HSPICE® Reference Manual: Commands and Control Options

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SYNOPSYS®

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Contents

About this Manual

This manual describes the individual HSPICE commands you can use to simulate and analyze your circuit designs.

Related Products and Trademarks

This manual refers to the following products:

Cadence® Virtuoso® Analog Design Environment
Synopsys HSPICE®
Synopsys SolvNet® support site

Conventions

The following conventions are used in Synopsys documentation.

Convention	Description
`Courier`	Indicates command syntax.
`Italic`	Indicates a user-defined value, such as *`object_name`*.
Purple	▪ Within an example, indicates information of special interest. ▪ Within a command-syntax section, indicates a default value, such as: `include_enclosing = true | false`
`Bold`	▪ Within syntax and examples, indicates user input—text you type verbatim. ▪ Indicates a graphical user interface (GUI) element that has an action associated with it.

Convention	Description
[ ]	Denotes optional parameters, such as: `write_file [-f filename]`
. . .	Indicates that parameters can be repeated as many times as necessary: `pin1 pin2 ... pinN`
|	Indicates a choice among alternatives, such as `low | medium | high`
\	Indicates a continuation of a command line.
/	Indicates levels of directory structure.
Edit > **Copy**	Indicates a path to a menu command, such as opening the **Edit** menu and choosing **Copy**.
Ctrl+C	Indicates a keyboard combination, such as holding down the Ctrl key and pressing the C key.

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Customer support is available through the Synopsys SolvNet customer support website and by contacting the Synopsys support center.

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1. Go to the web page at https://solvnet.synopsys.com.

2. If prompted, enter your user name and password. (If you do not have a Synopsys user name and password, follow the instructions to register.)

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- Go to the Synopsys Global Support site on synopsys.com. There you can find e-mail addresses and telephone numbers for Synopsys support centers throughout the world.
- Go to either the Synopsys SolvNet site or the Synopsys Global Support site and open a case online (Synopsys user name and password required).

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HSPICE Commands Introduction

Describes the commands you use to start HSPICE, including syntax, arguments, and examples.

This chapter provides the syntax and arguments for the `hspice` application commands. You can enter these commands at the command-line prompt to start HSPICE on all primary platforms.

The following sections show you how to invoke:

- Invoking HSPICE
- Starting HSPICE - Examples
- Viewing Online Help Topics from the Command-Line
- Interpreting Default Values of .OPTION in HSPICE
- Using the Example Syntax
- Using HSPICE for Calculating New Measurements

Invoking HSPICE

The following is the syntax for invoking HSPICE from the command-line prompt:

```
hspice [-i path/input_file]
       [-o path/output_file]
       [-n number]
       [-html path/html_file]
       [-gz]
       [-d]
       [-C path/input_file]
       [-CC path/input_file]
```

```
[-I]
[-K]
[-L command_file]
[-S]
[-case 0|1]
[-datamining -i datamining.cfg [-o outname]]
[-dp [#num]
     [-dpconfig dp_configuration_file]
     [-dplocation NFS|TMP]
     [-merge]
     [-dpgui]]
[-mp process_count]
[-mt thread_count]
[-hpp]
[-meas measure_file]
[-mrasim [0|1|2|3]]
[-top subcktname]
[-restore checkpoint_file]
[-hdl file_name]
[-hdlpath pathname]
[-vamodel name]
[-vamodel name2...]
[-sae]
[-help]
[-doc]
[-h]
[-v]
```

Argument	Description
`-i path/input_file`	Input netlist file name for which an extension *.*ext* is optional. If you do not specify an input file name extension in the command, HSPICE searches: ■ for a `*.sp#` file or: ■ for a `*.tr#`, `*.ac#`, or `*.sw#` file (PSF files are not supported). HSPICE uses the input file name as the root for the output files. To exceed 256 character use the `-i longpath_exceed256/filename` command. HSPICE also checks for an initial conditions file (.ic) that has the input file root name. The following is an example of an input file name: `/usr/sim/work/rb_design.sp` In this file name: ■ `/usr/sim/work/` is the directory path to the design ■ `rb_design` is the design root name. ■ `.sp` is the file name suffix.

Argument	Description
`-o` *path/output_file*	Name of the output file. Here, `output_file` is the root name of the output file. HSPICE appends the `.lis` extension to all output files. For example: ■ For the output log file: *output_file*`.lis` ■ For transient waveform: *output_file*`.tr0` ■ For transient measurement: *output_file*`.mt0` Everything up to the last period is the root file name and everything after the last period is the file name extension. ■ If you either do not use this option or you use it without specifying a file name, HSPICE uses the output root file name specified in the `-html` option. To turn off the html popup, use the `-o` following the input file name. ■ If you include the `.lis` extension in the file name that you enter using this option, then HSPICE does not append another `.lis` extension to the root file name of the output file. ■ If you do not specify an output file name, HSPICE directs output to stdout. For the .meas option, some case results differ from the measure result HSPICE produces. To exceed 256 character use the `-o longpath_exceed256/filename` command.
`-n` *number*	Starting number for numbering output data file revisions (*output_file*`.tr#`, *output_file*`.ac#`, *output_file*`.sw#`, where `#` is between 0 and 9999.).
`-html` *path/html_file*	HTML output file. ■ If a path is unspecified, HSPICE saves the HTML output file in the same directory that you specified in the `-o` option. ■ If you do not specify an `-o` option, HSPICE saves the HTML output in the working directory. ■ If you do not specify an output file name in either the `-o` or `-html` option, then HSPICE uses the input root file name as the output file root file name. If you add `.OPTION ITRPRT = 1` to your netlist to print output variables at their internal time points, and you use the `-html` option when invoking HSPICE, then HSPICE prints the values to a separate file (`*.printtr0`).
`-gz`	Generates compression output on analysis results for these output types: `.tr#, .ac#, .sw# .ma# .mt# .ms# .mc#.`
`-d`	(UNIX) Displays the content of `.st0` files on screen while running HSPICE. For example, to show the status during simulation.
`-C` *path/input_file*	Client/Server (C/S) mode. ■ Entering `hspice -C` checks out an HSPICE license and starts client/server mode. ■ Entering `hspice -C` *path/input_file* simulates your netlist. ■ Entering `hspice -C -K` releases the HSPICE license and exits. For additional information, see Using HSPICE in Client-Server Mode in the *HSPICE User Guide: Basic Simulation and Analysis*.

Argument	Description
`-CC` *path/input_file*	Advanced Client/Server mode. ■ Entering `hspice -CC` checks out an HSPICE license and starts the advanced client/server mode. ■ Entering `hspice -CC path/`*input_file* simulates your netlist. ■ Adding `-mp` [`process_count`] enables multiprocessing in the file containing Alter, Transient sweeps, or Monte Carlo trials. ■ Entering `hspice -CC -share common.sp -o output` redirects share file to avoid issues with *`.lis` file for the shared model file while running the multiple servers on a farm or multi-CPU machine. ■ Entering `hspice -CC -K` releases the HSPICE license and exits. For additional information, see Launching the Advanced Client-Server Mode (-CC) in the *HSPICE User Guide: Basic Simulation and Analysis*
`-I`	Interactive mode. ■ Entering `hspice -I` invokes interactive mode. ■ Entering `help` at the HSPICE prompt lists supported commands. ■ Entering `hspice -I -L` *file_name* runs a command file. ■ Entering `quit` at the `hspice` prompt exits interactive mode. For additional information, see Using Interactive Mode in the *HSPICE User Guide: Basic Simulation and Analysis*.
`-K`	Used with `-C` option to terminate client/server mode and exit.
`-L` *file_name*	Used with `-I` option to run commands contained in a command file.
`-S`	Performs as a server. Accepts data from SPEED2000, simulates the circuit, and returns results to SPEED2000. ■ On UNIX and Linux, HSPICE waits for successive simulations after invocation. ■ On Windows you must re-invoke for each successive simulation.
`-case 0|1`	■ 0: (default) case sensitivity disabled ■ 1: case sensitivity enabled Enables case sensitivity only for the following items (HSPICE commands and control options continue to be case-insensitive): ■ Parameter Names ■ Node Names ■ Instance Names ■ Model Names ■ Subcircuit Names ■ Data Names ■ Measure Names ■ File Names and Paths (case sensitive by default) ■ Library Entry Names

Argument	Description
`-datamining -i datamining.cfg [-o outname]`	HSPICE skips netlist `readin`, `errchk`, and simulation, and only does standalone data mining. The configuration file content includes: ■ *comments/description ■ *Required records ■ `.sampleFile input.mct` ■ `.measFile input .mt0 input .mt0A input.mt0B ...` ■ `.Option Screening_Method = Pearson | Spearman` See Monte Carlo Data Mining in the *HSPICE User Guide: Basic Simulation and Analysis*.
`-dp [#num]`	Invokes DP and specifies the number of workers. The workers can be distributed on one multiple core machine or multiple machines across the network. If you are running `-dp` on one multiple core machine, `#num` cannot be greater than the core count of the machine. If you do not specify `#num`, then DP defaults to the core count of the machine. When running `-dp` with `-dpconfig` on multiple machines across the network, you must specify `#num`. For details see Running Distributed Processing on a Network Grid in the *HSPICE User Guide: Basic Simulation and Analysis*.
`[-dpconfig dp_configuration_file]`	Specifies the configuration file for DP. Refer to the CDPL Users Manual for details about the configuration file. **Note:** If `-dp` is triggered without specifying the `-dpconfig dp_configuration_file` option, all the distributions are run on the same machine.
`[-dplocation NFS|TMP]`	By default, all the results files are written to the `/tmp` folder, and then move whatever output is needed to the `-o HSPICE output`. Otherwise, specify the location of where to write all the intermediate files during simulation such as `/my_location/tmp`.
`[-merge]`	Merges the output files from HSPICE only if you specify this option.
`[-dpgui]`	Launches the DP manager to monitor the status of the DP run. For more information on using DP Manager, See `$installdir/hspice/cdpl/doc/DPManagerUserGuide.pdf`
`-mp [process_count]`	Activates multiprocessing while running ALTER cases, transient sweeps, and Monte Carlo analyses on one machine with multiple processors/cores. If you specify the number of CPUs you can limit the number of CPUs to avoid overtaxing performance scalability. If a CPU number is not specified, HSPICE auto-determines the child processes by the number of available CPUs. For details see the *HSPICE User Guide: Basic Simulation and Analysis*. For additional information, see Running Multi-threading and Distributed Processing Concurrently in the *HSPICE User Guide: Basic Simulation and Analysis*.

Argument	Description
`-mt thread_count`	Invokes multithreading and specifies the number of processors for a multi-threaded simulation. If `thread_count` is not entered, HSPICE issues an error. For additional information, see Running Multi-threading and Distributed Processing Concurrently in the *HSPICE User Guide: Basic Simulation and Analysis*. See also .OPTION MTTHRESH in this manual.
`-hpp`	Enables HSPICE Precision Parallel. The multi-core algorithm can be applied without multithreading (-mt), but for best performance, use `-hpp -mt N`, together, where *N* is number of threads. For details, see the *HSPICE User Guide: Basic Simulation and Analysis*, section HSPICE Precision Parallel.
`-meas measure_file`	Re-invokes the measure file to calculate new measurements from a previous simulation. The format of measure_file is similar to the HSPICE netlist format. The first line is a comment line and the last line is an .END command. The following netlist commands are supported. ■ .MEASURE ■ .PARAM ■ .TEMP ■ .OPTION ■ .DATA ■ .ENDDATA ■ .FFT ■ .MEASURE FFT ■ .END **Note:** The .DATA command in the measure file must be consistent with the .DATA command in the wavefile. The following types of .OPTION commands are supported: ■ MEASFAIL ■ MEASFORM ■ NUMDGT ■ INGOLD ■ MEASDGT ■ EM_RECOVERY Warnings are issued if other options or commands are used. Syntax to perform spectrum analysis measurements from previous simulation results: `hspice -i *.tr0 -meas measure_file`
`-mrasim [0|1|2|3]`	Overwrites the value of `SimMode` in a `.MOSRA` command card: ■ 0: Selects pre-stress simulation only ■ 1: Selects post-stress simulation only ■ 2: Selects both pre- and post-stress simulation ■ 3: Selects continual degradation integration through `.ALTER`s For example: `hspice -i input.sp -o run1 -mrasim 2`

Argument	Description
`-top` *subcktname*	Top level subcircuit name. Effectively eliminates `.subckt` *subcktname* and corresponding `.ends` statements. Users do not need to instantiate top-level SUBCKT using "X" syntax of HSPICE.
`-restore checkpoint_file`	The `checkpoint_file` specifies from which simulation the checkpoint data is to be restored. The *restore* operation should be submitted on a machine that has the same kernel version as the machine used to store, otherwise, a failure may occur. Any output files generated by the previous simulation should not be removed. After the restore simulation is done, the output files will be updated. For example: `hspice -i test.sp -restore test.1e-7.ic0 -o test.` The simulation starts from the time point that data was stored at in the previously interrupted simulation. See Storing and Restoring Checkpoint Files for full details.
`-hdl` *file_name*	Verilog-A module. The Verilog-A file is assumed to have a *.va extension when only a prefix is provided. One -hdl option can include one Verilog-A file, use multiple -hdl options if multiple Verilog-A files are needed. This example loads the amp.va Verilog-A source file: `hspice amp.sp -hdl amp.va` When a module to be loaded has the same name as a previously-loaded module or the names differ in case only, the latter one is ignored and the simulator issues a warning message. If a Verilog-A module file is not found or the Compiled Model Library file has an incompatible version, the simulation exits and an error message is issued.
`-hdlpath` *pathname*	Search path for a Verilog-A file if HSPICE cannot find it in the current working directory. The search order for Verilog-A files is: 1. Current working directory 2. Path defined by command-line argument `-hdlpath` 3. Path defined by environment variable `HSP_HDL_PATH` The path defined by either `-hdlpath` or `HSP_HDL_PATH` can consist a set of directory names. The path separator must follow HSPICE conventions or platform conventions (";" on UNIX). Path entries that do not exist are ignored and no error/warning messages are issued. This example first searches the current working directory and when a `*.va` file is not found, the relative location `./my_modules` directory is searched: `hspice amp.sp -hdlpath ./my_modules`
`-vamodel` *name* `-vamodel` *name2...*	Cell names for Verilog-A definitions. *name* is the cell name that uses a Verilog-A definition rather than a subcircuit definition when both exist. Each `-vamodel` option can take no more than one name. Repeat this option if multiple Verilog-A modules are defined. If no name is supplied after `-vamodel`, then the Verilog-A definition will be used whenever it is available.

Argument	Description
`-sae`	Outputs a new `results.xml` file.
`-help`	Searchable browser-based help system for HSPICE. An html browser must be installed on your machine to access this help system. For more information, see Viewing Online Help Topics from the Command-Line section.
`-doc`	PDF documentation set user manuals for HSPICE. It is recommended that you have Adobe Acrobat Reader or another PDF format reader installed on your system. You can do full text searches of the documentation set. See the Release Notes for instructions.
`-h`	Displays a help message and exits.
`-v`	Outputs version information and exits.

Starting HSPICE - Examples

The following are more examples of commands to start running HSPICE.

- `hspice demo.sp -n 7 > demo.out`

  This command redirects output to a file instead of stdout. `demo.sp` is the input netlist file. The `.sp` extension is optional. The `-n 7` starts the output data file revision numbers at 7; for example: `demo.tr7`, `demo.ac7`, `demo.sw7`, and so forth. The `>` redirects the program output listing to file demo.out.

- `hspice -i demo.sp`

  `demo` is the root input file name. Without the `-o` argument and without redirection, HSPICE does not generate an output listing file.

- `hspice -i demo.sp -o demo`

  `demo` is the output file root name (designated with the `-o` option). Output files are named demo.lis, demo.tr0, demo.st0, and demo.ic0.

- `hspice -i rbdir/demo.sp`

  `demo` is the input root file name. HSPICE writes the demo.lis, demo.tr0, and demo.st0 output files into the directory where you executed the HSPICE command. It also writes the demo.ic0 output file into the same directory as the input source—that is, rbdir.

- `hspice -i a.b.sp`

  `a.b` is the root name. The output files are ./a.b.lis, ./a.b.tr0, ./a.b.st0, and ./a.b.ic0.

- `hspice -i a.b -o d.e`

  `a.b` is the root name for the input file. `d.e` is the root output file name, except for the .ic file to which HSPICE assigns the `a.b` input file root name. The output files are d.e.lis, d.e.tr0, d.e.st0, and a.b.ic0.

- `hspice -i a.b.sp -o outdir/d.e`

  HSPICE writes the output files as: `outdir/d.e.lis`, `outdir/d.e.tr0`, `outdir/d.e.st0`, and `outdir/d.e.ic0`.

- `hspice -i indir/a.b.sp -o outdir/d.e.lis`

  `a.b` is the root for the .ic file. HSPICE writes the .ic0 file into a file named indir/a.b.ic0. `d.e` is the root for the output files.

- `hspice test.sp -o test.lis -html test.html`

  This command creates output file in both .lis and .html format after simulating the test.sp input netlist.

- `hspice test.sp -html test.html`

  This command creates only a .html output file after simulating the test.sp input netlist.

- `hspice test.sp -o test.lis`

  This command creates only a .lis output file after simulating the test.sp input netlist.

- `hspice -i test.sp -o -html outdir/a.html`

  This command creates output files in both .lis and .html format. Both files are in the `outdir` directory and their root file name is a.

- `hspice -i test.sp -o out1/a.lis -html out2/b.html`

  This command creates output files in both .lis and .html format. The .lis file is in the out1 directory and its root file name is a. The .html file is in the out2 directory and its root file name is b.

- `hspice -i test.sp -o test -x`

  This command launches a full parasitic back-annotation for the file named `test.sp`.

Viewing Online Help Topics from the Command-Line

You can use the `-help` option from the command-line to access the online help topics:

Topic Type	Syntax	Example	Notes
Command	`hspice -help <command>`	`hspice -help .AC`	When issuing Digital Vector related commands, prefix the command with `.VEC_`
Control Option	`hspice -help .OPTION_<option>`	`hspice -help .OPTION_DELMAX`	You must concatenate the `.OPTION` and control name with an underscore "_" for the help topic to launch.
General	`hspice -help <keyword>`	`hspice -help bsim3v3`	See List of Keywords for Generic Online Help Topics

List of Keywords for Generic Online Help Topics

The following table lists the keyword and the corresponding topics that are displayed when you use one of the keywords in the `-help` expression:

Keyword	Topic
3DIC	Multi technology simulation of 3D integrated circuits
AC	Using the .AC Statement
ACMatch	ACMatch Analysis
Back_Annotation	Post-Layout Back-Annotation
Bisection	Timing Analysis Using Bisection
BJT	BJT Models
BSIM-CMG	BSIM-CMG MOSFET Model
BSIM3v3	Level 49 and 53 BSIM3v3 MOS Models

Keyword	Topic
BSIM4	BSIM4 Model
DC	.DC Statement—DC Sweeps
DCMatch	DCMatch Analysis
Diodes	Diode Models
dp	Multiple Simulations, DP, and HPP
Element_Templates	Element Template Listings
Exploration_Block	Exploration Block
FFT	.FFT Analysis
Field-Solver	Using the field solver to extract transmission lines
FinFET	BSIM-CMG MOSFET/FINFET Model
HB	Steady-State Harmonic Balance Analysis
HBAC	Multitone Harmonic Balance AC Analysis (.HBAC)
HBOSC	Harmonic Balance Oscillator Analysis (.HBOSC)
HiSIM-HV	HSPICE HiSIM-LDMOS/HiSIM-HV Model
HiSIM2	STARC HiSIM2 Model
HPP	HSPICE Precision Parallel (-hpp)
IBIS	Modeling Input/output Buffers Using IBIS Files
IBIS-AMI	Using IBIS-AMI Equalizer Models with StatEye
JFET_MESFET	JFET and MESFET Models
LIN	LIN Analysis
LSTB	Using .LSTB for Loop Stability Analysis
Monte_Carlo	Monte Carlo—Traditional Flow Statistical Analysis
MOSFET_Output_Templates	MOSFET Output Templates
MOSRA	MOSFET Model Reliability Analysis (MOSRA)

Keyword	Topic
NOISE	Using .NOISE for Small-Signal Noise Analysis
Phase_Noise	Phase Noise Analysis (.PHASENOISE)
Pole-Zero	Pole Zero Analysis
PSP	PSP100 DFM Support Series Model
S-Parameter	S-parameter Modeling Using the S-element
SI	Signal integrity
SN	Steady-State Shooting Newton Analysis
SNAC	Shooting Newton AC Analysis (.SNAC)
SNOSC	Oscillator Analysis Using Shooting Newton (.SNOSC)
SPUTIL	S-parameter Standalone Manipulation Utility (SPutil)
StatEye	Statistical Eye Analysis
TFT	TFT Model
TRAN	Transient Analysis
Transient_Noise	Transient Noise Analysis
Verilog-A	Using Verilog-A

Interpreting Default Values of .OPTION in HSPICE

The typical behavior for options is:

- Option not specified: value is default value, typically “OFF” or 0.
- Option specified but without value: typically turns the option “ON” or to a value of 1.

If an option has more than two values allowed, specifying it without a value sets it to 1, if appropriate.In most cases, options without values are allowed only for flags that can be on or off, and specifying the option without a value turns it on. There are a few options (such as POST), where there are more than two values

allowed, but you can still specify it without a value. Usually, you should expect it to be 1.

Using the Example Syntax

To copy and paste proven syntax use the demonstration files shipped with your installation of HSPICE (see Listing of Demonstration Input Files). Attempting to copy and paste from the book or help documentation may present unexpected results, as text used in formatting may include hidden characters, and white space for visual clarity.

Using HSPICE for Calculating New Measurements

When you want to calculate new measurements from previous simulation results produced by HSPICE you can use the following mode to rerun HSPICE without having to do another simulation:

```
hspice -meas measurefile -i wavefile -o outputfile -h -v
```

See the following table for arguments and descriptions:

Argument	Description
-meas *measurefile*	This format is similar to the HSPICE netlist format. The first line is a comment line and the last line is an `.END` command. The following netlist commands are supported: ■ .MEASURE ■ .PARAM ■ .TEMP ■ .OPTION ■ .DATA ■ .ENDDATA ■ .END **Note:** The `.DATA` command in the measure file must be consistent with the `.DATA` command in the waveform file. The `.OPTION` command supports the following types: ■ MEASFAIL ■ MEASFORM ■ NUMDGT ■ INGOLD ■ MEASDGT Warnings are issued if other options or commands are used.
-i *wavefile*	`Can be: *.tr#`, `*.ac#`, `*.sw#`, `*.hb0`, `*.sn0`, `*.pn0`, or `*.snpn0` waveform files produced by HSPICE. If a plot fails to open, it is due to one of the following reasons: ■ Waveform file format is not supported. ■ File format is not understood. ■ File is not found. ■ File larger than max size of x. **Note:** "x" depends on any file size limitation of your application. For example, a 2GB file size limitation exists on 32-bit HSPICE Linux and SuSe versions when reading the waveforms. Solaris has no such limitation. Limitations: ■ For `*.hb0` files, only measures those containing the keywords max, min, avg and rms are supported. ■ For `*.sn0` files, only FIND-AT measures and measures containing the keywords, max, min, avg and rms are supported. ■ For `*.pn0` and `*.snpn0` files, only measures those containing the keyword integral are supported. ■ `-meas` is not supported when the original advanced analog analysis contains a sweep analysis.

Argument	Description
-o *outputfile*	Produces the same output files as HSPICE. In some cases, the results are different from the measure result HSPICE produces due to an accuracy problem. **Note:** If a sweep transient, AC or DC analysis is specified and PSF waveform is also specified, the waveform file contains the extension `*@sweep_num#` and the measure result file will have the form `*mt*@sweep_num#` or `*ma*@sweep_num#` or `*ms*@sweep_num#`.
-h	Displays a help message and exits.
-v	Outputs version information and exits.

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HSPICE Simulation Command Reference

Presents reference information for each of the HSPICE commands.

This chapter provides the list of HSPICE commands in an alphabetical order, followed by detailed descriptions of the individual commands and control options.

