SYSTEMS PRODUCTS
LOGICAL PRODUCTS
PHYSICAL IMPLEMENTATION
SIMULATION AND ANALYSIS
LIBRARIES
TCAD

Aurora
DFM WorkBench
Davinci
Medici
Raphael
Raphael-NES
Silicon Early Access
TSUPREM-4
Taurus-Device
Taurus-Lithography
Taurus-OPC
Taurus-Process
Taurus-Topography
Taurus-Visual
Taurus-WorkBench

Aurora

Device Characterization and Parameter Extraction System

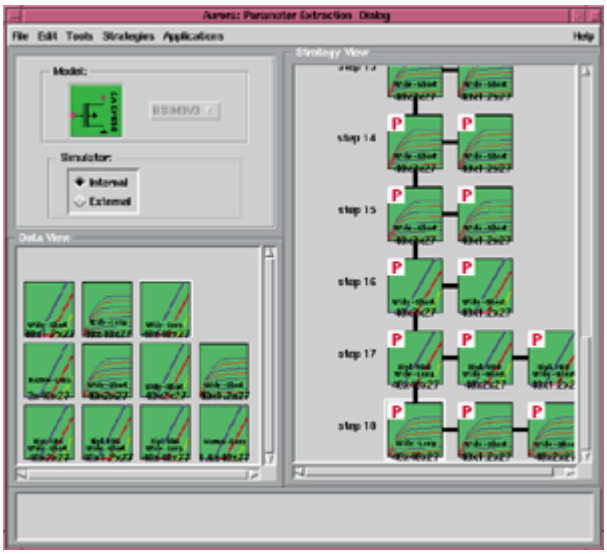
Aurora is a complete semiconductor device characterization and parameter extraction system, providing capabilities to measure device characteristics, extract circuit level model parameters measured or simulated data, and analyze results graphically.

AURORA KEY FEATURES

- Measure and analyze device characteristics through direct control of dc parametric teste LCR meters, switching matrices, network analyzers and wafer probers.
- Extract physically meaningful parameters for built-in SPICE models for MOSFETs (e.g. L 3, BSIM, BSIM2, BSIM3v3, MOS9), BJTs, junction capacitances, JFETs, Diodes from measured or simulated data.
- Directly extract parameters for proprietary device models implemented in Star-Hspice (e Levels 2, 3, 13, 28, 47, 49, 50).
- Extract parameters for proprietary device models embedded within commercial circuit simulators: PSPICE, Berkeley SPICE, Saber etc. using the external simulator interface.
- Develop new device models and custom parameter extraction strategies through a easy-to-use user interface.
- Interactively fit device model curves to data by varying model parameters.
- Create macro-models and add custom SPICE simulators within the graphical user interfa
- Obtain skew models from either simulated or measured data for best/worst design (withi DFM WorkBench environment, licensed separately).

DESCRIPTION

Aurora is designed for obtaining device characteristics and producing compact models for use during circuit simulation. It can be used interactively through the easy-to-use GUI, or in a produ environment by processing batch text files. The latter mode enables automated characterizatio Aurora includes three primary levels of functionality: electrical test, parameter extraction and graphical analysis.



The main aurora window represents data files and strategy steps as icons. To create strategy s data icons are dragged and dropped with the mouse from the Data View section to the Strategy View section. The ranges of variables, targets, and optimizable parameters are then specified.

Aurora contains a complete measurement interface, capable of driving equipment to acquire D

and capacitance data, as well as S-Parameters for high-frequency bipolar applications (through S-Parameter AAM). It can interface essentially with all industry-standard parametric testers, including equipment from Hewlett-Packard, Keithley Instruments and Tektronix. This allows dire measurement of electrical characteristics within Aurora's graphical environment, providing data directly for use with parameter extraction and graphical analysis.

