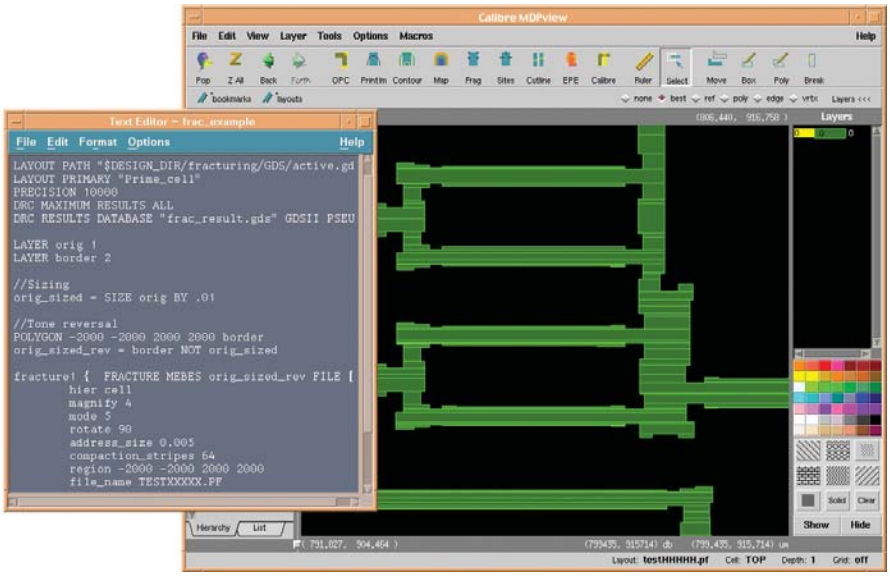
Calibre MDP: Mask Data Preparation

D A T A S H E E T



Calibre MDP offers a complete mask data generation and verification flow supporting formats such as MEBES, and Variable-Shaped-Beam (VSB) formats. Hierarchical geometry processing and mask rules checking enables fast turn-around times. The illustration shows part of a MEBES formatted file.

Extending Calibre's Performance into Mask Data Preparation

The Calibre MDP product line completes the integrated flow from IC design to IC mask manufacturing. The new tool suite allows for seamless continuation of the data manipulations required for resolution enhancement techniques (RET), such as phase shift mask (PSM), scattering bars (SB) and optical and process correction (OPC) to the mask data format conversion in one batch run. Calibre's unique hierarchical geometry processing includes functions like layer derivation, mirroring, scaling, rotation, planarization fill, global and selective sizing. The flow concludes with the output of the most important mask writer formats for advanced mask-making in the subwavelength era, Variable-Shaped- Beam (VSB) formats, and GDSII and OASIS. Hierarchical mask rule checking (MRC) is supported as well as mask proximity correction (MPC). Easy to handle viewing tools allow for fast assessment of problem areas.

Key Product Benefits:

- Integrated, single tool-mask data generation flow: Seamless extension of tape-out verification and RET into mask data generation.
- Hierarchical geometry processing: For fast turn-around time and data volume containment.
- Efficient, direct conversion of GDSII and OASIS input files into mask writer formats: Supports optimum mask writer performance.
- Hierarchical mask rule checking (MRC): Allows for quick assessment of manufacturability of the design, preventing time-consuming stops in the mask making process.
- Flexible SVRF command language: Enables mask proximity correction (MPC) via rules based adjustments.
- Easy to use: The graphical tools allow for easy visual assessment and verification of the results.

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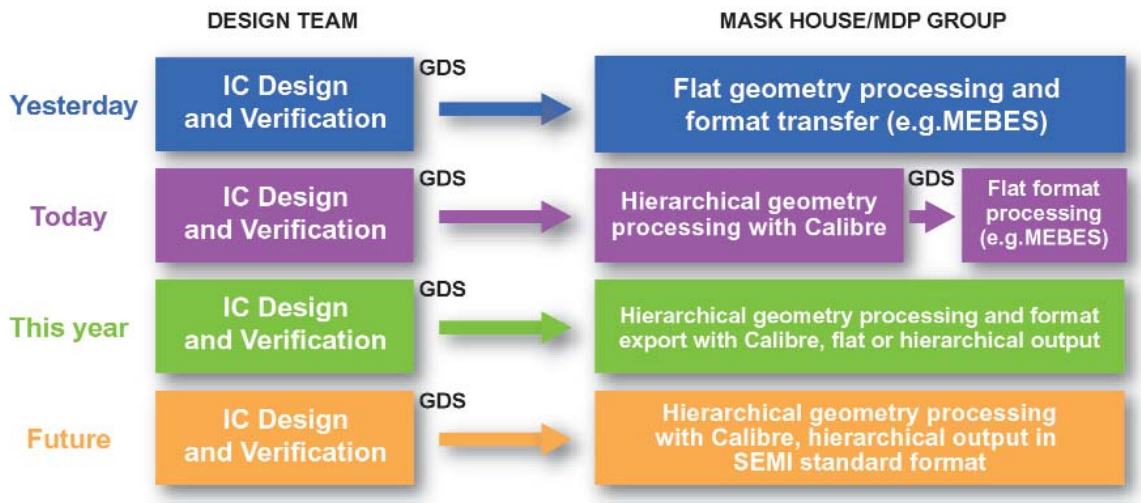
Evolution of the MDP Flow