Command	Description	Category	Control Options
.AC	Performs several types of AC analyses.	Analysis	-
.ACMATCH	Calculates the effects of variations in device characteristics and parasitic capacitance sensitivities on a circuit's AC response.	Analysis	.OPTION POST
.ACPHASENOISE	Helps you interpret signal and noise quantities as phase variables for accumulated jitter for closed-loop PLL analysis.	Analysis	-
.ALIAS	Renames a model or library containing a model; deletes an entire library of models.	Model and Variation	-
.ALTER	Reruns an HSPICE simulation using different parameters and data.	Alter Block	.OPTION ALTCC .OPTION MEASFILE .OPTION OPTCON
.APPENDMODEL	Appends the .MOSRA parameters to a model card.	Model and Variation	.OPTION APPENDALL
.BA_ACHECK	Specifies the rule for detecting node activity in back-annotation.	Output Porting	-

Command	Description	Category	Control Options
.BIASCHK	Monitors device voltage bias, current, size, expression, region, or temperature.	Output Porting	.OPTION BIASFILE .OPTION BIASINTERVAL .OPTION BIASNODE .OPTION BIASPARALLEL .OPTION BIAWARN
.CFL_PROTOTYPE	Specifies function protocol type for the Compiled Function Library capability.	Library Management	-
.CHECK EDGE	Verifies that a triggering event provokes an appropriate RISE or FALL action in HSPICE.	Analysis	-
.CHECK FALL	Verifies that a fall time occurs within a specified time window in HSPICE.	Analysis	-
.CHECK GLOBAL_LEVEL	Globally sets specified high and low definitions for all CHECK commands in HSPICE.	Analysis	-
.CHECK HOLD	Ensures that specified signals do not switch for a specified period of time in HSPICE.	Analysis	-
.CHECK IRDROP	Verifies that IR drop does not fall below or exceed a specified value in HSPICE.	Analysis	-
.CHECK RISE	Verifies that a rise time occurs within a specified time window in HSPICE.	Analysis	-
.CHECK SETUP	Verifies that specified signals do not switch for a specified time-period in HSPICE.	Analysis	-
.CHECK SLEW	Verifies that a slew rate occurs within a specified time window in HSPICE.	Analysis	-
.CLFLIB	Enables automatic selection for HSPICE Compiled Function Library function	Library Management	-

Command	Description	Category	Control Options
.CONNECT	Connects two nodes together; the first node replaces the second node in the simulation.	Node Naming	.OPTION NODE
.DATA	Concatenates or column-laminates data sets to optimize measured I-V, C-V, transient, or S-parameter data.	Setup	-
.DC	Performs several types of sweeps during DC analysis.	Analysis	.OPTION DCIC
.DCMATCH	Calculates the effects of variations on a circuit's DC characteristics.	Analysis	-
.DCSENS	Invokes DC sensitivity analysis using variation definitions as specified in the Variation Block.	Analysis	.OPTION OPFILE
.DCVOLT	Sets initial conditions in HSPICE.	Setup	-
.DEFPARAM	Overwrites the value of a subcircuit parameter by a new value.	Setup	-
.DEL LIB	Removes library data from memory for HSPICE.	Alter Block, Library Management	-
.DEL MODULE	.ALTER block instance statement removal/ replacement scheme for previously defined instances in a .MODULE construct.	3D-IC	-
.DEL MODULEVAR	.ALTER block instance statement replacement scheme for previously defined instances in a .MODULEVAR construct used for a 3D-IC simulation.	3D-IC	-
.DESIGN_EXPLORATION	Creates an Exploration Block to extract the parameters suitable for exploration from a netlist.	3D-IC	-

Command	Description	Category	Control Options
.DISTO	Computes the distortion characteristics of the circuit in an AC analysis.	Analysis	-
.DOUT	Specifies the expected final state of an output signal.	Output Porting	-
.EBD	Invokes IBIS Electronic Board Description (EBD) functionality.	IBIS	-
.ELSE	Precedes commands to be executed in a conditional block when preceding .IF and .ELSEIF conditions are false.	Conditional Block	-
.ELSEIF	Specifies conditions that determine whether HSPICE executes subsequent commands in a conditional block.	Conditional Block	-
.END	Ends a simulation run in an input netlist file.	Simulation Runs	-
.ENDDATA	Ends a .DATA block in an HSPICE input netlist file.	Setup	-
.ENDIF	Ends a conditional block of commands in an HSPICE input netlist file.	Conditional Block	-
.ENDL	Ends a .LIB command in an HSPICE input netlist file.	Library Management	-
.ENDMODULE	Completes a .MODULE block in a 3D-IC netlist.	3D-IC	
.ENDMODULEVAR	Signifies completion of a .MODULEVAR block in a 3D-IC netlist.	3D-IC	
.ENDS	Ends a subcircuit definition (.SUBCKT) in an HSPICE input netlist file.	Subcircuits	-
.ENV	Performs standard envelope simulation in HSPICE.	Analysis	-

Command	Description	Category	Control Options
.ENVFFT	Performs Fast Fourier Transform (FFT) on envelope output in HSPICE.	Analysis	-
.ENVOSC	Performs envelope simulation for oscillator startup or shutdown in HSPICE.	Analysis	-
.EOM	Ends a .MACRO command.	Subcircuits	-
.FFT	Calculates the Discrete Fourier Transform (DFT) value used for spectrum analysis. Numerical parameters (excluding string parameters) can be passed to the `.FFT` command.	Analysis	-
.FLAT	Provides subcircuit OP back annotation when a device is modeled as a subckt.	Subcircuits	
.FOUR	Performs a Fourier analysis as part of the transient analysis.	Analysis	-
.FSOPTIONS	Sets various options for the HSPICE Field Solver.	Field Solver	-
.GLOBAL	Globally assigns a node name.	Setup, Node Naming	-
.HB	Invokes the single and multi-tone harmonic balance algorithm for periodic steady state analysis.	Analysis	.OPTION HBCONTINUE .OPTION HBJREUSE .OPTION HBJREUSETOL .OPTION HBKRYLOVDIM .OPTION HBKRYLOVTOL .OPTION HBLINESEARCHFAC .OPTION HBMAXITER .OPTION HBKRYLOVMAXITER .OPTION HBSOLVER .OPTION HBTOL .OPTION LOADHB .OPTION SAVEHB .OPTION TRANFORHB

Command	Description	Category	Control Options
.HBAC	Performs harmonic-balance–based periodic AC analysis on circuits operating in a large-signal periodic steady state.	Analysis	.OPTION HBACTOL .OPTION HBACKRYLOVDIM
.HBLIN	Extracts frequency translation S-parameters and noise figures.	Analysis	-
.HBLSP	Performs periodically driven nonlinear circuit analyses for power-dependent S-parameters.	Analysis	-
.HBNOISE	Performs cyclo-stationary noise analysis on circuits operating in a large-signal periodic steady state.	Analysis	-
.HBOSC	Performs oscillator analysis on autonomous (oscillator) circuits.	Analysis	.OPTION HBFREQABSTOL .OPTION HBFREQRELTOL .OPTION HBOSCMAXITER .OPTION HBPROBETOL .OPTION HBTRANFREQSEARCH .OPTION HBTRANINIT .OPTION HBTRANPTS .OPTION HBTRANSTEP
.HBXF	Calculates transfer from the given source in the circuit to the designated output.	Analysis	-
.HDL	Specifies the Verilog-A source name and path.	Verilog-A	-
.IBIS	Provides IBIS functionality by specifying an IBIS file and component and optional keywords.	IBIS	-
.IC	Sets transient initial conditions in HSPICE.	Setup	.OPTION DCIC .OPTION GMAX .OPTION IC_ACCURATE

Command	Description	Category	Control Options
.ICM	Automatically creates port names that reference the pin name of an ICM model and generate a series of element nodes on the pin.	IBIS	-
.IF	Specifies conditions that determine whether HSPICE executes subsequent commands in conditional block.	Conditional Block	-
.INCLUDE	Includes another netlist as a subcircuit of the current netlist.	Subcircuits, Library Management	.OPTION PARHIER
.IVDMARGIN	Helps characterize Vd_{margin} using terminal I-V at MOSFET external nodes.	Library Management	.OPTION IVDMARGIN
.IVTH	Invokes the constant-current based threshold voltage characterization.	Library Management	.OPTION IVTH
.LAYERSTACK	Defines a stack of dielectric or metal layers.	Field Solver	-
.LIB	Creates and reads from libraries of commonly used commands, device models, subcircuit analyses, and commands.	Library Management	-
.LIN	Extracts noise and linear transfer parameters for a general multi-port network.	Analysis	-
.LOAD	Uses the operating point information of a file previously created with a .SAVE command.	Setup, Library Management	-
.LPRINT	Produces output in VCD file format from transient analysis in HSPICE.	Analysis	-
.LSTB	Invokes linear loop stability analysis.	Analysis	.OPTION UNWRAP
.MACRO	Defines a subcircuit in your netlist.	Subcircuits	-

Command	Description	Category	Control Options
.MALIAS	Assigns an alias to a diode, BJT, JFET, or MOSFET model that you defined in a .MODEL command.	Model and Variation	-
.MATERIAL	Specifies material to be used with the HSPICE field solver.	Field Solver	-
.MEASURE (ACMATCH)	Introduces special keywords to access results for ACMatch analysis.	Output Porting	-
.MEASURE (AVG, EM_AVG, INTEG, MIN, MAX, PP, and RMS)	Reports statistical functions of the output variable (voltage, current, or power).	Output Porting	.OPTION AUTOSTOP .OPTION EM_RECOVERY
.MEASURE (Multiple Measure Windows for MIN or MAX)	Specifies multiple measure windows within a .MEASURE command for MIN or MAX.	Output Porting	.OPTION AUTOSTOP .OPTION EM_RECOVERY
.MEASURE (Continuous Results)	Measures continuous results for TRIG-TARG, FIND-WHEN, Equation, and PARAM functions.	Output Porting	.OPTION AUTOSTOP
.MEASURE (DCMATCH)	Introduces special keywords to access the different types of results for DCMatch analysis.	Output Porting	-
.MEASURE (Derivative Function)	Provides the derivative of an output signal or sweep variable.	Output Porting	.OPTION AUTOSTOP
.MEASURE (Equation Evaluation/Arithmetic Expression)	Evaluates an equation that is a function of the results of previous .MEASURE commands.	Output Porting	.OPTION AUTOSTOP
.MEASURE (Error Function)	Reports the relative difference between two output variables.	Output Porting	.OPTION AUTOSTOP
.MEASURE (FIND and WHEN)	Measures independent and dependent variables (as well as derivatives of dependent variables if a specific event occurs).	Output Porting	.OPTION AUTOSTOP

Command	Description	Category	Control Options
.MEASURE (Integral Function)	Reports the real time integration (instantaneous time integral) of an output variable over a specified period.	Output Porting	.OPTION AUTOSTOP
.MEASURE (Pushout Bisection)	Specifies a maximum allowed pushout time to control the distance from failure in bisection analysis.	Output Porting	-
.MEASURE (Rise, Fall, Delay, and Power Measurements)	Measures independent-variable differentials such as rise time, fall time, and slew rate.	Output Porting	.OPTION AUTOSTOP
.MEASURE	Modifies information to define the results of successive simulations.	Output Porting	.OPTION NCWARN .OPTION MEASFAIL .OPTION MEASFILE .OPTION MEASOUT
.MEASURE FFT	Specifies measurement of FFT results.	Output Porting	-
.MEASURE LSTB	Enables the measurement of lstb output variables similar to any other common ac variable.	Output Porting	-
.MEASURE PHASENOISE	Enables measurement of phase noise at various frequency points in HSPICE.	Output Porting	.OPTION PHNOISEAMPM .OPTION AUTOSTOP
.MEASURE PTDNOISE	Allows for the measurement of integrated phase noise, time-point, tdelta-value, slewrate, and strobed jitter parameters in HSPICE.	Output Porting	-
.MODEL	Includes an instance of a predefined HSPICE model in an input netlist.	Model and Variation, Subcircuits	-
.MODEL_INFO	Enables printout of all or specified MOSFET model parameters for each simulation.	Model and Variation, Subcircuits	-

Command	Description	Category	Control Options
.MODULE	Helps you create a 3D-IC netlist to simulate multiple facets when two or more layers of active electronic components are integrated both vertically and horizontally into a single circuit.	3D-IC	.OPTION TNOM .OPTION SCALE .OPTION GEOSHRINK
.MODULEVAR	The .MODULEVAR and .ENDMODULEVAR block enables you to define the unique IC module entities for each top-level instance instantiation.	3D-IC	-
.MOSRA	Starts HSPICE HCI and/or BTI reliability analysis for HSPICE.	Model and Variation	-
.MOSRA_SUBCKT_PIN_VOLT	Starts HSPICE HCI and/or BTI reliability analysis for HSPICE.	Model and Variation	-
.MOSRAPRINT	Provides .PRINT/.PROBE capability for the electrical degradation elements.	Model and Variation	.OPTION MEASFORM
.NODESET	Initializes specified nodal voltages for DC operating point analysis and corrects convergence problems in DC analysis.	Setup	.OPTION DCHOLD
.NOISE	Controls the noise analysis of the circuit.	Analysis	-
.OP	Calculates the DC operating point of the circuit; saves circuit voltages at multiple time steps.	Analysis	.OPTION OPFILE
.OPTION	Modifies various aspects of an HSPICE simulation; individual options for HSPICE commands are described in Chapter 3, HSPICE Simulation Control Options Reference.	Setup	-
.PARAMETER	Defines parameters in HSPICE.	Setup	.OPTION LIST

Command	Description	Category	Control Options
.PAT	Specifies predefined pattern names to be used in a pattern source; also defines new pattern names.	Analysis	-
.PHASENOISE	Performs phase noise analysis on autonomous (oscillator) circuits in HSPICE.	Analysis	.OPTION PHNOISEAMPM .OPTION BPNMATCHTOL .OPTION PHASENOISEKRYLOVDIM .OPTION PHASENOISEKRYLOVITR .OPTION PHASENOISETOL .OPTION PHNOISELORENTZ
.PKG	Provides the IBIS Package Model feature; automatically creates a series of W-elements or discrete R, L and C components.	IBIS	-
.PORT_INFO	Provides an all-inclusive card type with a sub-command to perform different and extensible annotations.	Subcircuits	-
.POWER	Prints a table containing the AVG, RMS, MAX, and MIN measurements for specified signals in HSPICE.	Analysis	.OPTION SIM_POWER_ANALYSIS .OPTION SIM_POWER_TOP .OPTION SIM_POWERPOST .OPTION SIM_POWERSTART .OPTION SIM_POWERSTOP
.POWERDC	Calculates the DC leakage current in the design hierarchy.	Analysis	.OPTION SIM_POWERDC_ACCURACY .OPTION SIM_POWERDC_HSPICE
.PRINT	Prints the values of specified output variables.	Output Porting	-
.PROBE	Saves output variables to interface and graph data files.	Output Porting	.OPTION PROBE .OPTION PUTMEAS
.PROTECT	Keeps models and cell libraries private as part of the encryption process in HSPICE.	Encryption	.OPTION LIS_NEW

Command	Description	Category	Control Options
.PRUNE	Removes parasitics to speed up characterization flow by using the active-net file or inactive-net file.	Simulation Runs	-
.PTDNOISE	Calculates the noise spectrum and total noise at a point in time for HSPICE.	Analysis	-
.PZ	Performs pole/zero analysis.	Analysis	-
.SAMPLE	Analyzes data sampling noise.	Analysis	-
.SAVE	Stores the operating point of a circuit in a file that you specify in HSPICE.	Setup	-
.SENS	Determines DC small-signal sensitivities of output variables for circuit parameters.	Analysis	-
.SET_SAMPLE_TIME	Forces HSPICE to compute the data points with a fixed time step. It is available only for transient analysis.	Analysis	-
.SHAPE	Defines a shape to be used by the HSPICE field solver.	Field Solver	-
.SHAPE (Circles)	Defines a circle to be used by the HSPICE field solver.	Field Solver	-
.SHAPE (Polygons)	Defines a polygon to be used by the HSPICE field solver.	Field Solver	-
.SHAPE (Rectangles)	Defines a rectangle to be used by the HSPICE field solver.	Field Solver	-
.SHAPE (Strip Polygons)	Defines a strip polygon to be used by the HSPICE field solver.	Field Solver	-
.SHAPE (Trapezoids)	Defines a trapezoid to be used by the HSPICE field solver.	Field Solver	-

Command	Description	Category	Control Options
.SN	Performs Shooting Newton analysis. Supports both Time-Domain and Frequency-Domain sources and measurements.	Analysis	.OPTION LOADSNINIT .OPTION SAVESNINIT .OPTION SNACCURACY .OPTION SNCONTINUE .OPTION SNMAXITER
.SNAC	Runs a frequency sweep across a range for the input signal based on a Shooting Newton algorithm.	Analysis	-
.SNFT	Calculates the Discrete Fourier Transform (DFT) value used for Shooting Newton analysis.	Analysis	-
.SNNOISE	Runs a periodic, time-varying AC noise analysis based on a Shooting Newton algorithm.	Analysis	-
.SNOSC	Performs oscillator analysis on autonomous (oscillator) circuits. As with regular Shooting Newton analysis, input might be specified in terms of time or frequency values.	Analysis	.OPTION HBFREQABSTOL .OPTION HBFREQRELTOL .OPTION HBOSCMAXITER .OPTION HBPROBETOL .OPTION HBTRANFREQSEARCH .OPTION HBTRANINIT .OPTION HBTRANPTS .OPTION HBTRANSTEP
.SNXF	Calculates the transfer function from the given source in the circuit to the designated output.	Analysis	-
.STATEYE	Enables use of statistical eye diagram analysis.	Analysis	-
.STIM	Uses the results (output) of one simulation as input stimuli in a new simulation in HSPICE.	Output Porting	-
.STORE	Starts a store operation to create checkpoint files describing a running process during transient analysis.	Setup	-

Command	Description	Category	Control Options
.SUBCKT	Defines a subcircuit in a netlist.	Subcircuits	.OPTION LIST .OPTION PARHIER
.SURGE	Automatically detects and reports a current surge that exceeds the specified surge tolerance in HSPICE.	Analysis	-
.SWEEPBLOCK	Creates a sweep whose set of values is the union of a set of linear, logarithmic, and point sweeps in HSPICE.	Analysis	-
.TEMPERATURE	Specifies the circuit temperature for an HSPICE simulation.	Alter Block, Analysis, Simulation Runs	.OPTION TNOM .OPTION USE_TEMP
.TF	Calculates DC and AC small-signal transfer functions.	Analysis	-
.TITLE	Sets the simulation title.	Setup, Simulation Runs	-
.TRAN	Starts a transient analysis that simulates a circuit at a specific time.	Analysis	.OPTION DELMAX
.TRANNOISE	Activates transient noise analysis to compute the additional noise variables over a standard .TRAN analysis.	Analysis	.OPTION MCBRIEF .OPTION MACMOD .OPTION MODMONTE .OPTION MONTECON .OPTION RANDGEN .OPTION SEED
.UNPROTECT	Restores normal output functions previously restricted by a .PROTECT command as part of the encryption process in HSPICE.	Encryption	.OPTION LIS_NEW
.VARIATION	Specifies global and local variations on model parameters in HSPICE.	Model and Variation	-
.VEC	Calls a digital vector file from a HSPICE netlist.	Files	-

Command	Description	Category	Control Options
CHECK_WINDOW	Defines a time window around the vector strobe time or user-defined first_time such that the output comparison, for signals specified as output in the.IO statement, is checked over this time window.	Digital Vector	-
ENABLE	Specifies the controlling signal(s) for bidirectional signals.	Digital Vector	-
IDELAY	Defines an input delay time for bidirectional signals.	Digital Vector	-
IO	Defines the type for each vector: input, bidirectional, output, or unused.	Digital Vector	-
MASK	Allows a mask value to be assigned to variable and that variable can used in place of a mask value.	Digital Vector	-
ODELAY	Defines an output delay time for bidirectional signals.	Digital Vector	-
OUT	Specifies output resistance for each signal for which the mask applies.	Digital Vector	-
PERIOD	Defines the time interval for the Tabular Data section.	Digital Vector	-
RADIX	Specifies the number of bits associated with each vector.	Digital Vector	-
SLOPE	Specifies the rise/fall time for the input signal.	Digital Vector	-
STOP_AT_ERROR	Stop circuit simulation if output comparisons are performed resulting in mismatched outputs.	Digital Vector	-
TDELAY	Defines the delay time for both input and output signals in the Tabular Data section.	Digital Vector	-

Command	Description	Category	Control Options
TFALL	Specifies the fall time of each input signal for which the mask applies.	Digital Vector	-
TRISE	Specifies the rise time of each input signal for which the mask applies.	Digital Vector	-
TRIZ	Specifies the output impedance when the signal for which the mask applies is in tristate.	Digital Vector	-
TSKIP	Causes HSPICE to ignore the absolute time field in the tabular data.	Digital Vector	-
TUNIT	Defines the time unit for PERIOD, TDELAY, IDELAY, ODELAY, SLOPE, TRISE, TFALL, and absolute time.	Digital Vector	-
VCHK_IGNORE	Causes HSPICE to ignore checking for all nodes specified when you use the optional mask between times specified by t1 and t2.	Digital Vector	-
VIH	Specifies the logic-high voltage for each input signal to which the mask applies.	Digital Vector	-
VIL	Specifies the logic-low voltage for each input signal to which the mask applies.	Digital Vector	-
VNAME	Defines the name of each vector.	Digital Vector	-
VOH	Specifies the logic-high threshold voltage for each output signal to which the mask applies.	Digital Vector	-
VOL	Specifies the logic-low threshold voltage for each output signal to which the mask applies.	Digital Vector	-

Command	Description	Category	Control Options
VREF	Specifies the name of the reference voltage for each input vector to which the mask applies.	Digital Vector	-
VTH	Specifies the logic threshold voltage for each output signal to which the mask applies.	Digital Vector	-

.AC

Performs several types of AC analyses.

Syntax

Single or Double Sweep

```
.AC type np fstart fstop
.AC type np fstart fstop [SWEEP var [START=]start
+ [STOP=]stop [STEP=]incr]
.AC type np fstart fstop [SWEEP var type np start stop]
.AC type np fstart fstop
+ [SWEEP var START=”param_expr1”
+ STOP=”param_expr2” STEP=”param_expr3”]
.AC type np fstart fstop [SWEEP var start_expr
+ stop_expr step_expr]
```

Sweep Using Parameters

```
.AC type np fstart fstop [SWEEP DATA=datanm(Nums)]
.AC DATA=datanm
.AC DATA=datanm [SWEEP var [START=]start [STOP=]stop
+ [STEP=]incr]
.AC DATA=datanm [SWEEP var type np start stop]
.AC DATA=datanm [SWEEP var START="param_expr"
+ STOP="param_expr2" STEP="param_expr3"]
.AC DATA=datanm [SWEEP var start_expr stop_expr
+ step_expr]
```

Optimization

```
.AC DATA=datanm OPTIMIZE=opt_par_fun
+ RESULTS=measnames MODEL=optmod
```

Monte Carlo

`.AC` *`type np fstart fstop`* `[SWEEP MONTE=`*`MCcommand`*`]`

Argument	Description

DATA=datanm(*Nums*)	Data name, referenced in the `.AC` command, where (*Nums*) can be any of the following to allow selective runs for a .DATA structure:
	▪ One signal number to specify the sample number to execute. For example:
	`.ac .1n 1n sweep data=datanm(4)`
	▪ Sequence of signals as follows - (num1:num2 num3 num4:num5), where : Samples from num1 to num2, sample num3, and samples from num4 to num5 are executed. For example:
	`.ac 0.1n 1n sweep data=datanm(1:2 3 4:5)`

incr	Increment value of the voltage, current, element, or model parameter. If you use type variation, specify the np (number of points) instead of incr.
fstart	Starting frequency. If you use POI (list of points) type variation, use a list of frequency values, not fstart fstop.
fstop	Final frequency.
MONTE= MCcommand	Where MCcommand can be any of the following: ▪ *val* Specifies the number of random samples to produce. ▪ *val* firstrun=*num* Specifies the sample number on which the simulation starts. ▪ *list num* Specifies the sample number to execute. ▪ list(*num1:num2 num3 num4:num5*) Samples from *num1* to *num2*, sample *num3*, and samples from *num4* to *num5* are executed (parentheses are optional).
np	Number of points or points per decade or octave, depending on which keyword precedes it.
start	Starting voltage or current or any parameter value for an element or model.
stop	Final voltage or current or any parameter value for an element or a model.

Argument	Description
SWEEP	Second sweep.
TEMP	Temperature sweep
type	Any of the following keywords: ▪ DEC – decade variation. ▪ OCT – octave variation. ▪ LIN – linear variation. ▪ POI – list of points.
var	Name of an independent voltage or current source, element or model parameter or the TEMP (temperature sweep) keyword. HSPICE supports source value sweep, referring to the source name (SPICE style). If you select a parameter sweep, a .DATA command and a temperature sweep, then you must choose a parameter name for the source value. You must also later refer to it in the .AC command. The parameter name cannot start with V or I.
firstrun	The *val* value specifies the number of Monte Carlo iterations to perform. The *firstrun* value specifies the desired number of iterations. HSPICE runs from *num* to *num+val-1*.
list	Iterations at which HSPICE performs a Monte Carlo analysis. You can write more than one number after a list. The colon represents “from ... to ...". Specifying only one number causes to HSPICE run at only the specified point.

Description

The `.AC` command is usable in several different formats, depending on the application as shown in the examples. You can also use the `.AC` command to perform data-driven analysis in HSPICE.

If the input file includes an `.AC` command, HSPICE runs AC analysis for the circuit over a selected frequency range for each parameter in the second sweep.

For AC analysis, the data file must include at least one independent AC source element command (for example, `VI INPUT GND AC 1V`). HSPICE checks for this condition and reports a fatal error if you did not specify such AC sources.

Command Group

Analysis

Examples

```
.AC DEC 10 1K 100MEG
```

This example performs a frequency sweep by 10 points per decade from 1kHz to 100MHz.

See Also

.DC
.DISTO
.LSTB
.NOISE
.TRAN
AC Small-Signal and Noise Analysis
BJT and Diode Examples for the paths to the demo files `mextram_ac.sp` and `vbic99_ac.sp`, which use the `.AC` command.
Device Optimization Examples for paths to the demo netlists `bjtopt.sp` and `bjtopt2.sp` which use `.AC sweep` keywords.
MOSFET Device Examples for paths to the demo netlists `calcap.sp` and `cascode.sp` for use of the `.AC` command.
Applications of General Interest Examples for the paths to the demo files `alm124.sp` and `quickAC.sp`, for `.AC` command usage.
Transmission (W-element) Line Examples for the paths to the demo files `ex1.sp`, `ex2.sp`, `ex3.sp`, `rlgc.sp`, and `umodel.sp` for `.AC` command usage.

.ACMATCH

Calculates the effects of variations in device characteristics and parasitic capacitance sensitivities on a circuit's AC response.

Syntax

```
.ACMATCH OUTVAR [THRESHOLD=T] [FILE=string] [INTERVAL=Int]
+ [Virtual_Sensitivity=Yes|No] [Sens_threshold=x]
+ [Sens_node=(nodei_name,nodej_name),…,
+ (nodem_name,noden_name)]
```

Argument	Description
OutVar	OutputVariable can be one or several output voltages, difference voltages, or branch current through an independent voltage source. The voltage or current specifier is followed by an identifier of the AC quantity of interest: M: magnitude P: phase R: real part I: imaginary part
Threshold	Only devices with variation contributions above Threshold are reported in the table. Results for all devices are displayed if Threshold=0 is set. The maximum value for Threshold is 1.0, but at least 10 devices (or all) are displayed. Default is 0.01.
File	Valid file name for the output tables. Default is `basename.am#`, where # is the regular HSPICE sequence number.
Interval	This option applies to the frequency sweep definition in he `.AC` command. A table is printed at the first sweep point, then for each subsequent increment of SweepValue, and at the final sweep point.
Virtual_Sensitivity	Invokes ACmatch computation and output of virtual sensitivity; sensitivity table is printed even if variation block does not exist in netlist. Default: Yes
Sens_Threshold=x	Only nodes with sensitivity above x are reported. At least 10 sensitivities (or all) are displayed. This avoids generation of null output if you specify too large a value for x. Default: 1e-6
Sens_Node	Output all sensitivities associated with the requested nodes. The node name should appear in pairs. (See examples below.)

Description

Use to calculate the effects of variations in device characteristics on a circuit's AC response. ACMatch allows for calculation of parasitic capacitor sensitivities whose nominal values are “zero” in the original design. Such analysis is useful for high precision (differential) analog circuits and switched capacitor filters. If more than one ACMatch analysis is specified per simulation, only the last command is executed. dB syntax is supported in `.ACMatch` for Vdb and Idb, for local, global, and element variation.

Note: ACMatch does not support Spatial Variations.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION POST	Saves simulation results for viewing by an interactive waveform viewer.

Command Group

Analysis

Examples

```
.ACMATCH VM(out) VP(out) IM(x1.r1) IP(x1.r1) IM(c1) IP(c1)
.AC dec 10 1k 10Meg interval=10
```

When using the virtual capacitance sensitivity option `Sens_Node` multiple name pairs are supported with one comma between node names, but commas are optional between node name pairs. Either of the following specifications is valid in HSPICE:

```
.ACmatch v(out) virtual_sens=yes
+ sens_node= (out, xi82.net044),
+ (0,out), (xi82.net044,xi82.net031) sens_threshold=1e-6
```

or:

```
.ACmatch v(out) virtual_sens=yes
+ sens_node= (out, xi82.net044)
+ (0,out) (xi82.net044,xi82.net031) sens_threshold=1e-6
```

See Also

.AC
.MEASURE / MEAS
.MEASURE (ACMATCH)
.OPTION POST
ACMatch Analysis

.ACPHASENOISE

Helps you interpret signal and noise quantities as phase variables for accumulated jitter for closed-loop PLL analysis.

Syntax

```
.ACPHASENOISE output input [interval] carrier=freq
+ [listfreq=(frequencies|none|all)]
+ [listcount=val] [listfloor=val]
+ [listsources=(1|0)]
```

Description

The .ACPHASENOISE command aids in the ability to compute “Accumulated Jitter” or “Timing Jitter” for the closed loop PLL. The accumulated jitter response is essentially an integral transformation of the closed-loop PLL response. The .ACPHASENOISE analysis outputs raw data to *.pn0 and *.printpn0 files. The PHNOISE data is given in units of dBc/Hz, i.e., dB relative to the carrier, per Hz, across the output nodes specified by the .ACPHASENOISE command. The data plot is a function of offset frequency. If the “JITTER” keyword is present, .ACPHASENOISE also outputs the accumulated TIE jitter data to *.jt0 and *.printjt0 data files. These data are plotted as a function of time in units of seconds. The Timing Jitter data itself has units of seconds. The timing jitter calculations make use of the parameters given in the .ACPHASENOISE syntax, such as “freq” and “interval”.

For details, see Small-Signal Phase-Domain Noise Analysis (.ACPHASENOISE) in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Command Group

Analysis

.ALIAS

Renames a model or library containing a model; deletes an entire library of models.

Syntax

```
.ALIAS model_name1 model_name2
```

Description

Use in instances when you have used .ALTER commands to rename a model, to rename a library containing a model, or to delete an entire library of models in HSPICE. If your netlist references the old model name, then after you use one of these types of .ALTER commands, HSPICE no longer finds this model.

For example, if you use `.DEL LIB` in the `.ALTER` block to delete a library, the `.ALTER` command deletes all models in this library. If your netlist references one or more models in the deleted library, then HSPICE no longer finds the models.

To resolve this issue, HSPICE provides an `.ALIAS` command to let you keep the old model name that HSPICE can find in the existing model libraries.

Command Group

Model and Variation

Examples

Example 1 *For a scenario in which you delete a library named poweramp that contains a model named pa1, while another library contains an equivalent model named par: You can then convert the pa1 model name to the par1 model name.*

```
.ALIAS pa1 par1
```

Example 2 *During simulation when HSPICE encounters a model named pa1 in your netlist, it initially cannot find this model because you used an .ALTER command to delete the library that contained the model. However, the .ALIAS command indicates to use the par1 model in place of the old pa1 model and HSPICE does find this new model in another library so simulation continues.You must specify an old model name and a new model name to use in its place. You cannot use .ALIAS without any model names:*

```
.ALIAS
```

or with only *one* model name:

```
.ALIAS pa1
```

Example 3 *You also cannot alias a model name to more than one model name because the simulator cannot determine which of these new models to use in place of the deleted or renamed model. For the same reason, you cannot substitute a model name to a second model name and then substitute the second model name to a third model name.*

```
.ALIAS pa1 par1 par2
```

Example 4 *If your netlist does not contain an .ALTER command and if the .ALIAS does not report a usage error, then the .ALIAS does not affect the simulation results.*

```
.ALIAS pa1 par1
.ALIAS par1 par2
```

Your netlist might contain the command:

```
.ALIAS myfet nfet
```

Without an .ALTER command, HSPICE does not use nfet to replace myfet during simulation.

