

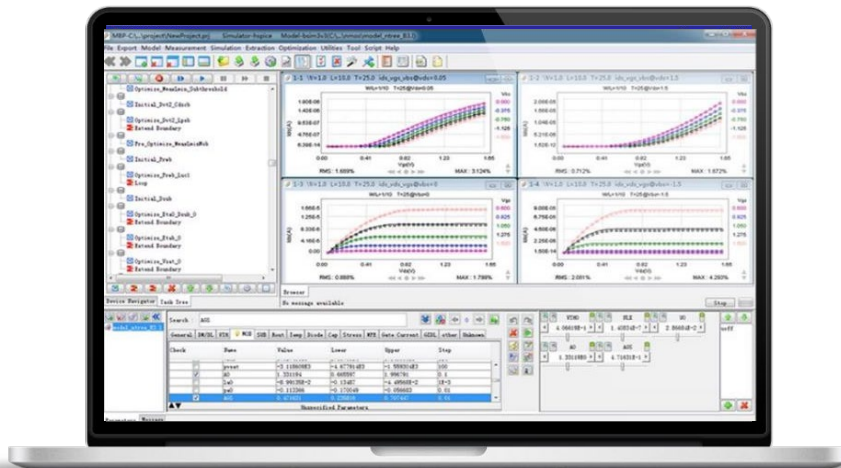
Device Modeling MBP

Complete Silicon Turnkey Device Modeling Software

About Device Modeling MBP

Device Modeling MBP is a complete modeling solution that integrates SPICE simulation, model parameter extraction, and model library generation. MBP supports the latest standard models, including BSIM-BULK, BSIM-CMG, and BSIM-IMG for logic, analog, and RF designs. Besides compact models, MBP supports the macro (subcircuit) and Verilog-A models.

MBP provides automatic extraction packages. The scripting environment enables extraction flow customization, device target definition, and GUI operations. With its superior optimization technology and advanced features, MBP provides the most comprehensive, accurate, and efficient modeling solutions, especially for silicon devices.



Key Features

- MBP implements the Keysight EDA machine learning-based optimizer.
- MBP provides the fully automated model extraction flow for various industry-standard models, including BSIM-BULK, BSIM3, BSIM4, BSIMSOI, PSP, HiSIM2, HiSIM_HV, Gummel-Poon, VBIC, and Mextram.
- Support for the advanced multi-gate FET models: BSIM-CMG, BSIM-IMG, and L-UTSOI
- Turnkey modeling packages for model re-centering and SRAM cell model generation
- The open interface enables users to customize modeling flows and internal functions using the MBP script and the Python script
- QA Express offers a one-click model QA function during model parameter tuning
- Built-in macro model tuning and optimization capabilities incorporating high voltage and layout-dependent effect (LDE) modeling
- The industry's most complete variation modeling solution to generate statistical and mismatch models based on either silicon data or technology spec
- Reliability modeling packages to extract MOSRA (level 1, level 3, and API), AgeMOS, URI, and TMI aging models
- Equipped with superior optimization technology balancing speed and accuracy
- Excellent usability with a friendly user interface, the efficient model equation viewer, and model library support

