# SILVACO

UTMOST SPICE Modeling Software

UTMOST™ SPICE Modeling Software generates the most accurate, linear, and continuous SPICE models for analog, mixed-signal, and nanometer digital applications. Leading IDMs, foundries, and fabless companies use UTMOST for the highest quality SPICE models from data acquisition, to parameter extraction, to model verification.

- Produces the most accurate, linear, and continuous SPICE models for analog and mixed-signal applications

- Offers the widest selection of pre-calibrated SPICE models from industry and universities for MOSFET, BJT, Diode, JFET, GaAs, SOI, TFT, and HBT

- Supports the widest selection of measurement equipment and probers from all vendors

- Fully interactive, semi-automatic or batch-mode operation with real-time model tuning with unique rubber-banding algorithm to achieve continuous models for rapid run-time SPICE convergence

- Integrated with TCAD and statistics package for smooth development of pre-silicon models

- Supports all leading SPICE simulators with DC, AC, transient, and capacitance test routines

- SPICE modeling services available using latest measurement equipment with 18 years experience

- Flexible measurement and analysis environment for device characterization and model generation

- Supports widest selection of instrument drivers, prober drivers, device models, operating platforms, and commercial circuit simulators

- Splits device characterization or modeling problems into separate measurement and analysis tasks

- Stores measured results in measurement log files for future analysis (search, averaging) so that valuable probe time is minimized

- Uses common data sets for extraction of parameters from different models

- Supports single test or step-and-repeat operation

- Extracts parameters with comprehensive library of built-in extraction algorithms, flexible user-defined local optimization strategies, more interactive global optimization procedures, or a combination of all three

- Store extracted parameters in multiple formats, including SPICE library format that can be read back into UTMOST as an initial estimate during future parameter extractions
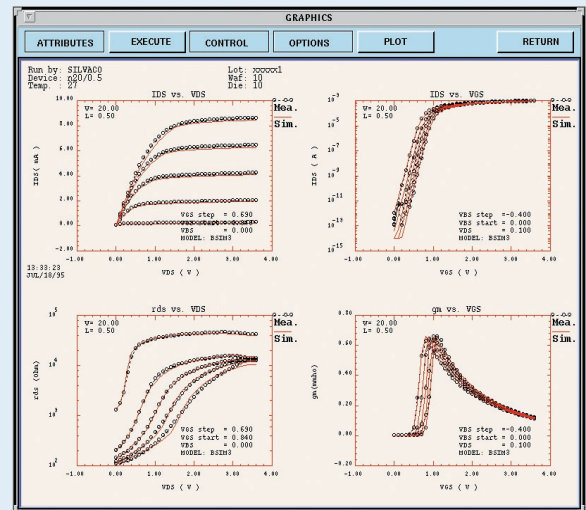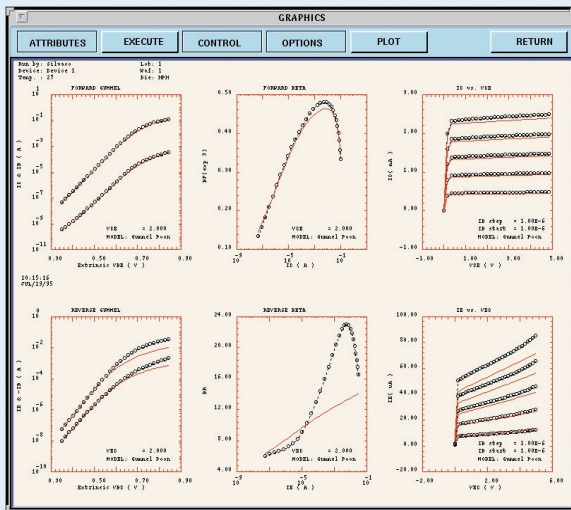
UTMOST acquires measured or TCAD simulated data, extracts parameters, and delivers accurate, linear, and continuous SPICE models

UTMOST addresses the practical needs of device characterization and modeling engineers with a flexible, productive workflow

Data Acquisition

- Drives most commonly used DC analyzers, AC analyzers, capacitance meters, switching matrix controllers, pulse generators, and oscilloscopes