If your netlist contains one or more .ALTER commands, the first simulation uses the original myfet model. After the first simulation if the netlist references myfet from a deleted library, .ALIAS substitutes nfet in place of the missing model.

- If HSPICE finds model definitions for both myfet and nfet, it reports an error and aborts.
- If HSPICE finds a model definition for myfet, but not for nfet, it reports a warning and simulation continues by using the original myfet model.
- If HSPICE finds a model definition for nfet, but not for myfet, it reports a "replacement successful" message.

See Also

.ALTER
.MALIAS

.ALTER

Reruns an HSPICE simulation using different parameters and data.

Syntax

.ALTER *title_string*

Argument	Description
title_string	Any string up to 80 characters. HSPICE prints the appropriate title string for each .ALTER run in each section heading of the output listing and in the graphical data (.tr#) files.

Description

Use this command to rerun an HSPICE simulation using different parameters and data. Use parameter (variable) values for .PRINT commands before you alter them. The .ALTER block cannot include .PRINT, or any other input/output commands. You can include analysis commands (.DC, .AC, .TRAN,

.FOUR, .DISTO, .PZ, and so on) in a .ALTER block in an input netlist file.

However, if you change only the analysis type and you do not change the circuit itself, then the simulation runs faster if you specify all analysis types in one block, instead of using separate .ALTER blocks for each analysis type.

To activate multiprocessing while running .ALTER cases, enter **hspice -mp** on the command line. While running in parallel mode, HSPICE checks if the input case has .ALTER commands. If it has, HSPICE splits the input case into several subcases, then fork HSPICE processes to run each subcase at the same time. After all HSPICE processes finish running the subcases, HSPICE merges all the output files of the subcases.

Note: Following are some important notes.

- Reloading the same files in .ALTER blocks can lead to slowdowns in performance.
- When using an .INCLUDE command within an .ALTER statement, the purpose of this feature is to enable you to *slightly* modify the original netlist; i.e., adding some elements/nodes without changing or deleting any elements/nodes that were already defined in the original .INC. This feature is *not* intended or able to significantly modify elements/nodes to the previously existing circuit topology. Using .INC statements within an .ALTER that disregard this limitation will yield simulation results that are unlikely to reflect the reality of the intended netlist.
- HSPICE reports the elapsed time for the top level simulation and each .ALTER block separately.

The .ALTER sequence or block can contain:

- Element commands (except E, F, G, H, I, and V source elements)
- .AC commands
- .ALIAS commands
- .DATA commands
- .DC commands
- .DEL LIB commands
- .HDL commands
- .IC (initial condition) commands

- .INCLUDE / INC / INCL commands
- .LIB commands
- .MODEL commands
- .NODESET commands
- .OP commands
- .OPTION / OPTIONS commands
- .PARAM / PARAMETER / PARAMETERS commands
- .TEMP / TEMPERATURE commands
- .TF commands
- .TRAN commands
- .VARIATION commands

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION ALTCC	Sets onetime reading of the input netlist for multiple .ALTER commands.
.OPTION MEASFILE	Controls whether measure information outputs to single or multiple files when an .ALTER command is present in the netlist.
.OPTION OPTCON	Continues running a bisection analysis (with multiple .ALTER commands) even if optimization failed.

Command Group

Alter Block

Examples

```
.ALTER simulation_run2
```

.APPENDMODEL

Appends the `.MOSRA` (model reliability) parameters to a model card.

Syntax

```
.APPENDMODEL SrcModel ModelKeyword1 DestModel ModelKeyword2
```

Argument	Description
SrcModel	Source model name, e.g., the name of the MOSRA model.
ModelKeyword	Model type for SrcModel. For example, the keyword `mosra`.
DestModel	Destination model name, e.g, the original model in the model library.
ModelKeyword2	Model type for DestModel. For example, 'nmos'.

Description

Appends the parameter values from the source model card (SrcModel) to the destination model card (DestModel). All arguments are required. Wildcards are supported for the .APPENDMODEL command. In addition, the .OPTION APPENDALL enables the top hierarchical level to use the .APPENDMODEL command even if the MOSFET model is embedded in a subcircuit.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION APPENDALL	Allows the top hierarchical level to use the .APPENDMODEL command even if the MOSFET model is embedded in a subcircuit.

Command Group

Model and Variation

Examples

Example 1 *Appending the content of the model card hci_1 to the b3_nch BSIM3 model card.*

```
.appendmodel hci_1 mosra b3_nch nmos
```

Example 2 *Model p1_ra is appended to all of the pmos models. Quotation marks are required if the model name is defined only by a wildcard.*

```
.appendmodel p1_ra mosra "*" pmos
```

Example 3 *The model p1_ra is appended to all of the pmos models that are named pch* (pch1, pch2, pch_tt, etc.).*

```
.appendmodel p1_ra mosra pch* pmos
```

See Also

.MODEL
.MOSRA

.BA_ACHECK

Specifies the rule for detecting node activity in back-annotation.

Syntax

```
.BA_ACHECK [include=node_pattern
   [;node_pattern2;node_pattern3....]]
+ [exclude=node_pattern
   [;node_pattern2;node_pattern3....]] [level=val2 0|1|n]
+ [dv=val] [start=start_time] [stop=stop_time]
+ [save_dir=path]
```

Argument	Description
include= node_pattern	Defines the signal node name(s) which can be the node name of a single node or a node name containing wildcard character '*' representing a group of node names. The node name with wildcard character must be quoted by single quotation marks as '*node_name*', because in HSPICE syntax, all characters after unquoted '*' are treated as comments and are ignored. You can specify multiple patterns using a semicolon or a space to delimit the patterns from each other.
exclude= node_pattern	Defines the signal node name(s) which are excluded from the list of nodes that need to be checked. Wildcard characters can be used and need to be quoted such as: 'a*'. You can specify multiple patterns using a semicolon or a space to delimit the patterns from each other.

Argument	Description
`level=val2`	The level value `val2` specifies the number of hierarchical depth levels when checking node activity. ■ When val2 is set to 0 (default), all subckt levels are considered for node activity. ■ When val2 is set to 1, only nodes in the root circuit are considered for node activity. ■ When val2 is set to n, nodes in the range from the root circuit to nth level subckt are considered for node activity.
`dv=`*`val`*	Defines the threshold of voltage variation. A node is considered active when the voltage change, compared to the initial value of the node, is larger than *val*. DEFAULT of *val* is 0.1 volt.
`start=`*`start_time`*`, stop=`*`stop_time`*	Specifies the start_time and stop_time in the time window. The activity is checked at the time within the specified time. If no time window is specified, the check is performed from the time 0 ns to the end of simulation.
`save_dir=`*`"path"`*	Use to set output path for back-annotation active file.

Description

Use this option to specify the rule for detecting node activity. A node is considered active if its voltage change exceeds the specified threshold during the simulation time.

Note: The `.BA_ACHECK` command is similar to the HSIM command: *acheck*.

Command Group

Output Porting

Examples

In the following example when you run HSPICE you can access the active back-annotation file from the specified save path (note quotes).

```
.ba_acheck dv=1 tstart=0 tstop=1u exclude='x*'
+ save_dir="/remote/hsp_build6/xyzuser/"
```

See Also

Post-Layout Back-Annotation
Back-Annotation Demo Cases

.BIASCHK

Monitors device voltage bias, current, size, expression, region, or temperature.

Syntax

As an expression monitor for a subcircuit definition:

```
.BIASCHK subckt expr='expression'
+ mname=sub_name
+ [condition='logical_expression']
+ [max=max] [min=min][limit=lim]
+ [simulation=op|dc|tr|all]
+ [tstart=time1] [tstop=time2] [autostop]
+ [interval=time]
+ [message='warning message']
```

As an expression monitor:

```
.BIASCHK 'expression' [limit=lim] [noise=ns] [max=max]
+ [min=min] [simulation=op|dc|tr|all] [monitor=v|i|w|l]
+ [tstart=time1] [tstop=time2] [autostop]
+ [interval=time] [BIASNAME=val]
+ [condition='logical_expression']
```

As an element and model monitor:

```
.BIASCHK type terminal1=t1 [terminal2=t2] [monitor=v|i]
+ [limit=lim] [noise=ns] [max=max] [min=min]
+ [simulation=op|dc|tr|all]
+ [name=name1,name2,...]
+ [mname=modname_1,modname_2,...]
+ [tstart=time1] [tstop=time2] [autostop]
+ [except=name_1,name_2,...]
+ [interval=time] [sname=subckt_name1,subckt_name2,...]
+ [device=active|off]
+ [BIASNAME=val][message="string"]
```

or:

```
.BIASCHK type monitor=param
+ [limit=lim] [noise=ns] [max=max] [min=min]
+ [simulation=op|dc|tr|all]
+ [name=name1,name2,...]
+ [mname=modname_1,modname_2,...]
+ [tstart=time1] [tstop=time2] [autostop]
+ [except=name_1,name_2,...]
```

```
+ [interval=time] [sname=subckt_name1,subckt_name2,...]
+ [device=active|off]
+ [BIASNAME=val][message="string"]
```

As an element or model expression monitor:

```
.BIASCHK type expr='real_expression'
+ [condition='logical_expression']
+ [max=max] [min=min]
+ [simulation=op|dc|tr|all]
+ [name=name1,name2,...]
+ [mname=modname_1,modname_2,...]
+ [tstart=time1] [tstop=time2] [autostop]
+ [except=name_1,name_2,...]
+ [interval=time] [sname=subckt_name1,subckt_name2,...]
+ [BIASNAME=val][message="string"]
```

As a region monitor:

```
.BIASCHK MOS [region=cutoff|linear|saturation]
+ [simulation=op|dc|tr|all]
+ [name=name1,name2,...]
+ [mname=modname_1,modname_2,...]
+ [tstart=time1] [tstop=time2] [autostop]
+ [except=name1,name2,...]
+ [interval=time] [sname=subckt_name1,subckt_name2,...]
+ [BIASNAME=val][message="string"]
```

As a length and width monitor:

```
.BIASCHK type monitor=w|l
+ [limit=lim] [noise=ns] [max=max] [min=min]
+ [simulation=op|dc|tr|all]
+ [name=devname_1,devname_2,...]
+ [name=devname_n,devname_n+1,...]
+ [mname=modelname_1,modelname_2,...]
+ [tstart=time1] [tstop=time2] [autostop]
+ [interval=time] [sname=subckt_name1,subckt_name2,...]
+ [BIASNAME=val] [message="string"]
```

As a temperature monitor:

```
.BIASCHK type monitor=temp
+ [limit=lim] [max=max] [min=min]
+ [simulation=op|dc|tr|all]
+ [name=devname_1,devname_2,...]
+ [mname=modelname_1,modelname_2,...]
+ [sname=subckt_name1, subckt_name2, ...]
```

```
+ [tstart=time1] [tstop=time2] [autostop]
+ [BIASNAME=val][message="string"]
```

As a conditional expression monitor:

```
.BIASCHK 'real_expression' [simulation=op|dc|tr|all]
+ [tstart=time1] [tstop=time2] [autostop]
+ [interval=time] [BIASNAME=val] [message='string']
```

Argument	Description
type	Element type to check. MOS (C, BJT, ...) For a monitor, *type* can be DIODE, BIPOLAR, BJT, JFET, MOS, NMOS, PMOS, R, or C. When used with REGION, *type* can be MOS only.
expr	Specify the expression to be checked for the Device. The expression can contain HSPICE output signals like LV1(*), vth(*). For the geometry parameters of a device, use the HSPICE template output. For example, lv1(*) for effective L length of a MOSFET. The wildcard character * can be used in conjunction with device categories, for example: VGS(*) and vth(*). **Note:** Please note the following limitations when using `expr` and `condition` options: 1. `condition='logical_expression'` only works for `expr='expression'` and an expression monitor (`.biaschk 'expression'`). When `'condition'` is used in `.biaschk 'expression'`, it cannot contain any wildcard characters. 2. `condtion='logical_expression'` and `expr='expression'` does not work for HPP. For bias checking a subcircuit, this argument specifies the expression to be checked for the `.subckt` definition. The expression can contain HSPICE output signals such as v(node1,node2) or isub(subckt_port), and parameters defined in `.subckt` and the top circuit. If the parameters in the expression are defined in both the top circuit and `.subckt`, the parameters defined in the top level have a higher priority. If `.option optparhier=local` is set, the parameters inside the `.subckt` have a higher priority.

Argument	Description
`real_expression`	Specifies the conditional expression when the `.biaschk` command is used as a conditional expression monitor. The conditional expression can use relational operators like '<', '>', '==', '<=', '>=', '!=', or '? :'.
`condition`	Define the condition for `expr='expression'`. When the condition is true, the `.biaschk` is enabled. If no condition is set, the `.biaschk` is always enabled. The expression can contain HSPICE output signals like LV1(*), vth(*). For the geometry parameters of a device, use the HSPICE template output. For example, lv1(*) for effective L length of a MOSFET. The wildcard character * can be used in conjunction with device categories, for example: VGS(*) and vth(*). **Note:** Please note the following limitations when using `expr` and `condition` options: 1. `condition='logical_expression'` only works for `expr='expression'` and an expression monitor (`.biaschk 'expression'`). When `'condition'` is used in `.biaschk 'expression'`, it cannot contain any wildcard characters. 2. `condtion='logical_expression'` and `expr='expression'` does not work for HPP.
`terminal 1, 2`	Terminals between which HSPICE checks (that is, checks between *terminal1* and *terminal2*): ▪ For MOS level 57: nd, ng, ns, ne, np, n6 ▪ For MOS level 58: nd, ngf, ns, ngb ▪ For MOS level 59: nd, ng, ns, ne, np ▪ For other MOS level: nd, ng, ns, nb ▪ For resistor: n1, n2 ▪ For capacitor: n1, n2 ▪ For diode: np, nn ▪ For bipolar: nc, nb, ne, ns ▪ For JFET: nd, ng, ns, nb For type=subckt, the terminal names are those pins defined by the subcircuit definition of mname.

Argument	Description
`limit`	Bias check limit that you define. Reports an error if the bias voltage (between appointed terminals of appointed elements and models) is larger than the limit.
`noise`	Bias check noise that you define. The default is 0.1v. Noise-filter some of the results (the local maximum bias voltage that is larger than the limit). The next local max replaces the local max if all of the following conditions are satisfied: `local_max-local_min < noise, next local_max -local_min < noise` and this local max is smaller than the next local max. For a parasitic diode, HSPICE ignores the smaller local max biased voltage and does not output this voltage. To disable this feature, set the noise detection level to 0. **Note:** `noise` works only with `limit` method.
`max`	Maximum value.
`min`	Minimum value.
`name`	Element name to check. If name and mname are not both set for the element type, the elements of this type are all checked. You can define more than one element name in keyword name with a comma (,) delimiter. If doing bias checking for subcircuits: ▪ When both mname and name are defined while multiple name definitions are allowed if a name is also an instance of mname, then only those names are checked, others will be ignored. ▪ This command is ignored if no name is an instance of mname. ▪ For name definitions which are not of the type defined in mname will be ignored. ▪ If a mname is not defined, the subcircuit type is determined by the first name definition.

Argument	Description
mname	Model name. If you are doing bias checking for a subcircuit, it is the subcircuit definition name. HSPICE checks elements of the model for bias. If you define mname, then HSPICE checks all devices of this model. You can define more than one model name in the keyword mname with the comma (,) delimiter. If *mname* and *name* are not both set for the element *type*, the elements of this type are all checked. If doing bias checking for subcircuits: ▪ Once there is one and only one mname defined, the terminal names for this command are those pins defined by the subckt definition of mname. ▪ Multiple mname definitions are not allowed. ▪ Wildcards are supported for mname. ▪ If only mname is specified in a subckt bias check, then all subcircuits will be checked. See also sname below.
region	Values can be cutoff, linear, or saturation. HSPICE monitors when the MOS device, defined in the .BIASCHK command, transitions to and from the specified region (such as cutoff).
simulation	Simulation type you want to monitor. You can specify op, dc, tr (transient), and all (op, dc, and tr). The tr option is the default simulation type.

Argument	Description
monitor	Type of value you want to monitor. You can specify v(voltage), i(current), w/l (device size for the element type/temperature), and param, where param can be: ■ Ic-Collector current of a BJT ■ Ie-Emitter current of a BJT ■ Id-Drain current of MOSFET or JFET ■ Ig-Gate current of a MOSFET or JFET ■ Is-Source current of a MOSFET, BJT, or JFET ■ Ib-Bulk current of a MOSFET or base current of a BJT ■ Vbe-Base/emitter voltage difference of a BJT (Vb-Ve) ■ Veb-Emitter/base voltage difference of a BJT (Ve-Vb) ■ Vbc-Base/collector voltage difference of a BJT (Vb-Vc) ■ Vcb-Collector/base voltage difference of a BJT (Vc-Vb) ■ Ves-Emitter/source voltage difference of a BJT (Ve-Vs) ■ Vse-Source/emitter voltage difference of a BJT (Vs-Ve) ■ Vcs-Collector/source voltage difference of a BJT (Vc-Vs) ■ Vsc-Source/collector voltage difference of a BJT (Vs-Vc) ■ Vce-Collector/emitter voltage difference of a BJT (Vc-Ve) ■ Vec-Emitter/collector voltage difference of a BJT (Ve-Vc) ■ Vbd-Bulk/drain voltage difference of a MOSFET or JFET (Vb-Vd) ■ Vdb-Drain/bulk voltage difference of a MOSFET or JFET (Vd-Vb) ■ Vds-Drain/source voltage difference of a MOSFET or JFET (Vd-Vs) ■ Vsd-Source/drain voltage difference of a MOSFET or JFET (Vs-Vd) ■ Vgb-Gate/bulk voltage difference of a MOSFET or JFET (Vg-Vb) ■ Vbg-Bulk/gate voltage difference of a MOSFET or JFET (Vb-Vg) ■ Vgd-Gate/drain voltage difference of a MOSFET or JFET (Vg-Vd) ■ Vdg-Drain/gate voltage difference of a MOSFET or JFET (Vd-Vg) ■ Vgs-Gate/source voltage difference of a MOSFET or JFET (Vg-Vs) ■ Vsg-Gate/source voltage difference of a MOSFET or JFET (Vs-Vg)

Argument	Description
	▪ Vbs-Bulk/source voltage difference of a MOSFET or base/source voltage difference of a BJT (Vb-Vs) ▪ Vsb - Source/bulk voltage difference of a MOSFET or source/base voltage difference of a BJT (Vs-Vb) ▪ Vs-Source voltage of a MOSFET, JFET or BJT ▪ VD-Drain voltage of a MOSFET/JFET ▪ VB-Bulk voltage of a MOSFET, JFET or BJT ▪ VG-Gate voltage of a MOSFET/JFET ▪ VC-Collector/base voltage of a BJT ▪ VE-Emitter voltage of a BJT
monitor	▪ Vneg-Cathode voltage of a DIODE or low-voltage terminal voltage of RESISTOR or CAPACITOR ▪ Vpos-Anode voltage of a DIODE or high-voltage terminal voltage of RESISTOR or CAPACITOR ▪ Vdip-Anode/Cathode voltage difference of a DIODE or high-voltage terminal/low-voltage terminal voltage difference of RESISTOR or CAPACITOR
tstart	Bias check start time during transient analysis. The default is 0.
tstop	Bias check end time during transient analysis. The analysis ends on its own by default if you do not set this parameter.
autostop	When set, HSPICE supports an autostop for a biaschk card so that it can report error messages and stop the simulation immediately.
except	Specify the element or instance that you do not want to bias check.
interval	Active when .OPTION BIASINTERVAL is set to a nonzero value. This argument prevents reporting intervals that are less than or equal to the time specified.
device	Additional condition when using bias check method such as limit/min/max for MOS monitor.

Argument	Description
sname	Name of the subcircuit definition that the *type* of element of lies in. HSPICE checks all elements in this subcircuit for bias. You can define more than one subcircuit name in the keyword *sname* with a comma (,) delimiter. If you are doing bias checking for a subcircuit, sname = the X-element name.
BIASNAME	Keyword to organize multiple .biaschk commands and their outputs in final bias check results file for viewing violation details in GUI applications such as SAE and HAI.
message	"string" is a user-defined warning message for any issue that .BIASCHK monitors. The issue is reported in the *.lis file, including the string you specify. See Example 11 on page 58.

Description

Use this command to monitor the voltage bias, current, device size, expression, region, or temperature during analysis. The output reports:

- Element (instance) name
- Time
- Terminals
- Bias that exceeds the limit
- Number of times the bias exceeds the limit for an element
- User-defined warning message for monitored temperature exceeding limits

HSPICE saves the information as both a warning and a bias check summary in the *.lis file or a file you define in the BIASFILE option. You can use this command only for active elements, resistors, capacitors, and subcircuits.

More than one simulation type or all simulation types can be set in a single .BIASCHK command. Also, more than one region can be set in a single .BIASCHK command.

After a simulation that uses the .BIASCHK command runs, HSPICE outputs a results summary including the element name, time, terminals, model name, and the number of times the bias exceeded the limit for a specified element.

The keywords *name*, *mname*, and *sname* act as OR'd filters for element selection. Also, if type is subckt in a .BIASCHK command that tries to check the ports of a subcircuit, the keyword *sname* then behaves identically to the

name keyword.

Element and model names can contain wildcards, either “?” (stands for one character) or “*” (stands for 0 or more characters).

If a model name that is referenced in an active element command contains a period (.), then `.BIASCHK` reports an error. This occurs because it is unclear whether a reference such as `x.123` is a model name or a subcircuit name (123 model in “x” subcircuit). With version F-2011.09-SP1, you can conduct node voltage error checks within model subcircuits instead of defining these in a netlist (top-level).

If you do not specify an element and model name, HSPICE checks all elements of this type for bias voltage (you must include `type` in the BIASCHK card). However, if `type` is `subckt` at least one element or model name must be specified in the `.BIASCHK` command; otherwise, a warning message is issued and this command is ignored.

Note: To perform a complete bias check and print all results in the Outputs Biaschk Report, do not use `.protect/.unprotect` in the netlist for the part that is used in `.biaschk`. For example: If a model definition such as model `nch` is contained within `.prot/.unprot` commands, in the `*.lis` you'll see a warning message as follows: `**warning** : model nch defined in .biaschk cannot be found in netlist--ignored`

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION BIASFILE	Sends .BIASCHK command results to a specified file.
.OPTION BIASFMT	Controls the format of .BIASCHK command output.
.OPTION BIASINTERVAL	Controls the level of information output during transient analysis.
.OPTION BIASNODE	Specifies whether to use node names or port names in element commands.
.OPTION BIASPARALLEL	Controls whether .BIASCHK sweeps the parallel elements being monitored.
.OPTION BIAWARN	Controls whether HSPICE outputs warning messages when local max bias voltage exceeds limit during transient analysis.

Command Group

Output Porting

Examples

Example 1 Check the MOSFET expression when the Vds of some MOSFET is larger than -0.4 and is less than 0.4.

```
.biaschk MOS expr='vds(*)-vth(*)' max=0.2  min=-0.1
+           condition='vds(*) > -0.4 && vds(*)<0.4'
```

Example 2 Check the absolute value of node voltage when the Vds of some MOSFET is not less than 0.4 or when the Vds of some MOSFET is not larger than -0.4.

```
.biaschk MOS expr='abs(V(2))' min=1.81
+            condition='(Vds(*)<=-0.4 || Vds(*)>=0.4)'
```

Example 3 Check the MOSFET whose bias voltage exceeds -0.1 and filter some results with noise 0.05.

```
.biaschk nmos terminal1=nb terminal2=ns limit=-0.1  noise=0.05
```

Example 4 Monitoring an expression:

```
.biaschk 'v(1)' min='v(2)*2' simulation= op
```

Example 5 Element and model monitor: Violations when Vds exceed 5.1 v and the device is on

```
.biaschk mos terminal1=nd terminal2=ns simulation=tr mname=n33
+ limit=5.1 device=active
```

Example 6 Monitoring element m1 and model types between two specified terminals.

```
.biaschk nmos terminal1=ng terminal2=ns simulation=tr name=m1
```

Example 7 Monitoring MOSFET model m1 whose bias voltage exceeds 2.5 V and interval exceeds 5 ns.

```
.biaschk nmos terminal1=nb terminal2=ng limit=2.5
+ mname=m1 interval=5n
```

Example 8 The following two examples use .BIASCHK commands that do not require terminal specifications. Example 4 monitors the MOS transistor region of operation

```
.biaschk mos region=saturation name=x1.m1 mname=nch name=m2
```

Example 9 Monitors MOS transistor length and width.

```
.biaschk mos monitor=l mname=m* p* min=1u simulation=op
```

Example 10 Temperature monitoring

```
*Monitor temperature (main netlist)
.temp 180
x1 c b e vpb4u area=4

*Model file
.subckt vpb4u 1 2 3 …
q0 c b e n_bjt  DTEMP=30
.model n_bjt npn
.ends vpb4u
.biaschk subckt monitor=temp  max=200 min=-40 mname=vpb4u
```

Output in `*.lis` file

```
**warning** (test.sp: 4) Element temperature of vpb4u.q0, 210,
has exceeded max or min limit.
```

Example 11 User defined message

```
.biaschk nmos terminal1=nd monitor=i limit=-1u
+ message=' mosfet terminal current exceeds max value'
```

The `*.lis` file reports the following warning:

```
**warning** (t1.sp:33) mosfet terminal current  exceeds max value
type terminals  time  Vbias method model-name element-name
subckt-name nmos i(nd) 0.  905.7552n limit  nmos x1.mn inv
```

For a full example netlist go to:

$installdir/demo/hspice/apps/biaschk.sp

Example 12 Bias checking a subcircuit

```
.biaschk subckt simulation=all
+ mname='XRPP'
+ expr='abs(v(pos,neg)*isub(pos))/(mx*(w+0.64u)*l/1.0e-12)'
+ max='180u' interval='0'
+ message='OOOPS'

.param w=1u l=2u

X1 n1 n2 XRPP R=1 W=2u L=6u
.subckt XRPP POS NEG R=0 W=0 L=0 MX=1
R1 POS NEG R M='MX' W='W' L='L'
.ENDS XRPP
```

For the expression `'abs(v(pos,neg)*isub(pos))/(mx*(w+0.64u)*l/1.0e-12)',v(pos,neg)` is the voltage between these two terminals/nodes in the subckt XRPP. `isub(pos)` is the current through terminal POS of the

subckt. `w` and `l` are the parameters defined in the top level `(w=1u, l=2u)`. `mx` is the parameter defined in `.subckt XRPP (mx=1)`.

Example 13 Conditional expression monitor

```
biaschk '((v(g)-v(b))- vth(m1)< 0)?((v(g)-v(b))< -1.99||(v(g)-
v(b))>1.99):((v(g)-v(b))< -3.97||(v(g)-v(b))>3.97)'
+ BIASNAME='esdegnfet : NMOSHV/OP4 : Out of process specification '
+ simulation=all interval=2e-9
```

If `((v(g)-v(b))- vth(m1)< 0)` is correct, checks `((v(g)-v(b))< -1.99||(v(g)-v(b))>1.99)`. If one of them is correct, issues warning.

If `((v(g)-v(b))- vth(m1)< 0)` is not correct, checks `((v(g)-v(b))< -3.97||(v(g)-v(b))>3.97) )`. If one of them is correct, issues warning.

.CFL_PROTOTYPE

Specifies function protocol type for the Compiled Function Library capability.

Syntax

```
.CFL_PROTOTYPE function_name(arg1_type, arg2 type,...,
+ argn type)
```

Argument	Description
function_name	CFL function name
arg_type	input argument type; it can be ■ *double*: (default) keyword argument passed to C library as C language's “double” type for C code used in C-based file (not HSPICE netlist); used to generate the `*.so` file (CFL library file) ■ *param*: parameter storage reference as output only

Description

This command specifies a function type.

