

SiMKit

Release Notes for SiMKit public version 5.9

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Preface

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These are the release notes for simkit version 5.9. Changes with respect to simkit 5.8 are reported in these release notes.

The main developments of this release are:

- the new model PSP104 was added to SiMKit: PSP104 is not backward compatible with PSP103, it contains important differences.
- a prototype for the new CMC ASMESD diode model with ESD.
- some changes were made on SOA checks.
- the SiMKit interface is now enabled for the handling of string and integer type parameters.

Overview

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SiMKit is a simulator-independent compact transistor model library.

Simulator-specific connections are handled through so-called adapters that provide the correct interfacing to:

- Spectre(/APS): the Cadence circuit simulator.
- ADS: the Keysight circuit simulator.
Simkit 5.9 supports ADS 2012 and higher. The SiMKit distribution is also available for ADS on Windows for ADS 2019.1 and higher.

Mica from NXP, AFS from Siemens, GoldenGate from Keysight, FineSim and CustomSim(XA) from Synopsys and several other simulators (e.g. APLAC/MWO from AWR) do provide an adapter for the SiMKit models.

For a complete description, please refer to:

<http://www.nxp.com/models/simkit.html>

New models

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- The PSP104 model was added to SiMKit. Changes with respect to PSP103 are such that PSP104 is not backward compatible with PSP103.
These changes are:
 - New DIBL model based on a quasi-Fermi level correction including

- screening effect in inversion regime.
- Addition of new parameters to improve gm description in saturation regime: THESATT (local model), THESATTO (global model), POTHESTATT (binning model).
- Bug-fix on the Cgb-Cbg reciprocity in strong inversion regime when the bias-dependence of interface states model is activated with high value of CTG/CTB parameters.
- New calculation of the drain saturation voltage to improve the drain saturation current of long channel transistors.
- Improvement of S/D symmetry for low value of AX parameter thanks to the introduction of a new mathematical function of linear-saturation transition.
- Bug-fix on the source and drain access resistances should be independent to the number of fingers NF.
- Removal of the effective doping bias-dependence effect in the surface potential equation and its associated parameters VNSUB. VNSUBO. POVNSUB. NSLP, NSLP0, PONSLP, DNSUB, DNSUBO and PODNSUB.
- New binning equations with "hybrid" approach to mix physical scaling rules with binning rules.
- Revisited DC operating point output variables with 2 new switches to configure the conventions: pmos convention with SWOPPMOS and drain configuration with SWOPDRAIN. The effects of access gate, drain and source resistances can be included in the calculation of several OP-output quantities using SWOPREXT.
- A prototype for the new ASMESD CMC diode model was added to SimKit. This model is an advance model for ESD diodes. It includes:
 - modeling of parasitic BJT in diodes
 - advanced approach for modeling the self-heating
 - modeling of transient or overshoot effects
 - parasitic BJT roll-off effect
 - an accurate modeling of post reverse breakdown I-V behavior

Model improvements and bug-fixes =====

JUNCAP200 -----

- The following model parameters were added as aliases to be able to handle model libraries using them instead of the CMC standard names:

pbotj=0.5	Alias of PBOT.
pstij=0.5	Alias of PSTI.
pgatj=0.5	Alias of PGAT.

SOA checks -----

- For SOACHECK_INFO messages, the severity field still depends on tmaxfrac, but with the following specification:

. for tmaxfrac=-2 (default)	: (no severity)
. for tmaxfrac=-1	: severity="review"
. for tmaxfrac>0.0	: severity="low" or severity="high", depending on the percentage of time out of SOA
- For debugging purposes, a SOACHECK_DEBUG message was added at the beginning of each analysis, on all available model cards, to only show that a model card has its SOA check enabled. The default value is 0, which disables this mechanism.

Spectre specific =====

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Known limitations

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Overvoltage checking:

- Overvoltage checks do not give warnings in ADS as in Spectre.

SOA check support in PrimeSim:

- At the time of this release, the required interface to enable SOA checking in SiMKit was not enabled yet in PrimeSim U-2023.03-SP2-2 and before. Hence SOA checking using SiMKit monitors will not work with PrimeSim.

Flexible topology in ADS and Spectre:

- A device will choose its topology based on the settings of certain parameters. So, e.g. a sweep of the parameter RGO (gate resistor) in PSP going from zero to another value, or a sweep over SWNQS in PSPNQS is not possible. The simulator will stop with an appropriate message because continuation would result in erroneous results.
- Internal node names in ADS for models with a flexible topology (from simkit 4.9 those are PSP, PSPNQS, MXT504, M1101 and M1102) might be wrong in the simulator output. The simulation results are not affected by this.

Instance scaling in ADS:

- Scaling of instance parameters via the option scale is not supported in ADS versions lower than 2019.1.

Aliasing of reference temperature for JFETIDG with ADS:

- Recognition of reference temperature names TNOM and its alias TREF is not working with ADS for ADS versions lower than 2022.

Transient noise:

- Transient noise is supported in general, but in cases where correlated noise (e.g. induced gate noise) is dominant, the results will be unreliable. This is because the separation between bias dependent and frequency dependent noise contributions is not strict, which is a requirement for the simulator interfaces.
A workaround is to switch off induced gate noise, which can be done in mosl101 and mosl102 by setting GATENOISE=1. Refer to artf79836 for details. From simkit 4.6 onward, a switch option SWIGN=2 was added to psp102 and from simkit 5.5 onward, this switch is also implemented in psp103:
 - . For SWIGN==0 the induced gate noise is switched off.
 - . For SWIGN==1 (default) the behavior is the same as in previous simkit version s.
 - . For SWIGN==2 the noise is treated in such a way that transient noise results are correct because the noise is implemented using white noise sources only (like in the Verilog-A version of PSP). Because extra internal nodes are needed, simulations will slow down.In practice, induced gate noise has a very minor effect and switching it off will hardly influence simulation results.