For parameter extraction, data from the measurement interface or from device simulation tools Medici) could be used. Accurate extraction strategies using local optimization techniques for industry-standard SPICE Models for both MOS (e.g. BSIM3v3, MOS 9) and BJTs are implemer and facilities are provided to customize the extraction methodology. The most recent enhancen to Aurora allows extraction of parameters for proprietary models implemented in Star-Hspice simulator directly using the Common Model Interface. This speeds up model generation considerably, maintaining the accuracy of parameter extraction. Aurora can also directly invoke external circuit simulators (e.g. PSPICE, Saber) to characterize embedded models. Aurora sup user-defined models and custom SPICE simulators that allows characterization of proprietary models and development of macro-models.

Fully interactive publication quality graphics are available within Aurora for data and post-extrac analysis.

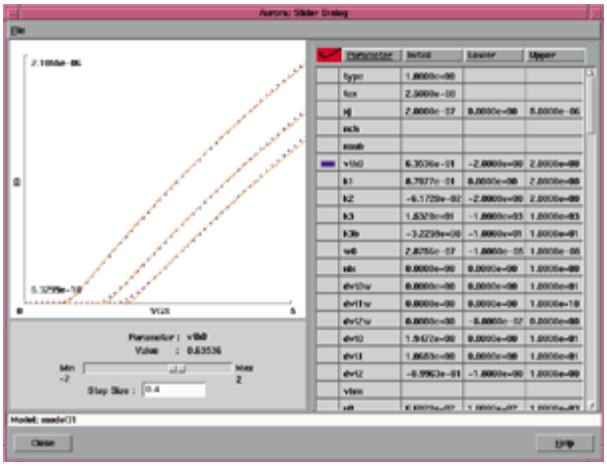
Model and Simulator Setup window lets the user add/change models or circuit simulators that w work with Aurora. Macro-model development is possible by the addition of user-defined circuit simulator and customizable netlist.

USER-DEFINED MODELS/CIRCUIT SIMULATORS

Aurora now supports userdefined Models and Circuit Simulators providing users with an easy mechanism for characterizing their own models, and developing complex macro-models within Aurora's graphical environment.

INTERACTIVE CURVE FITTING

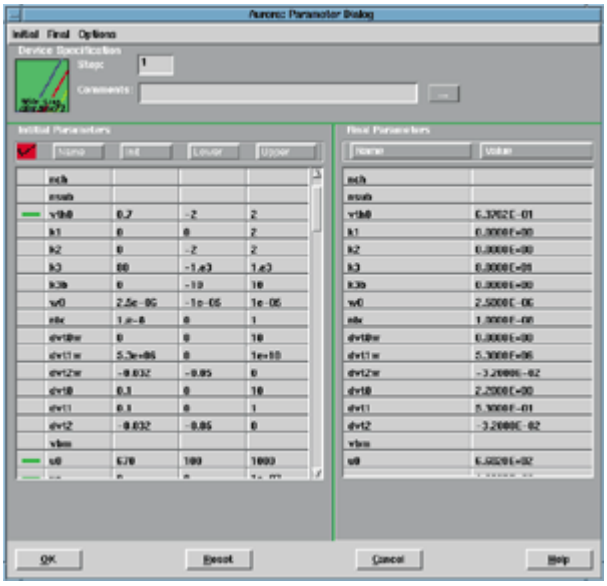
Aurora's Slider View helps to users to understand the effect of a model parameter on the devic characteristics. An interactive tool, it is used to view the variation of model curves with a change given parameter. The parameters associated with both built-in and userdefined models can be varied independently using a slider and the corresponding effect on the device characteristics c be graphically viewed. This contributes to better model optimization.



Slider view enables interactive curve-fitting of the model to the data, providing insight into the sensitivity of the model to a particular parameter.