Function types include:

- A predefined parameter value
- A mathematical expression of multiple predefined parameter values

- A built-in mathematical function in the standard library
- An output of another evaluated CFL function

The CFL function can re-assign local and global parameter values. Only local functions with the parameters in the argument list are updated with the new local values. The global functions are updated with the new global values.

The following rules apply:

- CFL functions cannot be used in `.PRINT`, `.PROBE` and `.MEASURE` statements.
- Only a single compiled CFL `*.so` file is allowed in the simulation input netlist.
- Parameter definition must be order-dependent when using multiple return values for the CFL functions (unlike the current HSPICE order-independent parameter definition requirement).
- If the CFL function name is same as the user-defined function (UDF), the UDF is used and CFL is not called.

Note: In the C code, the protocol type of C library must be `func(argc,argv)`, where `argc` is argument number, and `argv` is the argument array. See Examples 2 and 3 for sample CFL function syntax.

The CFL feature requires setting an environment variable, `CFL_COMPILED_LIB` *`CFL_library_file_name`*, (`*.so` file) and use of the `.OPTION CFLFLAG` to enable it in a netlist. For other descriptive information on the Compiled Library Function see Features in the *HSPICE User Guide: Basic Simulation and Analysis*.

Command Group

Library Management

Examples

Example 1 *Note the use of the "&" notation that signifies the bidirectional nature of an argument which means the value of the argument is updated upon returning from the function. The example presents multiple return values for the CFL functions:*

```
.CFL_PROTOTYPE xyz_eval (double, param)
.param p1=5
.param p2=9
.param p3= xyz_eval(p1, &p2)
```

Example 2 In this Sample CFL function, the content of the "return" parameters does not affect the calculated return values from the function with the same arguments. Parameters passed into the functions as references are used only as return values and do not contribute to the calculation inside the CFL function in any form.

```
double func1 (int argc, long **argv)
{
 double a1 = *(double*)argv[0];
 double *a2 = (double*)argv[1];
 return eval1_func(a1, a2);
}
double eval1_func (double arg1, double *arg2)
{
double val = 0;
*arg2 = arg1 + 2;
val = (*arg2) * (arg1 + 4)
return val
}
```

In Example 2, CFL C-code Function Implementation, CFL functions are an arbitrary number of function arguments with any combination of the argument base type as either "double" or parameter address. Example 3 is the function prototype:

Example 3 Netlist Showing Redefinition of User Functions

```
static double
eval1_func(double a1, double *a2)
{
 *a2 = a1 + 10;
 return a1 - 4;}
double xyz_eval 1(int argc, long **argv)
{
 double a1 = *(double *)(argv[0]);
 double *a2 = (double*)argv[1];
 return eval1_func(a1, a2);
}
static double
 eval2_func(double *a1, double a2, double *a3)
{
 *a1 = a2 + 2;
 *a3 = a2 - 3;
 return a2 - 1;
}
double xyz_eval_2(int argc, long **argv)
{
 double *a1 = (double*)(argv[0]);
 double a2 = *(double *)argv[1];
```

```
 double *a3 = (double *)argv[2];
 return eval2_func(a1, a2, a3);
}
```

Example 4 Redefinition following evaluations

```
.param p2 = 10
.param p1 = 2
.param p3 = func1 (p1, &p2)
```

After returning from evaluating `func1()`, `p3=24`, and user function are redefined to `p2=4`.

```
.subckt INV
.param p1 = 3
.param p2 = 3
.param p3 = func1(p1, &p2)
```

After returning from evaluating `func1()`, the user function `p1=3` is redefined to `p2=5` while `p3=35`.

```
.param p3 = 0
.param p4 = func1(p2, &p3)
```

After the evaluation of `func1()`, `p2=5` and `p3=7 & p4=63`.

```
.ends INV
```

Example 5 Sample Netlist

```
*
.cfl_prototype zyz_eval_1(double, param)
.cfl_prototpye xyz_eval_2(param, double, param)
*
.param p1 = 5
.param p2 = 8
.param p3 = 9
.param p4 = 7
.param p5 = 10
*
.param p7 = xyz_eval_1(p1, &p2)          * p2 = 15 ; p7 = 1
.param p8 = xyz_eval_2(&p3, p4, &p5) * p3 = 9; p5 = 4; p8 = 6
.param p9 = p8 + p5 - p3 + p2
*
R1 n1 A r="p2"        * R = 15
R2 n3 B r="p7"               * R = 1
M1 n1 n2 n3 NMOS w=5u l=6u bqi="p9"      * bqi = 16
```

See Also

.OPTION CFLFLAG

.CHECK EDGE

Verifies that a triggering event provokes an appropriate RISE or FALL action in HSPICE.

Syntax

```
.CHECK EDGE (ref RISE | FALL minmax RISE | FALL)
+ node1 [node2 ...] (hi lo hi_th low_th)
```

Argument	Description
ref	Name of the reference signal.
min	Minimum time.
max	Maximum time.
node1 *node2* ...	List of nodes to which you apply the edge condition.
hi lo hi_th lo_th	Logic levels for the timing check.

Description

Use a `.CHECK EDGE` command to verify that a triggering event provokes an appropriate RISE or FALL action within the specified time window.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

Examples

This example sets the condition that the rising action of the clock (clk) triggers the falling edge of VOUTA within 1 to 3 ns, as shown in Figure 1:

```
.CHECK EDGE (clk RISE 1ns 3ns FALL) VOUTA
```

Values for hi, lo, and the thresholds were defined in a `.CHECK GLOBAL_LEVEL` command placed earlier in the netlist.

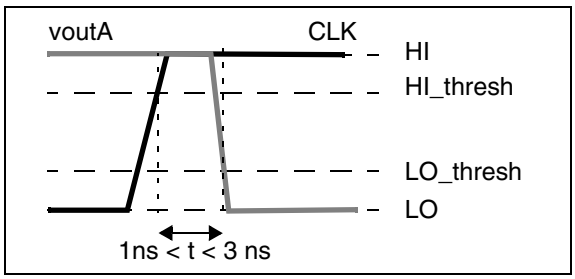


Figure 1 EDGE Example

See Also

.CHECK HOLD
.CHECK GLOBAL_LEVEL
.CHECK SETUP

.CHECK FALL

Verifies that a fall time occurs within a specified time window in HSPICE.

Syntax

```
.CHECK FALL (minmax) node1 [node2 ...]
(hi lo hi_th lo_th)
```

Argument	Description
min	Lower boundary for the time window.
max	Upper limit for the time window.
node1 node2 ...	List of all nodes to check.
hi lo hi_th lo_th	Logic levels for the timing check.

Description

Use a `.CHECK FALL` command verifies that a fall time occurs within the specified window of time.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

See Also

.CHECK GLOBAL_LEVEL
.CHECK RISE
.CHECK SLEW

.CHECK GLOBAL_LEVEL

Globally sets specified high and low definitions for all CHECK commands in HSPICE.

Syntax

```
.CHECK GLOBAL_LEVEL (hi lo hi_th lo_th)
```

Argument	Description
hi	Value for logic high.
lo	Value for logic low.
hi_th	Is the minimum value considered high.
lo_th	Is the maximum value considered low.

Description

Use this command to globally set the desired high and low definitions for all CHECK commands. The high and low definitions can be either numbers or expressions, and *hi_th* and *lo_th* can be either absolute values or percentages if punctuated with the % symbol. You can also locally set different logic levels for individual timing checks.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

Examples

Example 1 *Defines a logic high as 5 volts and a logic low as 0 volts. A voltage value as small as 4 V is considered high, while a value up to 1 V is low.*

```
.CHECK GLOBAL_LEVEL (5 0 4 1)
```

Example 2 *Illustrates an alternative definition for the first example.*

```
.CHECK GLOBAL_LEVEL (5 0 80% 20%)
```

See Also

.CHECK EDGE
.CHECK FALL
.CHECK HOLD
.CHECK IRDROP
.CHECK RISE
.CHECK SLEW

.CHECK HOLD

Ensures that specified signals do not switch for a specified period of time in HSPICE.

Syntax

```
.CHECK HOLD (ref RISE | FALL duration RISE | FALL)
+ node1 [node2 ...] (hi lo hi_th low_th)
```

Argument	Description
ref	Reference or trigger signal.
duration	Minimum time required after the triggering event before the specified nodes can rise or fall.
node1 node2 ...	List of nodes for which the HOLD condition applies.
hi lo hi_th lo_th	Logic levels for the timing check.

Description

Use this command to ensure that the specified signals do not switch for a specific period of time.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

Examples

This example specifies that vin* (such as vin1, vin2, and so on), must not switch for 2ns after every falling edge of nodeA (see Figure 2).

```
.CHECK HOLD (nodeA FALL 2ns RISE) vin*
```

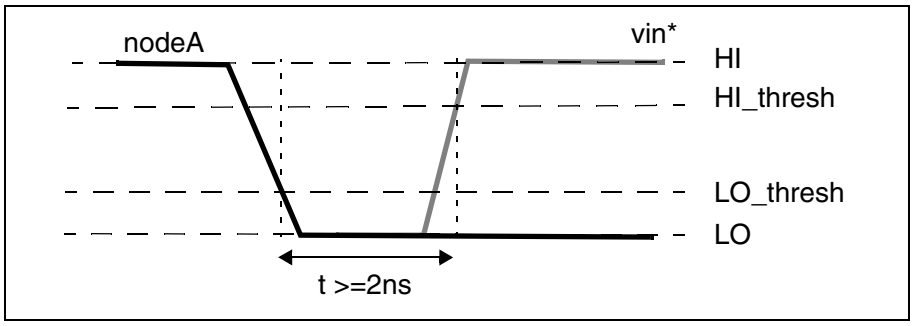


Figure 2 HOLD Example

See Also

.CHECK EDGE
.CHECK GLOBAL_LEVEL
.CHECK SETUP

.CHECK IRDROP

Verifies that IR drop does not fall below or exceed a specified value in HSPICE.

Syntax

```
.CHECK IRDROP (volt_valtimeduration) node1 [node2 ...]
+ (hi lo hi_th low_th)
```

Argument	Description
volt_val	Limiting voltage value. ▪ A positive *volt_val* (voltage value) indicates ground bounce checking. ▪ A negative *volt_val* denotes VDD drop.
duration	Maximum allowable time. If you set duration to 0, then HSPICE reports every glitch that strays beyond the specified *volt_val*.
node1 [node2 ...]	List of nodes for which the IR drop checking applies.
hi lo hi_th lo_th	Logic levels for the timing check.

Description

Use this command to verify that the IR drop does not fall below or exceed a specified value for a specified duration.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

Examples

This example specifies that `v1` must not fall below -2 volts for any duration exceeding 1ns (see Figure 3).

```
.CHECK IRDROP (-2 1ns) v1
```

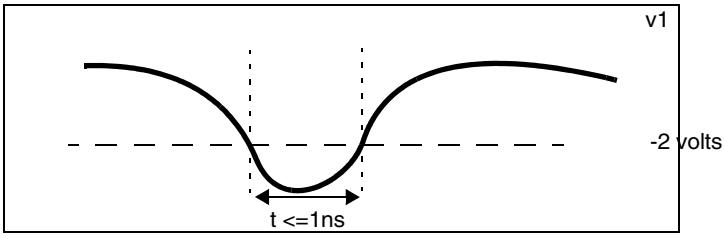


Figure 3 IR Drop Example

See Also

.CHECK EDGE

.CHECK GLOBAL_LEVEL
.CHECK SETUP

.CHECK RISE

Verifies that a rise time occurs within a specified time window in HSPICE.

Syntax

```
.CHECK RISE (minmax) node1 [node2 ...] (hi lo hi_th lo_th)
```

Argument	Description
min	Lower boundary for the time window.
max	Upper limit for the time window.
node1 *node2* ...	List of all nodes to check.
hi lo hi_th lo_th	Logic levels for the timing check.

Description

Use this command to verify that a rise time occurs within the specified window of time.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

Examples

This example defines a window between 1.5ns and 2.2ns wide, in which the va and vb signals must complete their rise transition (see Figure 4). Values for the HI, LO, and the thresholds were defined in a `.CHECK GLOBAL_LEVEL` command placed earlier in the netlist.

```
.CHECK RISE (1.5ns 2.2ns) va vb
```

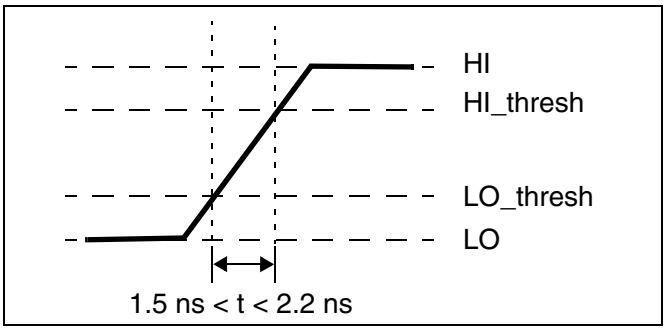


Figure 4 RISE Time Example

See Also

.CHECK GLOBAL_LEVEL
.CHECK FALL
.CHECK SLEW

.CHECK SETUP

Verifies that specified signals do not switch for a specified time-period when using the advanced analog feature.

Syntax

```
.CHECK SETUP (ref RISE | FALL duration RISE | FALL)
+ node1 [node2 ...] (hi lo hi_th low_th)
```

Argument	Description
ref	Reference or trigger signal.
duration	Minimum time before the triggering event during which the specified nodes cannot rise or fall
node1 [node2 ...]	List of nodes for which the HOLD condition applies.
hi lo hi_th lo_th	Logic levels for the timing check.

Description

Use to verify that specified signals do not switch for a specified period of time.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

Examples

This example specifies that v1 and v2 must not switch for 2 ns before every rising edge of nodeA (see Figure 5).

```
.CHECK SETUP (nodeA RISE 2ns FALL) v1 v2
```

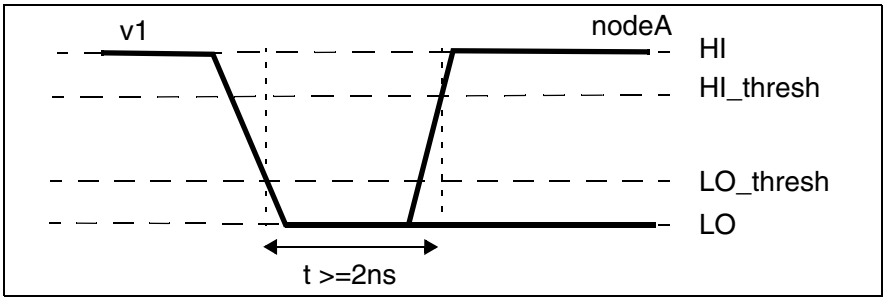


Figure 5 SETUP Example

See Also

.CHECK EDGE
.CHECK GLOBAL_LEVEL
.CHECK HOLD

.CHECK SLEW

Verifies that a slew rate occurs within a specified time window in HSPICE.

Syntax

```
.CHECK SLEW (minmax) node1 [node2 ...](hi lo hi_th lo_th)
```

Argument	Description
min	Lower boundary for the time window.
max	Upper limit for the time window.

Argument	Description
node1 node2 ...	List of all nodes to check.
hi lo hi_th lo_th	Logic levels for the timing check.

Description

Use this command to verify that a slew rate occurs within specified time range.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

Examples

This example sets the condition that nodes starting with a* nodes must have a slew rate between (HI_thresh - LO_thresh)/3ns and (HI_thresh - LO_thresh)/1ns. If either node has a slew rate greater than that defined in the `.CHECK SLEW` command, HSPICE reports the violation in the .err file.

```
.CHECK SLEW (1ns 3ns) a* (3.3 0 2.6 0.7)
```

The slew rate check in Figure 6 defines its own *hi*, *lo*, and corresponding threshold values, as indicated by the four values after the node names.

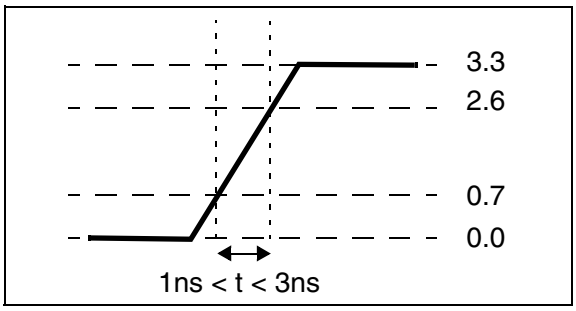


Figure 6 SLEW Example

See Also

.CHECK FALL
.CHECK GLOBAL_LEVEL
.CHECK RISE

.CLFLIB

Enables automatic selection for HSPICE Compiled Function Library function.

Syntax

```
.CFLLIB "%platform/func.so"
```

Description

Add this command and string to the netlist to automatically select the platform for CFL functions. This feature works similarly to that of HSIMPlus.

You can select the platform from any of the following:

- x86sol64
- x86sol32
- sparc64
- sparcOS5
- amd64
- linux
- suse64
- suse32
- unknown (when the platform does not match any of the above platforms)

Command Group

Library Management

.CONNECT

Connects two nodes together; the first node replaces the second node in the simulation.

Syntax

```
.CONNECT node1[.[global_node_label]]
+        node2[.global_node_label]
```

Argument	Description
node1	Name of the first of two nodes to connect together.
node2	Name of the second of two nodes to connect together. This node is replaced by Node1, which is the first node, in the simulation.
[global_node_label]	This option is available only when you are simulating a 3D-IC netlist. Use this option to access the global node inside a module from the top level or access the module based global nodes that are connected with the top level global nodes. By default, multiple instantiation with the same IC module does not make the module based global nodes connected together. You need to explicitly connect them as required. For more information on defining multiple tier IC module definitions, see .MODULE command.

Description

Use this command to connect two nodes together in your netlist. This causes the simulation to evaluate the two nodes as if they were only one node that uses the name of the first node. The name of the second node is not recognized in the simulation. Both nodes must be at the same level in the circuit design that you are simulating: you cannot connect nodes that belong to different subcircuits.

Note: The `.CONNECT` command is not supported inside of a subckt definition.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION NODE	Prints a node cross-reference table.

Command Group

Node Naming

Examples

Example 1 *A is the name of the first of two nodes to connect together and VSS is the name of the second of two nodes to connect together. A, the first node, replaces the second node, VSS, in the simulation.*

```
.CONNECT A VSS

     ...
.subckt eye_diagram node1 node2 ...
.connect node1 node2
...
.ends
```

Example 2 *Example 1 now is the same as the following:*

```
    ...
.subckt eye_diagram node1 node1 ...
...
.ends
...
```

HSPICE reports the following error message:

```
**error**: subcircuit definition duplicates node node1
```

To apply any HSPICE command to *node2*, apply it to *node1,* instead. Then, to change the netlist construction to recognize *node2*, use an .ALTER command.

HSPICE reports the following error message:

```
**error**: subcircuit definition duplicates node node1
```

To apply any HSPICE command to *node2*, apply it to *node1,* instead. Then, to change the netlist construction to recognize *node2*, use an .ALTER command.

In the following variation of the example, node1 node2 are not be the same in this situation and the duplicated node error message will not be issued.

```
.connect node1 node2
.subckt eye_diagram node1 node2 ...
...
.ends
```

Example 3 *The first .TRAN simulation includes two resistors. Later simulations have only one resistor because r2 is short-circuited by connecting cc with 1. v(1) does not print out, but v(cc) prints out instead.*

```
*example for  .connect
vcc 0 cc 5v
r1  0 1  5k
r2  1 cc 5k
.tran 1n 10n
.print i(vcc) v(1)
.alter
.connect cc 1
.end
```

Example 4 *Shows how to use multiple* .CONNECT *commands to connect several nodes together. This example connects both* node2 *and* node3 *to* node1*. All connected nodes must be in the same subcircuit or all in the main circuit. The first HSPICE simulation evaluates only node1; node2 and node3 are the same node as node1. Use .ALTER commands to simulate node2 and node3.*

```
.CONNECT node1 node2
.CONNECT node2 node3
```

If you set .OPTION NODE, then HSPICE prints out a node connection table.

```
vcc cc 0 5v
r1 cc net1 5k
r2 net1 net2 5k
c1 net2 0 1n
.tran 1n 10n
.connect net2 0
.print i(vcc) v(net2)
.end
```

This causes the circuit elements to be connected as shown in Example 5:

Example 5

```
vcc cc net2 5v
r1 cc net1 5k
r2 net1 net2 5k
c1 net2 net2 1n
.tran 1n 10n
.connect net2 0
.print i(vcc) v(net2)
.end
```

For Example 5, HSPICE reports the following error message for the elements `vcc r1` and `r2`, since there is now no ground node in the netlist.

```
**error** no dc path to ground from node
```

Example 6 The correct way to connect net2 to ground is to specify the .CONNECT command as follows:

```
.connect 0 net2
```

3D IC Netlist - Module Based Global Node Reference Examples

In this example, even though the `xtop1` and `xtop2` references to the same top subckt inside the IC module `tmod`, the `vdd` in the `xtop1` is not connected to `vdd` in the `xtop2` by default. It requires explicit definitions to connect the nodes if it is the intention. In this example, the `vdd` for both `xtop1` and `xtop2` are connected together with the `.connect` command.

```
Xtop1 … tmod::top
Xtop2 … tmod::top
.connect xtop1.vdd xtop2.vdd
.module tmod
     .global vdd
     .subckt top
          …
     .ends
.endmodule
```

In this example, the top level `vdd` and `xtop1.vdd` are connected together.

```
.global vdd
Xtop1 … tmod::top
.connect vdd xtop1.vdd
.module tmod
     .global vdd
     .subckt top
     …
     .ends
.endmodule
```

See Also

.ALTER

.DATA

Concatenates or column-laminates data sets to optimize measured I-V, C-V, transient, or S-parameter data.

Syntax

Inline command

```
.DATA datanm pnam1 [pnam2 pnam3 ... pnamxxx]
+   pval1 [pval2  pval3 ... pvalxxx]
+   pval1' [pval2' pval3' ... pvalxxx']
.ENDDATA
```

External File command for concatenated data files

```
.DATA datanm MER
+ FILE='filename1' pname1=col_num [pname2=col_num ...]
+ [FILE='filename2' pname1=col_num
+ [pname2=col_num ...] ... [OUT='fileout']
.ENDDATA
```

Column Laminated command (not available for HSPICE advanced analog analyses).

```
.DATA datanm LAM
+ FILE='filename1' pname1=col_num
+ [pname2=col_num ...]
+ [FILE='filename2' pname1=col_num
+ pname2=col_num ...] ... [OUT='fileout']
.ENDDATA
```

Argument	Description
col_num	Column number in the data file for the parameter value. The column does not need to be the same between files.
datanm	Data name—referenced in the .TRAN, .DC, or .AC command.
filenamei	Data file to read. HSPICE concatenates files in the order they appear in the .DATA command. You can specify up to 10 files.
fileouti	Data file name, where simulation writes concatenated data. This file contains the full syntax for an inline .DATA command and can replace the .DATA command that created it in the netlist. You can output the file and use it to generate one data file from many.

Argument	Description
LAM	Column-laminated (parallel merging) data files to use.
MER	Concatenated (series merging) data files to use.
pnami	Parameter names—used for source value, element value, device size, model parameter value, and so on. You must declare these names in a .PARAM command.
pvali	Parameter value.

Description

Use the .DATA command to concatenate or column-laminate data sets to optimize measured I-V, C-V, transient, or S-parameter data. Up to 1000 variables (columns) can be displayed.

You can also use the .DATA command for a first or second sweep variable when you characterize cells and test worst-case corners. Simulation reads data measured in a lab, such as transistor I-V data, one transistor at a time in an outer analysis loop. Within the outer loop, the analysis reads data for each transistor (IDS curve, GDS curve, and so on), one curve at a time in an inner analysis loop.

Data-driven analysis syntax requires a .DATA command and an analysis command that contains a DATA=dataname keyword.

The .DATA command specifies parameters that change values, and the sets of values to assign during each simulation. The required simulations run as an internal loop. This bypasses reading-in the netlist and setting-up the simulation, which saves computing time. In internal loop simulation you can also plot simulation results against each other and print them in a single output.

You can enter any number of parameters in a .DATA block. The .AC, .DC, and .TRAN commands can use external and inline data provided in .DATA commands. For example, to specify the circuit temperature for an HSPICE simulation you can use the .TEMP command, the TEMP parameter in the .DC, .AC, and .TRAN commands, or the TEMP/TEMPER parameter in the first column of the .DATA command.The number of data values per line does not need to correspond to the number of parameters. For example, you do not need to enter 20 values on each line in the .DATA block if each simulation pass requires 20 parameters: the program reads 20 values on each pass, however the values are formatted.

Each .DATA command can contain up to 1000 parameters.

HSPICE refers to .DATA commands by their data names so each data name must be unique. HSPICE supports three .DATA command formats:

- Inline data, which is parameter data, listed in a .DATA command block. The datanm parameter in a .DC, .AC, or .TRAN analysis command, calls this command. The number of parameters that HSPICE reads determines the number of columns of data. The physical number of data numbers per line does not need to correspond to the number of parameters. For example, if the simulation needs 20 parameters you do not need 20 numbers per line.
- Concatenated data from external files. Concatenated data files are files with the same number of columns, placed one after another.
- Data that is Column-laminated data from external files. Column-laminated data are columns of files with the same number of rows, arranged side-by-side.

To use external files with the .DATA format:

- Use the MER and LAM keywords to prepare HSPICE for external file data, rather than inline data.
- Use the FILE keyword to specify the external filename.
- Use simple file names, such as out.dat without single or double quotation marks (‘ ’ or “ ”), but use quotation marks when file names start with numbers, such as “1234.dat”.
- Use the proper case, since file names are case sensitive on UNIX systems.

For data-driven analysis, specify the start time (time 0) in the analysis command so that the analysis correctly calculates the stop time.

