

SiMKit

Release Notes for SiMKit public version 5.6

Eindhoven, June 2022

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Preface

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These are the release notes for simkit version 5.6. Changes with respect to simkit 5.5 are reported in these release notes.

The main developments of this release are:

- unit scaling correction in juncap2, psp102, psp103, jfetidg and psphv.
- Mextram 505 was updated to version 505.3.0.
- dio500_proto was added to SiMKit.

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 5.6 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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- dio500_proto was added to SiMKit. This device was previously only available as an SMK device under the name dio500. The version was also updated according to the latest available Verilog-A version.

Model improvements and bug-fixes

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Unit scaling correction

- Unit scaling for juncap2, psp102, psp103, jfetidg and psphv was behaving incorrectly with respect to clipping. Clipping was done before unit scaling, which was leading to incorrect internal values and/or incorrect values in the info output. This is now fixed.

Mextram 505.3.0

Additions and changes compared to 505.2 include:

- A new NBR base current model:
 - . swibl = 0 (default) uses Ib1 and Ib1s model in 505.2 and earlier versions.
 - . swibl = 1 uses new Ib1 and Ib1s model, new parameters are ibinbr, ibinbrs, vknbr and ibinbrqs, new temperature parameters are vgbnbrqs, vgbnbr, vgbnbrs and vgknbr.
- A limitation is added on Ibinbrqs to avoid large quasi-saturation component on reverse operation and breakdown.
- CB breakdown current is implemented between B2 and C1 when swibl = 1, as well as power dissipation and noise.
- A minimum resistance minr is added.
- Description of terminal currents in opinfo are fixed.
- Unphysical noise from GMIN currents in Ib2 and Ib3 are removed. The corresponding opinfo has been changed.
- Limits for p0star and pw are added, new parameters are p0starlim and pwlim.
- EB tunneling current calculation is improved with a new approach (from NXP) to improve stability and convergence at very low reverse bias: Parameter vzmin is kept for backwards-compatible, but it is no longer used. A small number 1.0e-30 is added to limit the value of Vb2e1/vde_t when calculating dE0EB. Using Taylor approximation for small dzeb.
- CB tunneling current calculation is improved in a similar manner.

Psphv

Until simkit 5.5 the noise contribution of the bulk-extrinsic drain diode was missing. This has been corrected.

Spectre specific

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Improvement SOA checking

- The SOACHECK_TR_END messages in the overview at the end of a transient analysis has been split into a SOACHECK_TR and a SOACHECK_INFO message. This was done to avoid confusion with designers and to ease parsing for SOA browsers. The TR message:
 - contains the exit/entry/peak value and the duration for the time window at the end of analysis
 - duration is only the duration of that particular time window at the end
 - no percentages are given
 - the entry value is the value at the end of the analysis and thus will be outside the safe area
 The INFO message:
 - has the peak value and time for the whole analysis
 - has the duration/duration percentage of the whole analysis
- The number of significant digits of values in SOA messages has been increased.
- In SiMKit 5.5 new vballmsg behavior was implemented for improved message suppression. This was dependent on the environment variable NEW_SOA_VBALLMSG. In SiMKit 5.6 this is the default behavior:
 - vballmsg=0: END/INFO messages only, all other messages are suppressed

vballmsg=1: In addition, show messages for individual violations for which the peak-value is higher than before (on the same instance and branch)
vballmsg=2: Show messages for all individual violations
vballmsg=3: Show message at every time step (during violation), but only if the voltage is higher than any previous voltage value (during the same violation)
vballmsg=4: Show message at every time step (during violation)
In the SOA messages in the overview at the end of a transient the number of suppressed messages is included.

ADS specific
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GoldenGate specific
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Known limitations
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Overvoltage checking:
- Overvoltage checks do not give warnings in ADS as in Spectre.

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 versions.
. 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
juncap	1	juncap	juncap	e	no	no
juncap	200	juncap200	juncap200	e	no	no
dio500_proto	500	dio500_proto	dio500_proto	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
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
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 rfldmos 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 5.6 are based on the following Verilog-A versions:

model	version
JUNCAP200	200.6.2
DIO500_PROTO	1.08
PSP102	102.5.0
PSP103	103.8.1
Mextram504	504.13.1
Mextram505	505.3.0
RFLDMOS602	602.01.00
PSPHV	1.0.5
JFETIDG	1.0.3
LUTSOI102	102.5

SiMKit interface

Simkit 5.6 incorporates interface version 11, which is also used in simkit 5.5, and which is backward compatible with version 10 used in simkit 4.7-5.4, 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.