- Controls most commercial automatic and semi-automatic probers

- Drives many temperature ovens and hot chucks

- Fully interactive, semi-automatic, or batch-mode operation

- Step-and-repeat operation, including wafer cassette control

- Configures elaborate computer controlled test systems

- Comprehensive selection of DC, AC, transient, and capacitance test routines for MOSFET, BJT, Diode, JFET, GaAs, SOI, TFT, and HBT modules

- Performs capacitance, transient, or s-parameter measurements on packaged devices, on a wafer or in wafer, stepping mode

- Interfaces to process and device simulators and to the SPAYN™ Statistical Parameter Analysis tool

- Supports the widest variety of models and circuit simulators
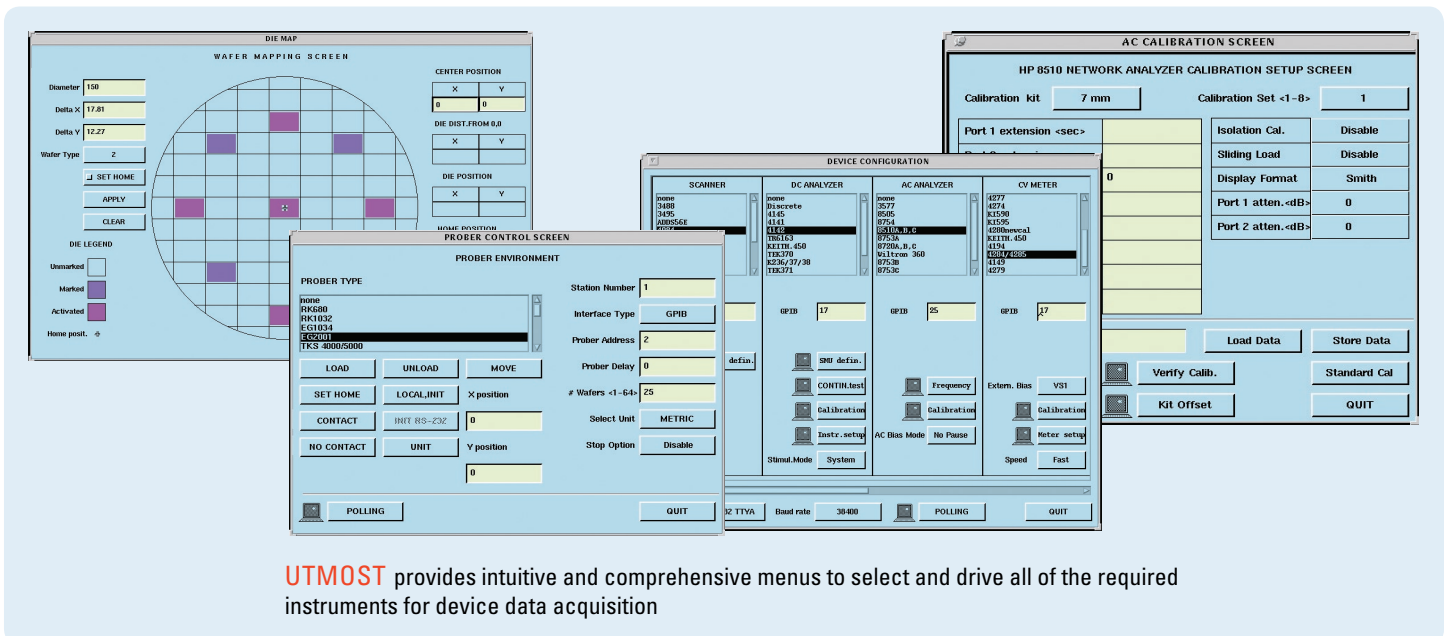
UTMOST provides intuitive and comprehensive menus to select and drive all of the required instruments for device data acquisition

UTMOST supports the widest selection of instruments

DC Analyzers	AC Analyzers	Scanners	Capacitance Meters	Probers
HP4145	HP8510A,B,C	HP4084	HP4284	Electroglas 1034
HP4141	HP8720A,B,C,D,E	HP4085	HP4285	RK 680
HP4142	HP8753A,B,C,D,E	HP4086	HP4262	RK 681
HP4155/56	HP3577	HP3488	HP4271	Cascade Summit
Keithley 236	HP8505	HP3495	HP4192	Alessi 5500
Keithley 237	HP8754	HP3852A	HP4275, HP4276, HP4277	TKS 4000
Keithley 238	HP8751	Keithley 705	HP4274	TKS 6000
Keithley S450	Wiltron 360	Keithley 706	HP4280	Tokyo
Tektronics 370/370A	HP8722D	Keithley 707	HP4194	Electron
Tektronics 371/371A		Keithley 7002	HP4279	Electroglas 2001
		RACAL 1251	Keithley 590	RK 1032
			Keithley 595	Alessi 4500
				Karl Suss (PE100/PA200 II)
				TKS 3000
				TKS 5000
				Wentworth MP-1100