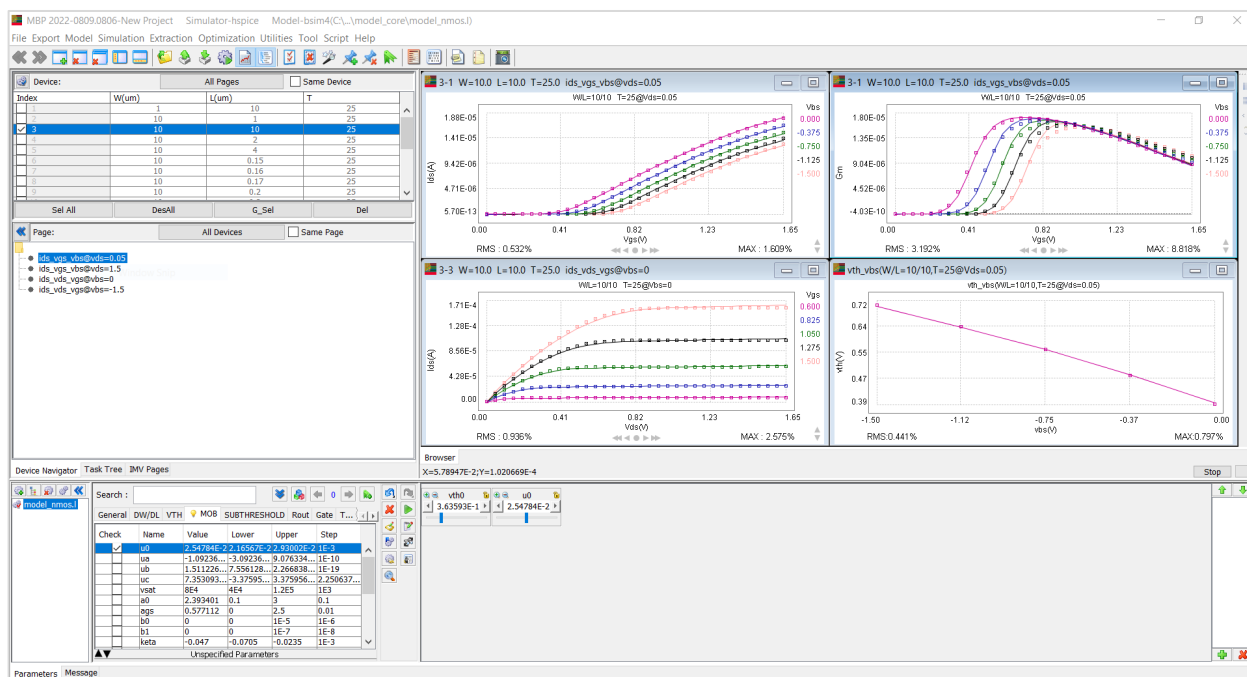


Figure 1. Device Modeling MBP Main User Interface

MBP Specifications

Internal SPICE Engine

- MBP's internal SPICE engine supports real-time model simulation and parameter tuning.
- Experience faster simulation speeds for large volumes of data with support for parallel simulation.

Table 1. MBP internal engine support list

Device Type	Support Models
MOSFET	BSIM3, BSIM4, BSIM-BULK, PSP, HiSIM2, HiSIM_HV, EKV3
SOI	BSIMSOI3, BSIMSOI4, L-UTSOI
MGFET	BSIM-CMG, BSIM-IMG
BJT	Gummel-Poon, VBIC, Mextram, HiCUM
Diode	Level1, Level3, Juncap2, Diode_CMC
Resistor	R2, R3
Inductor	
Capacitor	MOSVAR, MIM Capacitor
JFET	Level1

Optimizer

- The Machine Learning-based optimizer handles more parameters and avoids the local optima.
- Superior optimization technology balancing speed and accuracy
- Internal optimizer supports the optimization of general models, subcircuit models, design spec, and Intermediate Variables (IMVs)

Macro Modeling

- MBP provides the fastest optimization speed for macro modeling
- Enables optimization of macro variables and model parameters together at a fast speed
- Supports all popular simulator formats
- Equipped with pre-defined templates for high voltage device modeling and layout-dependent effect modeling such as STI and WPE

MBP Script

- MBP script enables GUI operation application, plot manipulation, data re-organization, IMV target definition, and extraction flow customization