SiMKit models

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The SiMKit library contains the most recent versions of the NXP transistor models. The following tables list the SiMKit models. The first table lists the 'real' SiMKit models while the second table lists the pre-SiMKit models, for which only a Spectre implementation is available.

In the following tables,
'e/g' stands for electric/geometric
't' stands for self-heating and
's' stands for substrate model

Table 1: Real SiMKit models

model	level	Spectre/APS/AFS	ADS	e/g	t	s
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juncap	1	juncap	juncap	e	no	no
juncap	200	juncap200	juncap200	e	no	no
psp	102	psp102e	psp102e	e*	no	no
psp	1020	psp1020	psp1020	g*	no	no
psp	1021	psp1021	psp1021	g*	no	no
pspnqs	102	pspnqs102e	pspnqs102e	e*	no	no
pspnqs	1020	pspnqs1020	pspnqs1020	g*	no	no
pspnqs	1021	pspnqs1021	pspnqs1021	g*	no	no
psp	103	psp103	psp103	eg	no	no
psp	103	psp103t	psp103t	eg	yes	no
pspnqs	103	pspnqs103	pspnqs103	eg	no	no
psp	104	psp104	psp104	eg	no	no
psp	104	psp104t	psp104t	eg	yes	no
pspnqs	104	pspnqs104	pspnqs104	eg	no	no
modella	500	bjt500	bjt500	e	no	no
modella	500	bjt500t	bjt500t	e	yes	no
mextram	504	bjt504	bjt504	e	no	yes
mextram	504	bjt504t	bjt504t	e	yes	yes
mextram	504	bjtd504	bjtd504	e	no	no
mextram	504	bjtd504t	bjtd504t	e	yes	no
mextram	505	bjt505	bjt505	e	no	yes
mextram	505	bjt505t	bjt505t	e	yes	yes
mextram	505	bjtd505	bjtd505	e	no	no
mextram	505	bjtd505t	bjtd505t	e	yes	no
mos	903	mos903e	mos903e	e	no	no
mos	903	mos903	mos903	g	no	no
mos	903	mos903t	mos903t	g	yes	no
mos	1101	mos1101e	mos1101e	e	no	no
mos	1101	mos1101et	mos1101et	e	yes	no
mos	11010	mos11010	mos11010	g	no	no
mos	11010	mos11010t	mos11010t	g	yes	no
mos	11011	mos11011	mos11011	g	no	no
mos	11011	mos11011t	mos11011t	g	yes	no
mos	1102	mos1102e	mos1102e	e	no	no
mos	1102	mos1102et	mos1102et	e	yes	no
mos	11020	mos11020	mos11020	g	no	no
mos	11020	mos11020t	mos11020t	g	yes	no
mos	11021	mos11021	mos11021	g	no	no
mos	11021	mos11021t	mos11021t	g	yes	no
mos	3100	mos3100	mos3100	e	no	no
mos	3100	mos3100t	mos3100t	e	yes	no
mos	40	mos40	mos4000/mos40	e	no	no
mos	40	mos40t	mos4000t/mos40t	e	yes	no
rflmos	602	rflmos602t	rflmos602t	g	yes	yes**
rflmos	602	rflmos602dt	rflmos602dt	g	yes	yes**
psphv	1	psphv	psphv	g	no	no
psphvt	1	psphvt	psphvt	g	yes	no
jfetidg	1	jfetidg	jfetidg	g	no	no
jfetidgt	1	jfetidgt	jfetidgt	g	yes	no
lutsoil02	102	lutsoil02	lutsoil02	g	no	no
lutsoil02t	102	lutsoil02t	lutsoil02t	g	yes	no
asmesd	101	asmesd	asmesd	g	yes	no
ovcheck	1	ovcheck	ovcheck	-	-	-
ovcheck	6	ovcheck6	ovcheck6	-	-	-

* For PSP the electrical model is referred to as the local model and the geometrical model as the global model.

** In the rflmos model, substrate effects are modeled but the substrate is connected to the source and not available as a separate terminal.

Table 2: Other (older) models (Spectre specific)

model	level	Spectre
diode	500	dio500
mos	902	mos902
mextram	503	bjt503

lpnp	301	bjt301
mos	705	mos705

From simkit 4.8 onwards, the mextram 3500 model is no longer supported. From simkit 4.0 onwards, mos1100, mos2002 and mos3002 are no longer supported. If these models are needed, please use older SiMKit versions and simulator versions compatible with these older SiMKit versions.

Table 3: Model version numbers

The models in simkit 5.9 are based on the following Verilog-A versions:

model	version
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JUNCAP200	200.6.2.nxp1
PSP102	102.5.0
PSP103	103.8.2
PSP104	104.0.0
Mextram504	504.13.1
Mextram505	505.4.0
RFLDMOS602	602.01.00
PSPHV	1.0.6
JFETIDG	1.0.4
LUTSOI102	102.6
ASMESD	101.1.0

SiMKit interface =====

Simkit 5.9 incorporates interface version 15, which is backward compatible with version 14 used in simkit 5.8, with version 13 used in simkit 5.7, with version 12 used in simkit 5.5-5.6, with version 11 used in simkit 5.1-5.4, with version 10 used in simkit 4.7-5.0, with version 9 used in 4.4-4.6 and with version 8 used in simkit 4.0-4.3 but not backward compatible with the interface versions used in simkit 3.8 and earlier.

The interface description document `simkitInterfaceDescription.pdf` is contained in the zipped model library.