processes and nodes.

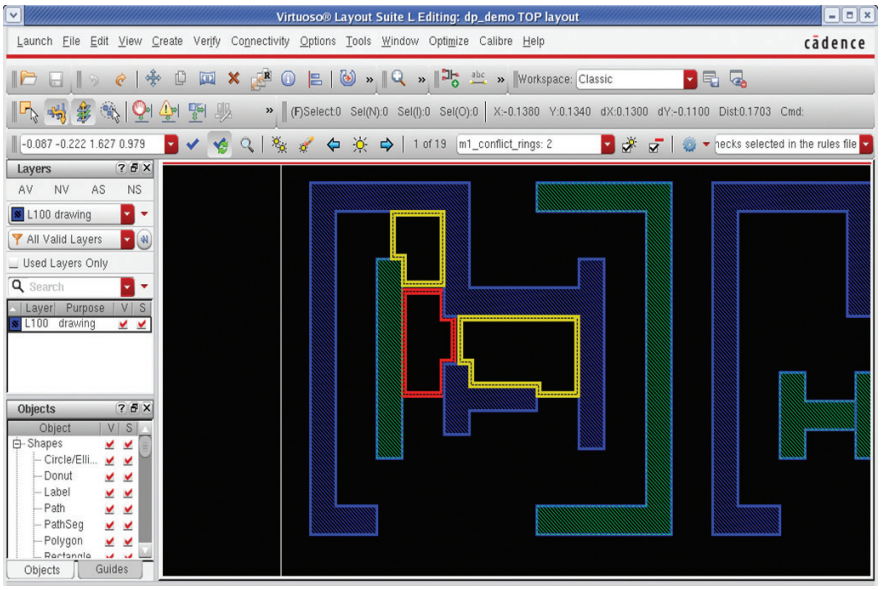
All foundry multi-patterning design requirements are addressed, including:

- Error checking
- Error debugging
- Coloring
- Stitching
- Anchoring
- Density balancing

Design tool integration

Calibre Multi-Patterning functionality is fully integrated into the Calibre platform, enabling designers to use one syntax, one deck, and one run to provide both traditional design rule and multi-patterning design verification simultaneously. With the Calibre platform, designers also know the results they get are signoff quality.

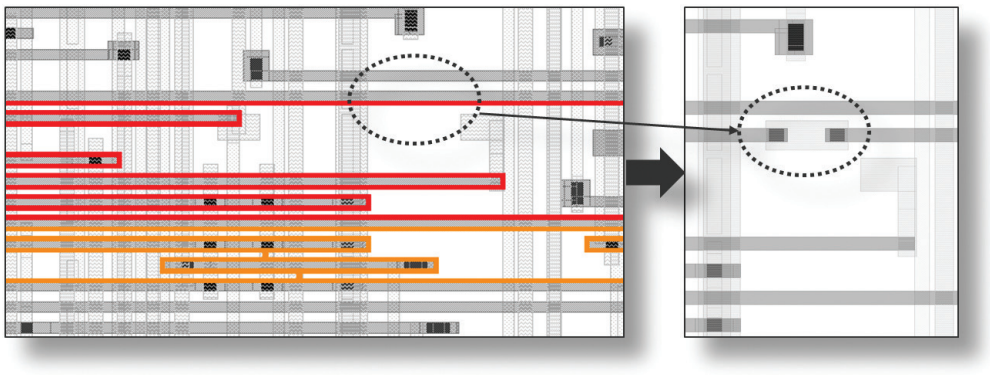
As part of the Calibre platform, Calibre Multi-Patterning functionality is also integrated with a wide range of custom design and place and route tools, as well as the most popular layout editors. Calibre's ability to read multiple formats (including LEF/DEF, GDSII, OASIS, OpenAccess and Milkyway) means no matter which tools you use, Calibre Multi-Patterning technology can help you design and tape out multi-patterned designs quickly and accurately.



Patent-pending warning ring technology helps custom designers avoid error propagation as they create a layout.

Custom design

By combining Calibre Multi-Patterning verification and debugging capabilities with the realtime feedback of the Calibre RealTime tool, custom designers can visualize and correct multi-patterning errors within the layout editor as they make changes to the layout. This instantaneous feedback and signoff-quality correction capability is extremely useful for debugging multi-patterning odd cycle violations.



Calibre Multi-Patterning functionality is available for a wide range of P&R tools.