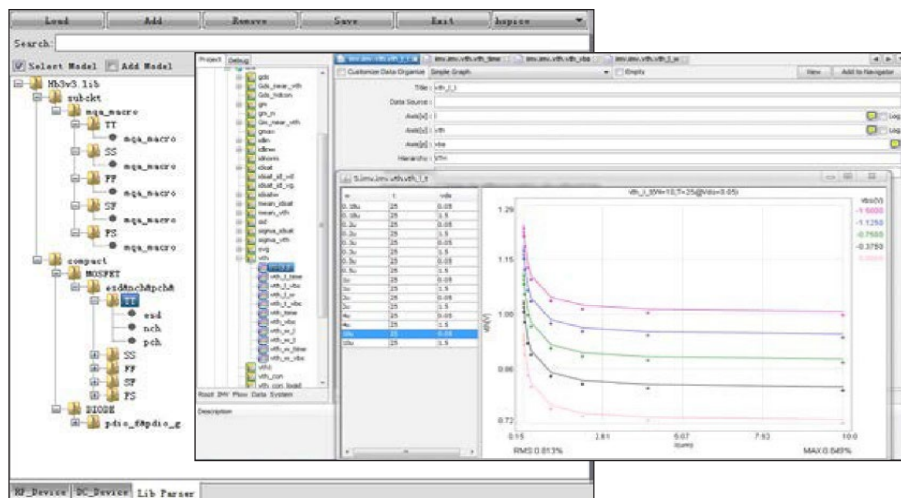


Figure 2. Device Modeling MBP Script

Automated Model Extraction Flow in MBP Script

- The fully automated extraction and optimization steps are implemented for the industry-standard models
- Extraction step adjustment supported for data/region selection, model parameters, graphs, and optimizer settings
- Supports script API to access the MBP functions
- Supports running assigned Python script in MBP flow

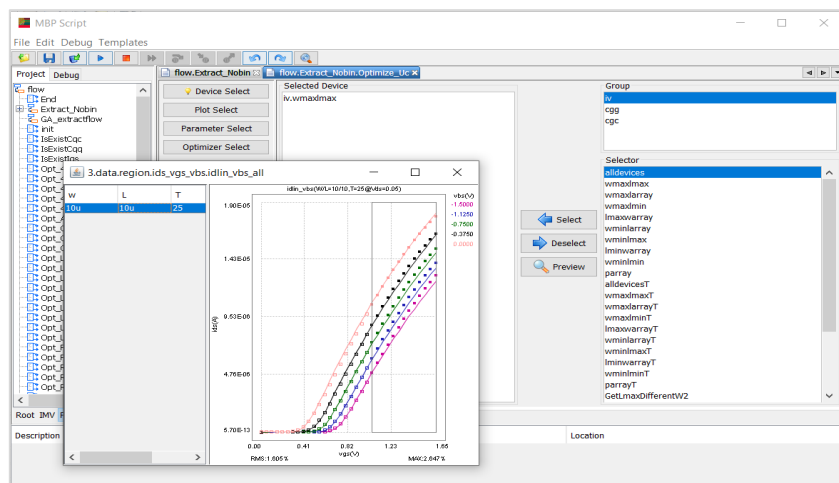


Figure 3. Device Modeling MBP GUI-Based Model Extraction Flow

MBP Python Script

- MBP Python script enables users to build a more complex, full automation modeling process in MBP.
- The auto extraction flow example using the built-in machine learning optimizer offers high robustness and an easy-to-customize modeling process.
- Equipped with MBP Python editor, MBP Python APIs, and MBP examples

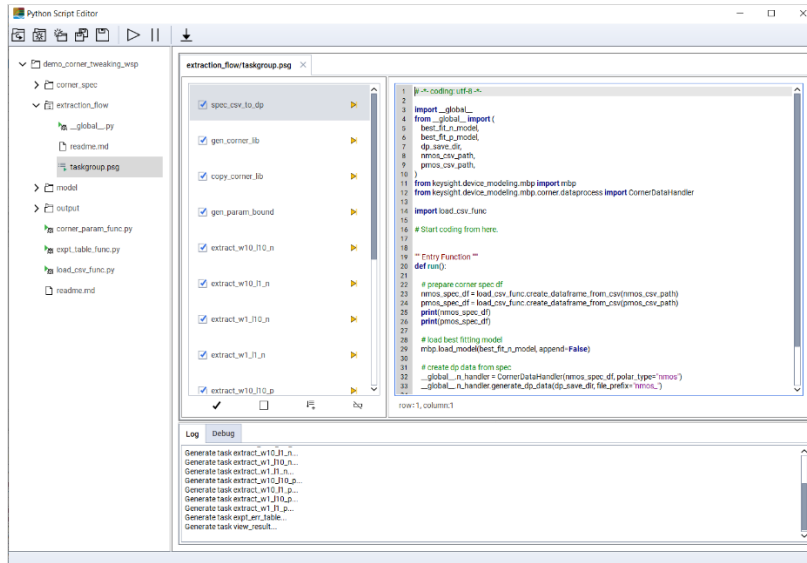


Figure 4. Device Modeling MBP Python Script

QA Express

- Enables a one-click model QA function during model parameter tuning
- Supports the single model QA and corner check
- Pre-defined check function: bin continuity, target trend plots, simulator warnings, etc.
- Customizable geometry, bias, rule to check

