



# Calibre 2024.3 Release Highlights

## Calibre Semiconductor Manufacturing Solutions

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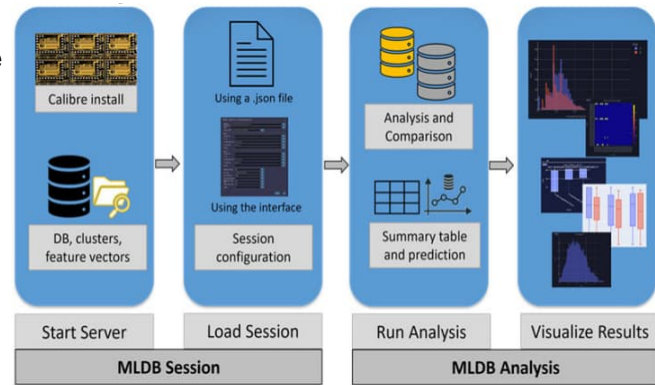
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## Calibre MLDB Xpert – New Infrastructure for All Tools Supporting Machine-Learning Data Base (MLDB)

New Product!

- Calibre MLDB Xpert is a data analytics and visualization tool, which analyzes and visualizes cluster and feature vector machine learning databases from Calibre SONR.
- Calibre MLDB Xpert provides great usability in creating session configuration, cluster comparison, heatmaps and feature histogram.
- To invoke Calibre MLDB Xpert, enter the following command in a terminal window:

```
mldbash [options]
```



This release introduces Calibre MLDB Xpert, a viewer for the MLDBs created by Calibre SONR. Calibre MLDB Xpert accepts cluster and feature vector MLDBs and allows users to visualize the database contents.

Calibre MLDB Dashboard has three analysis modes. “Two Clusters Comparison” mode compares two data clusters to identify the major differences between them. “Single Cluster Analysis” mode analyzes cluster database file with feature vector file. “DB Analysis” mode analyzes a feature-vector database file using a .oas layout file.

When running Calibre MLDB Dashboard, it creates a web interface for the server, allowing users to load data and begin analysis. To invoke Calibre MLDB Xpert, enter “mldbash” command in a terminal window. Several options are available to allow specifying the file location for storing the analysis log data (-log), the project file to load (-project\_file), a server port number to use (-port), the SSL context directory (-ssl\_context\_dir), and the color theme to use (-color) and more....Please refer to the user’s manual for more details.

## Calibre MLDB Xpert – Session Configuring

- Users specify the analysis session configurations which include:
  - Session directory, name, and mode
  - Input for two chip information
  - Boolean operation
  - Output file path and precision
  - The feature in the database to output a histogram for.
  - Size of the output sample clip, size of markers for clips, and the layers to output

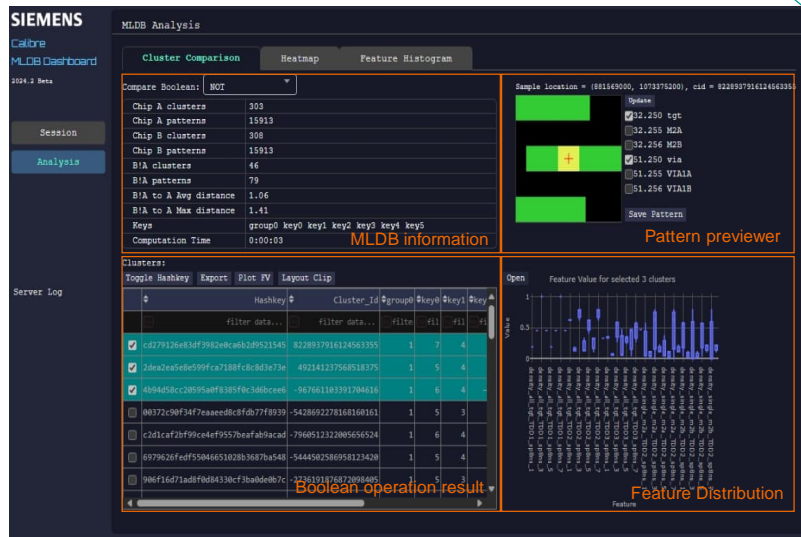
The screenshot shows the 'SIEMENS Calibre MLDB Dashboard' with a 'MLDB Session' configuration window. The window is divided into several sections: 'Session' (top), 'Input' (middle), and 'RDB' (bottom). The 'Session' section includes fields for 'Session Directory' (set to /wv/zkwak/2024\_AE\_Training/MLDB\_DASH/Workspace), 'Name' (bNOTa), and 'Session Mode' (Two Clusters Comparison). The 'Input' section is split into 'Chip A' and 'Chip B', each with fields for 'Cluster DB', 'FV DB', 'Cluster MLDB DIR', 'FV MLDB DIR', and 'Layout'. The 'RDB' section includes 'Compare Boolean' (NOT), 'RDB File' (bNOTa.rdb), 'RDB Precision' (40000), 'Histogram Feature' (empty), 'Sample Clip Size' (100), 'Marker Size' (1), and 'Layers' (\*). At the bottom, there are buttons for 'NEW', 'EDIT', 'Load', and 'Start Session'.