The following shows how different types of analyses use .DATA commands: .DC DATA=*dataname*

Operating point: .DC vin 1 5 .25 SWEEP DATA=*dataname*

DC sweep: .DC vin 1 5 .25 SWEEP DATA=*dataname*

AC sweep: AC dec 10 100 10meg SWEEP DATA=*dataname*

TRAN sweep: .TRAN 1n 10n SWEEP DATA=*dataname*

With the release of F-2011.09-SP2, HSPICE supports a second selective data sweep, by using syntax as follows:

- .DC *var1 type np start1 stop1* SWEEP DATA=*datanm*(*nums*)
- .AC *type np fstart fstop* SWEEP DATA=*datanm*(*nums*)

- `.TRAN` *`tstep1 tstop1 [tstep2 tstop2 ...tstepN tstopN]`*
  `+ [START=`*`val`*`] [UIC] SWEEP DATA=`*`datanm`*`(`*`nums`*`)`

  Where `nums` can be either of following:

  - one signal `num`, to specify the sample number to execute; for example:

    ```
    .tran 0.1n 1n sweep data=datanm(4)
    ```

  - `num1:num2 num3 num4:num5` — to execute samples from `num1` to `num2`, sample `num3`, and samples from `num4` to `num5`; for example:

    ```
    .tran 0.1n 1n sweep data=datanm(2 4:5 7)
    ```

Command Group

Setup

Examples

Example 1 *HSPICE performs these analyses for each set of parameter values defined in the .DATA command. For example, the program first uses the width=50u, length=30u, thresh=1.2v, and cap=1.2pf parameters to perform .TRAN, .AC, and .DC analyses. HSPICE then repeats the analyses for width=25u, length=15u, thresh=1.0v, and cap=0.8pf, and again for the values on each subsequent line in the .DATA block.*

```
* Inline .DATA statement
   .TRAN    1n   100n      SWEEP DATA=devinf
   .AC DEC    10   1hz   10khz   SWEEP DATA=devinf
   .DC TEMP   -55   125   10   SWEEP DATA=devinf
   .DATA   devinf   width   length   thresh   cap
  +        50u   30u   1.2v   1.2pf
  +        25u   15u   1.0v   0.8pf
  +         5u    2u   0.7v   0.6pf
.ENDDATA
```

Example 2 HSPICE performs a DC sweep analysis for each set of VBS, VDS, and L parameters in the .DATA vdot block. That is, HSPICE runs eight DC analyses one for each line of parameter values in the .DATA block.

```
* .DATA as the inner sweep
M1 1 2 3 0 N   W=50u   L=LN
   VGS 2 0 0.0v
   VBS 3 0 VBS
   VDS 1 0 VDS
   .PARAM VDS=0 VBS=0 L=1.0u
   .DC DATA=vdot
   .DATA vdot
      VBS   VDS   L
       0   0.1   1.5u
       0   0.1   1.0u
       0   0.1   0.8u
      -1   0.1   1.0u
      -2   0.1   1.0u
      -3   0.1   1.0u
       0   1.0   1.0u
       0   5.0   1.0u
.ENDDATA
```

Example 3 These values result in transient analyses at every time value from 0 to 100 ns in steps of 1 ns by using the first set of parameter values in the .DATA d1 block. Then HSPICE reads the next set of parameter values and does another 100 transient analyses. It sweeps time from 0 to 100 ns in 1 ns steps. The outer sweep is time and the inner sweep varies the parameter values. HSPICE performs 200 analyses: 100 time increments, times 2 sets of parameter values.

```
* .DATA as the outer sweep
   .PARAM W1=50u W2=50u L=1u CAP=0
   .TRAN 1n 100n SWEEP DATA=d1
   .DATA d1
      W1     W2    L      CAP
      50u    40u   1.0u   1.2pf
      25u    20u   0.8u   0.9pf
.ENDDATA
```

Example 4 This example shows the external file .DATA for concatenated data files.

```
* External File .DATA for concatenated data files
.DATA datanm MER
   + FILE=filename1 pname1 = colnum
   + pname2=colnum ...
   + FILE=filename2 pname1=colnum
   + pname2=colnum ...
   + ...
   + OUT=fileout
.ENDDATA
```

If you concatenate the three files (*file1*, *file2*, and *file3*).

```
file1   file2   file3
a a a   b b b   c c c
a a a   b b b   c c c
a a a
```

The data appears as follows:

Example 5

```
a a a
a a a
a a a
b b b
b b b
c c c
c c c
```

The number of lines (rows) of data in each file does not need to be the same. The simulator assumes that the associated parameter of each column of the A file is the same as each column of the other files. The `.DATA` command for this example is:

```
* External File .DATA statement
.DATA inputdata MER
   FILE='file1' p1=1 p2=3 p3=4
   FILE='file2' p1=1
   FILE='file3'
.ENDDATA
```

This example listing concatenates *file1*, *file2*, and *file3* to form the `inputdata` data set. The data in *file1* is at the top of the file, followed by the data in *file2*, and *file3*. The `inputdata` in the `.DATA` command references the data name specified in either the `.DC`, `.AC`, or `.TRAN` analysis commands. The parameter fields specify the column that contains the parameters (you must already have defined the parameter names in `.PARAM` commands). For example, the values for the p1 parameter are in column 1 of *file1* and *file2*. The values for the *p2* parameter are in column 3 of *file1*. For data files with fewer columns than others, HSPICE assigns values of zero to the missing parameters.

(Not valid for advanced analog functions) In Example 5 three files (D, E, and F) contain the following columns of data:

Example 6

```
File D   File E   File F
d1 d2 d3   e4 e5   f6
d1 d2 d3   e4 e5   f6
d1 d2 d3   e4 e5   f6
```

The laminated data appears as follows:

```
d1 d2 d3   e4 e5   f6
d1 d2 d3   e4 e5   f6
d1 d2 d3   e4 e5   f6
```

The number of columns of data does not need to be the same in the three files.

The number of lines (rows) of data in each file does not need to be the same. HSPICE interprets missing data points as zero.

The `.DATA` command for this example is:

```
* Column-Laminated .DATA statement
.DATA dataname LAM
   FILE='file1' p1=1 p2=2 p3=3
   FILE='file2' p4=1 p5=2
   OUT='fileout'
.ENDDATA
```

This listing laminates columns from *file1* and *file2* into the *fileout* output file. Columns one, two, and three of *file1* and columns one and two of *file2* are designated as the columns to place in the output file. You can specify up to 10 files per `.DATA` command.

If you run HSPICE on a different machine than the one on which the input data files reside (such as when you work over a network), use full path names instead of aliases. Aliases might have different definitions on different machines.

Example 7 HSPICE dumps separate plot files for each DATA sweep index by using distributed processing. For example:

```
.DATA PAM_SWP C_LOAD
10p
20p
.ENDDATA
```

When you submit the HSPICE job with the distributed processing switch `-dp` as follows:

```
hspice -i test.sp -o test -dp 2
```

... then HSPICE dumps separate plot files and they are stored under `task#/*.tr#`. HSPICE actually distributes two data sweep indexes into two tasks, named `task0` and `task1` here. Individual plot files are stored under each task.

See Also

.AC
.DC
.ENDDATA
.PARAM / PARAMETER / PARAMETERS
.TRAN

.DC

Performs several types of sweeps during DC analysis.

Syntax

Sweep or Parameterized Sweep:

```
.DC var1 START=start1 STOP=stop1 STEP=incr1
.DC var1 START=[param_expr1]
+ STOP=[param_expr2] STEP=[param_expr3]
.DC var1 start1 stop1 incr1
+ [SWEEP var2 type np start2 stop2]
.DC var1 start1 stop1 incr1 [var2 start2 stop2 incr2]
.DC var1 SWEEPBLOCK=swblockname
.DC var1 start1 stop1 incr1
+ [SWEEP SWEEPBLOCK=swblockname]
```

Data-Driven Sweep:

```
.DC var1 type np start1 stop1 [SWEEP DATA=datanm(Nums)]
.DC DATA=datanm [SWEEP var2 start2 stop2 incr2]
.DC DATA=datanm(Nums)
```

Monte Carlo and Corners Analysis:

```
.DC var1 start1 stop1 incr1 [SWEEP MONTE=MCcommand]
.DC var1 START=start1 STOP=stop1 STEP=incr1 [SWEEP
   MONTE=MCcommand]
.DC MONTE=McCommand
.DC var1 start1 stop1 incr1 [SWEEP MONTE=MCcommand]
+[corner_percentile=val]
```

Optimization:

```
.DC DATA=datanm OPTIMIZE=opt_par_fun
+ RESULTS=measnames MODEL=optmod
.DC var1 start1 stop1 SWEEP OPTIMIZE=OPTxxx
+ RESULTS=measname MODEL=optmod
```

Argument	Description

DATA=datanm(*Nums*)	Data name, referenced from a `.DATA` command in the `.DC` command, where (*Nums*) can be any of the following to allow selective runs for a .DATA structure:
	▪ One signal number to specify the sample number to execute. For example:
	`.DC .1n 1n sweep data=datanm(4)`
	▪ Sequence of signals as follows - (num1:num2 num3 num4:num5), where : Samples from num1 to num2, sample num3, and samples from num4 to num5 are executed. For example:
	`.DC 0.1n 1n sweep data=datanm(1:2 3 4:5)`

incr1...	Voltage, current, element, or model parameters; or temperature increments.
MODEL	Optimization reference name. The `.MODEL OPT` command uses this name in an optimization analysis
MONTE=MCcommand	Where MCcommand can be any of the following: ▪ *val* Specifies the number of random samples to produce. ▪ *val* firstrun=*num* Specifies the sample number on which the simulation starts. ▪ *list num* Specifies the sample number to execute. ▪ list(*num1:num2 num3 num4:num5*) Samples from *num1* to *num2*, sample *num3*, and samples from *num4* to *num5* are executed (parentheses are optional).
corner_percentile	Default 0.0. This option specifies the percentiles used to find corners. The value field is a non-negative number in the range (0.0~0.5). For example, if value=0.1, then HSPICE will sort the measure results, and choose the points below the 10th percentile and those above the 90th percentile as corners. If the value = 0.0, then HSPICE will use the maximum and minimum values as corners.

Argument	Description
np	Number of points per decade or per octave or just number of points, based on which keyword precedes it.
OPTIMIZE	Specifies the parameter reference name, used for optimization in the .PARAM command
RESULTS	Measure name used for optimization in the .MEASURE command
start1 ...	Starting voltage, current, element, or model parameters; or temperature values. If you use the POI (list of points) variation type, specify a list of parameter values, instead of *start stop*. When using HSPICE advanced analog functions, the start and stop syntax is not supported.
stop1 ...	Final voltage, current, any element, model parameter, or temperature values.
SWEEP	Second sweep has a different type of variation (DEC, OCT, LIN, POI, or DATA command; or MONTE=*val*).
TEMP	Temperature sweep.
type	Can be any of the following keywords: ▪ DEC — decade variation ▪ OCT — octave variation ▪ LIN — linear variation ▪ POI — list of points
var1 ...	▪ Name of an independent voltage or current source, or ▪ Name of any element or model parameter, or ▪ TEMP keyword (indicating a temperature sweep). HSPICE supports a source value sweep, which refers to the source name (SPICE style). However, if you select a parameter sweep, a .DATA command, and a temperature sweep, then you must select a parameter name for the source value. A later .DC command must refer to this name. The parameter must not start with the TEMP keyword. The *var1* parameter should be defined in advance using the .PARAM command.

Argument	Description
firstrun	The *val* value specifies the number of Monte Carlo iterations to perform. The *firstrun* value specifies the desired number of iterations. HSPICE runs from num1 to num1+val-1.
list	The iterations at which HSPICE performs a Monte Carlo analysis. You can write more than one number after list. The colon represents “from ... to ...". Specifying only one number makes HSPICE run at only the specified point.

Description

You can use the .DC command in DC analysis to:

- Sweep any parameter value.
- Sweep any source value.
- Sweep temperature range.
- Perform a DC Monte Carlo (random sweep) analysis.
- Perform a data-driven sweep.
- Perform a DC circuit optimization for a data-driven sweep.
- Perform a DC circuit optimization by using start and stop.
- Perform a DC model characterization.

The format for the .DC command depends on the application that uses it. The DC sweep functionality is enhanced by use of the GSHUNT algorithm.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION DCIC	Specifies whether to use or ignore commands in the netlist.

Command Group

Analysis

Examples

Example 1 Sweeps the value of the VIN voltage source from 0.25 volts to 5.0 volts in increments of 0.25 volts.

```
.DC VIN 0.25 5.0 0.25
```

Example 2 Sweeps the drain-to-source voltage from 0 to 10 v in 0.5 v increments at VGS values of 0, 1, 2, 3, 4, and 5 v.

```
.DC VDS 0 10 0.5 VGS 0 5 1
```

Example 3 Starts a DC analysis of the circuit from -55°C to 125°C in 10°C increments.

```
.DC TEMP -55 125 10
```

Example 4 Script runs a DC analysis at five temperatures: 25, 50, 75, 100, and 125 °C.

```
.DC XVAL 1K 10K .5K SWEEP TEMP LIN 5 25 125
```

Example 5 Runs a DC analysis on the circuit at each temperature value. The temperatures result from a linear temperature sweep from 25°C to 125°C (five points), which sweeps a resistor value named xval from 1 k to 10 k in 0.5 k increments.

```
.DC XVAL 1K 10K .5K SWEEP TEMP LIN 5 25 125
```

Example 6 Specifies a sweep of the par1 value from 1 k to 100 k in increments of 10 points per decade.

```
.DC DATA=DATANM SWEEP PAR1 DEC 10 1K 100K
```

Example 7 Requests a DC analysis at specified parameters in the .DATA DATANM command. It also sweeps the par1 parameter from 1k to 100k in increments of 10 points per decade.

```
.DC PAR1 DEC 10 1K 100K SWEEP DATA=DATANM
```

Example 8 Invokes a DC sweep of the par1 parameter from 1k to 100k by 10 points per decade by using 30 randomly generated (Monte Carlo) values.

```
.DC PAR1 DEC 10 1K 100K SWEEP MONTE=30
```

Example 9 Schmitt Trigger script.

```
*file: bjtschmt.sp   bipolar schmitt trigger
.OPTION post=2
vcc 6 0 dc 12
vin 1 0 dc 0 pwl(0,0 2.5u,12 5u,0)
cb1 2 4 .1pf
rc1 6 2 1k
rc2 6 5 1k
rb1 2 4 5.6k
rb2 4 0 4.7k
re 3 0 .47k
diode 0 1 dmod
q1 2 1 3 bmod 1 ic=0,8
q2 5 4 3 bmod 1 ic=.5,0.2
.dc vin 0,12,.1
.model dmod d is=1e-15 rs=10
.model bmod npn is=1e-15 bf=80 tf=1n
+ cjc=2pf cje=1pf rc=50 rb=100 vaf=200
.probe v(1) v(5)
.print
.end
```

Example 10 Invokes a DC sweep of the par1 parameter from 1k to 100k by 10 points per decade and uses 10 Monte Carlo) values from 11th to 20th trials.

```
.DC par1 DEC 10 1k 100k SWEEP MONTE=list(10 20:30 35:40 50)
```

Example 11 Invokes a DC sweep of the par1 parameter from 1k to 100k by 10 points per decade and a Monte Carlo analysis at the 10th trial, then from the 20th to the 30th trials, followed by the 35th to 40th trials and finally at the 50th trial.

```
.DC par1 DEC 10 1k 100k SWEEP MONTE=list(10 20:30 35:40 50)
```

See Also

.MODEL
.OPTION DCIC
.PARAM / PARAMETER / PARAMETERS
Behavioral Application Examples for the path to the demo file `inv_vin_vout.sp`

.DCMATCH

Calculates the effects of variations on a circuit's DC characteristics.

Syntax

```
.DCMATCH OUTVAR [THRESHOLD=T] [FILE=string] [INTERVAL=Int]
```

Argument	Description
OUTVAR	One or more node voltages, voltage differences for a node pair, or currents through an independent voltage source or currents through a resistor, a capacitor, or an inductor.
THRESHOLD	Report devices with a relative contribution above Threshold in the summary table. ▪ T=0: reports results for all devices ▪ T<0: suppresses table output; however, individual results are still available through .PROBE or .MEASURE commands. The upper limit for T is 1, but at least 10 devices are reported or all if there are less than 10. Default value is 0.01.
FILE	Valid file name for the output tables. Default is basename.dm# where "#" is the usual sequence number for HSPICE output files.
INTERVAL	Applies only if a DC sweep is specified. `Int` is a positive integer. A summary is printed at the first sweep point, then for each subsequent increment of *Int* and then if not already printed at the final sweep point. Only single sweeps are supported.

Description

Use this command to calculate the effects of variations in device characteristics on the DC solution of a circuit.

You can perform only one DCMATCH analysis per simulation. Only the last `.DCMATCH` command is used in case more than one in present. The others are discarded with warnings.

Command Group

Analysis

Examples

Example 1 *HSPICE reports DCMatch variations on the voltage of node 9, the voltage difference between nodes 4 and 2, and on the current through the source VCC and on the current through resister x1.r1.*

```
.DCMatch V(9) V(4,2) I(VCC) I(x1.r1)
```

Example 2 *The variable XVal is being swept in the .DC command. It takes nine values in sequence from 1k to 9k in increments of 1k. Tabular output for the.DCMATCH command is only generated for the set XVal={1k, 4k, 7k, 9k}.*

```
.DC XVal Start=1K Stop=9K Step=1K
.DCMATCH V(vcc) interval=3
```

See Also

.DC
.MEASURE (DCMATCH)
.PROBE
DCMatch Analysis

.DCSENS

Invokes DC sensitivity analysis using variation definitions as specified in the Variation Block.

Syntax

```
.DCSENS Output_Variable [File=string] [Perturbation=x]
+ [Interval=SweepValue] [Threshold=x] [GroupByDevice=0|1]
```

Argument	Description
Output_Variable	Response with regard to the parameters designated in Sensitivity Block. Similar to the `.DCMATCH` command, the Output_Variable can be node voltage or branch current in a circuit.
File=*string*	Valid file name for the output tables. Default=*basename*`.ds#` where “#” is a number in the style of ds0, ds1, etc. If multiple dcsweep commands are specified in the netlist, then sensitivity analysis table results for each dcsweep are listed in `*.ds#` files. If `.OPTION OPFILE` specified, sensitivity result tables on operating points are listed in `*.dp#` files, otherwise, these tables are listed in the `*.lis` file.
Perturbation=*x*	Perturbations of x standard deviation are used in computing the finite difference approximations to device derivatives. The valid range for the parameter is 0.0001 to 1.0 with a default value of 0.05.

Argument	Description
Interval=SweepValue	This option only applies to one dimensional sweeps. The SweepValue fields are positive integers. A summary is printed at the first sweep point, then for each subsequent increment of SweepValue, and then, if not already printed, at the final sweep point. The Interval key is ignored with a warning if a sweep is not being carried out. The option only controls the printed summary table. The analysis may be carried out at additional sweep values if required by other forms of output such as Probe and Measure statements.
Threshold=*x*	Only devices with absolute sensitivity value above x are reported. Results for all devices are displayed if Threshold=0 is set. Default=10u.
GroupByDevice = 0|1	Alternate mode of generating sensitivity result tables; Default=0

Description

Use this command to calculate the parameter sensitivity in the following instances:

- Global variation
- Local variation
- Local element variation with model type and model parameters that are permitted for DCmatch, including subckt variation

The methodology is based on using a finite difference approximation algorithm. DC sensitivity analysis combines the device derivatives, the DC solution, and the adjoint variables to get the sensitivity. DC sensitivity analysis enables you to compute sensitivity of any model parameter and many more models than traditional HSPICE sensitivity analysis. In addition, the analysis supports sensitivity for Probe and Measure output statements and for DC sweeps.

Note: `.DCSENS` does not support spatial variation and global element variation.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION OPFILE	Outputs the operating point information to a file.

Command Group

Analysis

Examples

In the following example, the variable `XVal` is being swept in the DC command. It takes nine values in sequence from 1K to 9K in increments of 1K. Tabular output for the sensitivity command is only generated for the set XVal={1K, 4K, 7K, 9K}.

```
.DC XVal Start=1K Stop=9K Step=1K
.DCsens V(vcc) Interval=3
```

See Also

DC Sensitivity Analysis and Variation Block

.DCVOLT

Sets initial conditions in HSPICE.

Syntax

```
.DCVOLT V(node1)=val1 V(node2)=val2 ...
.DCVOLT V node1val1 [node2val2 ...]
```

Argument	Description
val1 ...	Voltages. The significance of these voltages depends on whether you specify the UIC parameter in the `.TRAN` command.
node1 ...	Node numbers or names can include full paths or circuit numbers.

Description

Use the `.IC` command or the `.DCVOLT` command to set transient initial conditions in HSPICE. How it initializes depends on whether the `.TRAN` analysis command includes the `UIC` parameter.

If you specify the UIC parameter in the .TRAN command, HSPICE does not calculate the initial DC operating point but directly enters transient analysis. Transient analysis uses the .IC initialization values as part of the solution for timepoint zero (calculating the zero timepoint applies a fixed equivalent voltage source). The .IC command is equivalent to specifying the IC parameter on each element command but is more convenient. You can still specify the IC parameter, but it does not take precedence over values set in the .IC command.

If you do *not* specify the UIC parameter in the .TRAN command, HSPICE computes the DC operating point solution before the transient analysis. The node voltages that you specify in the .IC command are fixed to determine the DC operating point. Transient analysis releases the initialized nodes to calculate the second and later time points.

Command Group

Setup

Examples

```
.DCVOLT 11 5 4 -5 2 2.2
```

See Also

.IC
.TRAN

.DEFPARAM

Overwrites the value of a subcircuit parameter by a new value.

Syntax

```
.DEFPARAM param_name=val
```

Argument	Description
param_name	Specifies the parameter name to overwrite in a netlist. You can use the wildcard character * in the parameter name.

Description

Use a .DEFPARAM statement to overwrite the value of a subcircuit parameter by a new value. The parameter name is the hierarchical name, and this parameter has received a value during elaboration. You can use .DEFPARAM to overwrite

this value without having to change the values of parameters passed to X instances.

You can use .DEFPARAM to conveniently overwrite a definition without modifying the netlist. For example, you can specify the .DEFPARAM statements in an .INCLUDE file, without modifying the netlist.

Command Group

Setup

Examples

```
.SUBCKT foo a b par1 = 3
R1 a b par1
.ends
X1 p1 p2 foo par1 = 10
X2 p1 p2 foo
X3 p1 p2 foo par1 = 7
.DEFPARAM X1.par1 = 2
```

In the preceding example, the value of X1.R1 will be 2 ohms and not 10; the value of X2.R1 is 3 and the value of X3.R1 is 2.

See Also

.PARAM / PARAMETER / PARAMETERS
.SUBCKT
.INCLUDE / INC / INCL

.DEL LIB

Removes library data from memory for HSPICE.

Syntax

```
.DEL LIB '[file_path]file_name' entry_name
.DEL LIB libnumber entryname
.DEL LIB All
```

Argument	Description
entry_name	Name of entry used in the library call command to delete.

Argument	Description
file_name	Name of a file to delete from the data file; the file path, plus the file name, can be up to 256 characters long. You can use any file name that is valid for the operating system that you use. Enclose the file path and file name in single or double quotation marks.
file_path	Path name of a file if the operating system supports tree-structured directories.
libnumber	Library number, used in the library call command to delete.
all	Deletes all loaded libraries.

Description

Use this command to remove library data from memory. The next time you run a simulation, the `.DEL LIB` command removes the `.LIB` call command with the same library number and entry name from memory. You can then use a `.LIB` command to replace the deleted library. In this way, `.DEL LIB` helps you avoid name conflicts.

You can use the `.DEL LIB` command with the `.ALTER` command.

Command Group

Alter Block and Library Management

Examples

Example 1 *Calculates a DC transfer function for a CMOS inverter using these steps:*
1. HSPICE simulates the device by using the NORMAL inverter model from the MOS.LIB library.
2. Using the `.ALTER` block and the `.LIB` command, HSPICE substitutes a faster CMOS inverter, FAST for NORMAL.
3. HSPICE then resimulates the circuit.
4. Using the second `.ALTER` block, HSPICE executes DC transfer analysis simulations at three different temperatures and with an n-channel width of 100 mm, instead of 15 mm.
5. HSPICE also runs a transient analysis in the second `.ALTER` block

and uses a .MEASURE command to measure the rise time of the inverter.

```
FILE1: ALTER1 TEST CMOS INVERTER
   .OPTION ACCT LIST
   .TEMP 125
   .PARAM WVAL=15U VDD=5
   *
   .OP
   .DC VIN 0 5 0.1
   .PRINT DC V(3) V(2)
   *
   VDD 1 0 VDD
   VIN 2 0
   *
   M1 3 2 1 1 P 6U 15U
   M2 3 2 0 0 N 6U W=WVAL
   *
.LIB 'MOS.LIB' NORMAL
.ALTER
   .DEL LIB 'MOS.LIB' NORMAL $removes LIB from memory
.DEL LIB 'MOS.LIB' NORMAL $removes normal library from memory
.LIB 'MOS.LIB' FAST          $get fast model library
.ALTER
   .OPTION NOMOD OPTS        $suppress printing model
                             $parameters and print the
                             $option summary
   .TEMP -50 0 50            $run with different temperatures
   .PARAM WVAL=100U VDD=5.5  $change the parameters using
   VDD 1 0 5.5               $VDD 1 0 5.5 to change the power
                             $supply VDD value doesn't work
   VIN 2 0 PWL 0NS 0 2NS 5 4NS 0 5NS 5
                             $change the input source
   .OP VOL                   $node voltage table of
                             $operating points
   .TRAN 1NS 5NS             $run with transient also
   M2 3 2 0 0 N 6U WVAL      $change channel width
   .MEAS SW2 TRIG V(3) VAL=2.5 RISE=1 TARG V(3)
   + VAL=VDD CROSS=2         $measure output
   *
.END
```

Example 2 *The .ALTER block adds a resistor and capacitor network to the circuit. The network connects to the output of the inverter and HSPICE simulates a DC small-signal transfer function.*

```
FILE2: ALTER2.SP CMOS INVERTER USING SUBCIRCUIT
.OPTION LIST ACCT
.MACRO INV 1 2 3
M1 3 2 1 1 P 6U 15U
M2 3 2 0 0 N 6U 8U
.LIB 'MOS.LIB' NORMAL
.EOM INV
XINV 1 2 3 INV
VDD 1 0 5
VIN 2 0
.DC VIN 0 5 0. 1
.PRINT V(3) V(2)
.ALTER
.DEL LIB 'MOS.LIB' NORMAL
.TF V(3) VIN         $DC small-signal transfer
      $function
*
.MACRO INV 1 2 3               $change data within
      $subcircuit def
M1 4 2 1 1 P 100U 100U         $change channel length,width,also
                               $topology
M2 4 2 0 0 N 6U 8U           $change topology
R4 4 3 100                     $add the new element
C3 3 0 10P                     $add the new element
.LIB 'MOS.LIB' SLOW            $set slow model library
$.INC 'MOS2.DAT'               $not allowed to be used
                               $inside subcircuit, allowed
                               $outside subcircuit
.EOM INV
.END
```

See Also

.ALTER
.LIB

.DEL MODULE

.ALTER block instance statement removal/replacement scheme for previously defined instances in a .MODULE construct.

Syntax

```
.DEL MODULE existing_module_label
```

Argument	Description
existing_module_label	Name of original label used in a .MODULE statement which contains instances, parameters, etc. for a 3D-IC simulation.

Description

The .DEL MODULE command undefines the previously defined .MODULE construct and prepares it for redefinition. The .DELMODULE construct can *only* be defined inside .ALTER blocks and all the contents previously defined with the specified .MODULE label are no longer referenced.

Command Group

3D-IC

Examples

This example redefines the top label.

```
.module top
       .subckt inv
       m1…
       m2…
       .ends inv
.endmodule
xtop … top::inv
.alter s1
       .del module top * Undefine the "top" IC module.
                       * Redefine the "top" IC module
       .module top
              .subckt inv
              xm1 … nch
              xm2 … pch
              .ends inv
              .subckt nch
               …
              .ends
              .subckt pch
               …
              .ends
       .endmodule
.end
```

See Also

.ALTER
.MODULE
.DEL MODULEVAR
Multi-Technology Simulation of 3D Integrated Circuit

.DEL MODULEVAR

.ALTER block instance statement replacement scheme for previously defined instances in a .MODULEVAR construct used for a 3D-IC simulation.

Syntax

```
.DELMODULEVAR existing_modulevar_label
```

Argument	Description
existing_modulevar_label	Name of original label used in a .MODULE statement which contains instances, parameters, etc. for a 3D-IC simulation.

Description

In a 3D-IC simulation, the .DEL MODULEVAR command undefines the previously defined .MODULEVAR construct and prepares it for redefinition. The .DEL MODULEVAR construct can *only* be defined inside .ALTER blocks and all the contents previously defined with the specified .MODULEVAR label are no longer referenced.

Command Group

3D-IC

Examples

This example shows the parameter `p=0.06u` redefined to `p=0.06u` for this `.ALTER` run `s2`.

```
.module top
       .subckt inv
       m1… w=p l=0.02u
       .ends inv
.endmodule

.modulevar ic1
       .param p=0.05u
.endmodulevar
.param p=0.06u
xtop … top::inv modulevar="ic1"

.alter s1
       .del modulevar ic1  * "xtop.m1" will have "0.06u" as
width.

.alter s2
       .del modulevar ic1
       .modulevar ic1
           .param p=0.07u * "xtop.m1" will have "0.07u" as width.
       .endmodulevar
.end
```

See Also

.ALTER
.MODULEVAR
Multi-Technology Simulation of 3D Integrated Circuit

.DESIGN_EXPLORATION

Creates an Exploration Block to extract the parameters suitable for exploration from a netlist.

Syntax

```
.Design_Exploration
 Options
          Parameter Parameter_Name = value
          Parameter Parameter_Name = expression
     .Data BlockName
```

```
            Index Name Name, …
 …
     .EndData
.End_Design_Exploration
```

Argument Option	Description
`Option Explore_only Subckts= SubcktList`	This command is executed hierarchically—the specified subcircuits and all instantiated subcircuits and elements underneath are affected. Thus, if an inverter with name `INV1` is placed in a digital control block called `DIGITAL` and in an analog block `ANALOG`, and `Option Explore_only Subckts = ANALOG`, then the perturbations only affect the `INV1` in the analog block. You must create a new inverter `INV1analog`, with the new device sizes.
`Option Do_not_explore Subckts= SubcktList`	Excludes listed subcircuits.
`Option Export=yes`	Exports extraction data and runs one simulation with the original netlist
`Option Export=no`	(Default) Runs a simulation with Exploration data
`Option Exploration_method= external Block_name= Block_name`	The block_name is the same as the name specified in the `.DATA` block; HSPICE will sweep the row content with the *EXCommand*.
`Option Ignore_exploration= yes|no`	(Default=no) HSPICE ignores the content in the design_exploration block, when `Ignore_exploration=yes`.