Place and route

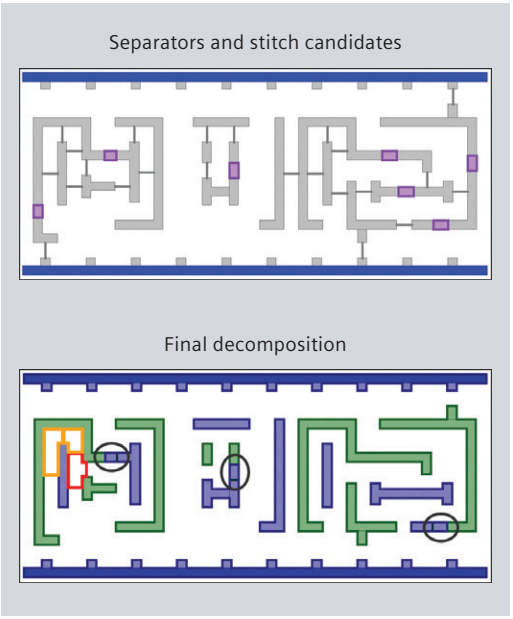
Calibre Multi-Patterning technology is integrated with a wide range of place and route tools to provide fully automated design decomposition, as well as multi-patterning verification and automated error correction.

When used with Olympus-SoC and Calibre InRoute tools, Calibre Multi-Patterning functionality provides fast, simplified implementation of multi-patterned layouts, as well as Calibre signoff-quality results.

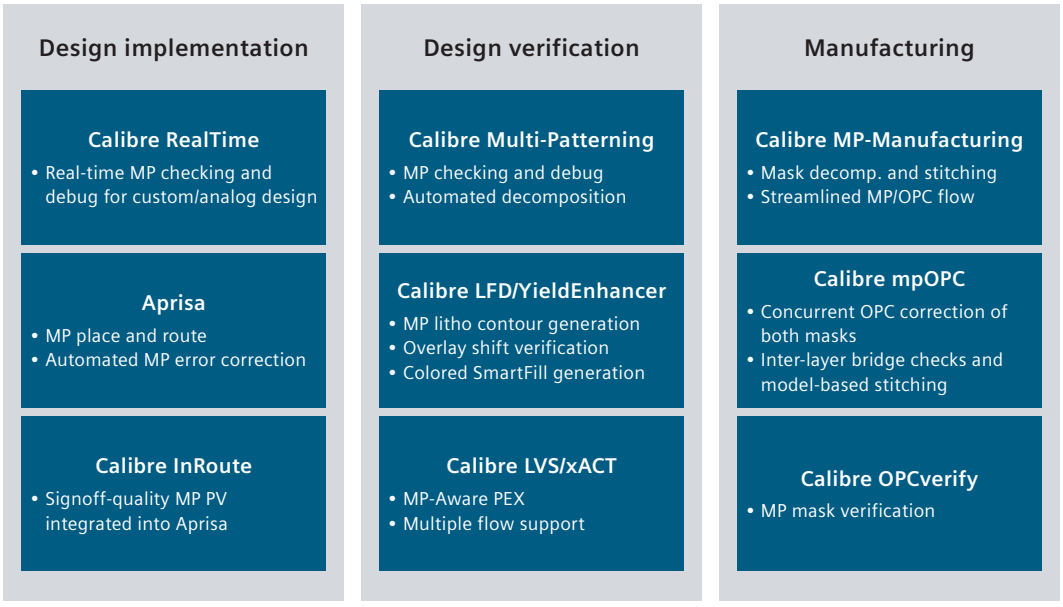
Multi-patterning verification, debugging and automated fixing

The unique nature of multi-patterning creates distinctive challenges in design verification and debugging. Calibre Multi-Patterning functionality encompasses the full range of multi-patterning error analysis, enabling designers to quickly and accurately understand and correct multi-patterning errors.

The patent-pending warning rings in the Calibre Multi-Patterning debugging technology predict double patterning error propagation, enabling designers to avoid creating new errors when correcting existing DP errors. Because Calibre Multi-Patterning error results are inspected in the Calibre RVE™ viewer in conjunction with standard DRC results, designers can implement multi-patterning in a familiar interface, substantially reducing their learning curve.



Calibre Multi-Patterning functionality supports automated insertion of stitches that break individual polygons into separately colored sections to resolve color alternation issues.



Calibre Multi-Patterning functionality is available across the entire design, verification, and manufacturing flow.

If stitching is supported by the foundry, Calibre Multi-Patterning technology can automatically insert stitches that break individual polygons into opposite-color pieces to fix non-decomposable layout constructs. Stitches can fix layout constructs without requiring a change to the fundamental design.

Calibre comprehensive multi-patterning solution

Siemens provides comprehensive support for multi-patterning requirements across the entire design and manufacturing flow. For example, Calibre Multi-Patterning technology can be used in conjunction with Calibre LFD™ analysis to find and eliminate lithography hotspots caused by multi-patterned configurations or mask misalignment. Similarly, Calibre Multi-Patterning functionality can be combined with Calibre xACT products to account for electrical variation due to multi-patterned mask misalignment.

No matter how or where you address multi-patterning requirements, Siemens Digital Industries Software provides the technology you need to implement multi-patterning efficiently and accurately.

The Calibre nm platform

The Calibre nm platform, the industry's leading physical verification platform, is known for delivering best-in-class performance, accuracy, and reliability. Complete Calibre rule files and extensive coverage of Calibre processes for DRC and DFM are available at all major semiconductor foundries.

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