Before analyzing and visualizing the data, users need to specify the analysis session configurations using the server interface or by loading a configuration file.

In the MLDB Session Configuration dialog, users can specify the path to the working directory, specify the name for the session, and set the session mode. Depending on the session mode selected, the input for chip information needs to be provided. The logical operator to use for the comparison are “NOT” or “AND”. Users can also specify the output RDB file name and set the precision for the output RDB file. Default precision is 1000. To output a histogram, the starting feature in the databased should be specified. Lastly, users can include pattern reviewer settings in the session configuration.

## Calibre MLDB Xpert – Cluster Comparison

- Users can perform cluster comparison from the GUI.
- MLDB information is summarized, and Boolean operation results are displayed.
- From the analysis controls, users can
  - write the cluster list to a CSV.
  - display a simple feature value plot based on a selected cluster.
  - display a small window of layout.
- Users can save and update patterns in the pattern previewer as well as create a feature distribution using a boxplot.

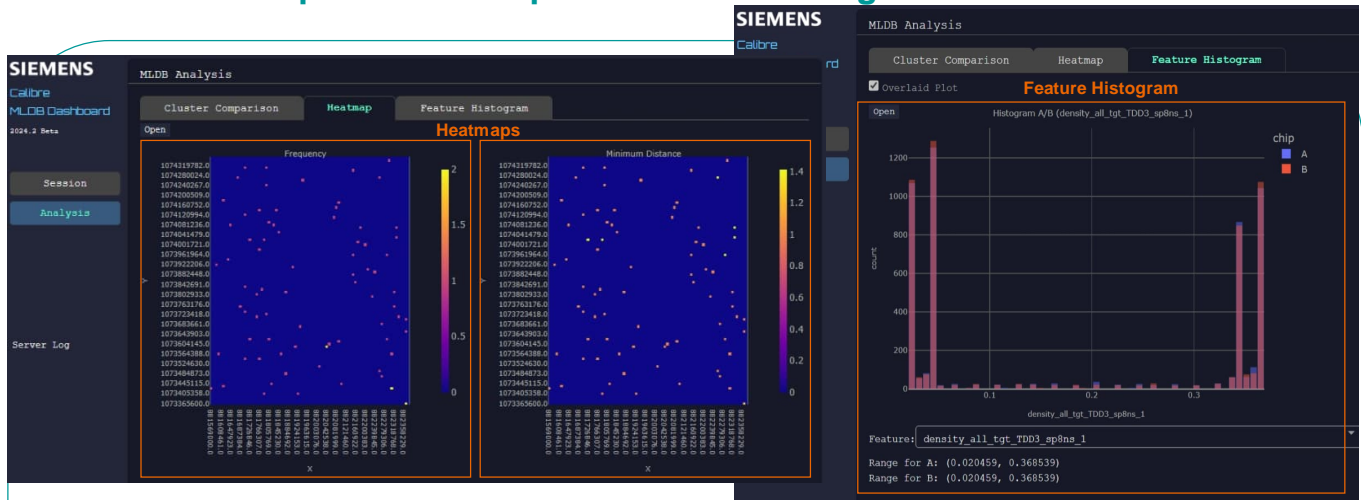


From this main tab, it shows the results of comparing two chip cluster files (designated A and B). In this case, the Boolean operation used is “NOT”.

In the window showing the Boolean operation result, users have a few analysis controls. Users can click “Export” to write the cluster list to a CSV file, click “Plot” to display a simple feature value plot based on a selected cluster in the Plot Display, and click “Layout Clip” to display a small POV window representative of the selected cluster in the Layout Clip Display.

In the pattern previewer, users are allowed to save the representative patterns of all clusters and reflect layer selections to pattern previewer. Users can also create feature distribution using a boxplot. If needed, a new browser tab can be opened for the plot.

## Calibre MLDB Xpert – Heatmap and Feature Histogram



- Heatmap shows the frequency of unique clusters, feature vector points, or features occur in the object being analyzed.
- Feature histogram can be created to compare between two chips for one specified feature.

Heat map can be used to overview the location of the new patterns. The brighter the displayed point, the more uniques are at that location. Users have options for data controls to adjust the way value are sorted. On this slide are examples of heat maps displaying frequency and minimum distance.

Users can display a histogram analysis plot of selected data. From the feature selector, users select the feature to display the histogram data. The range for the histogram for the selected feature is shown below the feature selector. In Two Cluster Comparison mode, an additional checkbox (Overlaid Plot) allows to choose between separate and stacked histograms.

## New Calibre Interactive GUI for DFM - LFD

- Starting in 2024.3, users can optionally run Calibre LFD from the updated Calibre Interactive GUI for DFM by setting an environment variable. This GUI is streamlined and configurable with similar options and settings to the default classic Calibre Interactive GUI.
- To enable the updated Calibre Interactive GUI for DFM, set the required environment variable. For example, using csh:

```
setenv CALIBRE_ENABLE_NEW_CI_DFM 1
```

- To invoke the Calibre Interactive for DFM GUI from a command line:

```
calibre -gui -dfm
```

- To invoke Calibre Interactive for DFM GUI from a supported layout viewer or design tool with a Calibre interface and an open layout, for example, in Calibre DESIGNrev:

```
Verification > Run DFM
```

Users can now use the updated Calibre Interactive GUI for DFM to run Calibre LFD. This updated GUI for DFM tools provides a streamlined configurable interface similar to the standard Calibre Interactive GUI used for running Calibre nmDRC and other Calibre tools. Users can enable the new Calibre Interactive GUI for DFM by setting the environment variable.

