Calibre eqDRC

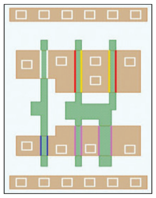
Benefits

- Define complex manufacturing issues
  - Describe layout geometries that are too complex for traditional design rule definition
- Define Non-Manhattan structures more precisely
  - Accurate verification of curved geometries represented by a series of skew edges
- Improved variability control
  - Make reliable design decisions that reduce process variation while preserving design intent and performance
- Reduced cell/design area
  - Accurate representation of manufacturing limitations eliminates over-constraint
- Improved turnaround time
  - Quickly and accurately verify and debug advanced checks while meeting production timelines
- Reduced rule file size
  - Simplified rule coding for advanced checks

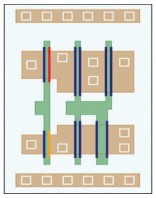
Identifying and prioritizing design layout issues that affect manufacturing success create the biggest impacts on turnaround time. With traditional design rules, designers have little understanding of which factors in a design actually create manufacturing failures. Additionally, there have always been design issues that are simply too complex to capture with conventional measurement techniques.

With the Calibre® eqDRC language, an extension of the Standard Verification Rule Format (SVRF), traditional design rule checking (DRC) capability is extended to assist users in analyzing complex and multi-dimensional rules that are hard or impossible to implement with conventional physical verification. For example, complex rules used for common structures can be modeled into equations to enable accurate results capture, without the inclusion of false errors. Moreover, rule writers can apply conditional DRC rules with multidimensional tolerance values to perform difficult checks on curvilinear and non-Manhattan shapes.

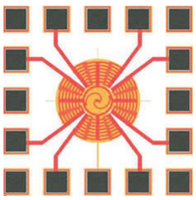
With these verification capabilities, foundries can provide designers with accurate characterizations of complex, multi-variate design issues that have a direct impact on process variation. Armed with this information, designers can measure the impact of multiple simultaneous variables and make reliable design tradeoffs. They can perform verification on non-Manhattan shapes with confidence in the accuracy of the results. They also have better debugging information when failures occur, because they can now use equations to solve for different variables and determine the best fix.

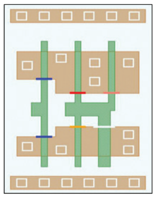


Current crowding

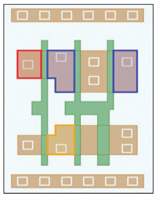


L-shape active to gate width





SD contact coverage



L-shape poly to gate length

Non-Manhattan geometries

The Calibre eqDRC language provides designers and foundries a way to characterize and evaluate a wide variety of complex, multi-variate, 3D, and non-Manhattan checks.

Calibre eqDRC

Features

- Capture actual measurement values and use them within equations or between geometries
- Characterize any mathematical equation – numbers, unary and binary operations, conditionals, algebraic and transcendental functions
- Characterize multiple interaction types – inputs can be polygonal, edge, or edge cluster types
- Invoke commonly used equations with function support
- View equation results on output for debugging

The Calibre eqDRC functionality is included in Calibre nmDRC™ as part of the Calibre nmPlatform, the industry's leading physical verification platform, known for delivering best-in-class performance, accuracy, and reliability.

Improving design decisions

Foundries can write rules for situations where the interplay of factors prohibits a simple definition. They can also accurately capture the nature of more complex issues. Both these capabilities lead to simplified rule coding for advanced checks, a smaller rule file size, and a more accurate implementation of the design rule manual.