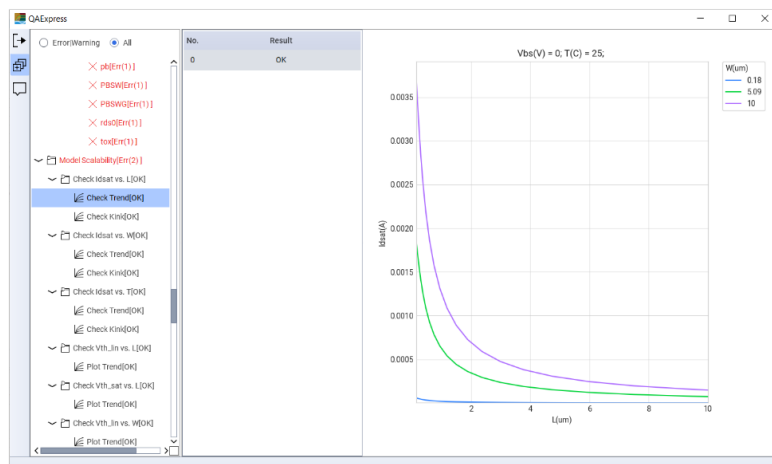


Figure 5. Device Modeling MBP QA Express

IMV and DP

- Enables users to optimize on Vth, I_{dsat}, I_{off}, or any user-defined targets vs. W/L/T. For example, the parameters like n_{lx}, dvt0, and dvt1 can be optimized directly on Vth vs. L curve at different V_bs
- Enables loading Device Parameter (DP) data and using it as a target to tweak model parameter
- Enables target table display with single or multiple targets
- Enables parameter effective value vs. W/L for binning model
- Enables DP data display on the IV curves

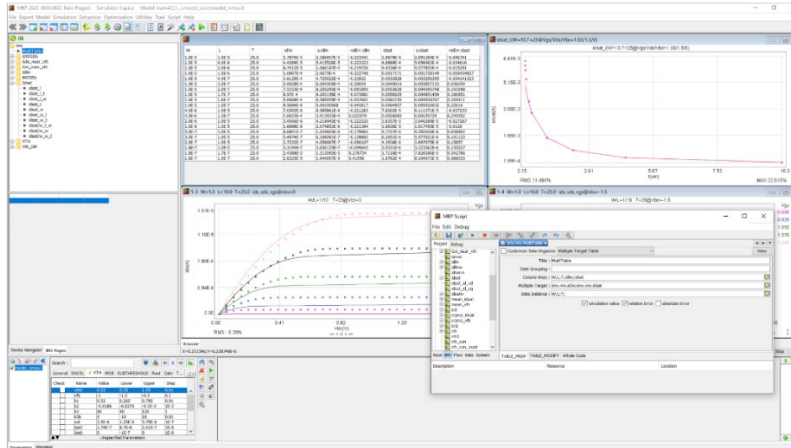


Figure 6. Device Modeling MBP IMV plots

Re-Centering

- Enables to define the acceptance criteria and display the fitting error in different colors
- Presents both error table and IMV plots at the same time
- Targets and plot customization with MBP Script
- Supports exporting the error table in an Excel file