Argument Option	Description
`Option Secondary_param= yes|no`	(Default = no) If `Secondary_param= yes`, HSPICE exports the MOSFET secondary instance parameters to a `*.mex` file (created when `option export=yes`), and also permits the secondary parameters to be imported as a column header in the .DATA block (`option export=no`).

Description

Use the command to create an exploration block to extract prearrangers from a netlist to explore in the early stages of designing integrated circuits in CMOS technology.

Exploration is currently supported for:

- Independent sources: DC value
- MOS devices: W, L, M, dtemp
- Resistors: R or W, L, M, dtemp
- Capacitors: C or W, L, M, dtemp

When designing circuits, the multiplicity factor `M` is always a positive integer, but the Exploration tool can request arbitrary positive values.

To preserve relationships which have been previously defined through expressions, exploration can only be applied to parameters which are defined with numerical values.

The Export and non-export modes of exploration are distinguished by setting `Export` either `yes` or `no`.

The perturbation types are selected by setting any of the last three option listed in the Argument section.

For a detailed description of the Exploration Block usage, see Exploration Block in the *HSPICE User Guide: Basic Simulation and Analysis*.

Command Group

Exploration

.DISTO

Computes the distortion characteristics of the circuit in an AC analysis (Not valid for advanced analog functions).

Syntax

```
.DISTO Rload [inter [skw2 [refpwr spwf]]]
```

Argument	Description
Rload	Resistor element name of the output load resistor into which the output power feeds.
inter	Interval at which HSPICE prints a distortion-measure summary. Specifies a number of frequency points in the AC sweep (see the *np* parameter in the `.AC` command). ▪ If you omit inter or set it to zero, HSPICE does not print a summary. To print or plot the distortion measures, use the `.PRINT` command. ▪ If you set `inter` to 1 or higher, HSPICE prints a summary of the first frequency and of each subsequent inter-frequency increment. To obtain a summary printout for only the first and last frequencies, set inter equal to the total number of increments needed to reach fstop in the `.AC` command. For a summary printout of only the first frequency, set inter to greater than the total number of increments required to reach fstop. HSPICE prints an extensive summary from the distortion analysis for each frequency listed. Use the inter parameter in the `.DISTO` command to limit the amount of output generated.
skw2	Ratio of the second frequency (F2) to the nominal analysis frequency (F1) in the range 1e-3 < skw2 < 0.999. If you omit skw2, the default value is 0.9.
refpwr	Reference power level—used to compute the distortion products. If you omit `refpwr`, the default value is 1mW—measured in decibels magnitude (dbM). The value must be ≥ 1e-10.
spwf	Amplitude of the second frequency (F2). The value must be ≥ 1e-3. The default is 1.0.

Description

Use the .DISTO command to calculate the distortion characteristics of the circuit in an AC small-signal, sinusoidal, steady-state analysis. The program computes and reports five distortion measures at the specified load resistor. The analysis assumes that the input uses one or two signal frequencies.

- HSPICE uses the first frequency (F1, the nominal analysis frequency) to calculate harmonic distortion. The .AC command frequency-sweep sets it.
- HSPICE uses the optional second input frequency (F2) to calculate intermodulation distortion. To set it implicitly, specify the skw2 parameter, which is the F2/F1 ratio

HSPICE performs only one distortion analysis per simulation. If your design contains more than one .DISTO command, HSPICE runs only the last command. The .DISTO command calculates distortions for diodes, BJTs (levels 1, 2, 3, and 4), and MOSFETs (Level49 and Level53, Version 3.22). You can use the .DISTO command only with the .AC command.

Command Group

Analysis

Examples

```
.DISTO RL 2 0.95 1.0E-3 0.75
```

See Also

.AC

.DOUT

Specifies the expected final state of an output signal.

Syntax

```
.DOUT nd VTH (time state [time state])
.DOUT nd VLO VHI (time state [timestate])
```

Argument	Description
nd	Node name
time	Absolute time point (maximum 60)

Argument	Description
state	Expected condition of the nd node at the specified *time*: ■ 0: Expect ZERO,LOW. ■ 1: Expect ONE,HIGH. ■ Else: Do not care.
VTH	Single voltage threshold
VLO	Voltage of the logic-low state
VHI	Voltage of the logic-high state

Description

Use .DOUT to specify the expected final state of an output signal. During simulation, HSPICE compares simulation results with the expected output. If the states are different, an error report results.

For both syntax cases, the *time*, *state* pair describes the expected output. During simulation, the simulated results are compared against the expected output vector.

.DOUT State values are 0, 1, X, x, U, u, Z, z. Legal values for *state* are:

- 0: Expect zero
- 1: Expect one
- X, x: Do not care
- U, u: Do not care
- Z, z: Expect high impedance (do not care)

In addition, HSPICE supports multiple nodes in the .DOUT statement. This enables you to verify signals at the same time point in a single .DOUT statement.

Command Group

Output Porting

Examples

Example 1 *The .PARAM command in this example sets the VTH variable value to 3. The .DOUT command, operating on the node1 node, uses VTH as its threshold voltage.*
When node1 is above 3V, it is a logic 1; otherwise, it is a logic 0.

At 0ns, the expected state of node1 is logic-low.
At 2ns, 3ns, and 4ns, the expected state is "do not care."
At 5ns, the expected state is again logic low.

```
.PARAM VTH=3.0
.DOUT node1 VTH(0.0n 0 1.0n 1
+ 2.0n X 3.0n U 4.0n Z 5.0n 0)
```

Example 2 Multiple nodes: verifying signals at the same time point

```
.DOUT  B C D (0n 1 1 0 5n 0 0 0)
```

See Also

.MEASURE / MEAS
.PARAM / PARAMETER / PARAMETERS
.PRINT
.PROBE
.STIM

.EBD

Invokes IBIS Electronic Board Description (EBD) functionality.

Syntax

```
.EBD ebdname
+ file = 'filename'
+ component = 'comp_or_ebd_name:reference_designator'
+ {component
= 'comp_or_ebd_name:reference_designator'...}
+ {usemap = package_value}
```

Argument	Description
comp_or_ebd_name	Name after the .IBIS command that describes a component or r name after the .EBD command that describes an electronic board.
reference_designator	Reference designator that maps the component.
package_value	Value=0,1, 2,or 3 sets the package value (the same as option 'package' of .IBIS) of all components in [Reference Designator Map]. Default=0.

Description

Enter the .EBD command to use the IBIS EBD feature. HSPICE uses the EBD file when simulating the line connected with the reference_designator. When the keyword 'usemap' is added to the .EDB command, new components are added into the circuit according to the [Reference Designator Map]. The new component names are: 'Comp'+referenceName+'_'+ebdName

In Figure 7, CompU22_ebd and CompU23_ebd are added if U22 and U23 occur in [Reference Designator Map].

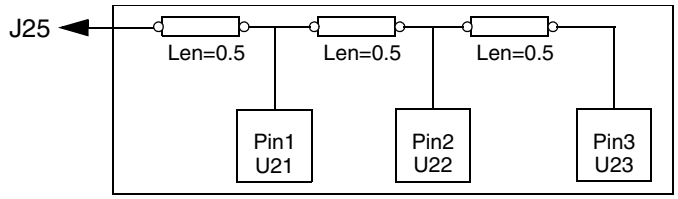


Figure 7 Circuit Connection for EBD Example

If a component is associated with both the keywords component and usemap, then the mapping relation defined by component only is used. The format of the node name on the EBD side is *ebdName_pinName*. For example, the name **J25** is ebd_J25

Note: If a component pin is not found and it is not a terminal node in the EBD path, then the name is used to designate the related node. For example, in Figure 7 on page 109, if U22_2 (here, 2 is the pin name) does not exist, then the node name will be ebd_U22_2.

If the component pin is a terminal node in the EBD path and is not found, then the node and the associated section will not be added into circuit. For example, in Figure 7, if U23_3 does not exist, then the section between Pin2 and Pin3 will be ignored and U22_2 is the terminal node.

Command Group

Input/Output Buffer Information Specification (IBIS)

Examples

Example 1 *This example corresponds to the .ebd file that follows. See Figure 7 on page 109 for the circuit connection.*

```
.ebd ebd
   + file = 'test.ebd'
   + model = '16Meg X 8 SIMM Module'
   + component = 'cmpnt:u21'
   * + usemap = 0
.ibis cmpnt
   + file = 'ebd.ibs'
   + component = 'SIMM'
   + nowarn

   ..................
   [Begin Board Description] 16Meg X 8 SIMM Module
   ..................
   [Pin List] signal_name
   J25 POWER5
   [Path Description] CAS_2
   Pin J25
   Len=0.5 L=8.35n C=3.34p R=0.01 /
   Node u21.1
   Len=0.5 L=8.35n C=3.34p R=0.01 /
   Node u22.2
   Len=0.5 L=8.35n C=3.34p R=0.01 /
   Node u23.3
```

Example 2 This example corresponds to the following two .ebd files below:

```
.ebd ebd1
+ file = 'testebd1.ebd'
+ model = 'testebd1'
+ component = 'cmp1:u2'
+ component = 'ebd2:u20'
.ebd ebd2
+ file = 'testebd2.ebd'
+ model = 'testebd2'
+ component = 'cmp1:u2'
.ibis cmp1
+ file = 'testibis.ibs'
+ component = 'testibis'
+ nowarn

[Begin Board Description]  testebd1
[Manufacturer]             Test
|...
[Pin List]  signal_name
12        RDQ8
[Path Description] 12
Pin 12
Len=0.10604 L=8.39999e-009 C=2.74272e-012 R=0.25139 /
Len=0 R=15.00000 /
Fork
  Len=0.07935 L=8.39999e-009 C=2.74272e-012 R=0.25139 /
  Node U2.C8
Endfork
Len=0.07063 L=8.39999e-009 C=2.74272e-012 R=0.25139 /
Node U20.A13

[Begin Board Description]  testebd2
[Manufacturer]             Test
|...
[Pin List]  signal_name
A13       DQ1
[Path Description] A13
Pin A13
Len=0.18690 L=8.38871e-009 C=2.32868e-012 R=0.12121 /
Node U2.C8
```

See Also

.IBIS
.PKG
IBIS Examples and see `.EBD` command use in `ebd.sp` and `pinmap.sp`

.ELSE

Precedes commands to be executed in a conditional block when preceding .IF and .ELSEIF conditions are false (Not valid for advanced analog functions).

Syntax

```
.ELSE
```

Description

Use this command to precede one or more commands in a conditional block after the last .ELSEIF command, but before the .ENDIF command.

HSPICE executes these commands by default if the conditions are all false in the preceding .IF command and in all of the preceding .ELSEIF commands in the same conditional block.

For the syntax and a description of how to use the .ELSE command within the context of a conditional block, see the .IF command.

For information on use of conditional blocks with the Exploration Block, see, Specifying Constraints in the *HSPICE User Guide: Basic Simulation and Analysis*.

Command Group

Conditional Block

See Also

.ELSEIF
.ENDIF
.IF

.ELSEIF

Specifies conditions that determine whether HSPICE executes subsequent commands in a conditional block.

Syntax

```
.ELSEIF (condition)
```

Description

HSPICE executes the commands that follow the first .ELSEIF command only if *condition1* in the preceding .IF command is false and *condition2* in the first .ELSEIF command is true.

If *condition1* in the .IF command and *condition2* in the first .ELSEIF command are both false, then HSPICE moves on to the next .ELSEIF command if there is one.

If this second .ELSEIF condition is true, HSPICE executes the commands that follow the second .ELSEIF command, instead of the commands after the first .ELSEIF command.

HSPICE ignores the commands in all false .IF and .ELSEIF commands, until it reaches the first .ELSEIF condition that is true. If no .IF or .ELSEIF condition is true, HSPICE continues to the .ELSE command.

For the syntax and a description of how to use the .ELSEIF command within the context of a conditional block, see the .IF command.

For information on use of conditional blocks with the Exploration Block, see, Specifying Constraints in the *HSPICE User Guide: Basic Simulation and Analysis*.

Command Group

Conditional Block

See Also

.ELSE
.ENDIF
.IF

.END

Ends a simulation run in an input netlist file.

Syntax

.END [*comment*]

Argument	Description
comment	Can be any comment. Typically, the comment is the name of the netlist file or of the simulation run that this command terminates.

Description

An .END command must be the last command in the input netlist file. The period preceding END is required. Text that follows the .END command is regarded as a comment only. An input file that contains more than one simulation run must include an .END command for each simulation run. You can concatenate several simulations into a single file.

Command Group

Simulation Runs

Examples

```
MOS OUTPUT
   .OPTION NODE NOPAGE
   VDS 3 0
   VGS 2 0
   M1 1 2 0 0 MOD1 L=4U W=6U AD=10P AS=10P
   .MODEL MOD1 NMOS VTO=-2 NSUB=1.0E15 TOX=1000
   + UO=550
   VIDS 3 1
   .DC VDS 0 10 0.5 VGS 0 5 1
   .PRINT DC I(M1) V(2)
.END MOS OUTPUT
MOS CAPS
   .OPTION SCALE=1U SCALM=1U WL ACCT
   .OP
   .TRAN .1 6
   V1 1 0 PWL 0 -1.5V 6 4.5V
   V2 2 0 1.5VOLTS
   MODN1 2 1 0 0 M 10 3
   .MODEL M NMOS VTO=1 NSUB=1E15 TOX=1000
   + UO=800 LEVEL=1 CAPOP=2
   .PRINT TRAN V(1) (0,5) LX18(M1) LX19(M1) LX20(M1)
   + (0,6E-13)
.END MOS CAPS
```

.ENDDATA

Ends a .DATA block in an HSPICE input netlist file.

Syntax

.ENDDATA

Description

Use this command to terminate a .DATA block in an HSPICE input netlist.

Command Group

Setup

See Also

.DATA

.ENDIF

Ends a conditional block of commands in an HSPICE (only) input netlist file.

Syntax

```
.ENDIF
```

Description

Use this command to terminate a conditional block of commands that begins with an `.IF` command.

For the syntax and a description of how to use the `.ENDIF` command within the context of a conditional block, see the `.IF` command.

Command Group

Conditional Block

See Also

.ELSE
.ELSEIF
.IF

.ENDL

Ends a `.LIB` command in an HSPICE input netlist file.

Syntax

`.ENDL` *`entry_name`*

Description

Use this command to terminate a `.LIB` command in an HSPICE input netlist.

Command Group

Library Management

Examples

Either the .ENDL command or the .ENDL command with the *entry_name* specified is valid for ending a .LIB statement.

```
.lib tt
.param vth=0.1
.include 'model_tt.sp'
.endl tt
```

or

```
.lib tt
.param vth=0.1
.include 'model_tt.sp'
.endl
```

See Also

.LIB

.ENDMODULE

Completes a .MODULE block in a 3D-IC netlist.

Syntax

.ENDMODULE [*label*]

Description

Use this command to complete a .MODULE block when simulating 3D-IC circuits.

Command Group

3D-IC

See Also

.MODULE

.ENDMODULEVAR

Signifies completion of a .MODULEVAR block in a 3D-IC netlist.

Syntax

```
.ENDMODULEVAR [label]
```

Description

Use this command to complete a .MODULE block when simulating 3D-IC circuits.

Command Group

3D-IC

See Also

.MODULEVAR

.ENDS

Ends a subcircuit definition (.SUBCKT) in an HSPICE input netlist file.

Syntax

```
.ENDS subckt_name
```

Argument	Description
subckt_name	Subcircuit name definition to end a command that begins with a .SUBCKT command.

Description

Use this command to terminate a .SUBCKT command. This command must be the last for any subcircuit definition that starts with a .SUBCKT command. You can nest subcircuit references (calls) within subcircuits in HSPICE.

Note: Using -top subck_name on the command line effectively eliminates the need for the .subckt *subckt_name* and .ends *subckt_name*

Command Group

Subcircuits

Examples

Example 1 Terminates a subcircuit named mos_circuit.

```
.ENDS mos_circuit
```

Example 2 *Terminates all subcircuit definitions that begin with a .SUBCKT command.*

```
.ENDS
```

See Also

.SUBCKT

.ENV

Performs standard envelope simulation in HSPICE.

Syntax

```
.ENV TONES=f1 [f2...fn] NHARMS=h1[h2...hn]
+ ENV_STEP=tstep ENV_STOP=tstop
```

Argument	Description
TONES	Carrier frequencies, in hertz
NHARMS	Number of harmonics
ENV_STEP	Envelope step size, in seconds
ENV_STOP	Envelope stop time, in seconds

Description

Use this command to perform standard envelope simulation.

The simulation proceeds just as it does in standard transient simulation, starting at `time=0` and continuing until `time=env_stop`. An HB analysis is performed at each step in time. You can use Backward-Euler (`BE`), trapezoidal (`TRAP`), or level-2 Gear (`GEAR`) integration.

- For `BE` integration, set `.OPTION SIM_ORDER=1`.
- For `TRAP`, set `.OPTION SIM_ORDER=2` (default) `METHOD=TRAP` (default).
- For `GEAR`, set `.OPTION SIM_ORDER=2` (default) `METHOD=GEAR`.

Command Group

Analysis

See Also

.ENVOSC

.HB
.PRINT
.PROBE

.ENVFFT

Performs Fast Fourier Transform (FFT) on envelope output in HSPICE.

Syntax

```
.ENVFFT output_var NP=value FORMAT=keyword
+ WINDOW=keyword ALFA=value
```

Argument	Description
output_var	Any valid output variable.
NP	Number of points to use in the FFT analysis. *NP* must be a power of 2. If not a power of 2, then it is automatically adjusted to the closest higher number that is a power of 2. The default is 1024.
FORMAT	Output format: NORM= normalized magnitude UNORM=unnormalized magnitude (default)
WINDOW	Window type to use: ▪ RECT=simple rectangular truncation window (default) ▪ BART=Bartlett (triangular) window ▪ HANN=Hanning window ▪ HAMM=Hamming window ▪ BLACK=Blackman window ▪ HARRIS=Blackman-Harris window ▪ GAUSS=Gaussian window ▪ KAISER=Kaiser-Bessel window
ALFA	Controls the highest side-lobe level and bandwidth for GAUSS and KAISER windows. The default is 3.0.

Description

Use this command to perform Fast Fourier Transform (FFT) on envelope output. This command is similar to the `.FFT` command. In HSPICE the data

being transformed is complex. You usually want to do this for a specific harmonic of a voltage, current, or power signal.

Command Group

Analysis

See Also

.ENV
.ENVOSC
.FFT

.ENVOSC

Performs envelope simulation for oscillator startup or shutdown in HSPICE.

Syntax

```
.ENVOSC TONE=f1 NHARMS=h1 ENV_STEP=tstep ENV_STOP=tstop
+ PROBENODE=n1,n2,vosc [FSPTS=num, min, max]
```

Argument	Description
TONES	Carrier frequencies, in hertz.
NHARMS	Number of harmonics.
ENV_STEP	Envelope step size, in seconds.
ENV_STOP	Envelope stop time, in seconds.
PROBENODE	Defines the nodes used for oscillator conditions and the initial probe voltage value.
FSPTS	Specifies the frequency search points used in the initial small-signal frequency search. Usage depends on oscillator type.

Description

Use `.EVOSC` to perform envelope simulation for oscillator startup or shutdown. Oscillator startup or shutdown analysis must be helped along by converting a bias source from a DC description to a PWL description that either:

- Starts at a low value that supports oscillation and ramps up to a final value (startup simulation)
- Starts at the DC value and ramps down to zero (shutdown simulation).

In addition to computing the state variables at each envelope time point, the .ENVOSC command also computes the frequency. This command is applied to high-Q oscillators that take a long time to reach steady-state. For these circuits, standard transient analysis is too costly. Low-Q oscillators, such as typical ring oscillators are more efficiently simulated with standard transient analysis.

Command Group

Analysis

See Also

.ENV
.ENVFFT

.EOM

Ends a .MACRO command.

Syntax

.EOM *subckt_name*

ArgumentArgument	DescriptionDescription
subckt_name	Subcircuit name definition to end a macro that begins with a .SUBCKT command.

Description

Use this command to terminate a .MACRO command. .EOM must be the last for any subcircuit definition that starts with a .MACRO command. You can nest subcircuit references (calls) within subcircuits.

Command Group

Subcircuits

Examples

Example 1 Terminates a subcircuit named diode_circuit.

```
.EOM diode_circuit
```

Example 2 *If you omit the subcircuit name as in this second example, this command terminates all subcircuit definitions that begin with a .MACRO command.*

```
.EOM
```

See Also

.MACRO

.FFT

Calculates the Discrete Fourier Transform (DFT) value used for spectrum analysis. Numerical parameters (excluding string parameters) can be passed to the .FFT command.

Syntax

Syntax # 1 Alphanumeric input

```
.FFT output_var [START=value] [STOP=value]
+ NP=value [FORMAT=keyword]
+ [WINDOW=keyword] [ALFA=value]
+ [FREQ=value] [FMIN=value] [FMAX=value]
```

Syntax #2 Numerics and expressions

```
.FFT [output_var] [START=param_expr1] [STOP=param_expr2]
+ [NP=param_expr3] [FORMAT=keyword]
+ [WINDOW=keyword] [ALFA=param_expr4]
+ [FREQ=param_expr5] [FMIN=param_expr6] [FMAX=param_expr7]
```

Syntax # Verilog-A Blocks

```
.FFT VAblock:SigName StartIdx=n1 StartIdx=n2
+ SamplePeriod=val
+ ...
```

Argument	Description
output_var	Any valid output variable, such as voltage, current, or power.
START	Start of the output variable waveform to analyze. Defaults to the START value in the .TRAN command (tstart), which defaults to 0.
FROM	An alias for START in .FFT commands.

Argument	Description
STOP	End of the output variable waveform to analyze. Defaults to the TSTOP value in the .TRAN command.
TO	An alias for STOP, in .FFT commands.
NP	Number of points to use in the FFT analysis. NP must be a power of 2. If NP is not a power of 2, HSPICE automatically adjusts it to the closest higher number that is a power of 2. The default is 1024.
FORMAT	Output format: ■ NORM= normalized magnitude (default) ■ UNORM=unnormalized magnitude
WINDOW	Window can be one of the following types: ■ RECT=simple rectangular truncation window (default). ■ BART=Bartlett (triangular) window. ■ HANN=Hanning window. ■ HAMM=Hamming window. ■ BLACK=Blackman window. ■ HARRIS=Blackman-Harris window. ■ GAUSS=Gaussian window. ■ KAISER=Kaiser-Bessel window.
ALFA	Parameter to use in GAUSS and KAISER windows to control the highest side-lobe level, bandwidth, and so on. 1.0 <= ALFA <= 20.0 The default is 3.0
FREQ	Frequency to analyze–Not the sampling frequency. If FREQ is nonzero, the output lists only the harmonics of this frequency based on FMIN and FMAX. HSPICE also prints the THD for these harmonics. The default is 1.0/(STOP-START) (Hz).
FMIN	Minimum frequency for which HSPICE prints FFT output into the listing file. THD calculations also use this frequency. T=(STOP-START) The default is 1.0/T (Hz).
FMAX	Maximum frequency for which HSPICE prints FFT output into the listing file. THD calculations also use this frequency. The default is 0.5*NP*FM IN (Hz).

Argument	Description
VAblock	Name of the Verilog-A block.
SigName	Parameter name of the series output from Verilog-A. It should have the following type definition in Verilog-A block: `(* desc="SigName" *) real SigName[n1:n2];`
StartIdx	Start index of the series for FFT.
StopIdx	End index of the series for FFT; it must be greater than StartIdx; otherwise, HSPICE uses the whole series for the FFT process.
SamplePeriod	Time interval between two samples inside the series. It must be a positive value, the default value is 1 second.

Description

Use this command to calculate the Discrete Fourier Transform (DFT) values for spectrum analysis. `.FFT` uses internal time point values to calculate these values. A DFT uses sequences of time values to determine the frequency content of analog signals in circuit simulation. You can pass numerical parameters/expressions (but no string parameters) to the `.FFT` command. Output variables for `.FFT` can be voltage, current, or power, followed by a parenthesis containing the instance name. If it is power, for example, you need to write the signal's name in the format `p(`*`instance_name`*).

You can specify only one output variable in an `.FFT` command. The following is an *incorrect* use of the command because it contains two variables in one `.FFT` command:

For an `.FFT` analysis using a Verilog A-block, the FFT time window is:
`TimeWindow = SamplePeriod*(`*`stopidx-startidx`*`)`

A FFT process requires sampling the waveform with equally spaced time points, and the total point number must be 2^N (N: integer). Therefore, the start/stop time points, fundamental frequency, sampling rate, and total point number are not independent of each other. They need to satisfy the following relationship:

$$\frac{point\_number}{t_{stop} - t_{start}} = sample\_rate, \text{ where } point\_number = 2^N$$

$$F_{fund} = \frac{M}{t_{stop} - t_{start}}, \text{ where } M \text{ is an integer number}$$

If that relationship is compromised, conflicts between parameters may arise. To avoid such conflicts, HSPICE conducts an error check process according to the following:

Parameter	Check if input...	Adjust if input...	Set if not input...
START	Error if < tstart (start point in `.TRAN`)	N/A	=tstart (start point in `.TRAN`
STOP	Error if > tstop (stop point in `.TRAN`)	N/A	=tstop (stop point in `.TRAN`
NP	Error if NP< 4Error if NP > 227	Is not a power of 2; adjust to nearest power of 2, issue warning and final value	Default value (1024)
FREQ	Error if $< \frac{1}{\mathrm{STOP} - START}$	If not integer multiple of 1/(STOP-START)), adjust to nearest multiple of 1/(STOP-START), issue warning and final value	$\frac{1}{\mathrm{STOP} - START}$
SamplePeriod	Error if non-positive	Use default value: 1s	1 second
StartIdx	Error if $\geq$ StopIdx	N/A	Start index of the VA array
StopIdx	Error if $\leq$ StartIdx	N/A	Stop index of the VA array

An embedded `.FFT` command in a `measure_file` can be called to perform FFT measurements from previous simulation results as follows:

```
HSPICE -i *.tr0 -meas measure_file
```

Command Group

Analysis

Examples

```
.FFT v(1)
.FFT v(1,2) np=1024 start=0.3m stop=0.5m freq=5.0k
+ window=kaiser alfa=2.5
.FFT I(rload) start=0m to=2.0m fmin=100k fmax=120k
+ format=unorm
.FFT par('v(1) + v(2)') from=0.2u stop=1.2u
+ window=harris
```

The example below generates an `.ft0` file for the FFT of v(1) and an `.ft1` file for the FFT of v(2).

```
.FFT v(1) np=1024
.FFT v(2) np=1024
```

See Also

.TRAN
.MEASURE FFT
Spectrum Analysis
Fourier Analysis Examples for demo files on window weighting including

- `gauss.sp`
- `hamm.sp`
- `hann.sp`
- `harris.sp`
- `kaiser.sp`
- `rect.sp`

Fourier Analysis Examples, netlists demonstrating use of the `.FFT` command:

- `fft5.sp` (data-driven with transient analysis)
- `fft6.sp` and `sine.sp` (sine source)
- `intermod.sp` (intermodulation distortion)
- `mod.sp` (modulated pulse)
- `pulse.sp` (pulse source)
- `pwl.sp` (PWL source)
- `sffm.sp` (single-frequency FM source)
- `swcap5.sp` (fifth-order elliptic, switched-capacitor filter)

.FLAT

Provides subcircuit OP back annotation when a device is modeled as a subckt.

Syntax

If defined in subckt definition block:

```
.FLAT element_name
```

If defined in main circuit:

`.FLAT` *`subckt_nameelement_name`*

Description

This command enables subcircuit OP back annotation when a device is modeled as a subckt.

Note: `subckt_name` is the name appearing in a `.subckt` definition statement; `element_name` is a simple element name which is defined in the same subckt definition block.

When a device is modeled as a subcircuit rather than as `.MODEL`, using the `.FLAT` command within a subcircuit allows the writing of a results file with proper values for the device. Back-annotation is done by retrieving results from the `input.op0` (for DC) and `input.op1` (for transient) results files. For the OP output, the `.FLAT` command works for `*.wdf` and `*.psf` (`*.op#`) formats. For the waveform, the `.FLAT` command works for `*.wdf` format, `*.psf`, and `*.post` formats.