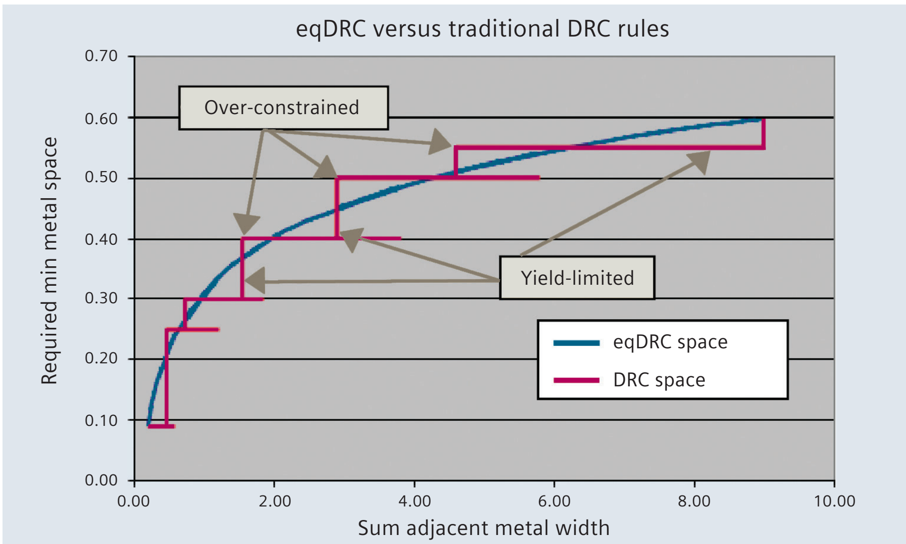
Not only can Calibre eqDRC can be used to characterize multiple interaction types (polygonal, edge or edge cluster), but all of these types may be used in equations without limits as to their number. Because Calibre eqDRC captures actual measurement values, such as counts, areas, perimeters, over- laps, lengths, widths, spacings, and more, these values can be used within equations. Calibre eqDRC also provides complete equation characterization – numbers, unary and binary operations, conditionals, and algebraic and transcendental functions are all supported. Commonly used equations may be invoked with function support. Equation results can be associated with and passed from one geometry to another.

Advanced process impacts, such as dishing caused by CMP, are typically difficult to implement with traditional design rules. A common approach is to use width-based spacing checks, where metal layers are "binned" and different spacing rules are applied to each bin. This approach allows for significant inaccuracies, leading to increased area where the design is over-constrained, or reduced yield where the rule does not fully satisfy the process ramifications.

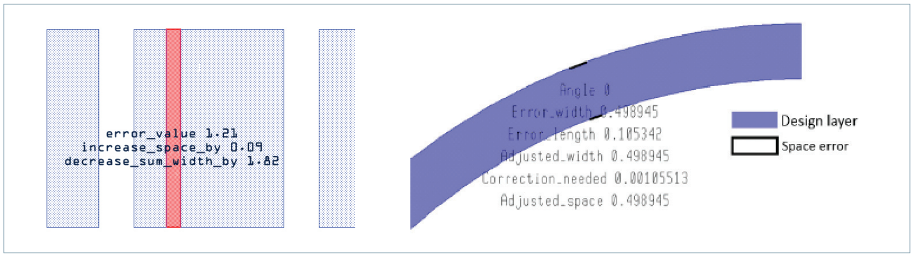
Equation-based DRC efficiently describes and implements an accurate representation based on multiple geometric interactions with a single equation:

$$\frac{0.09}{space*\ln(2)} *\ln\left(\frac{width1+width2}{0.09}\right) > 1$$

With Calibre eqDRC, designers now have a accurate implementation approach for the characterization of advanced manufacturing and process issues. Using this information, they can reduce cell and design areas that were formerly over-constrained, and remain confident that the features are manufacturable.



Verification of non-Manhattan geometries is quite different from traditional IC design verification. Unlike rectilinear layouts, non-Manahattan devices have many curves and non-orthogonal angles. When converted into a gridded structure, such as GDSII, unexpected errors can be flagged. With Calibre eqDRC, rules can be written more accurately, allowing filtering of false errors.



During debugging, multiple equation results may be viewed on output for debugging. Debugging is faster and more productive, because Calibre eqDRC provides the designer with the measured metrics for each failure and calculation of the required corrections for each failure. Designers can use eqDRC to solve for the most appropriate fix based on design and production goals.

Foundries and library providers use Calibre eqDRC technology for signoff of the most advanced design checks, making the decision to use Calibre technology the best choice for achieving your performance, yield, reliability, and design area goals.

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