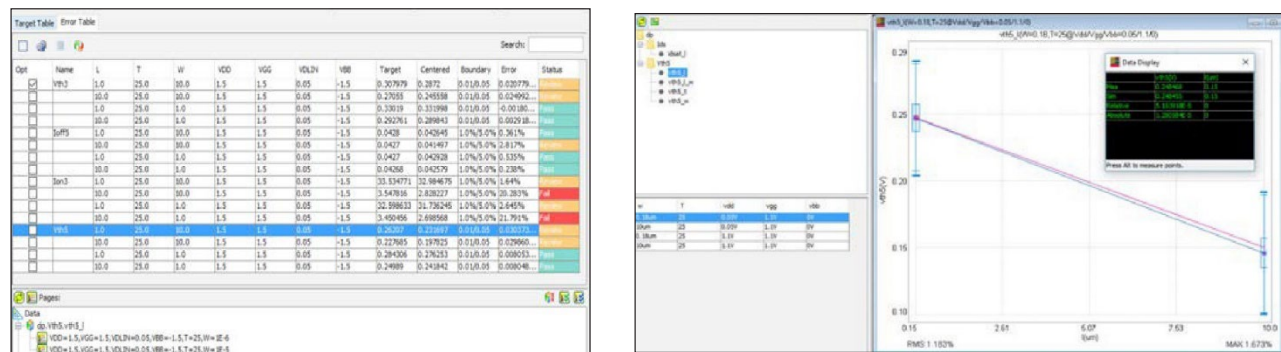


Figure 7. Device Modeling MBP Re-centering

Corner Tweaking

- Construct a corner library from either a model card or library template
- Optimize the selected devices and targets for all the corners
- Corner spec edit, import, and export
- Pre-defined targets and plots for tweaking or automated optimization

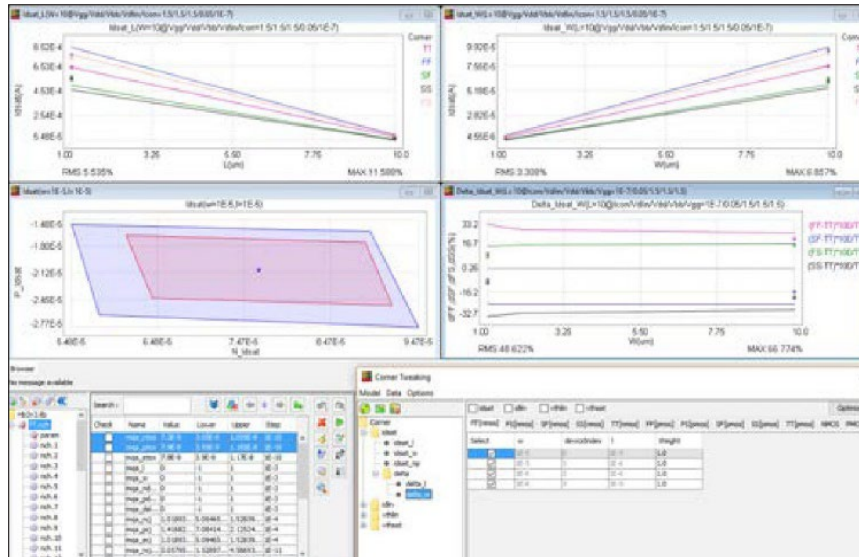


Figure 8. Device Modeling MBP Corner Tweaking

Lib parser

- Directly import and export model libraries of HSPICE and Spectre format
- Simulate and tune the parameters in the model libraries directly

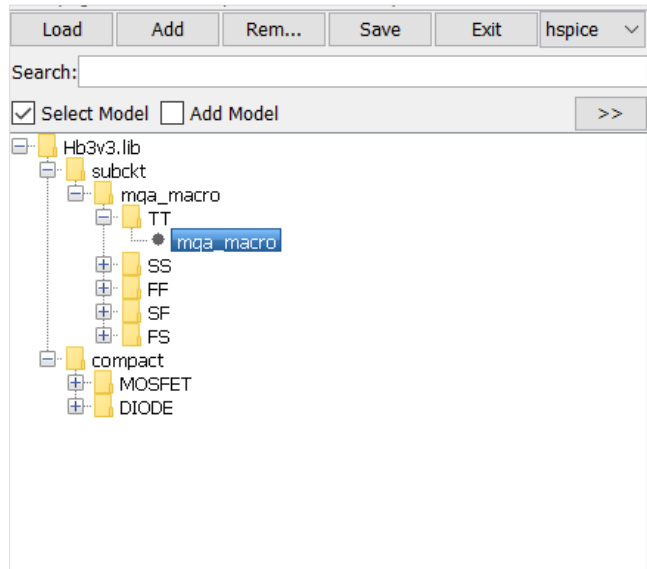


Figure 9. Device Modeling MBP Lib Parser

External Simulator Link

- Enables to call external HSPICE, Spectre, and ADS (HSPICE or Spectre syntax) to simulate
- An exclusive Advanced HSPICE Link on Linux offers 10 times faster simulation speed