Parameter Extraction

- Includes comprehensive set of DC extraction routines for process-monitor and device model parameters

- Flexible local optimization procedures for any supported model as substitute or supplement to built-in routines

- Supports bipolar routines to extract resistance, breakdown, saturation, temperature, leakage, forward and reverse gain, early voltage, knee current, bipolar junction capacitance, and basic Gummel-Poon parameters from DC measured characteristics

- Provides extraction routines for cut off frequency, forward and reverse transit time, base resistance, and excess phase parameters are implemented for s-parameter measurements

- Extracts DC MOSFET parameters including length reduction, width reduction, threshold voltage, low-field mobility, body effect, velocity saturation, resistance, breakdown, and subthreshold slope parameters

- Supports the extraction of overlap and junction capacitances from capacitance measurements
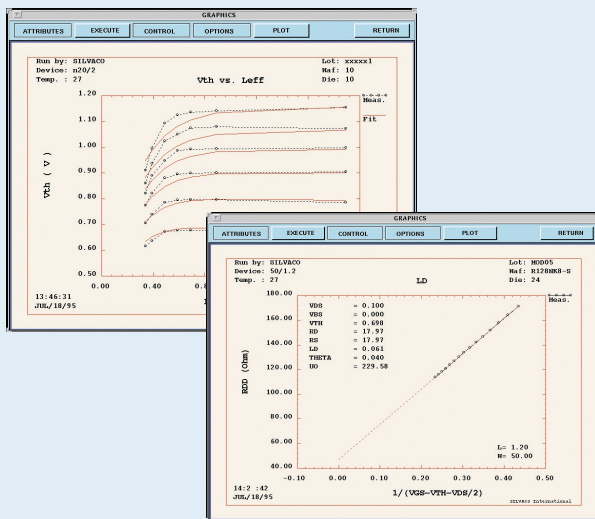
UTMOST extracts MOSFET parameters, including BSIM4
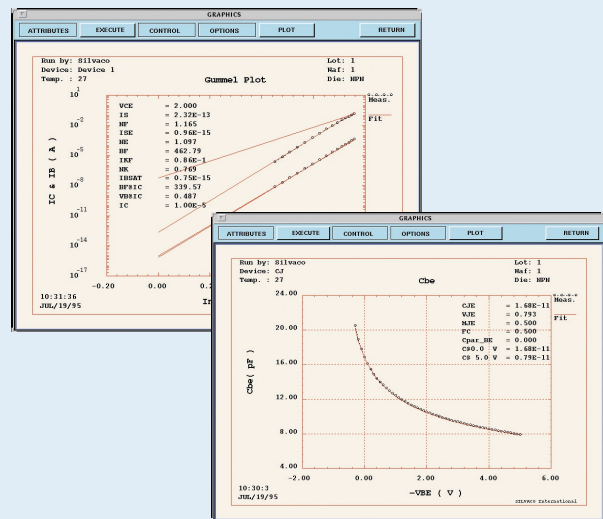
UTMOST extracts parameters for Bipolar (above), BJT, Diode, JFET, GaAs, SOI, TFT, HBT, and passive devices for RF

Advanced Parameter Extraction

- SOI module permits characterization of all transistor properties, including 4/5 terminals device, bipolar parasitic effects, and Body or BackGate currents

- Measured s-parameters can be converted to h, z, and y-parameters

- Supports standard, one step and two step, de-embedding procedures for determining MOSFET s-parameters

- Includes special extraction algorithms for the extraction of BSIM1, BSIM2, BSIM3, and MOS9 parameters, for single or multiple geometries

- Available universal multi-target / multi-geometry measurement routine for SOI and MOS technology

Parameter Optimization

- Offers both local and global parameter optimization options

- Optimize multiple device geometries simultaneously (up to 36 devices) and mix device currents and conductances as optimization targets