Note: The `.FLAT` command is used mainly in ADE or SAE environments for device information back annotation.

This subckt file	...is equal to
.subckt nmos_sub d g s b m0 d g s b nmos 10u 10u r0 int_d d 100 .flat m0 .model nmos nmos level=49 .ends nmos_sub	.flat nmos_sub m0 .subckt nmos_sub d g s b m0 d g s b nmos 10u 10u r0 int_d d 100 .model nmos nmos level=49 .ends nmos_sub

If the `.FLAT` command is in both the subckt definition block and main circuit, the subckt block `.FLAT` takes priority. If more than one `.FLAT` is defined for the same subckt, the last one takes priority.

Command Group

Subcircuits

Examples

```
.subckt nmossub D G S B l=l w=w
M1 D_int G_int S_int B nch l=l w=w
M2 D_int G_int S_int B nch l=l w=w
RD D D_int 100
RG G G_int 10
RS S S_int 400
.flat M1
.ends nmossub

X1 1 2 0 0 nmossub
```

.FOUR

Performs a Fourier analysis as part of the transient analysis.

Syntax

.FOUR freq *ov1* [*ov2 ov3 ...*]

Argument	Description
freq	Fundamental frequency
ov1 ...	Output variables to analyze

Description

Use this command to perform a Fourier analysis as part of the transient analysis. You can use this command in HSPICE to perform the Fourier analysis over the interval (tstop-fperiod, tstop), where:

- tstop is the final time, specified for the transient analysis.
- fperiod is a fundamental frequency period (`freq` parameter).

HSPICE performs Fourier analysis on 501 points of transient analysis data on the last 1/f time period, where f is the fundamental Fourier frequency. HSPICE interpolates transient data to fit on 501 points, running from (tstop-1/f) to tstop.

To calculate the phase, the normalized component and the Fourier component, HSPICE uses 10 frequency bins. The Fourier analysis determines the DC component and the first nine AC components. For improved accuracy, the `.FOUR` command can use non-linear, instead of linear interpolation.

You can use a .FOUR command only with a .TRAN command.

Command Group

Analysis

Examples

```
.FOUR 100K V(5)
```

See Also

.TRAN
.FFT

.FSOPTIONS

Sets various options for the HSPICE Field Solver.

Syntax

```
.FSOPTIONS name [ACCURACY=HIGH|MEDIUM|LOW]
+ [GRIDFACTOR=val] [COMPUTE_GO=YES|NO]
+ [COMPUTE_GD=YES|NO] [COMPUTE_RO=YES|NO]
+ [COMPUTE_RS=YES|NO|DIRECT|ITER]
+ [COMPUTE_TABLE=FREQENCY_SWEEP]
+ [PRINTDATA=YES|NO|APPEND]
```

Argument	Description
name	Option name.
ACCURACY	Determines the number of segments used by the boundary element method field solver for each conductor shape. Solver accuracy is one of the following: ▪ HIGH (Default) ▪ MEDIUM ▪ LOW
GRIDFACTOR	Multiplication factor (integer) to determine the final number of segments used to define the shape. If you set COMPUTE_RS=yes, the field solver does not use this parameter to compute Ro and Rs values.

Argument	Description
COMPUTE_GO [or] COMPUTEGO	Computes the static conductance matrix.
COMPUTE_GD [or] COMPUTEGD	Computes the dielectric loss matrix.
COMPUTE_RO [or] COMPUTERO	Computes the DC resistance matrix.
COMPUTE_RS [or] COMPUTERS	Activates and chooses filament solver to compute R_o and R_s. The solver computes the skin-effect resistance matrix. ▪ YES: activate filament solver with direct matrix solver ▪ NO: (Default) Does not perform filament solver ▪ DIRECT: Activate filament solver with direct matrix solver (same as “YES”) ▪ ITER: Activates filament solver with iterative matrix solver
COMPUTE_TABLE [or] COMPUTETABLE	Specifies a type of frequency sweep for extracting RLGC Tabular Model. You can specify either LIN, DEC, OCT, POI. Specify the nsteps, start, and stop values using the following syntax for each type of sweep: ▪ `LIN` *`nsteps start stop`* ▪ `DEC` *`nsteps start stop`* ▪ `OCT` *`nsteps start stop`* ▪ `POI` *`nsteps freq_values`*
PRINTDATA	When PRINTDATA=APPEND, RLGC model output is appended to the specified output file.

Description

Use the `.FSOPTIONS` command to set various options for the field solver. The following rules apply to the field solver when specifying options with the `.FSOPTIONS` command:

- The field solver always computes the L and C matrixes.
- If COMPUTE_RS=YES, the field solver starts and calculates L_o, R_o, and R_s.
- For each accuracy mode, the field solver uses either the predefined number of segments or the number of segments that you specified. It then multiplies this number times the GRIDFACTOR to obtain the final number of segments.

Because a wide range of applications are available, the predefined accuracy level might not be accurate enough for some applications. If you need a higher accuracy than the value that the HIGH option sets, then increase either the GRIDFACTOR value or the N, NH, or NW values to increase the mesh density. NW and NH quantities are used for rectangles and N is used for circles, polygons and strips. See the .SHAPE commands in this chapter for the complete syntax for each shape.

Note: The forms of the following arguments are interchangeable:

```
COMPUTE_GO : COMPUTEGO
COMPUTE_GD : COMPUTEGD
COMPUTE_RO : COMPUTERO
COMPUTE_RS : COMPUTERS
COMPUTE_TABLE : COMPUTETABLE
```

See the *HSPICE User Guide: Signal Integrity Modeling and Analysis* for more information on Extracting Transmission Line Parameters (Field Solver).

Command Group

Field Solver

Examples

```
// LU solver
*.fsoptions printem printdata=yes compute_rs=direct
compute_gd=yes
// GMRES solver
.fsoptions printem printdata=yes compute_rs=iter compute_gd=yes
```

See Also

.LAYERSTACK
.MATERIAL
.SHAPE
Transmission (W-element) Line Examples
Using the Field Solver to Extract a RLGC Tabular Model

.GLOBAL

Globally assigns a node name.

Syntax

```
.GLOBAL node1 node2 node3 ...
```

Argument	Description
node1, node2...	Name of a global nodes, such as supply and clock names; overrides local subcircuit definitions.

Description

Use this command to globally assign a node name in HSPICE. This means that all references to a global node name, used at any level of the hierarchy in the circuit, connect to the same node.

The most common use of a `.GLOBAL` command is if your netlist file includes subcircuits. This command assigns a common node name to subcircuit nodes. Another common use of `.GLOBAL` commands is to assign power supply connections of all subcircuits. For example, `.GLOBAL VCC` connects all subcircuits with the internal node name VCC.

Typically, in a subcircuit, the node name consists of the circuit number concatenated to the node name. When you use a `.GLOBAL` command, HSPICE does not concatenate the node name with the circuit number and assigns only the global name. You can then exclude the power node name in the subcircuit or macro call.

Command Group

Setup and Node Naming

Examples

This example shows global definitions for `VDD` and `input_sig` nodes.

```
.GLOBAL VDD input_sig
```

.HB

Invokes the single and multi-tone harmonic balance algorithm for periodic steady state analysis.

Syntax

Syntax # 1 without SS_TONE

```
.HB TONES=F1 [F2 … FN] [SUBHARMS=SH]
+ [NHARMS=H1, H2 … HN] [INTMODMAX=n]
+ [SWEEP parameter_sweep]
```

Syntax#2 with SS_TONE

```
.HB TONES=F1 [F2 … FN] [SUBHARMS=SH]
+ [NHARMS=H1, H2 … HN] [INTMODMAX=n]
+ [SS_TONE=n] [SWEEP parameter_sweep]
```

Argument	Description
TONES	Fundamental frequencies.
SUBHARMS	Allows subharmonics in the analysis spectrum. The minimum non-DC frequency in the analysis spectrum is f/subharms, where f is the frequency of oscillation.
NHARMS	Number of harmonics to use for each tone. Must have the same number of entries as TONES. You must specify NHARMS, INTMODMAX or both.
INTMODMAX	INTMODMAX is the maximum intermodulation product order that you can specify in the analysis spectrum. You must specify NHARMS, INTMODMAX or both.
SWEEP	Type of sweep. You can sweep up to three variables. You can specify either LIN, DEC, OCT, POI, SWEEPBLOCK, DATA, OPTIMIZE or MONTE. Specify the nsteps, start, and stop times using the following syntax for each type of sweep: ▪ LIN *nsteps start stop* ▪ DEC *nsteps start stop* ▪ OCT *nsteps start stop* ▪ POI *nsteps freq_values* ▪ SWEEPBLOCK=*swblockname* ▪ DATA=*dataname* ▪ OPTIMIZE=OPT*xxx* ▪ MONTE=*val*
SS_TONE	Small-signal tone number for HBLIN analysis. The value must be an integer number. The default value is 0, indicating that no small signal tone is specified.

Description

Use this command to invoke the single and multi-tone harmonic balance algorithm for periodic steady state analysis.

The NHARMS and INTMODMAX input parameters define the spectrum.

- If INTMODMAX=N, the spectrum consists of all f=a*f_1+b*f_2+...+n*fn frequencies so that f>=0 and |a|+|b|+...+|n|<=N. The a,b,...,n coefficients are integers with absolute value <=N.
- If you do not specify INTMODMAX, it defaults to the largest value in the NHARMS list.
- If entries in the NHARMS list are > INTMODMAX, HSPICE advanced analog analyses adds the m*f_k frequencies to the spectrum, where f_k is the corresponding tone, and m is a value <= the NHARMS entry.

Example 1 *The resulting HB analysis spectrum={dc, f_1, f_2}*

```
.hb tones=f1, f2 intmodmax=1
```

Example 2 *The resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2}*

```
.hb tones=f1, f2 intmodmax=2
```

Example 3 *The resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2, 2*f_1+f_2, 2*f_1-f_2, 2*f_2+f_1, 2*f_2-f_1, 3*f_1, 3*f_2}*

```
.hb tones=f1, f2 intmodmax=3
```

Example 4 *The resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2}*

```
.hb tones=f1, f2 nharms=2,2
```

Example 5 *The resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2, 2*f_1-f_2, 2*f_1+f_2, 2*f_2-f_1, 2*f_2+f_1}*

```
hb tones=f1, f2 nharms=2,2 intmodmax=3
```

Example 6 *The resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2, 2*f_1-f_2, 2*f_1+f_2, 2*f_2-f_1, 2*f_2+f_1, 3*f_1, 3*f_2, 4*f_1, 4*f_2, 5*f_1, 5*f_2}*

```
.hb tones=f1, f2 nharms=5,5 intmodmax=3
```

For detailed discussion of HBLIN analysis, see Frequency Translation S-Parameter (HBLIN) Extraction in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION HBCONTINUE	Specifies whether to use the sweep solution from the previous simulation as the initial guess for the present simulation. ■ HBCONTINUE=1 (default): Use solution from previous simulation as the initial guess. ■ HBCONTINUE=0: Start each simulation in a sweep from the DC solution.
.OPTION HBJREUSE	Controls when to recalculate the Jacobian matrix: ■ HBJREUSE=0 recalculates the Jacobian matrix at each iteration. ■ HBJREUSE=1 reuses the Jacobian matrix for several iterations, after sufficient error reduction. The default is 0 if HBSOLVER=1 or 2, or 1 if HBSOLVER=0.
.OPTION HBJREUSETOL	Determines when to recalculate Jacobian matrix (if HBJREUSE=1). The percentage by which HSPICE advanced analog analyses must reduce the error from the last iteration so you can use the Jacobian matrix for the next iteration. Must be a real number, between 0 and 1. The default is 0.05.
.OPTION HBKRYLOVDIM	Dimension of the Krylov subspace that the Krylov solver uses. Must be an integer, greater than zero. Default is 40.
.OPTION HBKRYLOVTOL	The error tolerance for the Krylov solver. Must be a real number, greater than zero. The default is 0.01.
.OPTION HBLINESEARCHFAC	The line search factor. If Newton iteration produces a new vector of HB unknowns with a higher error than the last iteration, then scale the update step by HBLINESEARCHFAC, and try again. Must be a real number, between 0 and 1. The default is 0.35.
.OPTION HBMAXITER	Specifies the maximum number of Newton-Raphson iterations that the HB engine performs. Analysis stops when the number of iterations reaches this value. The default is 10000.
.OPTION HBKRYLOVMAXITER	Specifies the maximum number of GMRES solver iterations performed by the HB engine.
.OPTION HBSOLVER	Specifies a pre-conditioner to solve nonlinear circuits. ■ HBSOLVER=0: invokes the direct solver. ■ HBSOLVER=1 (default): invokes the matrix-free Krylov solver. ■ HBSOLVER=2: invokes the two-level hybrid time-frequency domain solver.
.OPTION HBTOL	The absolute error tolerance for determining convergence. Must be a real number that is greater than zero. The default is 1.e-9.

Option	Description
.OPTION LOADHB	LOADHB = “filename” loads the state variable information contained in the specified file. These values initialize the HB simulation.
.OPTION SAVEHB	SAVEHB = “filename”’ saves the final state (that is, the no sweep point or the steady state of the first sweep point) variable values from a HB simulation in the specified file. Load this file as the starting point for another simulation by using a LOADHB option.
.OPTION TRANFORHB	■ TRANFORHB=1: forces HB to recognize V/I sources that include SIN, PULSE, VMRF, and PWL transient descriptions, and to use them in analysis. However, if the source also has an HB description, analysis uses the HB description instead. ■ TRANFORHB=0: forces HB to ignore transient descriptions of V/I sources, and to use only HB descriptions. To override this option, specify TRANFORHB in the source description.

Command Group

Analysis

Examples

In Example 1, the resulting HB analysis spectrum={dc, f_1, f_2}.

Example 7

```
.hb tones=f1, f2 intmodmax=1
```

In Example 2, the HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2}.

Example 8

```
.hb tones=f1, f2 intmodmax=2
```

In Example 3, the resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2, 2*f_1+f_2, 2*f_1-f_2, 2*f_2+f_1, 2*f_2-f_1, 3*f_1, 3*f_2}.

Example 9

```
.hb tones=f1, f2 intmodmax=3
```

In Example 4, the resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1,2*f_2}.

Example 10

```
.hb tones=f1, f2 nharms=2,2
```

In Example 5, the resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2, 2*f_1-f_2, 2*f_1+f_2, 2*f_2-f_1, 2*f_2+f_1}.

Example 11

```
hb tones=f1, f2 nharms=2,2 intmodmax=3
```

The resulting HB analysis spectrum={dc, f_1, f_2, f_1+f_2, f_1-f_2, 2*f_1, 2*f_2, 2*f_1-f_2, 2*f_1+f_2, 2*f_2-f_1, 2*f_2+f_1, 3*f_1, 3*f_2, 4*f_1, 4*f_2, 5*f_1, 5*f_2}.

Example 12

```
.hb tones=f1, f2 nharms=5,5 intmodmax=3
```

See Also

.ENV
.HBAC
.HBLIN
.HBNOISE
.HBOSC
.OPTION HBCONTINUE
.OPTION HBJREUSE
.OPTION HBJREUSETOL
.OPTION HBACKRYLOVDIM
.OPTION HBKRYLOVTOL
.OPTION HBLINESEARCHFAC
.OPTION HBMAXITER / HB_MAXITER
.OPTION HBSOLVER
.OPTION HBTOL
.OPTION LOADHB
.OPTION SAVEHB
.OPTION TRANFORHB
.PRINT
.PROBE

.HBAC

Performs harmonic-balance–based periodic AC analysis on circuits operating in a large-signal periodic steady state.

Syntax

```
.HBAC frequency_sweep
```

Argument	Description
frequency_sweep	Specifies the type, nsteps, and start and stop frequency or frequency points for each sweep type, where: ▪ type = frequency sweep type which can be OCT, DEC, LIN, POI or SWEEPBLOCK. ▪ nsteps = number of steps per decade or total number of steps. ▪ start = starting frequency. ▪ stop = ending frequency. ▪ p1, p2, ... pn = frequency points. The four parameters determine the offset frequency sweep about the carrier used for the phase noise analysis. ▪ LIN *nsteps start stop* ▪ OCT *nsteps start stop* ▪ DEC *nsteps start stop* ▪ POI *nsteps p1, p2, ...pn* ▪ SWEEPBLOCK sweepblock = *swblockname*

Description

Use this command to invoke a harmonic balance-based periodic AC analysis to analyze small-signal perturbations on circuits operating in a large-signal periodic steady state.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION HBACTOL	Specifies the absolute error tolerance for determining convergence.
.OPTION HBACKRYLOVDIM	Specifies the dimension of the Krylov subspace used by the Krylov solver.

Command Group

Analysis

See Also

.HB
.HBNOISE
.HBOSC
.OPTION HBACTOL

.OPTION HBACKRYLOVDIM
.PRINT
.PROBE

.HBLIN

Extracts frequency translation S-parameters and noise figures.

Syntax

Without `SS_TONE`

```
.HBLIN frequency_sweep
+ [NOISECALC=1|0|yes|no] [FILENAME=file_name]
+ [DATAFORMAT=ri|ma|db]
+ [MIXEDMODE2PORT=dd|cc|cd|dc|sd|sc|cs|ds]
```

With `SS_TONE`

```
.HBLIN [NOISECALC=1|0|yes|no] [FILENAME=file_name]
+ [DATAFORMAT=ri|ma|db]
+ [MIXEDMODE2PORT=dd|cc|cd|dc|sd|sc|cs|ds]
```

Argument	Description
frequency_sweep	Specifies the type, nsteps, and start and stop frequency or frequency points for each sweep type, where: ■ type = frequency sweep type which can be OCT, DEC, LIN, POI or SWEEPBLOCK. ■ nsteps = number of steps per decade or total number of steps. ■ start = starting frequency. ■ stop = ending frequency. ■ p1, p2, ... pn = frequency points. The four parameters determine the offset frequency sweep about the carrier used for the phase noise analysis. ■ LIN *nsteps start stop* ■ OCT *nsteps start stop* ■ DEC *nsteps start stop* ■ POI *nsteps p1, p2, ...pn* ■ SWEEPBLOCK sweepblock = *swblockname*
NOISECALC	Enables calculating the noise figure. The default is no (0).

Argument	Description
FILENAME	Output file name for the extracted S-parameters or the object name after the -o command-line option. The default is the netlist file name.
DATAFORMAT	Format of the output data file. ■ dataformat=RI, real-imaginary. This is the default for `.sc#/citi` file. ■ dataformat=MA, magnitude-phase. This is the default format for Touchstone file. ■ dataformat=DB, DB(magnitude)-phase.
MIXEDMODE2PORT	Mixed-mode data map of output mixed mode S-parameter matrix. The availability and default value for this keyword depends on the first two port (P element) configuration as follows: ■ case 1: p1=p2=single-ended (standard-mode P element) available: ss default: ss ■ case 2: p1=p2=balanced (mixed-mode P element) available: dd, cd, dc, cc default: dd ■ case 3: p1=balanced p2=single-ended available: ds, cs default: ds ■ case 4: p1=single p2=balanced available: sd, sc default: sd

Description

Use this command in HSPICE to extract frequency translation S-parameters and noise figures.

Command Group

Analysis

See Also

.HB
.HBAC
.PRINT
.PROBE

.HBLSP

Performs periodically driven nonlinear circuit analyses for power-dependent S parameters.

Syntax

```
.HBLSP NHARMS=nh [POWERUNIT=dbm|watt]
+ [SSPCALC=1|0|YES|NO] [NOISECALC=1|0|YES|NO]
+ [FILENAME=file_name] [DATAFORMAT=ri|ma|db]
+ FREQSWEEP freq_sweep POWERSWEEP power_sweep
```

Argument	Description
NHARMS	Number of harmonics in the HB analysis triggered by the `.HBLSP` command.
POWERUNIT	Power unit. Default is watt.
SSPCALC	Extract small-signal S-parameters. Default is 0 (NO).
NOISECALC	Perform small-signal 2-port noise analysis. Default is 0 (NO).
FILENAME	Output data `.p2d#` filename. Default is the netlist name or the object name after the -o command-line option.
DATAFORMAT	Format of the output data file. Default is ma (magnitude, angle).
FREQSWEEP	Frequency sweep specification. A sweep of type LIN, DEC, OCT, POI, or SWEEPBLOCK. Specify the *nsteps*, *start*, and *stop* times using the following syntax for each type of sweep: ■ LIN *nsteps start stop* ■ DEC *nsteps start stop* ■ OCT *nsteps start stop* ■ POI *nsteps freq_values* ■ SWEEPBLOCK=*swblockname* This keyword must appear before the POWERSWEEP keyword.

Argument	Description
POWERSWEEP	Power sweep specification. A sweep of type LIN, DEC, OCT,POI, or SWEEPBLOCK. Specify the nsteps, start, and stop times using the following syntax for each type of sweep: ▪ LIN *nsteps start stop* ▪ DEC *nsteps start stop* ▪ OCT *nsteps start stop* ▪ POI *nsteps power_values* ▪ SWEEPBLOCK=*swblockname* This keyword must follow the FREQSWEEP keyword.

Description

Use this command in HSPICE to invoke periodically driven nonlinear circuit analyses for power-dependent S-parameters.

For details, see the *HSPICE User Guide: Advanced Analog Simulation and Analysis*, Large-Signal S-parameter (HBLSP) Analysis.

Command Group

Analysis

See Also

.HB
.PRINT
.PROBE

.HBNOISE

Performs cyclo-stationary noise analysis on circuits operating in a large-signal periodic steady state.

Syntax

```
.HBNOISE output insrc parameter_sweep
+ [n1, n2, …, nk,+/-1]
+ [listfreq=(frequencies|none|all)] [listcount=val]
+ [listfloor=val] [listsources=on|off]
```

Argument	Description
output	Output node, pair of nodes, or 2-terminal element. HSPICE references equivalent noise output to this node (or pair of nodes). Specify a pair of nodes as V(n+,n-). If you specify only one node, V(n+), then HSPICE assumes that the second node is ground. You can also specify a 2-terminal element name that refers to an existing element in the netlist.
insrc	Input source. If this is a resistor, HSPICE uses it as a reference noise source to determine the noise figure. If the resistance value is 0, the result is an infinite noise figure.
parameter_sweep	Frequency sweep range for the input signal. Also referred to as the input frequency band (IFB) or *fin*). You can specify LIN, DEC, OCT, POI, SWEEPBLOCK, DATA, MONTE, or OPTIMIZE sweeps. Specify the nsteps, start, and stop frequencies using the following syntax for each type of sweep: ▪ LIN *nsteps start stop* ▪ DEC *nsteps start stop* ▪ OCT *nsteps start stop* ▪ POI *nsteps freq_values* ▪ SWEEPBLOCK=*swblockname* ▪ DATA *dataname* ▪ MONTE *niterations* ▪ OPTIMIZE *optxxx*
n1,n2,...,nk, +/-1	Index term defining the output frequency band (OFB or *fout*) at which the noise is evaluated. Generally, fout=ABS(n1*f1+n2*f2+...+nk*fk+/-fin) where: ▪ f1,f2,...,fk are the first through k^{th} steady-state tones determined from the harmonic balance solution ▪ n1,n2,...,nk are the associated harmonic multipliers ▪ fin is the IFB defined by *parameter_sweep*. The default index term is [1,1,...1,-1]. For a single tone analysis, the default mode is consistent with simulating a low-side, down conversion mixer where the RF signal is specified by the IFB and the noise is measured at a down-converted frequency that the OFB specifies. In general, you can use the [n1,n2,...,nk,+/-1] index term to specify an arbitrary offset. The noise figure measurement is also dependent on this index term.

Argument	Description
listfreq	Prints the element noise value to the .lis file. You can specify at which frequencies the element noise value is printed. The frequencies must match the sweep_frequency values defined in the *parameter_sweep*, otherwise they are ignored.In the element noise output, the elements that contribute the largest noise are printed first. The frequency values can be specified with the NONE or ALL keyword, which either prints no frequencies or every frequency defined in *parameter_sweep*. Frequency values must be enclosed in parentheses. For example:`listfreq=(none) listfreq=(all) listfreq=(1.0G) listfreq=(1.0G, 2.0G)` The default value is NONE.
listcount	Prints the element noise value to the .lis file, which is sorted from the largest to smallest value. You do not need to print every noise element; instead, you can define `listcount` to print the number of element noise frequencies. For example, `listcount=5` means that only the top 5 noise contributors are printed. The default value is 1.
listfloor	Prints the element noise value to the `.lis` file and defines a minimum meaningful noise value (in $V/Hz^{1/2}$ units). Only those elements with noise values larger than `listfloor` are printed. The default value is 1.0e-14 $V/Hz^{1/2}$.
listsources	Prints the element noise value to the `.lis` file when the element has multiple noise sources, such as a FET, which contains the thermal, shot, and 1/f noise sources. You can specify either ON or OFF: ON Prints the contribution from each noise source and OFF does not. The default value is OFF. When `listsources` is turned on, the element noise source contributions will also be output into the `*.pn#` file.

Description

Use this command to invoke cyclo-stationary noise analysis on circuits operating in a large-signal periodic steady state.

Command Group

Analysis

See Also

.HB
.HBAC

.HBOSC

Performs oscillator analysis on autonomous (oscillator) circuits. The input syntax for HBOSC analysis supports two different formats, depending on whether the PROBENODE location is specified using a circuit element (current source) or using the HBOSC PROBENODE parameters:

Syntax

Syntax #1

```
.HBOSC TONE=F1 NHARMS=H1
+ PROBENODE=N1,N2,VP
+[FSPTS=NUM, MIN, MAX] [STABILITY=(-2|-1|0|1|2)]
+[SWEEP PARAMETER_SWEEP] [SUBHARMS=I]
```

Syntax #2 (Uses current source to set PROBENODE)

```
ISRC N1N2 HBOSCVPROBE=VP
.HBOSC TONE=F1 NHARMS=H1
+[FSPTS=NUM, MIN, MAX] [STABILITY=(-2|-1|0|1|2)]
+[SWEEP PARAMETER_SWEEP] [SUBHARMS=I]
```

Argument	Description
TONE	Approximate value for oscillation frequency (Hz). The search for an exact oscillation frequency begins from this value unless you specify an FSPTS range or transient initialization.
NHARMS	Number of harmonics to use for oscillator HB analysis.

Argument	Description
PROBENODE	Circuit nodes that are probed for oscillation conditions. ▪ N1 and N2 are the positive and negative nodes for a voltage probe inserted in the circuit to search for oscillation conditions. ▪ VP is the initial probe voltage value (suggested: 1/2 the supply voltage). The phase of the probe voltage is forced to zero; all other phases are relative to the probe phase. HSPICE uses this probe to calculate small-signal admittance for the initial frequency estimates. It should be connected near the “heart” of the oscillator (near resonators, inside the ring of a ring oscillator, and so on). Note: The PROBENODE pins and approximate voltage value can also be set by using a zero amp current source that uses the HBOSCVPROBE keyword.
HBOSCVPROBE= VP	Sets PROBENODE with a current source. If a current source with HBOSCVPROBE is used, the PROBENODE syntax is not necessary.
FSPTS	Frequency search points that HSPICE uses in its initial small-signal frequency search to find an oscillation frequency. Optional, but recommended for high-Q and most LC oscillators. ▪ NUM is an integer. ▪ MIN and MAX are frequency values in units of Hz. If the FSPTS analysis finds an approximate oscillation frequency, the TONE parameter is ignored. An option for FSPTS

Argument	Description
STABILITY	When used with FSPTS, activates the additional oscillator stability analyses depending on the following values: ■ 0: A single point oscillator frequency-search stability analysis is performed. The FSPTS search is executed, and the first successful linear oscillation frequency value found is used as the starting point for the two-tier Newton nonlinear oscillator analysis. The probenode vp value specified is used as the starting amplitude for the Newton solver. ■ 1: (default) A single point oscillator frequency-search stability analysis, plus an estimate of oscillator amplitude, is performed. The FSPTS search is executed, and the first successful linear oscillation frequency value found is used as the starting point for the two-tier Newton nonlinear oscillator analysis. An additional analysis for automatically estimating the probenode amplitude is also performed, and this value is used as the starting amplitude for the two-tier Newton solver. ■ –1: A single point oscillator frequency-search stability analysis, plus an estimate of oscillator amplitude, is performed. The FSPTS search is executed, and the first successful linear oscillation frequency value found is accurately computed and reported. An additional analysis for automatically estimating the probenode amplitude is also performed, and this value is also reported. The analysis aborts without attempting the two-tier Newton nonlinear oscillator analysis. By using STABILITY=–1, a check can be made if any linear oscillation conditions are found, before attempting the nonlinear oscillator analysis. ■ 2: A multipoint frequency-search stability analysis is performed. The FSPTS search is executed, and all successful linear oscillation frequency values found over the entire FSPTS search range are reported. For each potential oscillation frequency found, an additional analysis for estimating the probenode amplitude is also performed. All frequency and amplitude values are reported. The frequency value that has the largest predicted amplitude is used as the starting point for the two-tier Newton nonlinear oscillator analysis. ■ –2: A multipoint frequency-search stability analysis is performed. The FSPTS search is executed, and all successful linear oscillation frequency values found over the entire FSPTS search range are reported. For each potential oscillation frequency found, an additional analysis for estimating the probenode amplitude is also performed. All frequency and amplitude values are reported. The analysis aborts without attempting the two-tier Newton nonlinear oscillator analysis. By using STABILITY=–2, a check can be made if any linear oscillation conditions are found, before attempting the nonlinear oscillator analysis.