## Enhancements for Calibre LSG DRM-Mode

### New Reference option (Design Style File)

- Users can now specify the `Reference` keyword with the `Start`, `Center`, or `End` keyword.
- This determines whether the placement location for a preferred direction wire is measured from the bottom boundary of the highlight layer to the start (default), center, or end of the track.
- For example:

```
PDWire
{
  Width { 0.06; 0.10; 0.14 }
  Length { 0.18:2 }

  PlacementLocations {
    Reference {Start}
    {Width {0.06} Locations {0.006:4:0.01} }
    {Width {0.10} Locations {0.002:4:0.01} }
    {Width {0.14} Locations {0.006:4:0.01} }
  }
}
```

### Updates to Save behavior (Rule Creator GUI)

- The behavior for the `Save` menu functionality now enables users to save user-defined rules generated from the Rule Creator GUI to separate files with unique names.
- When updating and saving a rule file generated from the Rule Creator GUI, the `Save` functionality prompts the users to either rename the file or overwrite the existing file with the same name.

Calibre LSG DRM-Mode has been enhanced in 2024.3 release.

`Reference {Start | Center | End}` is a new optional keyword and argument choice specifying whether the location values are measured from the bottom boundary of the highlight layer to the start (default), center, or end of the track.

There are also updates to `Save` behavior in the Rule Creator GUI. Users can choose to keep the default name or specify a new name.



## New Auto Model Creator Utility in Calibre SONR

- New auto model creator runs multiple trials to tune hyperparameters before creating the actual model. It uses the hyperparameter settings that produced the best model in the trials to produce the final supervised machine learning model.
- The example creates a fully supervised machine learning model. It runs 40 trials to determine the best hyperparameters before creating the actual supervised machine learning model.

```
sonr --model_creator auto_model_2 --i sonr_collect.db  
--f sonr_collect.mod --l pinch --trial 40
```

```
=====
2. Initializing model.
=====
[logging] 2024-06-07 17:27:16.125152
Initializing model.
[ status ] Searching for the best ML model
[ status ] Search 0 started.
[ status ] Search 0 completed with score: 0.5333. Current best is: 0.5333
[ status ] Trial 0 finished with value: 0.533333.
[ status ] Currently found best is trial 0 with value: 0.533333.
[ status ] Search 1 started.
[ status ] Search 1 completed with score: 0.5333. Current best is: 0.5333
[ status ] Trial 1 finished with value: 0.533333.
[ status ] Currently found best is trial 0 with value: 0.533333.
[ status ] Search 2 started.
[ status ] Search 2 completed with score: 0.625. Current best is: 0.625
[ status ] Trial 2 finished with value: 0.625.
[ status ] Currently found best is trial 2 with value: 0.625.
[ status ] Search 3 started.
[ status ] Search 3 completed with score: 0. Current best is: 0.625
[ status ] Trial 3 finished with value: 0.
[ status ] Currently found best is trial 2 with value: 0.625.
...
[ status ] Trial 38 finished with value: 0.823529.
[ status ] Currently found best is trial 38 with value: 0.823529.
[ status ] Search 39 started.
[ status ] Search 39 completed with score: 0.6316. Current best is: 0.8235
[ status ] Trial 39 finished with value: 0.631579.
[ status ] Currently found best is trial 38 with value: 0.823529.
[logging] Elapsed time for step 2: 00:01:51.40
[logging] Elapsed seconds for step 2: 111.40
[logging] Total elapsed time: 00:02:19.66
[logging] Total elapsed seconds: 139.66
[logging] Available / Total Virtual Mem (MB): 28612.613 31887.457
[logging] Cur / Max RSS (MB): 598.746 625.387
```

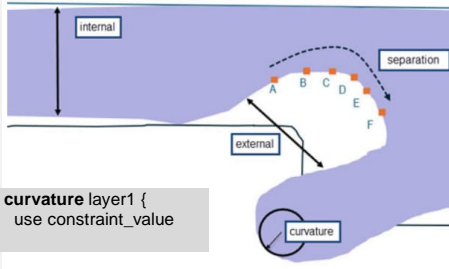
This release adds a new utility to the sonr command line. Users can now have the model creator utility to adjust the hyperparameters for the creation of supervised machine learning models. When `auto_model_2` is specified, the utility runs a set of trials and keeps the hyperparameter settings that provided the highest score, then uses those while creating the model.

Users are required to specify the choice to create a supervised machine learning model. Prior to 2024.3, `model_2` is the only available option which creates a supervised machine learning model using hyperparameters that satisfy most conditions. Starting from 2024.3, `auto_model_2` is available which runs preliminary trials to adjust hyperparameters then creates a supervised machine learning model. This requires more time and memory and does not guarantee the best model. Users can optionally specify how many trials the automatic hyperparameter search should run. The default is 40.