Best Usability

- Flexible and simple device navigation
- Equation viewer enables easy debugging of model issues on the fly

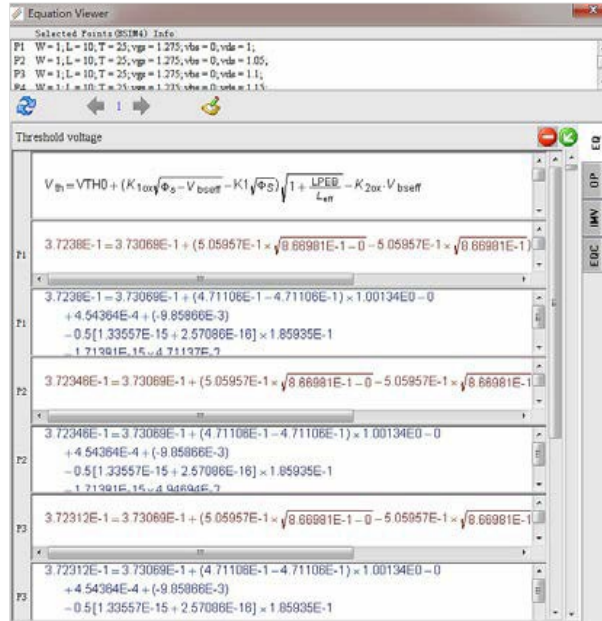


Figure 10. Device Modeling MBP Equation Viewer

- Easy parameter selection and optimization
- The model comparison function enables in-progress model comparison during the model extraction process
- Error monitor provides a global view of fitting error



Figure 11. Device Modeling MBP Error Monitor

- MBP's internal functions can be customized, such as math transforms and RMS definition, through the open interface
- Parameter guide allows to lookup parameters related information such as definition, default value, boundary, and equations

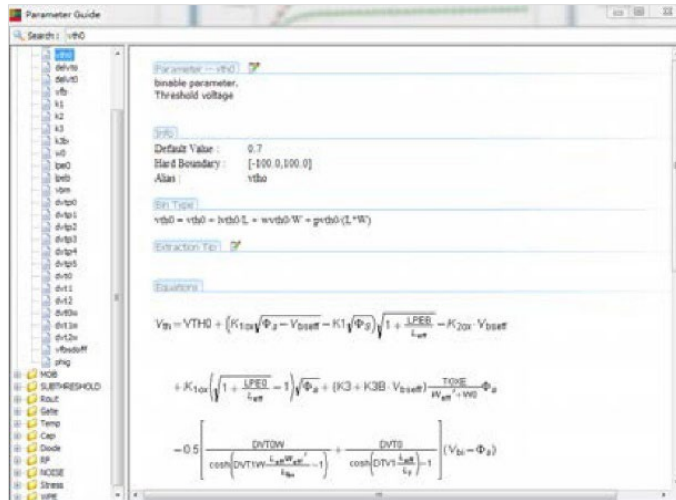


Figure 12. Device Modeling MBP Parameter Guide

- Pin function provides the measured, simulation value, and fitting error of specific measurement points