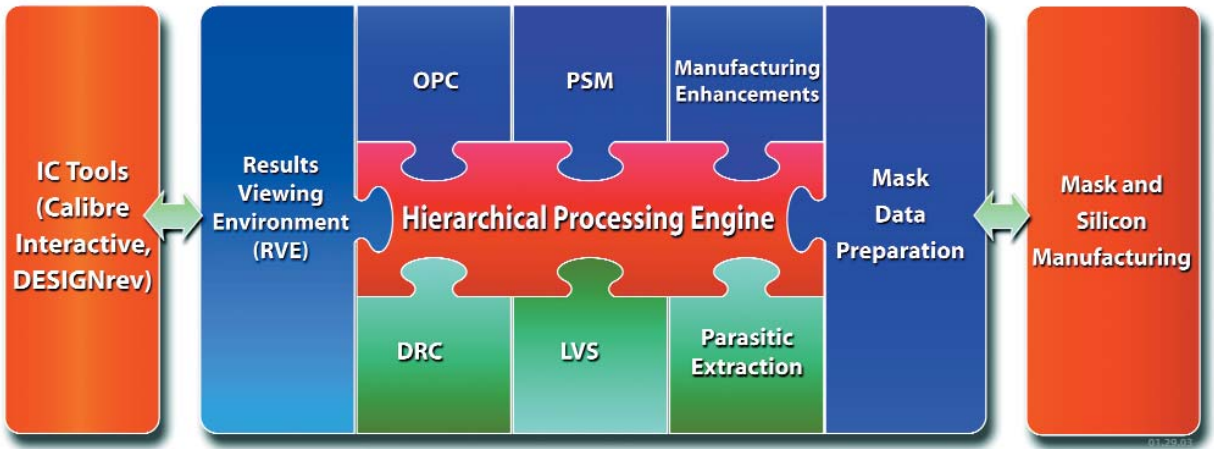
Calibre returns the layout-to-silicon flow into an efficient single tool solution.

Calibre enters the mask data preparation arena

Tape-out groups and mask makers are facing a tremendous growth in data volumes and computing times driven by the deployment of ever larger designs and ever more-intense resolution enhancement techniques, such as optical proximity corrections, phase shifting masks, scatter-bars, for integrated circuit manufacturing.

The historic approach of transferring the design data into the mask writer formats with a FLAT shape processing engine, including a wide range of geometry processing steps, can no longer be sustained.

Alternative tools such as Calibre have already been deployed to take over part of the functions, in particular, geometry processing. Mentor Graphics' newest Calibre tool suite, MDP, integrates all functions necessary back into a single tool software flow. Furthermore, it connects seamlessly to the data manipulation steps necessary for the implementation of RET, allowing for an efficient, all-in-one run batch computing mode. The increased complexity of all the data manipulation steps after a layout is finished, combined with the demand for short cycle time in mask manufacturing, requires comprehensive manufacturability checks (MRC).



Mask writer formatting completes the Design-to-Manufacturing flow in Calibre.

Proven technology

The core of the mask data preparation tool suite is Calibre's hierarchical shape processing engine (Calibre DRC, DRC-H), which is successfully deployed as the engine of tools such as Calibre OPCpro, Calibre PSMgate, Calibre ORC and others. Following the concept of "staying in hierarchy as long as possible," it uses proven database algorithms such as Selective Promotion, Hierarchical Injection and Bin Injection to process the data. Combined with the multi-threading capabilities, it offers fast processing times.

Calibre MDP product line

- FRACTUREm (MEBES)
- FRACTUREj (JEOL)
- FRACTUREt (Toshiba/NuFlare)
- FRACTUREh (Hitachi)
- FRACTUREc (Micronic)
- MDPverify
- MDPview
- MDPmerge
- MRC for mask rule checking
- MPCpro for mask process correction

High data integrity

Calibre FRACTURE tools export the mask-prepared design data into the specified mask writer format. Extensive customer testing has proven that data integrity matches that of the traditional fracturing utility. Fast runtimes and reduced file sizes have been achieved in very large data sets in the Calibre unified, hierarchical approach.

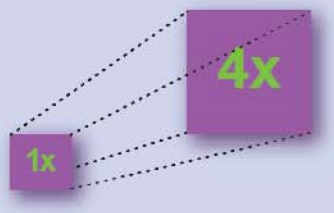
Optimized data conversion for high-throughput

The output format is optimized for most efficient operation of the mask writer, verified by extensive testing. Calibre MDPview provides the capability for quick and easy review of the incoming GDS data, any intermediate state of the process and the final fractured output files in all supported formats. By invoking the RVE integrated debugging interface, MRC problem areas can be highlighted and quickly analyzed or fixed.