The example creates a fully supervised machine learning model. It runs 40 trials to determine the best hyperparameters before creating the actual supervised machine learning model. In the status lines, notice that trial 3 performed worse than trial 2, so the search keeps trial 2 as the best model. After all the trials, the parameter settings with the best results were those of trial 38. These are then used for creating the final supervised model in the next stages.

## New Features in Calibre OPC Solutions

### New curvature check in Calibre nmCLOPC



### New options for curved-based anchor point insertion in Calibre nmCLOPC

- New keyword specifies the minimum change of direction a curved section must have in order to have anchor points inserted.
- New keyword ensures the minimum separation is maintained in cases where the curved region is small, and anchor points may be too closely placed.

```
anchor_point_layer .. ap_curve... [-angle_filter_threshold degrees] [-enforce]
```

### New options for outputting sites associated with anchor points

- The POINTSET\_SITES\_DUMP command has new options to output square markers to indicate where the EPE for a process window intersects the control site, and to preserve the orientation of small sites.

```
POINTSET_SITES_DUMP... [-epe process_window_name] [-force_directional_sites]
```

### New keywords in tagging controls

- New arguments `corner1_tol` and `corner2_tol` in NEWTAG edge and NEWTAG fragment prevent an angle between two edges or fragments being treated as a corner if the angle is less than degrees from 180.
- This can be especially useful for Calibre nmCLBIAS Gen 1.

### Sites creation and deletion for etch EPE

- The SITES\_CREATE and SITES\_DELETE commands add a new type, ETCH\_EPE, so that rules can work explicitly with etch sites instead of creating them indirectly with SITES\_DUMP.

### New command for curvilinear biasing

- New command, `curvilinear_jog_angle_threshold`, controls the insertion of jogs between adjacent, almost-collinear fragments.

`cl_mrc_rule` command is available since 2024.2 and can be used to specify precise MRC rules for spacing and width checks on the output from `spline_opc`. The command allows users to specify external and internal constraint checks between spline segments in curvilinear layers in 2024.2. Starting from 2024.3, `cl_mrc_rule` command is updated to perform curvature checks.

`anchor_point_layer` creates anchor points for use with the `spline_opc` and `POINTSET` commands. In 2024.3, there are new options added to further constrain curved-based anchor point insertion. The new `-angle_filter_threshold` keyword specifies the minimum change of direction a curved section must have in order to have anchor points inserted by `ap_curve`. This filter can be used to ignore slight dips or bulges in the input. If a curved section does not reach this threshold, the curvature-type anchor points are removed. The other new keyword is `-enforce`. In cases where the curved region is small, anchors may be placed closer than `-distance`, which can cause jogs at a tile boundary. With `-enforce`, the minimum separation is maintained.

`POINTSET_SITES_DUMP` outputs all sites associated with anchor points from the input set. This command has a new `-epe` option which outputs square markers to indicate where the EPE for a process window intersects the control site. There is another new argument, -

`force_directional_sites`, added for preserving the orientation of small sites.

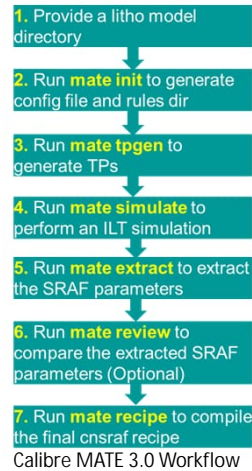
`NEWTAG edge` and `NEWTAG fragment` are Calibre nmOPC Tcl Scripting Commands for tagging controls. In 2024.3, both commands have new `corner1_tol` and `corner2_tol` options to prevent an angle between two edges or fragments being treated as a corner if the angle is less than degrees from 180.

The `SITES_CREATE` and `SITES_DELETE` commands add a new type, `ETCH_EPE`, so that rules can work explicitly with etch sites instead of creating them indirectly with `SITES_DUMP`.

New command, `curvilinear_jog_angle_threshold`, controls the insertion of jogs between adjacent, almost-collinear fragments. For all-angle biasing with Calibre nmCLBIAS only.

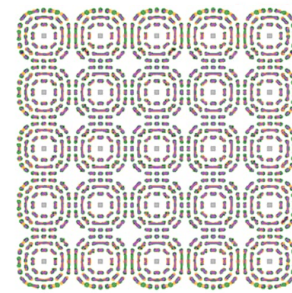
## Reorganized Model-Assisted Template Extractor (MATE 3.0) for CNSRAF Development

- Calibre MATE is restructured to operate on a single test chip design, leveraging Calibre's built-in parallel execution mechanism (MTFlex) to perform all simulation & extraction operations in parallel.
- MATE 3.0 reduces the development time and expertise needed for template-based (cnsraf) rule development by automating the workflow.
- MATE 3.0 and curvilinear SRAF templates ensure quality curvilinear SRAF insertion.



Calibre MATE 3.0 Demo Snapshot: Final SRAFs on contact layer for random logics.

Blue (solid) - Target  
Blue (dotted) - pxSRAF  
Red - CLMATE SRAF



Coverage check between ILT and cnsraf SRAFs on training patterns.