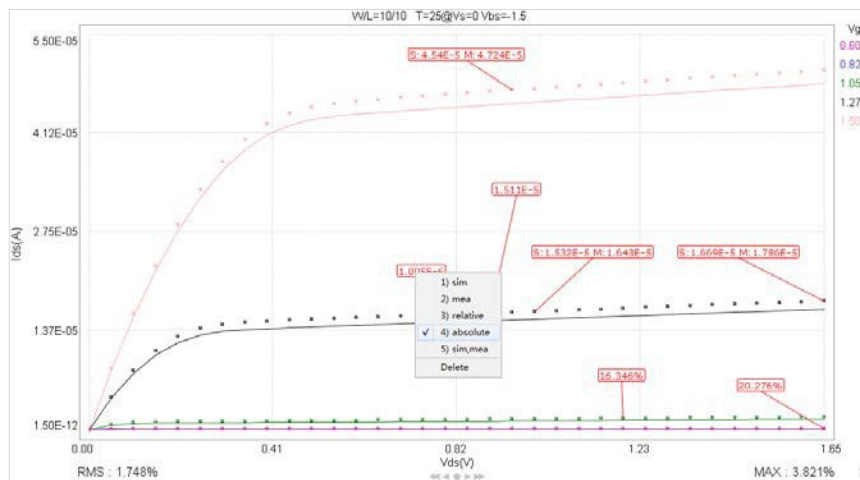


Figure 13. Device Modeling MBP Pin Function

Comprehensive Modeling Package

- Monte-Carlo model support for global statistical and local mismatch modeling
- One-stop statistical modeling tool offers a complete global statistical, local mismatch, and corner model solution.
- Flexible variation model extraction flow supports different types of inputs and considers N/P correlation
- A state-of-the-art subcircuit modeling approach for high-voltage device modeling
- Circuit-based model extraction based on the figure of merits of benchmark circuit (ex. RO stage delay, dynamic power, leakage power)
- The turnkey reliability modeling package to extract MOSRA (level 1 and level 3), MOSRA API, AgeMOS, and URI models
- SRAM model generation package allows optimizing NMOS&PMOS transistor models and memory cell models in one MBP session

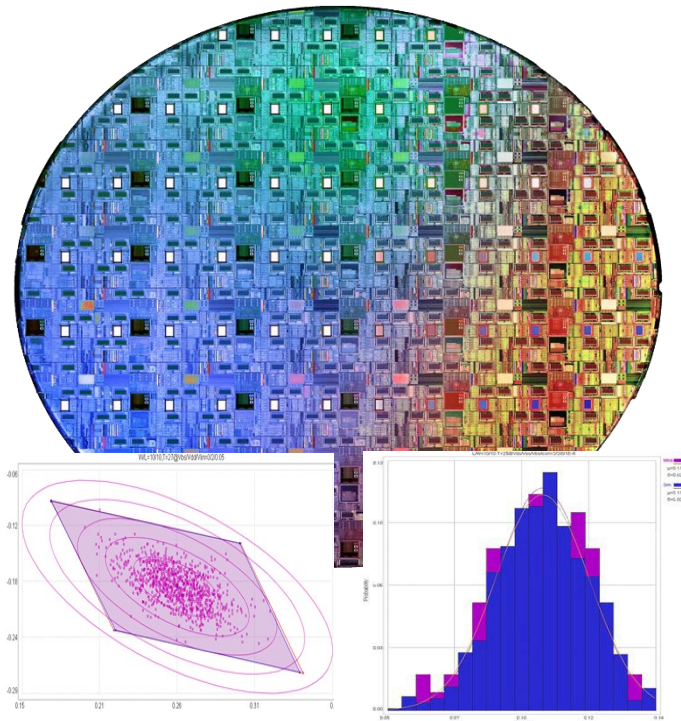
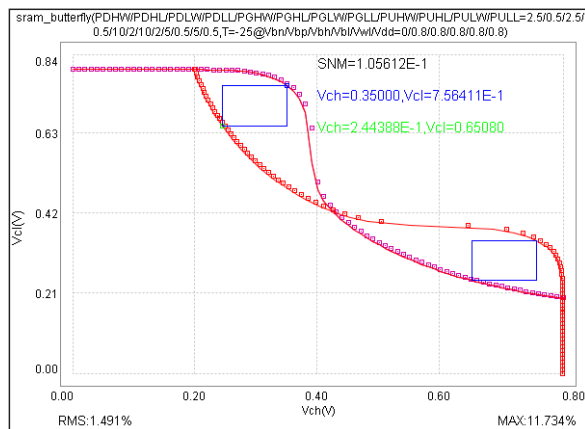
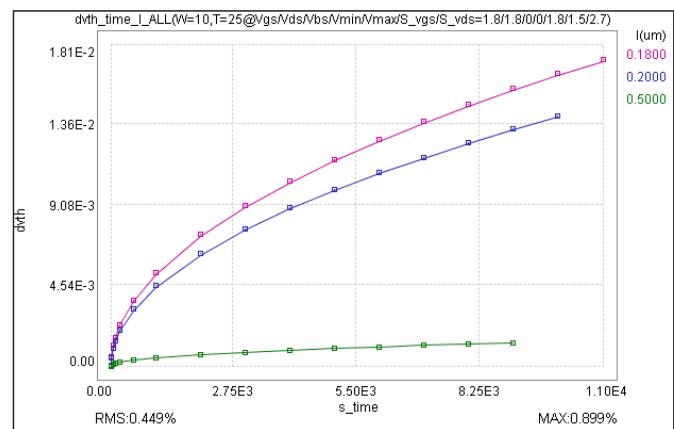


Figure 14. Device Modeling MBP Statistical, SRAM, Reliability Modeling package

Product Configuration

Device Modeling MBP is a one-stop solution that provides both automation and flexibility for silicon device modeling.