Effective shape processing with flexible and powerful commands

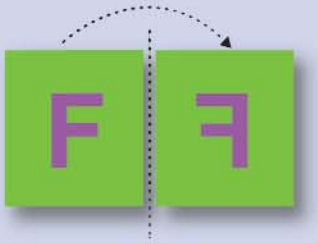
Using the SVRF command language, Calibre enables geometry processing steps, including global and selective data sizing, rotation, mirroring, scaling, mask tone reversal, boolean layer operation, planarization fill and off-setting of data. Multiple functions and commands can be easily mixed and matched on various input layers in a combined script. Rules based mask proximity corrections can be incorporated into the scripts.

Geometric Processing Functions

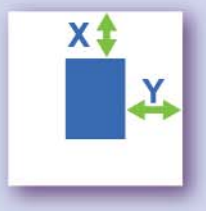


Scale

Rotate



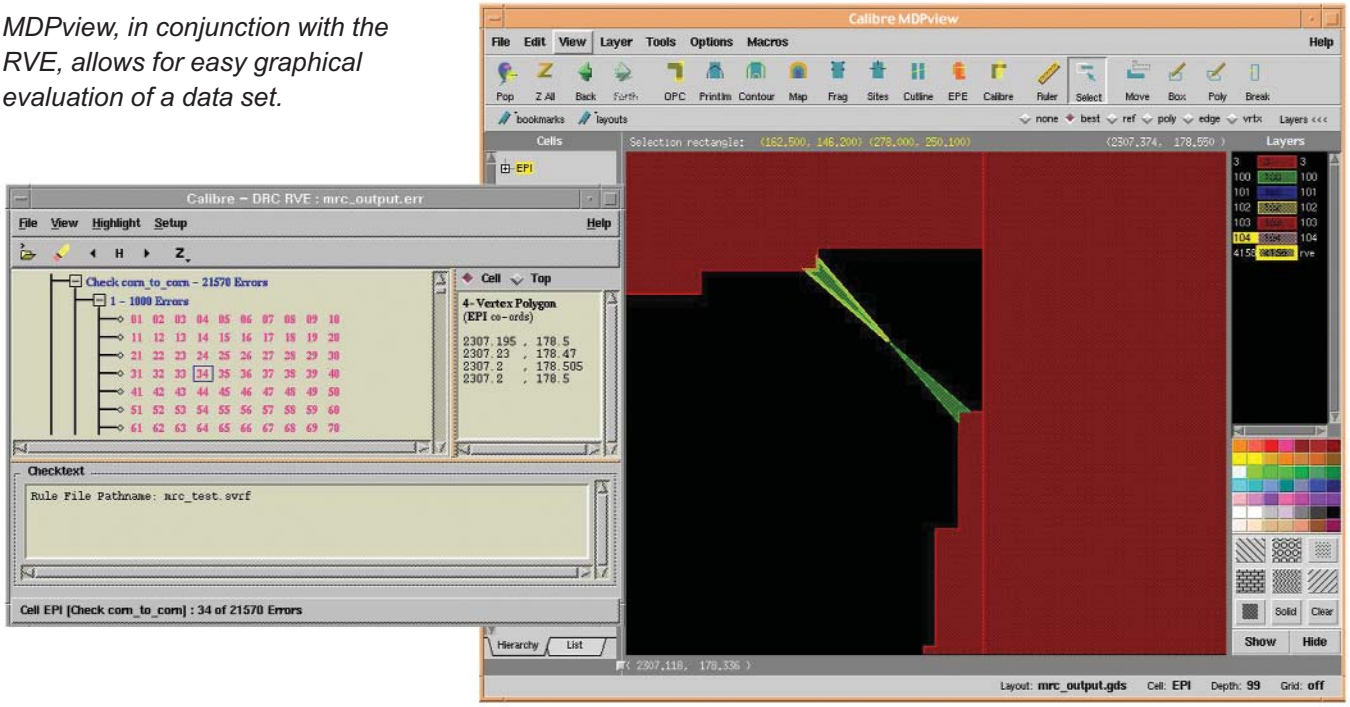
Mirror



Size

Tone Reversal

MDPview, in conjunction with the RVE, allows for easy graphical evaluation of a data set.



Assuring the manufacturability of the photomask

It is of tremendous importance to evaluate the compliance of a data set to the mask making limits prior to manufacturing. Calibre allows you to conduct a fast and reliable check of the mask making rules based on a flexible, programmable rules deck (MRC). Calibre OPCpro also offers in-line enforcement of mask-making constraints, ensuring that OPC movement of edges do not violate mask constraints. The error output is easily assessed using RVE, Calibre's interactive results viewing environment, which is integrated with most popular IC layout editors, or Mentor Graphics' own viewing products, MDPview, DESIGNrev, Calibre WORKbench and Calibre LITHOview.

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