In 2024.3, Calibre MATE is restructured to operate on a single test chip design, leveraging Calibre's built-in parallel execution mechanism (MTFlex) to perform all simulation & extraction operations in parallel. Calibre MATE 3.0 uses a set of commands executed directly in the CLI. Test patterns are generated in a single layout. The flow can be used with Calibre MTFlex to enable parallel processing. Calibre MATE 3.0 uses a configuration file and a set of commands to automate the development of cnsraf recipes from ILT-based simulation results. To run Calibre MATE 3.0, users need to have an optimized Calibre pxOPC recipe and a +/-20nm to +/-50nm defocus litho model ready for the run.

Calibre MATE reduces the development time and expertise needed for cnsraf rule development by automating the workflow. The advantages of MATE 3.0 flow is that the users will not handle directories with hundreds or thousands of files. There is no special job scheduler is required. There is no issue detecting end of task run. End of a job is indicated by Calibre exit code, closure of log file and readability of result oasis file.

## New Job Type in Calibre pxOPC

- New `Reopen` job in Calibre pxOPC reinitializes main features while fixing the assist features.
- New `Spa` job in Calibre pxOPC can be used to replace the `Correct` job if the `Correct` job removes features too aggressively while suppressing extra printing.

Default Iterations		
Job	Standalone pxOPC	LPE-Driven pxOPC
Reopen version 1	10	10
Reopen version 2	20	20
Spa	20	20

- Calibre pxOPC adds support of the `Refine` job type in Calibre LPE runs.
- There are changes the `Finalize` job type to optimize main features while freezing SRAFs in addition to other performance changes.

Calibre pxOPC adds the `Reopen` job type with versions 1 and 2 in 2024.3 release. The `Reopen` job reinitializes main features while fixing the assist features. Calibre pxOPC also adds the `Spa` job type. The `Spa` job type replaces the `Correct` job if the `Correct` job removes features too aggressively while suppressing extra printing.

In addition, Calibre pxOPC adds support of the `Refine` job type in Calibre LPE runs. Previous releases supported the `Finetune` job type in place of the `Refine` job type. There are also changes the `Finalize` job type to optimize main features while freezing SRAFs in addition to other performance changes.

Also, starting from 2024.3 release, specifying commands in unsupported job types will cause the tool issue an error message.

## New Model Testing and Selection Tool - Bayesian Information Criterion (BIC)

Calibration Jobs Compare (CJ-4,CJ-6,CJ-8,CJ-10)

Plots Parameters Parameters Plots **AIC / BIC** Iterstats Iterstats Pareto Model Error Report

Resist Model Analysis  Tool Model Analysis  User Defined Parameters

Job Id	Description	Gauge Count	K (No. Of Params)	AICc	AIC Delta	BICc	BIC Delta	Likelihood	Weight	Rms Weighted
1	CJ-4 Resist - MF 10 ...	246	8	956.693	32.643	984.128	9.81851	8.15824e-08	7.81105e-08	5.34817
2	CJ-6 Resist - MF 11 ...	246	11	938.523	14.473	975.954	1.64429	0.00071957	0.000688948	4.83745
3	CJ-8 Resist - MF 20 ...	246	13	930.309	6.2595	974.309		0.0437282	0.0418673	4.59489
4	CJ-10 Resist - MF 21 ...	246	18	924.049		984.132	9.82288		0.957444	4.27583

Export to CSV

Compare Summary Close All Close

Starting from 2024.3, the Calibration Jobs Compare dialog box is updated with the AIC/BIC tab to raise the Akaike Information Criterion calibration parameters page. In addition to the AIC data, the Bayesian Information Criterion (BIC) data is also supplied.

Akaike Information Criterion Tab has been renamed with AIC/BIC Tab.

"BICc" and "BIC Delta" values are displayed.

Akaike information criterion (AIC) is an information-theoretic approach to model selection that seeks to minimize over-fitting risk. AIC considers the goodness of fit, number of parameters, and gauges to determine the best model based on a weight.

Bayesian information criterion (BIC) is another criteria for model selection that measures the trade-off between model fit and complexity of the model. A lower AIC and BIC value indicates a better fit.

The following equations are used to estimate the AIC and BIC of a model:

$$AIC = -2 * \ln L + 2 * k$$

$$BIC = -2 * \ln L + 2 * \ln N * k$$

Where L is the value of the likelihood, N is the number of recorded measurements, and k is the number of estimated parameters.

when we have term\_count and rms\_val\_sgd as our secondary objective in MOGA , AIC and BIC will be calculated together.



## Calibre nmModelflow GUI Updates and New Default

- Updated Gauge Analysis Tab to specify PW Weight value.

The screenshot displays the Calibre nmModelflow GUI. The 'Flow Stage Wizard : Optimizer Settings with Resist (on)' window is in the foreground, and the 'Gauge Analysis' window is in the background. Callouts highlight several updates:

- New "Monitor Verification Accuracy" checkbox:** Enables verification and runs the "mdf optimize verify" CLI command.
- Updated Flow Stage Wizard:** Shows newer secondary objectives for genetic algorithm, including `rms_sgd`, `abserr`, `pwerr`, `rms_ccal`, `tolerance1`, `parameter_limits`, `correlation`, `aidiff`, `collinearity`, `arid_shift_consistency`, and `cm1_interaction_radius`.
- Updated Gauge Analysis Tab:** A new field for 'PW Weight' is added, with a callout showing the value '1.00'.