- Rubberband interactive parameter extraction defines initial parameter estimates enabling modeling engines to observe the effects of parameter variations on device characteristics

- Supports single or multi-geometry optimization with graphical updating of simulated characteristics and supports multi-step optimization all in real-time

- Offers flexible local optimization facility and optimization boundary boxes

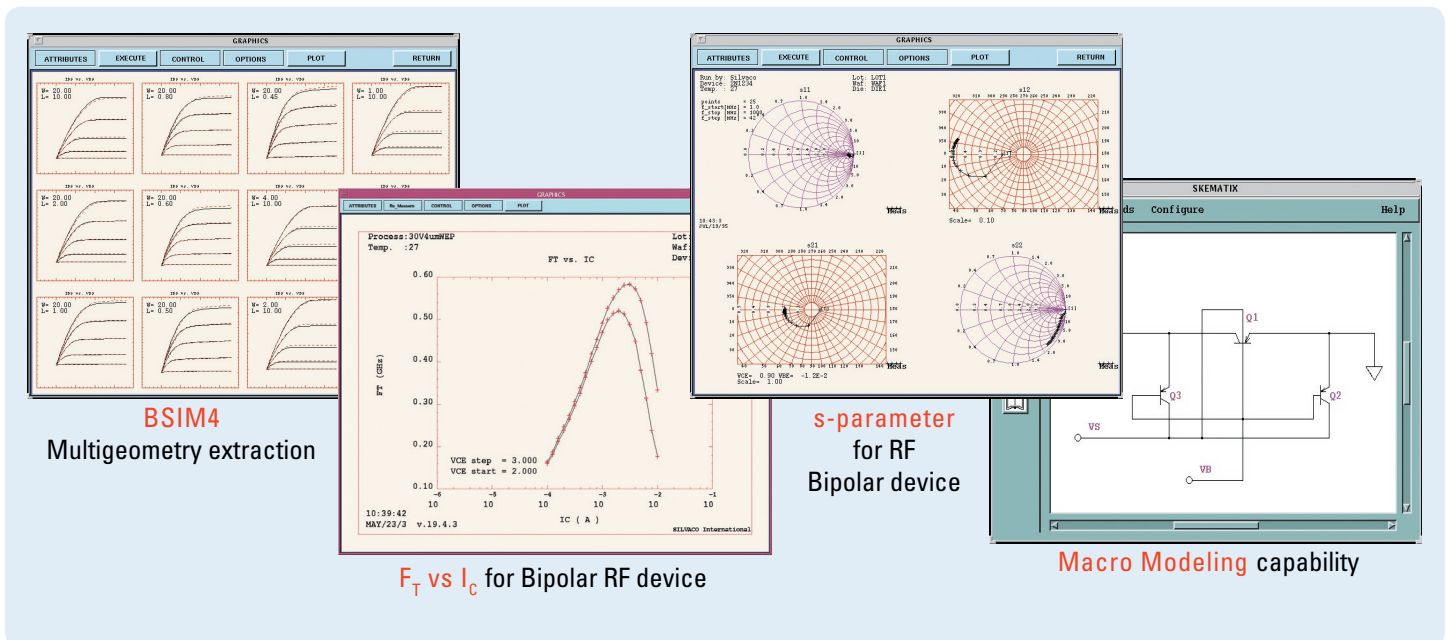- Supports graphical parameter sensitivity and error history information
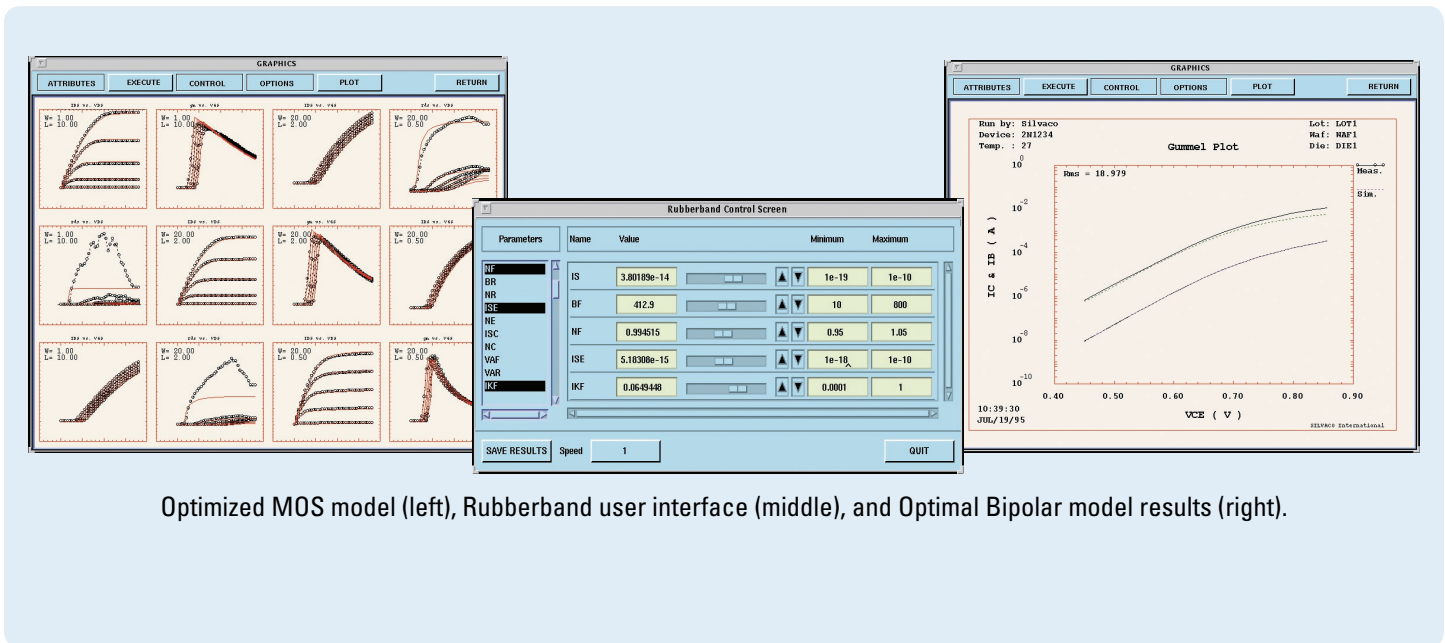
Optimized MOS model (left), Rubberband user interface (middle), and Optimal Bipolar model results (right).

