SiMKit

Release Notes for simkit version 4.9_pub

Eindhoven, May 2017

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Preface
=======
These are the release notes for simkit version 4.9_pub. Changes with respect to simkit 4.8.1_pub are reported in these release notes.

The main developments of this release are:
- The 12-terminal overvoltage checking device (ovcheck6) was added
- The SOA message format was improved
- Corrected false SOA warning with APS
- Updated to PSP103.5 including a small bug fix
- Corrected noise source types of some models (previously ignored by AFS)
- For Spectre, an alias 'pwr' for the OP-parameter Pdiss was added
- Some performance improvements.

```
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 and APS: the Cadence circuit simulators.
- ADS: the Keysight circuit simulator.
  Simkit 4.9_pub supports ADS 2012, 2014, 2015, 2016. The SiMKit
  distribution is also available for ADS on Windows for the same
  versions.

Note that several other simulators (e.g. AFS from Mentor, GoldenGate from
Keysight, APLAC/MWO from AWR) do provide an adapter for the
SiMKit models.

For a complete description, please refer to:

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


New models
==========

OVCHECK 6 (ovcheck6)
--------------------
This ovcheck model is a 12-terminal generalisation of the 2-terminal
ovcheck model. For each pair of terminals a safe interval for the voltage
difference between the terminals can be defined. If a pair of voltages is
not used the corresponding terminals should be grounded.

Model Parameters:
1       level=6         Level of device.
2       paramchk=0      Level of clip warning info.
3       vlow1=0 V       Vlow voltage first pair.
4       vhigh1=0 V      Vhigh voltage first pair.
5       vlow2=0 V       Vlow voltage second pair.
6       vhigh2=0 V      Vhigh voltage second pair.
7       vlow3=0 V       Vlow voltage third pair.
8       vhigh3=0 V      Vhigh voltage third pair.
9       vlow4=0 V       Vlow voltage fourth pair.
10      vhigh4=0 V      Vhigh voltage fourth pair.
11      vlow5=0 V       Vlow voltage fifth pair.
12      vhigh5=0 V      Vhigh voltage fifth pair.
13      vlow6=0 V       Vlow voltage sixth pair.
14      vhigh6=0 V      Vhigh voltage sixth pair.
15      vballmsg=1      All ovcheck messages if set to 1.
16      tmin=0 s        tmin value.
17      tdelay=0 s      tdelay value.
18      stop=0          Stop simulation on overvoltage when STOP==1.
```

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Model improvements and bug-fixes
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PSP (PSP 103.5.0  including JUNCAP2 200.5.0)
--------------------------------------------
Simkit 4.9 contains the 103.5 release of PSP103.
PSP 103.5 is backwards compatible with PSP 103.4


The main changes are:


Addition of new mobility parameters for coulomb scattering effect:
    THECS, STTHECS (local model),
    THECSO, STTHECSO (global model)
    POTHECS, POSTTHECS (binning model).


Addition of new parameters for quadratic temperature dependence of
flatband voltage:
    ST2VFB (local model)
    ST2VFBO (global model)
    POST2VFB (binning model)


A small error in the clipping of the NOV and NOVD parameters was solved.
These parameters are declared with a range of [1.0e23;1.0e27], but were
clipped internally to [1.0e20;1.0e27]. This has been fixed, the clipping
is now done with a range identical to the range used for the declaration.


The functionality of the PSP102 (PSP 102.5.0) model has not been changed.



New Safe Operating Area (SOA) message format
--------------------------------------------
The main diffences between the old and the new format for SOA messages
are:
- The prefix [OVCHECK_END] has been replaced with [OVCHECK_TR_END] and
  [OVCHECK_DC_END]. This makes it easier to distinguish between SOA
  summary messages given at the end of DC and the end of a transient
  analysis.
- SOA messages are now presented as a prefix followed by a comma
  separated list of key:value pairs, wich makes the messages better
  readable and easier to parse by a SOA message browser. If a value
  contains a comma this value will be put between double quotes.


Examples:
    [OVCHECK_TR_END] instance: juncap_4, model: myjuncap, branch: Vak,
                boundary: "[-1.000e+00, 0.000e+00]", value: -1.067e+00,
                exit value: -1.106e+00, exit time: 5.002e-02,
                peak value: -1.158e+01, peak time: 1.500e-02,
                duration: 5.630e-02, duration percentage: 93.8%

    [OVCHECK_TR] instance: psp1021n, branch: Vgd,
                boundary: "[-1.000e+00, 1.000e+00]",
                exit value: -1.200e+00, exit time: 2.000e-06,
                entry value: -9.980e-01, entry time: 1.168e-04,
                peak value: -1.200e+00, peak time: 2.000e-06
```

Note: For readability in these release notes the messages are split over
      several lines. In the simulator log file the message will be one
      single line.

Corrected false SOA warning with APS

In SiMKit versions 4.7_pub untill 4.8.1_pub false SOA warnings were
issued when using Spectre +aps on more than one CPU. This has been
corrected.

Corrected the noise source types for some models

In the models juncap200, psp102, psp103 some time varying but frequency
independent noise sources were given the wrong type. A side effect was
that these noise sources were ignored by AFS during transient noise while
giving a warning message. This has been corrected.

Spectre specific
================
In simkit 4.9_pub for simkit models that have a 'Pdiss' OP parameter an
alias 'pwr' is created. This is on request by Cadence to get a correct
power dissipation for subckts.

Performance improvements
========================
- The overhead of the SOA detection has been minimized resulting in 5-10%
  performance improvement with Spectre, also when SOA detection is not
  used.
- The number of branches for mos1101, 1102 have been reduced.
- In juncap, Mextram 504 and Modella the derivatives are only stamped if
  needed.

```
Known limitations
=================


Overvoltage checking:
- Overvoltage checks do not give warnings in ADS as in Spectre. The full
  functionality is only available in Spectre and APS and in Mentor AFS
  per 2015_Q1_update1.

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 (in
  simkit 4.9_pub those are PSP, PSPNQS, MXT504, M1101 and M1102) might
  be wrong in the simulator output. The simulation results are not
  affected by this.


Transient noise:
- Transient noise simulations with MOST devices are currently not
  supported. The noise results are unreliable. A workaround is to switch
  off induced gate noise, which can be done in mos 1101 and 1102 by
  setting GATENOISE=1.
  In simkit 4.8.1_pub a switch SWIGN was added to PSP103:
  . For SWIGN=1 (default) the behaviur is the same as in previous
    simkit versions.
  . For SWIGN=0 the induced gate noise is switched off.
```

```
SiMKit models
=============
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
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
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

```
rfldmos    602    rfldmos602t      rfldmos602t      g    yes  yes **
rfldmos    602    rfldmos602dt     rfldmos602dt     g    yes  yes **
ovcheck    1      ovcheck          ovcheck          -    -    -
ovcheck    6      ovcheck6         ovcheck6         -    -    -
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```

* 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_pub onwards, the mextram 3500 model is no longer
supported.
From simkit 4.0_pub 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.

SiMKit interface
================
Simkit 4.7_pub, 4.8.1_pub and 4.9_pub incorporate interface version 10
which is backward compatible with version 9 used in 4.4_pub - 4.6_pub and
with version 8 used in simkit 4.0_pub - 4.3_pub but not backward
compatible with the interface versions used in simkit 3.8_pub and
earlier.

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