Keyword or Variable	Previous Default	New Default
Calibre nmModelflow thresholdtolerance parameter	1.5	5

Reason for Change: Results in better models with less extra printing.

- New default value for resist model calibration.

Calibre nmModelflow GUI is enhanced with new features. In the gauge analysis tab, it is updated with a new field to specify PW Weight value. In the flow stage wizard, there is a new checkbox for monitoring verification accuracy. When this checkbox is enabled, additional controls appear to split the input gauges into training and verification sets. The flow stage wizard is also updated to show newer secondary objectives for genetic algorithm.

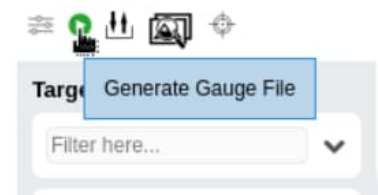
The last to mention is that the default `thresholdtolerance` value for resist model optimization (using the `mdf optimize set` command) has been increased from 1.5% to 5% starting from 2024.3 release which results in better models with less extra printing.

## Calibre SEMSuite New Features

- In the Raw Data Filtering (RDF) tool, new options are available in the Gauge File Generation dialog box to extend/double the gauge length for 2D features and to select the max length across dose/focus.



: Object to open the Gauge File Generation dialog box.



- In the Contour Data Flow (CDF) tool, several new features are available:
  - New features in CDF Runs Browser to import run/setup settings from previous runs/setups.
  - New options in CDF Runs Browser to import the run decisions from the selected run/setup combination.
  - New right-click option for classifying images in the Repeat Run Metrics table.
  - New Re-run Options in CDF Runs Browser:
    - Contours Averaging On
    - EPE Measurements Generation
    - Merged Layout Generation



: Object to re-run the contour extraction run with some changes.

Prior to 2024.3, the “Generate Gauge File” icon in RDF tool produces two types of outputs – Original SEM images without markup and Validated center of each target in the gauge file. Starting from 2024.3, new output options are available for directional measurement for 2D features. The new options allow to extend the gauge length for 2D features and to extend the maximum length across dose and focus conditions.

In the Contour Data Flow (CDF) tool, there are new features for extracting contours from CD SEM images. Users can now alternatively create a new run in the Runs Browser that includes Auto Setup Tuning Parameters to find optimal contour extraction settings. Users can now import the settings from another run if other runs and setups exist. To import the settings, users should first activate “Repeat Selection and Decisions Cloning”.

When extracting contours from CD SEM images, the tool allows to categorize SEM images (as accepted, rejected, or undecided) by selecting the target cards or individual images. Starting from 2024.3, users can also classify images from the Repeat Run Metrics table. In addition, users can choose to re-run the contour extraction with some changes by clicking the Re-run Options icon if users are not satisfied with the results.



## Calibre SEMSuite New Commands

- New command to activate turning of an interpolation factor in the search space during Auto SetupTuning.
- The default behavior is tuning deactivated.

`interpolation_factor_tuned false | true`

- New command to specify the type of image format and compression for all images saved during contour extraction.
- By default, the tool saves images in the JPEG format which uses higher compression and occupies less disk space

`output_image_format jpg | bmp`

- New command to control the saving of intermediate contours during contour extraction.
- By default, the tool saves intermediate contours.

`dump_intermediate_contour true | false`

- Two new commands in CDF API when applying a series of transformations to the input SEM image before contour extraction.
- NoiseRemoval\_12 performs noise removal while preserving edges.
- NoiseRemoval\_13 performs noise removal using a filter that extracts or enhances the ridges in images.

`preprocess_step NoiseRemoval_12`

`preprocess_step NoiseRemoval_13`

The CDF API has new `interpolation_factor_tuned` command in Auto Setup Tuning to control tuning the interpolation factor. The interpolation factor is a multiplier applied to the number of pixels in the input SEM image to produce an interpolated image. For example, an interpolation factor of 2 doubles the size of interpolated image used for contour extraction. Activating tuning of the interpolation factor searches a range of 1 to 2.

The CDF API has new `output_image_format` command to specify the format for all dumped images. By default, the CDF tool saves images in the JPEG format to occupy less disk space.

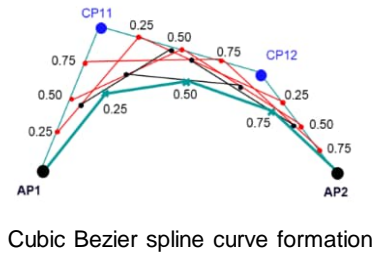
New command, `dump_intermediate_contours`, in CDF API specifies whether intermediate contours are saved during contour extraction. Specify `true` to save intermediate contours. Specify `false` to save no intermediate contours. The default behavior is to save intermediate contours.

The `preprocess_step` command applies a series of transformations to the input SEM image before contour extraction. In 2024.3, the CDF API adds `NoiseRemoval_12` and

NoiseRemoval\_13 to the preprocess\_step command.