Core Environment includes all the necessary components for data loading, model simulation, parameter extraction, model generation, and reporting. Simulation can be performed by either the internal engine or external simulators (e.g., HSPICE, Spectre). The extraction packages for BSIM3, BSIM4, Gummel–Poon, resistor, capacitor, diode, JFET, and macro model are included by default.

Base Bundle

The W6300B Device Modeling MBP core bundle is the foundation for all other Device Modeling MBP elements. It contains the Device Modeling MBP user environment, including the internal engine simulation and extraction package for BSIM3, BSIM4, EKV3, MOS level 2, MOS level 3, Gummel–Poon, resistor, capacitor, diode, JFET, and macro model built on these models.

Model	Name	Description
W6300B	Device Modeling MBP core bundle	Includes Device Modeling MBP core environment, and extraction packages for a few selected models
W6301B	Device Modeling MBP core and QA Express	Includes Device Modeling MBP core environment, and QA Express
W6325B	Device Modeling MBP/IC-CAP modeling bundle	Includes Device Modeling MBP core environment and Device Modeling IC-CAP core environment, simulation, and analysis module
W6328B	Device Modeling MBP/MQA modeling bundle	Includes Device Modeling MBP core environment and Device Modeling MQA core environment
W6329B	Device Modeling MBP core, QA Express, and machine learning toolkit	Includes Device Modeling MBP core environment, QA Express, and the machine learning toolkit

Elements

Model	Name	Description
W6011E	Device Modeling MBP Bulk MOSFET	Model extraction packages for PSP, HiSIM2, and BSIM-BULK

Model	Name	Description
W6012E	Device Modeling MBP BJT/HBT	Model extraction packages for Mextram, HICUM, and VBIC
W6013E	Device Modeling MBP HV/LDMOS	Model extraction packages for HiSIM_HV and Level 66 HVMOS
W6014E	Device Modeling MBP Multi-gate FET	Model extraction packages for BSIM-CMG and BSIM-IMG
W6015E	Device Modeling MBP BSIMSOI Model Generation	Model extraction package for BSIM-SOI
W6016E	Device Modeling MBP UTSOI Model Generation	Model extraction package for UTSOI
W6017E	Device Modeling MBP Viewer	A graphical user interface that enables you to view model fitting results and generate reports
W6018E	Device Modeling MBP Silicon Model Extraction Package	Model extraction packages for PSP, BSIM-SOI, HiSIM2, HiSIM_HV, HICUM, VBIC and Mextram
W6019E	Device Modeling MBP CMOS Modeling Package	CMOS modeling packages for Verilog-A, reliability, statistical, SRAM cell and re-centering
W6021E	Device Modeling MBP Advanced HSPICE Link	Fast Link to PrimeSim HSPICE (Linux only)
W6022E	Device Modeling MBP QA Express	One-click model QA function during model parameter tuning
W6023E	Device Modeling MBP Machine Learning Toolkit	Machine learning optimizer and the extraction flow examples

License and Subscription Types

Each MBP module is available in two license versions:

1. A node-locked version allowing the software to execute only on a single PC
2. A network-licensed version for execution on multiple workstations or PCs on a network, allowing various workgroups to share the software. Three types of floating license are available: N - Single site: 1-mile radius from the server; R - Single region 2: Americas, Europe, Asia, and W - Worldwide (export restriction identified in End User License Agreement (EULA))

World-Class Service and Support

Keysight Design Software is committed to helping you achieve success with Device Modeling MBP through customer education courses, technical support, and custom solution services.

To help you begin using MBP quickly and productively, a comprehensive training course is offered at various locations in Keysight facilities or online.

A support contract includes automatic software updates, literature, and documentation for the latest product enhancements and features.

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