PARAMETER EXTRACTION

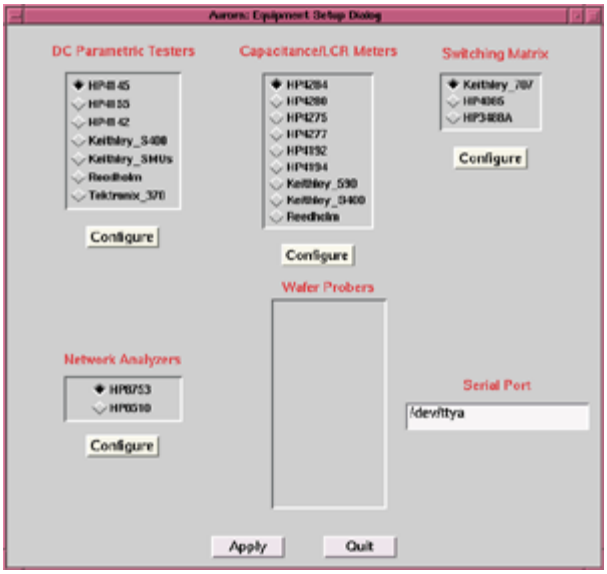
The basis of obtaining physically meaningful device models is a well designed extraction strateg Only through a well conceived sequence of local optimization steps, based on a thorough understanding of the device model, can a meaningful parameter set be determined. Aurora's intuitive menus let the user easily examine and customize the various steps in Avant! develope extraction strategies, or design a new strategy for unique technology or model.



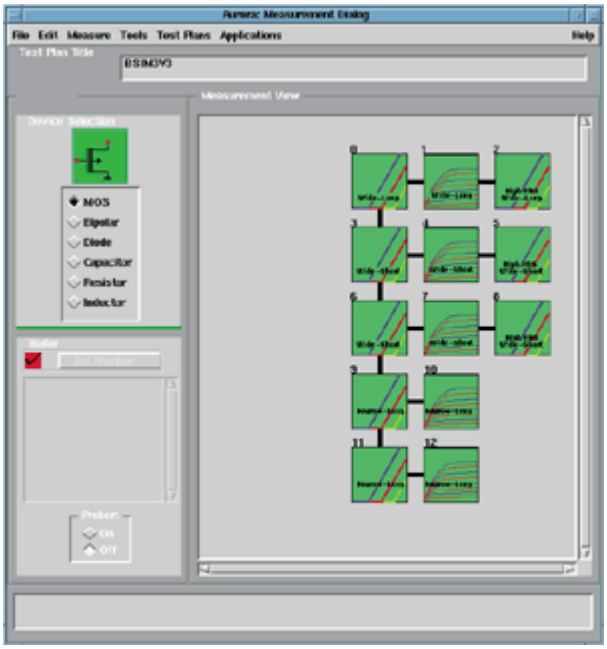
The Parameter window allows the parameters associated with the model to be selected for optimization. Multiple parameters, with an initial, lower and upper bound specified, could be incl for simultaneous optimization.

MEASUREMENT INTERFACE

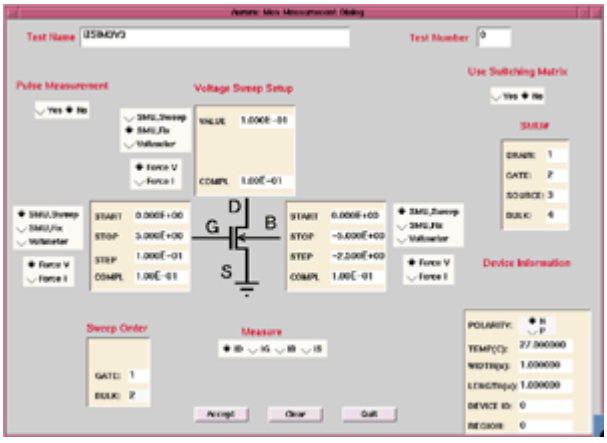
The measurement interface allows data acquisition from industry-standard semiconductor test equipment for all standard devices (e.g. MOSFETs, BJTs, diodes, capacitors, inductors and resistors). The test equipment is controlled by GPIB and the data collected is in ASCII, ready fo use with the parameter extraction module. Equipment and test plans can be set up graphically the Measurement Interface. The acquired data can be plotted to verify its nature.