## Spline-Based Curvilinear MPC and multi-PNG File Support

- Industry-wide effort: The migration from the piece-wise linear polygons to piece-wise Bezier.
- Spline-based nmCLMPC acts on piecewise Bezier curves using anchor point sets for correction.
- Spline-based nmCLMPC advantages: Output shapes are less prone to show high frequency noise and there is file size reduction on output files.

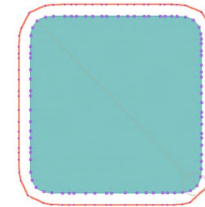


- Users can now specify a root directory for multi-PNG files (mPNG) when loading model information for PEC, FEC and LEC.

```
pec_model_map <pec model file> pec_map <mPNG directory> -mpng
```

```
fec_model_map <fec model file> fec_map <mPNG directory> -mpng
```

```
lec_model_map <lec model file> lec_map <mPNG directory> -mpng
```



Red: Results of Spline- Based nmCLMPC

In 2024.3, spline based curvilinear MPC is production released. Calibre nmMPC is capable of supporting spline-based mask process correction using anchor points like Calibre nmOPC Generation 2.

Starting from 2024.3, Calibre nmMPC is enhanced for multi-PNG support. Users can specify the mPNG directory together with `-mpng` keyword when loading PEC, FEC and LEC models.

The commonly used terms here are Proximity Effect Correction (PEC) for backscatter, Fogging Effect Correction (FEC) for fogging, and Loading Effect Correction (LEC) for long-range loading effects.

## New and Updated Commands in Calibre Cluster Manager (CalCM)

### New Commands for Performance Monitoring

- Users can now monitor performance with the three new performance monitoring message commands to start and stop the performance monitoring, as well as to display the performance metrics.
- `perfmon_start [sample_period]`
- `perfmon_stop`
- `perfmon_view`

```
$. /calcm_send_message perfmon_view
CalCM performance metric
Performance monitor start time: Thu May 9 17:31:32
End time of last sample period: Thu May 9 17:35:52
Sample period: 10 seconds
Next sampling : 8 seconds remained
```

Metrics	Last	Max	Min	Avg	Total
Jobs submitted	5	5	0	2	5
Jobs dispatched	5	5	0	0	5
Jobs completed	2	2	0	1	2
cjobs queries	0	0	0	0	0
chosts queries	0	0	0	0	0
cqueues queries	0	0	0	0	0

Scheduler Metrics	Last	Max	Min	Avg	Total
Scheduling interval in second(s)	2	2	1	1	
Total updated cycles					8

Example output from performance monitoring

### Updated Command in CalCM

- The `JOB PRE_CHECK_EXEC_IN_QUEUE` command is renamed to `JOB PRE_EXEC_IN_QUEUE`. It also now includes a new argument to specify parameters to pass into the script.

```
JOB PRE_EXEC_CHECK_IN_QUEUE filename [parameters]
```

CalCM is implemented with three new performance monitoring message commands. Unless specified with `sample_period`, `perfmon_start` starts the performance monitor with a default sample period of 60 seconds, and `perfmon_stop` stops performance monitoring. The `perfmon_view` message command displays the performance metrics.

The `JOB PRE_CHECK_EXEC_IN_QUEUE` command has been renamed to `JOB PRE_EXEC_IN_QUEUE` for consistency with other commands. It also now includes a new argument to specify parameters to pass into the script.

## Updates for CalScope

### New Keyword in CalScope Configuration File

- Users can now add a keyword to the CalScope configuration file to discard duplicate dmesgs or to collect all dmesgs during dmesg collection.
- Example below specifies 1 to discard duplicate dmesgs. This is default behavior.

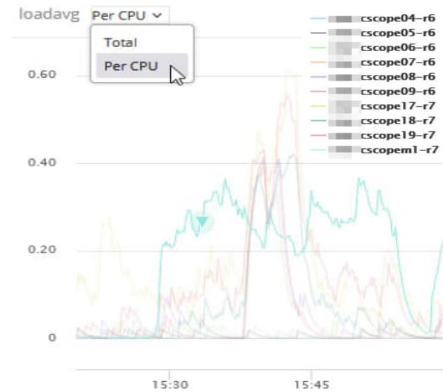
```
hw_monitor:  
  collect_dmesg: 1
```

- Example below specifies 2 to collect all dmesgs including duplicates.

```
hw_monitor:  
  collect_dmesg: 2
```

### New Option to View CalScope Results Per CPU

- Users can now view CalScope's plots either by total value or per CPU core by selecting it from the dropdown menu above the plot.



CalScope configuration file has new keyword to manage dmesg collection. Starting from 2024.3, there is collect\_dmesg keyword added to the hw\_monitor section for users to choose whether to discard duplicate dmesgs or to collect all dmesgs during dmesg collection.

Also, starting from 2024.3, users can now choose to view CalScope's loadavg, system\_total, and user\_total plots either by total value or per CPU core by selecting it from the dropdown menu above the plot.