UTMOST supports both Levenberg-Marquardt methodology, which computes both first and second derivative for quick conversion, and the simpler Downhill Simplex methodology.
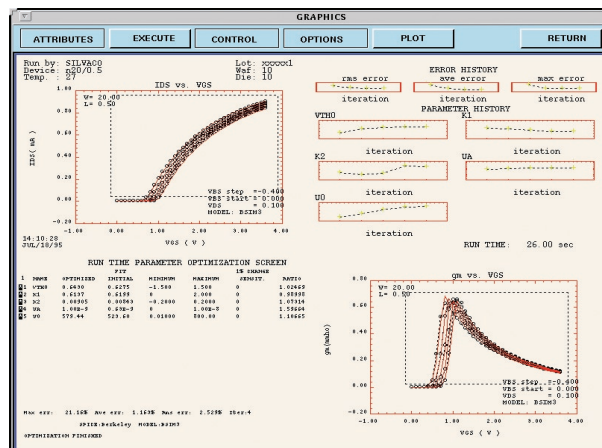
Model Generation

- Supports widest selection of commercially available device models

- Offers model definition choice between External SPICE , SmartLib™, and Internal Models

- External SPICE mode accesses models native to target SPICE simulator

- SmartLib mode accesses SmartSpice™ supported models or those models dynamically linked to SmartSpice for Rubberband mode operation

- Internal Models mode accesses models hard-coded into UTMOST

- Supports the conversion of model parameter sets from one model to another

- Macro modeling and parameter extraction is available for devices which cannot be adequately modeled by any existing device models

- User-defined models linked dynamically

- Support for SmartSpice interpreter models

- Supports large number of commercial device models, some of which are listed below

- Fast simulation using SmartLib Model and Fast internal solver

BSIM4
Multigeometry extraction

F_T vs I_C for Bipolar RF device

s-parameter
for RF
Bipolar device

Macro Modeling capability

Model Features

MOSFET models
Berkeley Level 1
Berkeley Level 2
Berkeley Level 3
BSIM1
BSIM2
BSIM3
Philips Level 9
EKV
MASTAR
BSIM4
Philips Level 11
User models