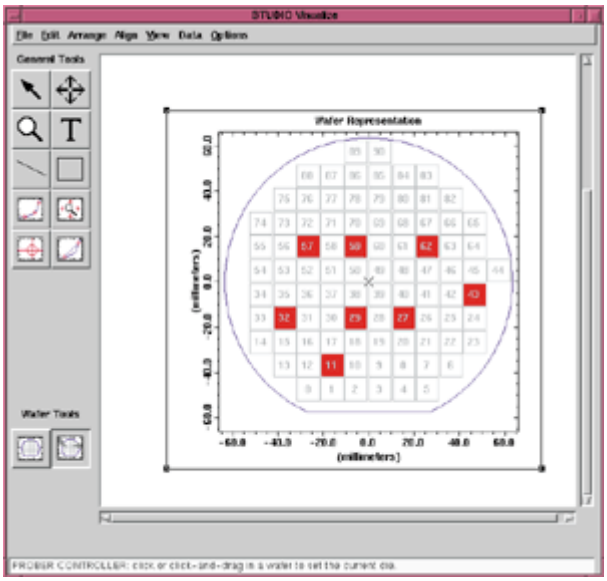
The Equipment setup window allows the user to select the desired DC parametric tester (inclua pulse measurement) LCR Meter, Switching Matrix, Network Analyzer, and Wafer Prober. The selected equipment can be configured for data acquisition through GPIB from Aurora's graphica environment



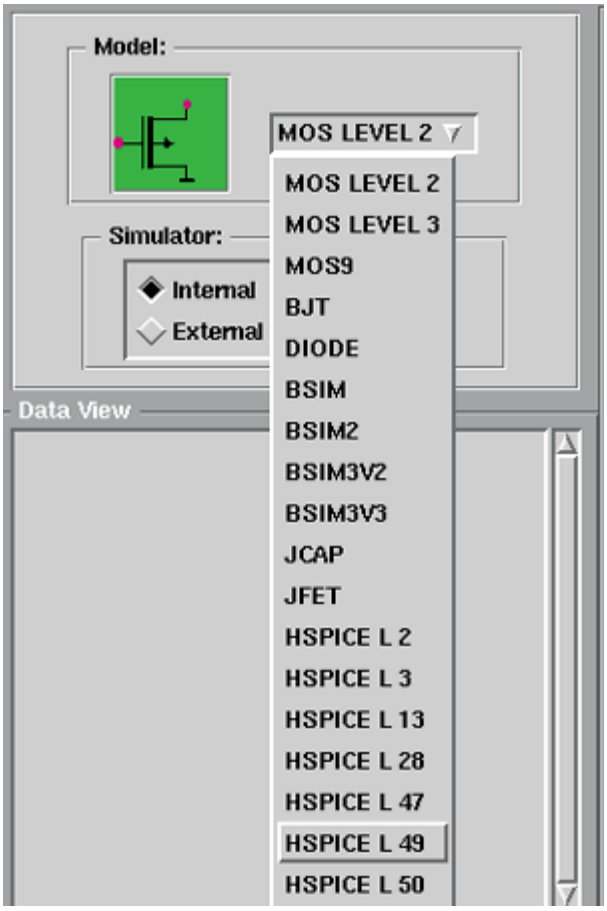
*The Measurement Dialogue window enables the user to set up the equipment and test plans fo devices to be measured.*0



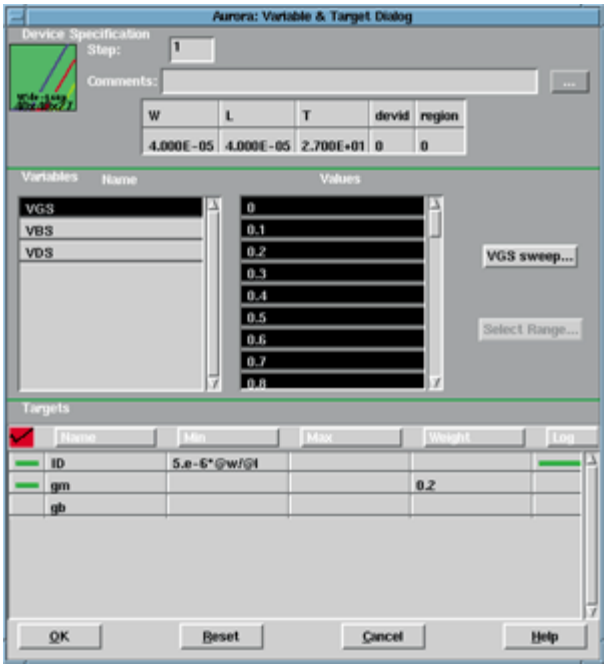
Voltage and current sweeps, and the sweep order can be set using the Device Sweep window. terminal can have its voltage or current forced or measured, and it can be swept, fixed or floate



