SiMKit
Release Notes

for SiMKit version 3.1 and versions 3.1.1, 3.1.2

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Preface

These are the release notes for SiMKit version 3.1, 3.1.1 and 3.1.2.
All changes with respect to SiMKit 3.0.3 are reported in these release notes.
Changes that are only available in SiMKit 3.1.1 and/or 3.1.2 are marked as such.

Overview

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, the circuit simulator from Cadence
- Pstar, the circuit simulator from NXP Semiconductors
- ADS, the circuit simulator from Agilent.

The SiMKit library contains the most recent versions of the NXP transistor models. The following two tables list the SiMKit models. The first lists the 'real' SiMKit models, the second lists the models for which only a Pstar and Spectre implementation are available. For a full description please check:

http://www.nxp.com/models/

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	Pstar	Spectre	ADS	e/g	t	s
juncap	1	juncap	juncap	juncap	e	no	no
juncap	200	juncap	juncap200	juncap200	e	no	no
psp	102	pspe	psp102e	psp102e	e*	no	no
psp	1020	psp	psp1020	psp1020	g*	no	no
psp	1021	psp	psp1021	psp1021	g*	no	no
pspnqs	102	pspnqse	pspnqs102e	pspnqs102e	e*	no	no
pspnqs	1020	pspnqs	pspnqs1020	pspnqs1020	g*	no	no
pspnqs	1021	pspnqs	pspnqs1021	pspnqs1021	g*	no	no
modella	500	tpl	bjt500	bjt500	e	no	no
modella	500	tplt	bjt500t	bjt500t	e	yes	no
mextram	504	tns/tps	bjt504	bjt504	e	no	yes
mextram	504	tnst/tpst	bjt504t	bjt504t	e	yes	yes
mextram	504	tn/tp	bjtd504	bjtd504	e	no	no
mextram	504	tnt/tpt	bjtd504t	bjtd504t	e	yes	no
mos	1100	mne/mpe	mos1100e	mos1100e	e	no	no
mos	1100	mn/mp	mos1100	mos1100	g	no	no
mos	1101	mne/mpe	mos1101e	mos1101e	e	no	no
mos	1101	mnet/mpet	mos1101et	mos1101et	e	yes	no
mos	11010	mn/mp	mos11010	mos11010	g	no	no
mos	11010	mnt/mpt	mos11010t	mos11010t	g	yes	no
mos	11011	mn/mp	mos11011	mos11011	g	no	no

mos	11011	mnt/mpt	mos11011t	mos11011t	g	yes	no
mos	1102	mne/mpe	mos1102e	mos1102e	e	no	no
mos	1102	mnet/mpet	mos1102et	mos1102et	e	yes	no
mos	11020	mn/mp	mos11020	mos11020	g	no	no
mos	11020	mnt/mpt	mos11020t	mos11020t	g	yes	no
mos	11021	mn/mp	mos11021	mos11021	g	no	no
mos	11021	mnt/mpt	mos11021t	mos11021t	g	yes	no
mos	2001	mne/mpe	mos2001e	mos2001e	e	no	no
mos	2001	mnet/mpet	mos2001et	mos2001et	e	yes	no
mos	2001	mn/mp	mos2001	mos2001	g	no	no
mos	2001	mnt/mpt	mos2001t	mos2001t	g	yes	no
mos	2002	mne/mpe	mos2002e	mos2002e	e	no	no
mos	2002	mnet/mpet	mos2002et	mos2002et	e	yes	no
mos	2002	mn/mp	mos2002	mos2002	g	no	no
mos	2002	mnt/mpt	mos2002t	mos2002t	g	yes	no
mos	3100	mn/mp	mos3100	mos3100	e	no	no
mos	3100	mnt/mpt	mos3100t	mos3100t	e	yes	no
mos	40	mn/mp	mos40	mos4000	e	no	no
mos	40	mnt/mpt	mos40t	mos4000t	e	yes	no

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

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

model	level	Pstar	Spectre
diode	500	d	dio500
mos	3002	mn/mp	mos3002
mos	902	mn/mp	mos902
mos	902	mne/mpe	-
mos	903	mn/mp	mos903
mos	903	mne/mpe	-
mextram	503	tn/tp	btj503
mextram	503	tns/tps	bjt503
lpnp	301	tpl	bjt301
mos	705	mne/mpe	mos705

Release notes

The release notes can be obtained by entering the following command:

```
cadenv -q simkit
```

1 - Improvements

Spectre specific improvements:

Several problems regarding SiMKit models and noise calculations in Spectre are known to us. In this SiMKit version 3.1 we have improved the noise implementation, but this does not solve all existing problems.
However, since SiMKit 2.5 wrong Pnoise results were obtained for mos1100. This was a reason for some people to keep using SiMKit 2.4. These Pnoise problems are solved.

The introduction of the flexible topology lead to an error in the previous SiMKit versions when using altergroup statement in Spectre. This issue has been solved in SiMKit 3.1.
SiMKit 3.1.2: Not all issues were solved in 3.1 - therefore a another update was necessary.