Bipolar models
Gummel-Poon
Quasi RC
IGBT
QBBJT MEXTRAM
HBT
HICUM
MEXTRAM504
User models

SOI model
Honeywell
FLORIDA FD
FLORIDA NFD
BSIM3SOI FD
BSIM3SOI DD
BSIM3SOI PD
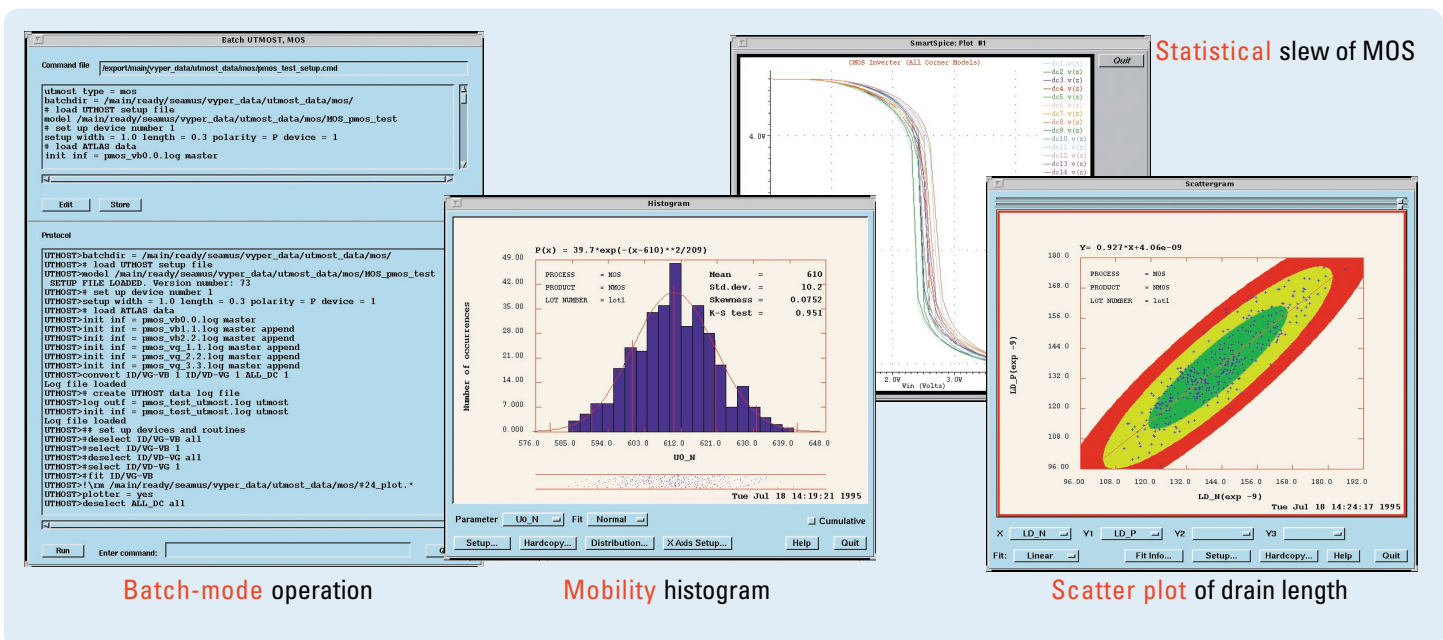STAG SOI
CEA/LETI
User models

MESFET model
JFET
Statz
Curtice 1
Curtice 2
User models

TFT models
Amorphous TFT
Polysilicon TFT
RPI a-Si
RPI p-Si

UTMOST Operation

- Operates in manual, semi-automatic, automatic, and batch mode operation
- Includes technology modules for MOS, Bipolar, Diode, JFET, GaAs, SOI, TFT, and HBT
- Automatically converts TCAD device characteristics from TCAD process and device simulations
- Performs detailed parameter extractions on TCAD data in batch mode to develop nominal and worst-case models for a process under development
- Stores model parameters and device characteristics in SPAYN format for statistical parametric analysis and worst-case model definitions