The wafer specifications are entered in the Wafer map window and the dies to be measured are selected. The wafer prober would be stepped from die-to-die performing the measurement spec in the Measurement Dialogue window.



The list of built-in models available in Aurora facilitates extraction of parameters for UC Berkele well as Star-HSPICE implementation of the models



The Variable & Target window provides the availability to select range of variables and targets. Multiple targets with relative weights assigned to them as well as derivatives and logs of targets selectable.

MODELS
Complete set of industry-standard device models:

- Level 2 and 3, BSIM, BSIM2 and BSIM3
- Version 3 for MOS.
- Philips MOS Level 9.
- Gummel-Poon for bipolar.
- Junction capacitance model.
- JFET model.
- Diode model.
- Star-Hspice models (Levels 2, 3, 13, 28, 47, 49, 50).
- Allows essentially arbitrary user-defined models to be specified and used.
- Examples provided to aid in model development and implementation.
- Models may have up to 50 independent variables, 500 fitting parameters and 50 depend variables or targets.
- Up to 60 parameters may be Ft simultaneously.

INPUT/OUTPUT

- Aurora functions with Avant! TCAD tools in Taurus WorkBench environment to go from process specification and mask layout to circuit performance.
- I-V characteristics can be read from Davinci, Medici and formatted text files, allowing the extraction of device model parameters using simulated electrical data.
- Intuitive drag-and-drop user interface for easy operation.

AVAILABLE FUNCTIONALITY INCLUDES

- Measurement of device electrical characteristics.
- Extraction of physically meaningful model parameters.
- Fully interactive graphical display of measured data and simulation results.
- Programmable command language available to provide maximum flexibility for automate characterization.

SYSTEM CONFIGURATION REQUIREMENTS

- Platforms: Aurora operates on UNIX workstations from Hewlett-Packard, IBM and Sun Microsystems.
- Memory: 50 Mbytes.
- Disk space: 90 Mbytes.

AURORA SPECIFICATIONS
Parameter extraction features and strategies:

- Accurate, flexible and dependable extraction of device and other model parameters.
- Parameter extraction for internal and external models supported.
- Physically meaningful parameter values determined through use of extraction strategies logical sequence of local optimizations.
- Parameter values calculated using mature
- Avant! TCAD proprietary optimizer.
- Proven Avant! TCAD extraction strategies for industry-standard models.
- Provides ability to define and modify extraction strategies.
- Multiple step strategies supported with the ability to specify subsets of parameters and d to be used within individual optimization steps.
- Derivatives, ratios and other quantities can be computed and used as optimization targe

TEST EQUIPMENT INTERFACES
Controls industry-standard test equipment for direct measurement of device electrical characteristics, including:

- Hewlett-Packard: 4142, 4145A/B and 4155/56 parametric testers; 4192, 4275, 4277, 428 and 4284 capacitance meters; 8510, 8753 network analyzers; 4085 switching matrix.
- Keithley: 707 switching matrix; 236, 237 and 238 SMUs; 590 capacitance meter; S400 parametric tester.
- Tektronix 370 programmable curve tracer.
  Imports data from Keithley S900 self-driven tester.
- Supports S-parameter measurement and analysis for AC bipolar parameters (via optiona S-Parameter Advanced Application Module).

CIRCUIT SIMULATOR INTERFACE
Interfaces directly to commercial circuit simulators, ensuring accurate parameter extraction for embedded proprietary device models:

- Star-Hspice.
- PSpice.
- Saber.