## Updates for CalDash

### New Aggregation Function in CalDash

- Users can now specify which aggregation function to use when aggregating hardware metrics data by using `-aggr` keyword.
- Listed below are the available choices:
  - `max` — Aggregates using the maximum values (Default).
  - `min` — Aggregates using the minimum values.
  - `avg` — Aggregates using the average values.
  - `lttb` — Aggregates using the LTTB (Largest Triangle Three Buckets) function.
  - `none` — Does not aggregate values.

### New Access to Litho Timing Reports

- Users can now access litho timing reports, if available, from the CalDash dashboard.
- When there is litho timing information, the OP Name column of the Operations table displays a clock icon.

Operations

Operation	OP Name	Operator	Start Time	End Time
1	target	OR target	85	86
2	mask_opc	OR mask_opc	85	137
3	mask_sraf	OR mask_sraf	142	399
4	img_cm1	LITHO EUV OPCVERIFY mask_opc ...	410	9,985

Litho Timing Information Available

CalDash is enhanced to allow specifying the aggregation function to use when aggregating hardware metrics data. When invoking CalDash, users can use `-aggr` to specify one of the aggregation function. By Default, the tool uses “max” aggregation function which aggregates using the maximum values.

CalDash dashboard is also enhanced to allow accessing litho timing reports, when the reports are available. When there is litho timing information, the OP Name column of the Operations table displays a clock icon. Users can click the icon to open the litho timing report in a new tab.

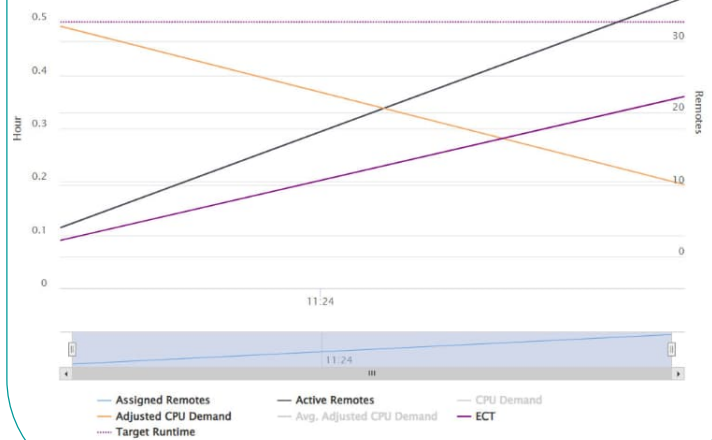
## Additional Updates for CalCM+

### New Prediction-Based TAT Control

- Users can now use prediction-based TAT control for more efficient resource allocation based on runtime prediction.
- Use the following new options to setup TAT control:
  - New `TATCONTROL` argument in `calcm_rmanager_app.tcl` to enable the control.
  - New `JOB TARGETRUNTIME` configuration statement in the job configuration file to set the target runtime.
  - New `adjust_targetruntime` message command to adjust the target runtime.

### New Estimated Completion Time Plot

- For FullScale jobs with ERT (estimated remaining time) data, the job plots in CalCM now show the estimated completion time (ECT).



There are a couple more updates related to CalCM+ in 2024.3 release.

Users can now use prediction-based TAT control for more efficient resource allocation based on runtime prediction. This feature is only available for Calibre FullScale jobs that have ERT data. New options to setup TAT control include

1. The `calcm_rmanager_app.tcl` application's new `TATCONTROL` argument to enable prediction-based TAT control.
2. The new `JOB TARGETRUNTIME` configuration statement in the `job.conf` file to set the job's target runtime.
3. The new `adjust_targetruntime` message command to adjust the target runtime.

For FullScale jobs with ERT (estimated remaining time) data, the job plots in CalCM now show the estimated completion time (ECT). This can help users understand why and when your jobs get additional CPUs.





## Changes for Accessing Calibre Product Documentation

- The default option is accessing product documentation from Support Center.
- New option is available to configure a documentation proxy for viewing documentation on Support Center without needing a Support Center account.
- Alternatively, users have the option to download and set up the Siemens Documentation Server to view the documentation package on local netw
- This change provides a unified and consistent method for accessing product documentation for all Siemens products and reduces the size of the software download.
- The Siemens EDA documentation InfoHub is no longer available, and documentation is not included in the Calibre software installation directory.



The 2024.3 release changes the method for accessing Calibre product documentation. The default option serves your product documentation from Support Center, giving you immediate access to the latest release-specific documentation.

You can optionally configure a documentation proxy for viewing documentation on Support Center. The proxy server removes the need for users to have a Support Center account or to log into Support Center to view documentation.

Alternatively, you have the option to download and set up the Siemens Documentation Server to view the documentation package on your local network. This is useful if your site has restricted internet access or if you want to make local documentation available. After installing the Siemens Documentation Server, you must download the documentation package for the Calibre release and install it on the server.

This change provides a unified and consistent method for accessing product documentation for all Siemens products and reduces the size of the software download. The documentation has the same look and feel as the current documentation on Support Center and includes both PDF and HTML manuals. The new delivery model

also provides more flexibility in documentation updates, a more modern HTML viewer with wider compatibility, and a search function that searches both HTML and PDF documents. In addition, all the benefits of Support Center are available with the Support Center login, including enhanced AI search.

# | Thank You!

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