Statistical slew of MOS

Batch-mode operation

Mobility histogram

Scatter plot of drain length

Specifications

Equipment	Probers	Circuit Simulators
Agilent/HP	Electroglas	SmartSpice ™
Keithley	Rucker-Koll	HSpice ™
Tektronics	Cascade-Summit	PSpice ™
Wiltron	TKS	Spectre ™
	TEL	ELDO ™
	Karl Suss	
	Wentworh	
	Alessi	

- Leader in supplying accurate SPICE models from wafers or packaged parts

- Aggressive in providing rapid turnaround

- Specializing in BSIM3 and BSIM4 models for analog/mixed-signals

- Extraction of DC, AC (s-parameters), capacitance, temperature, noise, and SPICE parameters

- Temperature range from -55 degrees C to + 150 degrees C

- All commercially available SPICE models supported

- Model validation in accordance with Fabless Semiconductor Association (FSA), Compact Modeling Council, and IEEE test procedure #P1485 recommendations

- Deliver worst case and corner model generation
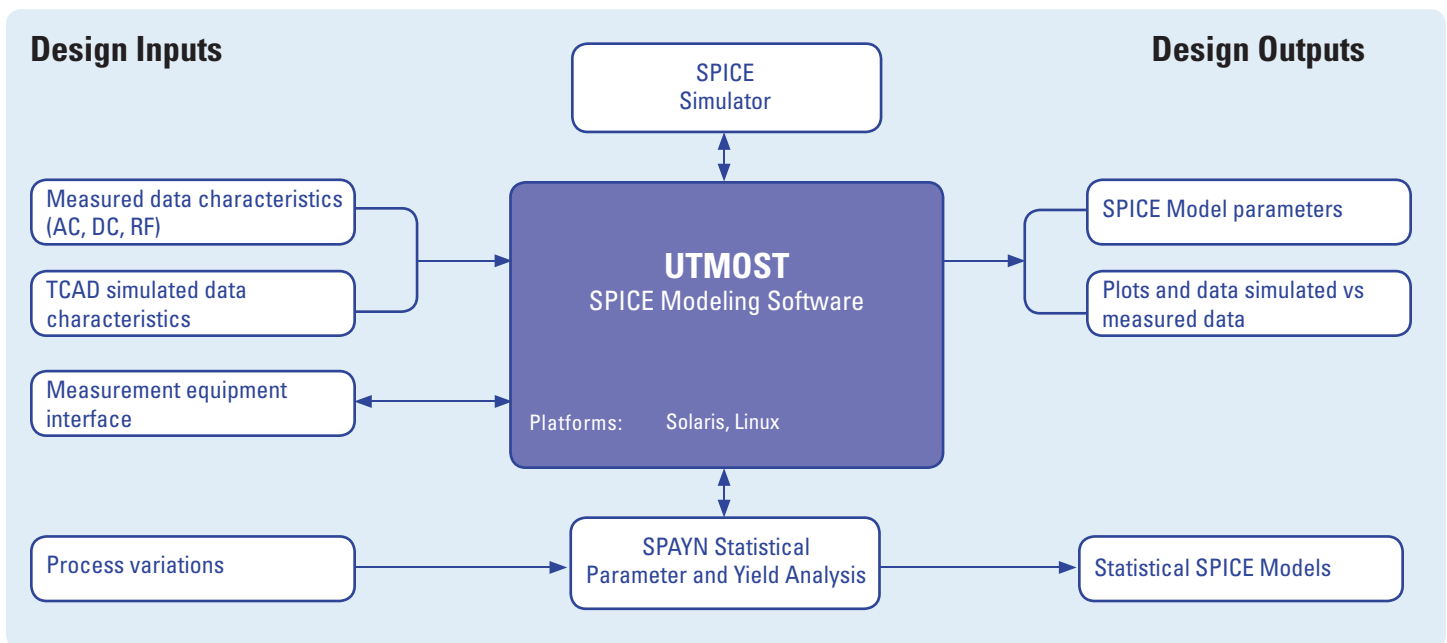
Design Inputs   Design Outputs

SPICE Simulator

Measured data characteristics (AC, DC, RF)

TCAD simulated data characteristics

UTMOST
SPICE Modeling Software

Platforms: Solaris, Linux

SPICE Model parameters

Plots and data simulated vs measured data

Measurement equipment interface

Process variations

SPAYN Statistical Parameter and Yield Analysis

Statistical SPICE Models

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