In some specific cases, when instances of a model are very similar but not the same, and where a parameter sweep is executed, SiMKit would use the wrong model and produce incorrect results. This has been corrected. See the following part of a Spectre job for an example of the specific circumstances:

```
----example--------------
parameters widthTest=1

M_nsvtlp_1  (22_1 22_1 0 0)   nsvtlp w=1 l=1
J_nsvtlp_1 (0 22_1)  isource dc=100n

VDN (1 0) vsource dc=1.2

nsvtlp_w0  (1 1 0 0)  nsvtlp w=widthTest l=1
nsvtlp_2   (1 1 0 0)  nsvtlp w=0.15      l=1

save nsvtlp_w0:1 nsvtlp_2:1

sweepdcwidth dc print=yes param=widthTest  values=[0.12 0.15]
----example--------------
```

The combination of Spectre versions using CMI5 (cadence_mmsim 6.2.* and higher)

with the SMK model mos903 gave wrong results when sweeps were performed, e.g. temperature sweeps. This problem has been resolved.

SiMKit 3.1.1 and SiMKit 3.1.2:

The search strategy for finding the libnxp_models.so library has been modified. A new environment variable has been added, SIMKIT_LD_LIBRARY_PATH, which is the first place to look for the libnxp_models.so.

SiMKit 3.1.1 and SiMKit 3.1.2 support ADS 2008 versions

Model Improvements
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PSP

For a number of effects in the MOSFET an extra set of parameters has been introduced, so that the consequences of a special drain-junction (different from the source junction) can be modeled.

These are the effects:
1. junction currents and capacitances
2. gate current (the overlap part)
3. overlap-capacitances and fringe capacitances
4. GIDL

This leads to the new following parameters introduced:

Junctions	Gate-overlap current overlap capacitance		GIDL	
(local & global)	(local)	(global)	(local)	(global)
- CJORGATD	- IGOVD	- IGOVDW	- AGIDLD	- AGIDLDW
- VBIRGATD	- TOXOVD	- TOXOVDO	- BGIDLD	- BGIDLDO
- PGATD	- NOVD	- LOVD	- CGIDLD	- CGIDLDO
- PHIGGATD	- CGOVD	- NOVDO		
- IDSATRGATD				
- CSRHGATD				
- CTATGATD				
- VBRGATD				

The new model has a switching parameter SWJUNASYM = 0 or 1 in order to allow backwards compatibility.

* When SWJUNASYM=0 (default) the model works as before. For both source and drain-side the source parameters are set. If drain-side parameters are set they will be ignored
* When SWJUNASYM=1 the model becomes asymmetric. For the source side the source parameters are used for the drain-side the drain parameters are used.

Added exponent EF in the 1/f noise. (flicker noise)

Changed scaling of NFA, NFB, NFC (flicker noise coefficients)

Changed clipping of NP (gate poly-silicon doping)

The NQS network in PSPNQS has been implemented by making use of the flexible topology. This implies that when SWNQS is smaller than 9 the PSPNQS model will contain less internal nodes, and therefore is faster than before.

SiMKit 3.1.1 and 3.1.2: the correlation coefficient in the noise model is correctly clipped.

Mextram504

Introduction of the distributed parasitic collector resistance, which is needed for adequate ac-modeling, e.g. simultaneous modeling of cut-off frequency, bandwidth and unilateral power gain.
Added model parameters:
RCBLX: Resistance of Collector Buried Layer under the eXtrinsic transistor
RCBLI: Resistance of Collector Buried Layer under the Intrinsic transistor
Default values are RCBLX = 0 and RCBLI = 0, so the implementation is backwards compatible with previous implementations.

New operation point information has been added:
Vb1c4: External base-collector bias with contact resistance RCBLI
Vc3c4: External collector-collector bias over contact resistance RCBLX
Vc4c1: Bias over intrinsic buried layer
IRBC: Current through constant base resistance
IRCC: Current through collector contact resistance

IRCBLX: Current through extrinsic collector resistance
RCBLX: Resistance of Collector Buried Layer under the eXtrinsic transistor
RCBLI: Resistance of Collector Buried Layer under the Intrinsic transistor

Pdiss is formulated in terms of conductances GCBLX and GCBLI.
These are set to zero in case the corresponding nodes vanish (so when RCBLX = 0 and RCBLI = 0).

The calculation of BnT_Bn has been made more robust.

A problem in the temperature scaling of the emitter-base diffusion voltage VDE, the collector-base diffusion voltage VDC, and the collector-substrate diffusion voltage VDS in case of Tk = Trk has been corrected.

At high voltage values, an error in the derivatives could lead to convergence problems. The derivatives have been corrected.

MOS1102

For a certain set of parameters the initialization of the Newton process for the surface potential could cause problems leading to floating point exceptions. These problems have been solved.

MOS2002

A discontinuity in drain current in MOS model 2002 has been resolved. The discontinuity occurred in the accumulation region.

The parameters the3d and a1dr scale (inversely) with the drift-region width, rather than with the channel-region width.

MOS2001

The output units of the parameters KOD and KODR have been corrected to V^1/2.

Known limitations

Non.

Flexible Topology in ADS and Spectre

For both Spectre and ADS a model can only choose one topology at a time. This topology must remain fixed throughout the simulation. 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 (in SiMKit 3.0 that is only PSP and PSPNQS) might be wrong in the output.