Argument	Description
SWEEP	Type of sweep. You can sweep up to three variables. You can specify either LIN, DEC, OCT, POI, SWEEPBLOCK, DATA, OPTIMIZE, or MONTE. Specify the nsteps, start, and stop frequencies using the following syntax for each type of sweep: ■ LIN *nsteps start stop* ■ DEC *nsteps start stop* ■ OCT *nsteps start stop* ■ POI *nsteps freq_values* ■ SWEEPBLOCK=*swblockname* ■ DATA=*dataname* ■ OPTIMIZE=OPT*xxx* ■ MONTE=*val*
SUBHARMS	Subharmonics in the analysis spectrum. The minimum non-DC frequency in the analysis spectrum is f/subharms, where f is the frequency of oscillation. Use this option if your oscillator circuit includes a divider or prescaler that result in frequency terms that are subharmonics of the fundamental oscillation frequency

Description

Use this command to invoke oscillator analysis on autonomous (oscillator) circuits.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION HBFREQABSTOL	Specifies the maximum absolute change in frequency between solver iterations for convergence.
.OPTION HBFREQRELTOL	Specifies the maximum relative change in frequency between solver iterations for convergence.
.OPTION HBOSCMAXITER / HBOSC_MAXITER	Specifies the maximum number of outer-loop iterations for oscillator analysis.
.OPTION HBPROBETOL	Searches for a probe voltage at which the probe current is less than the specified value.
.OPTION HBTRANFREQSEARCH	Specifies the frequency source for the HB analysis of a ring oscillator.

Option	Description
.OPTION HBTRANINIT	Selects transient analysis for initializing all state variables for HB analysis of a ring oscillator.
.OPTION HBTRANPTS	Specifies the number of points per period for converting time-domain data results into the frequency domain for HB analysis of a ring oscillator.
.OPTION HBTRANSTEP	Specifies transient analysis step size for the HB analysis of a ring oscillator.

Command Group

Analysis

Examples

Example 1 *Performs an oscillator analysis searching for frequencies in the vicinity of 900 MHz. This example uses nine harmonics with the probe inserted between the gate and gnd nodes. The probe voltage estimate is 0.65 V.*

```
.HBOSC tone=900MEG nharms=9 probenode=gate,gnd,0.65
```

Example 2 *Performs an oscillator analysis searching for frequencies in the vicinity of 2.4 GHz. This example uses 11 harmonics with the probe inserted between the drainP and drainN nodes. The probe voltage estimate is 1.0 V.*

```
.HBOSC tone=2400MEG nharms=11
+ probenode=drainP,drainN,1.0 fspts=20,2100MEG,2700MEG
```

Another means to define the probenode information is through a zero-current source. Examples 3 and 4 shows two methods define an equivalent `.HBOSC` command.

Example 3 *Method 1*

```
.HBOSC tone = 2.4G nharms = 10
+ probenode = drainP, drainN, 1.0
+ fspts = 20, 2.1G, 2.7G
```

In Method 2, the `PROBENODE` information is defined by a current source in the circuit. Only one such current source is needed, and its current must be 0.0

with the HBOSC `PROBENODE` voltage defined through its `HBOSCVPROBE` property.

Example 4 Method 2

```
ISRC drainP drainN 0 HBOSCVPROBE = 1.0
.HBOSC tone = 2.4G nharms = 10
+ fspts = 20, 2.1G, 2.7G
```

See Also

.HB
.OPTION HBFREQABSTOL
.OPTION HBFREQRELTOL
.OPTION HBOSCMAXITER / HBOSC_MAXITER
.OPTION HBPROBETOL
.OPTION HBTRANFREQSEARCH
.OPTION HBTRANINIT
.OPTION HBTRANPTS
.OPTION HBTRANSTEP
.PRINT
.PROBE

.HBXF

Calculates transfer from the given source in the circuit to the designated output.

Syntax

`.HBXF` *`out_varfreq_sweep`*

Argument	Description
out_var	Specify `i(2_`*`port_elem`*`)` or `V(`*`n1`*`<,`*`n2`*`>)`

Argument	Description
freq_sweep	A sweep of type LIN, DEC, OCT, POI, or SWEEPBLOCK. Specify nsteps, start/stop times the syntax below for each type of sweep: ■ LIN *nsteps start stop* ■ DEC *nsteps start stop* ■ OCT *nsteps start stop* ■ POI *nsteps freq_values* ■ SWEEPBLOCK=*swblockname* Specify the frequency sweep range for the output signal. HSPICE determines the offset frequency in the input sidebands; for example,f1 = abs(fout - k*f0) s.t. f1<=f0/2The f0 is the steady-state fundamental tone and f1 is the input frequency.

Description

Calculates the transfer function from the given source in the circuit to the designated output.

Command Group

Analysis

Examples

Here, trans-impedance from `isrc` to `v(1)` is calculated based on HB analysis.

```
.hb tones=1e9 nharms=4
.hbxf v(1) lin 10 1e8 1.2e8
.print hbxf tfv(isrc) tfi(n3)
```

See Also

.HB
.HBAC
.HBNOISE
.HBOSC
.SNXF

.HDL

Specifies the Verilog-A source name and path.

Syntax

```
.HDL "file_name" [module_name] [module_alias]
```

Argument	Description
file_name	Verilog-A or CML file.
module_name	Optional module name. If a module is specified, then only that module is loaded from the specified Verilog-A or CML file. If the module is not found or if the module specification is not uniquely case-insensitive inside, then an error is generated. (Not valid for advanced analog functions).
module_alias	If specified (in addition to a module name), then that module is loaded into the system using the alias in place of the module name defined in the Verilog-A source file. Thereafter, any reference to the module is made using its alias. The system behaves as if the module had the alias as its module name. A module might be loaded with any number of aliases in addition to being loaded without an alias. This argument is useful when loading modules of the same name from different files. See Example 4 below. (Not valid for advanced analog functions)

Description

Use `.HDL` commands to specify the Verilog-A or compiled model library (CML) source name and path within a netlist. The Verilog-A file is assumed to have a `*.va` extension only when a prefix is provided. You can also use `.HDL` commands in `.ALTER` blocks to vary simulation behavior. For example, to compare multiple variations of Verilog-A modules.

In `.MODEL` commands you must add the Verilog-A type of model cards. Every Verilog-A module can have one or more associated model cards. The type of model cards should be the same as the Verilog-A module name. Verilog-A module names cannot conflict with HSPICE built-in device keywords. If a conflict occurs, HSPICE issues a warning message and the Verilog-A module definition is ignored.

The `module_name` and `module_alias` arguments can be specified without quotes or with single or double quotes. Any tokens after the module alias are ignored.

The same Verilog-A case insensitivity rules used for module and parameter names apply to both the `module_name` and `module_alias` arguments, and the same module override logic applies.

Command Group

Verilog-A

Examples

Example 1 loads the `res.va` Verilog-A model file from the directory `/myhome/Verilog_A_lib`.

Example 1

```
.HDL "/myhome/Verilog_A_lib/res.va"
```

Example 2 loads the `va_models.va` Verilog-A model file (not va_model file) from the current working directory.

Example 2

```
.HDL "va_models"
```

Example 3 loads the module called `va_amp` from the `amp_one.va` file for the first simulation run. For the second run, HSPICE loads the `va_amp` module from the `amp_two.va` file.

Example 3

```
* simple .alter test
.hdl amp_one.va
v1 1 0 10
x1 1 0 va_amp
.tran 10n 100n
.alter alter1
.hdl amp_two.va
.end
```

See Also

.ALTER
.MODEL
Using Verilog-A Modules Within the .MODULE Scope (for 3D-IC simulation)
.MODULE

.IBIS

Provides IBIS functionality by specifying an IBIS file and component and optional keywords.

Syntax

```
.IBIS 'ibis_name'
+ file='ibis_file_name'
+ component='component_name' [time_control=0|1]
```

```
+ [mod_sel='sel1=mod1,sel2=mod2,...']
+ [package=0|1|2|3] [pkgfile='pkg_file_name']
+ [typ={typ|min|max}]
+ [nowarn]
+ rlclen=0|1
+ ...
```

Argument (Keyword)	Description
ibis_name	Instance name of this ibis command.
file	Name of ibis (`*.ibs`) file.
component or cname	Component name.
time_control	Invokes an HSPICE time-control algorithm to achieve greater accuracy for high speed digital signal buffers: ■ 0: (default) Time step algorithm will not take effect. ■ 1: Launches the time-step algorithm.
mod_sel	Assigns special model for model selector, here model selector can be used for series model. If model selector is used for a pin of a component, but `mod_sel` is not set in the `.ibis` command, then the first model under the corresponding [Model Selector] will be selected as default.
package	When package equals: 0, then the package is not added into the component. 1, then RLC of [Package] (in the `.ibs` file) is added. 2, then RLC of [Pin] (in the `.ibs` file) is added. 3 (default), and if [Package Model] is defined, set package with a package model. If the [Package Model] is not defined, set the package with [Pin]. If the package information is not set in [Pin], set the package with [Package] as a default. You can define the [Package Model] in an IBIS file specified by the *file* keyword or a PKG file specified by the ***pkgfile*** keyword. The pkgfile keyword is useful only when package =3
typ	The value of the typ signifies a column in the *IBIS* file from which the current simulation extracts data. The default is typ=typ. If min or max data are not available, typ data are used instead.

Argument (Keyword)	Description
nowarn	The nowarn keyword suppresses warning messages from the IBIS parser.
rlclen	Sets the length of W element for R,L,C matrix based package model. Valid values are 0 (default) and 1. If `rlclen=0`, HSPICE creates lumped R,L,C instances for package with data from R,L,C matrixes in package model.

Description

The general syntax above shows the `.IBIS` command when used with a component. The optional keywords are in square brackets.

Command Group

Input/Output Buffer Information Specification (IBIS)

Examples

```
.ibis cmpnt
+ file = 'ebd.ibs'
+ component = 'SIMM'
+ hsp_ver=2002.4 nowarn package=2
```

This example corresponds to the following `ebd.ibs` file:

```
[Component]   SIMM
[Manufacturer]   TEST
[Package]
R_pkg    200m    NA   NA
L_pkg    7.0nH    NA    NA
C_pkg    1.5pF    NA    NA
|
[Pin]   signal_name   model_name   R_pin   L_pin   C_pin
|
1    ND1    ECL    40.0m   2n   0.4p
2    ND2    NMOS    50.0m   3n   0.5p
.................
```

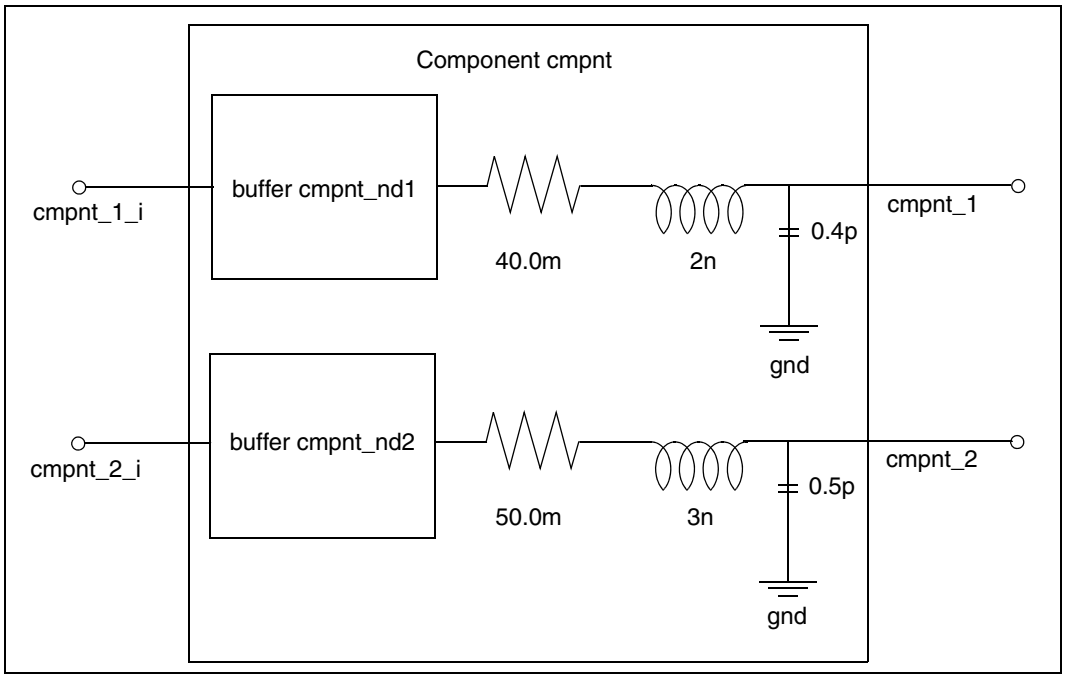


Figure 8 Equivalent Circuit for IBIS Component Example

```
.IBIS cmpt1
+ file='example.ibs'
+ component='EXAMPLE'
+ mod_sel = 'DQ = DQ_FULL'
```

In the following example, the model `DQ_FULL` will be used for all pins that use the model name `DQ`.The corresponding IBIS file, `example.ibs`, contains the following [Model Selector] section:

```
|**********************MODEL SELECTOR**********************
|
Model Selector] DQ
|
DQ_FULL                Full-Strength IO Driver
DQ_HALF                54% Reduced Drive Strength IO Driver
*
```

See Also

.EBD
.PKG
IBIS Examples (`iob_ex1.sp`) for demonstration files and see `.IBIS` command use in `ebd.sp` and `pinmap.sp`

.IC

Sets transient initial conditions in HSPICE.

Syntax

```
.IC V(node1)=val1 V(node2)=val2 ... [subckt=sub_name]
```

Argument	Description
val1 ...	Specifies voltages. The significance of these voltages depends on whether you specify the UIC parameter in the .TRAN command.
node1 ...	Node numbers or names can include full paths or circuit numbers.
subckt=*sub_name*	Initial condition is set to the specified node name(s) within all instances of the specified subcircuit name. This subckt setting is equivalent to placing the .IC statement within the subcircuit definition. The tool supports wildcards in subckt argument values of .IC statements.

Description

Use the .IC command or the .DCVOLT command to set transient initial conditions in HSPICE. How it initializes depends on whether the .TRAN analysis command includes the UIC parameter. This command is less preferred compared to using the .NODESET command in many cases.

The value set by an .IC statement is a Norton equivalent circuit that contains the finite conductance value of GMAX (100 mhos by default). For most cases, this model has good performance and accuracy. If a Norton equivalent circuit created by that source is comparable with the conductance of other parts of the circuit, the DC node voltages will deviate from those specified in the .IC statement. To counteract such deviance, use .OPTION IC_ACCURATE=1.

When using the .IC command, forcing circuits are connected to the .IC nodes for the duration of DC convergence. After DC convergence is obtained, the forcing circuits are removed for all further analysis. The DC operating point for each .IC'd node should be very close to the voltage specified in the .IC command. If a node is not, then that node has a DC conductance to ground comparable to GMAX. This is almost certainly an error condition. In the rare

case that it is not, GMAX can be increased to prevent appreciable current division. Example: `.OPTION GMAX=1000`

Note: In nearly all applications, `.NODESET` should be used to ensure a true DC operating point is obtained. Intentionally floating (or very high impedance) nodes should be set to a known good voltage using `.IC`.

If you do not specify the UIC parameter in the .TRAN command, HSPICE computes the DC operating point solution before the transient analysis. The node voltages that you specify in the `.IC` command are fixed to determine the DC operating point. They are used only in the first iteration to set an initial guess for the DC operating point analysis. The `.IC` command is equivalent to specifying the IC parameter on each element command, but is more convenient.

If you specify the UIC parameter in the `.TRAN` command, HSPICE does not calculate the initial DC operating point, but directly enters transient analysis. When you use `.TRAN` UIC, the `.TRAN` node values (at time zero) are determined by searching for the first value found in this order: from `.IC` value, then IC parameter on an element command, then `.NODESET` value; otherwise, use a voltage of zero.

Note that forcing a node value of the dc operating point may not satisfy KVL and KCL. In this event you may likely see activity during the initial part of the simulation.This may happen if UIC is used and some node values left unspecified, when too many (conflicting) `.IC` values are specified, or when node values are forced and the topology changes. In this event you may likely see activity during the initial part of the simulation. Forcing a node voltage applies a fixed equivalent voltage source during DC analysis and transient analysis removes the voltage sources to calculate the second and later time points.

Therefore, to correct DC convergence problems use `.NODESET`s (without `.TRAN` UIC) liberally (when a good guess can be provided) and use `.IC`s sparingly (when the exact node voltage is known).

You can use wildcards in the `.IC` command. See Using Wildcards on Node Names in the *HSPICE User Guide: Basic Simulation and Analysis*. Expressions containing ternary operators are not supported in `.IC` command and, if used, can produce unexpected results.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION DCIC	Specifies whether to use or ignore .IC commands in the netlist.
.OPTION GMAX	Specifies the maximum conductance in parallel with a current source for .IC and .NODESET initialization circuitry.
.OPTION IC_ACCURATE	Improves the accuracy of the .IC command.

Command Group

Setup

Examples

Example 1

```
.IC V(11)=5 V(4)=-5 V(2)=2.2
```

Example 2 All settings in this statement are applied to subckt my_ff.

```
.IC V(in)=0.9 subckt=my_ff
```

See Also

.DCVOLT
.TRAN
.NODESET

.ICM

Automatically creates port names that reference the pin name of an ICM model and generate a series of element nodes on the pin.

Syntax

```
.ICM icmname
+ file='icmfilename'
+ model='icmmodelname'
```

Argument	Description
icmname	.ICM command card name.

Argument	Description
icmfilename	Name of an `*.icm` file that contains an ICM model.
icmmodelname	Working model in an `*.icm` file.
nodemapname	Name of the [ICM node map] keyword in an .icm file.
pinmapname	Name of the [ICM pin map] keyword in an .icm file.
pinname	Name of the first column of entries of the [ICM node map] or [ICM pin map].
sidename	Name of the side subparameter

Description

Use this command to automatically create port names that reference the pin name of an ICM model and generate a series of element (W/S/RLGCK) nodes on the pin when one of the following conditions occur:

- If the model is described using [Nodal Path Description] 'icmname'_'nodemapname'_'sidename'_'pinname'
- If the model is described using [Tree Path Description] 'icmname'_'pinmapname'_'sidename'_'pinname'

Note: If a side subparameter is not used in an ICM file, then 'sidename'_ (above) should be removed.

Command Group

Input/Output Buffer Information Specification (IBIS)

Examples

```
.ICM icm1
+ file='test1.icm'
+ model='FourLineModel1'
```

The following example shows how to reference a pin of the ICM model in a HSPICE netlist.

```
icm1_NodeMap1_SideName1_pin1, icm1_NodeMap2_SideName2_pin1,
icm1_NodeMap2_SideName2_pin2, ...
```

See Also

IBIS Examples for .ICM command usage (RLGC approach—/icm/nodepath_rlgc/bga_1.sp), (S-element approach—/icm/nodepath_sele/test1.sp), (treepath—test1.sp), and treepath swath matrix expansion (/icm/treepath_swath/complex.sp)

.IF

Specifies conditions that determine whether HSPICE executes subsequent commands in conditional block.

Syntax

```
.IF (condition1)...
+ [.ELSEIF (condition2)...]
+ [.ELSE ...]
.ENDIF
```

Argument	Description
condition1	Condition that must be true before HSPICE executes the commands that follow the .IF command.
condition2	Condition that must be true before HSPICE executes the commands that follow the .ELSEIF command. HSPICE executes the commands that follow *condition2* only if *condition1* is false and *condition2* is true.
(def(flag))	This function allows for checking whether a parameter exists (is defined), and with the if-else construct allows for including certain parts of a model or library, if the parameter has been defined elsewhere in the netlist, or omit the part, if the parameter does not exist. The flag can be the parameterName. See example 2 for syntax.

Description

HSPICE executes the commands that follow the first .ELSEIF command only if *condition1* in the preceding .IF command is false and *condition2* in the first .ELSEIF command is true.

If *condition1* in the .IF command and *condition2* in the first .ELSEIF command are both false, then HSPICE moves on to the next .ELSEIF command if there is one. If this second .ELSEIF condition is true, HSPICE executes the commands that follow the second .ELSEIF command, instead of

the commands after the first .ELSEIF command.

HSPICE ignores the commands in all false .IF and .ELSEIF commands, until it reaches the first .ELSEIF condition that is true. If no .IF or .ELSEIF condition is true, HSPICE continues to the .ELSE command.

.ELSE precedes one or more commands in a conditional block after the last .ELSEIF command, but before the .ENDIF command. HSPICE executes these commands by default if the conditions in the preceding .IF command and in all of the preceding .ELSEIF commands in the same conditional block all false.

The .ENDIF command ends a conditional block of commands that begins with an .IF command.

For information on use of conditional blocks with the Exploration Block, see, Specifying Constraints in the *HSPICE User Guide: Basic Simulation and Analysis*.

Command Group

Conditional Block

Examples

Example 1

```
.IF (a==b)
.INCLUDE /myhome/subcircuits/diode_circuit1
...
.ELSEIF (a==c)
.INCLUDE /myhome/subcircuits/diode_circuit2
...
.ELSE
.INCLUDE /myhome/subcircuits/diode_circuit3
...
.ENDIF
```

Example 2 *Using the def (Defined) parameter so that if parameterName is available it is included; if not it is excluded without generating an error.*

```
.if (def(flag))
     .inc "file1.dat"
.else
    .inc "file2.dat"
.endif
```

See Also

.ELSE

.ELSEIF
.ENDIF

.INCLUDE / INC / INCL

Includes another netlist as a subcircuit of the current netlist.

Syntax

```
.INCLUDE 'file_pathfile_name'
```

Argument	Description
file_path	Path name of a file for computer operating systems that support tree-structured directories. An include file can contain nested .INCLUDE calls to itself or to another include file. If you use a relative path in a nested .INCLUDE call, the path starts from the directory of the parent .INCLUDE file, not from the current working directory. If the path starts from the current working directory, HSPICE can also find the .INCLUDE file, but prints a warning.
file_name	Name of a file to include in the data file. The file path, plus the file name, can be up to 16 characters long. You can use any valid file name for the computer's operating system.

Description

Use this command to include another netlist in the current netlist. You can include a netlist as a subcircuit in one or more other netlists. You must enclose the file path and file name in single or double quotation marks. Otherwise, an error message is generated. Any file name following an .INC command is case sensitive. You can define the models inside of a subcircuit using .INCLUDE statements. The parameters defined in the included models are global by default but you want any parameters defined in the included file to be local to the subcircuit if you want to define a model that is specific to only one subcircuit. This means that you will also need to set .OPTION PARHIER=LOCAL so that parameter scoping rules are correct for this case.

This command can be used as part of a compressed (.gzip) netlist file.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION PARHIER / PARHIE	Specifies scoping rules for netlist parameters.

Command Group

Subcircuits and Library Management

Examples

Example 1 Simple syntax example

```
.INCLUDE `/myhome/subcircuits/diode_circuit´
```

Example 2 Showing use of .OPTION PARHIER

```
...
.option PARHIER=LOCAL
.subckt INV IN OUT
.include 'weak_ model.inc'
M1 ...
M2 ...
.ends INV
..
X1 IN OUT INV
..
```

See Also

.SUBCKT

.IVDMARGIN

Helps characterize Vdmargin using terminal I-V at MOSFET external nodes.

Syntax

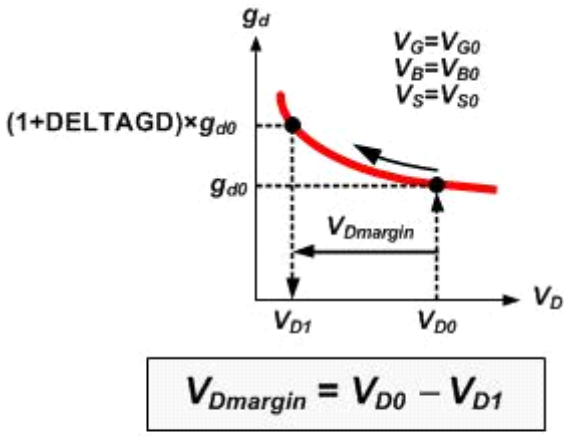
.IVDMARGIN *instance_name*|*macromodel_name* DELTAGD=*val*

Argument	Description
instance_name	When specified, this element uses the command-line specified DELTAGD value for the iVdmargin calculation.

Argument	Description
macromodel_name	When specified, all the elements in the subcircuit use the command-line specified DELTAGDS value for iVdmargin calculation.
DELTAGD	Default=0.1. A positive variable in double type to define the relative gd change on the right side of the equation. DELTAGD is typically in a range of 0 to 1. If not specified, HSPICE uses DELTAGD=0.1.

Description

Vdmargin, as shown in the following plot, is defined as the MOSFET drain voltage range within which the change in the MOSFET drain conductance $g_d = \frac{\partial I_d}{\partial V_d}$ (with respect to reference (the gd value at operating point) is smaller than a user-specified target. It provides a heuristic measure of how much the drain voltage can be reduced, particularly in the saturation region of MOSFET operation, beyond which the MOSFET drain conductance has degraded beyond a user-specified tolerance.



Command Group

Library Management

Examples

Example 1 The M3 instance uses DELTAGD=0.3.

```
.iVdmargin M3 DELTAGD=0.3
```

Example 2 Both M1 and M2 use DELTAGD=0.2.

```
.iVdmargin XM5 DELTAGD=0.2
XM5 n00 n01 vdd vss inv
     .subckt inv in out vdd vss
       M1 out in vss vss nch w=1e-6 l=0.3e-6
       M2 out in vdd vdd pch w=1e-6 l=0.3e-6
     .ends
```

See Also

.OPTION IVDMARGIN

.IVTH

Invokes the constant-current based threshold voltage characterization.

Syntax

```
.IVTH model_name Ivth0=val DW=val DL=val VDSMIN=val
+ [.OPTION SX_factor=x]
```

Argument	Description
model_name	Model name that iVth characterization applies to.
Ivth0=val	Constant drain terminal current density.
DW=*val*	Width offset for iVth current calculation.
DL=*val*	Length offset for iVth current calculation.
VDSMIN=*val*	User-defined minimum vds value.
.OPTION SX_factor	A special option, .OPTION SX_factor, is provided to scale the width and length specifically for iVth characterization.

Description

Use this command to enable constant current-based threshold voltage characterization. The threshold voltage reported by iVth characterization is

defined as the MOSFET's gate-to-source voltage at which the drain terminal current reaches the user-defined constant current value. The drain and body biases of the device are set to their corresponding bias conditions in the circuit. For example, in DCOP, the drain and body bias of the device is set to its operating point condition. In DC sweep or transient analysis, drain and body bias of the device is set to its solution at each sweep or time point.

The constant current for each MOSFET is given as follows:

```
Ivth=Ivth0 * (Wdrawn * SX_factor + DW)/(Ldrawn * SX_factor + DL)
```

VDSMIN provides a user-defined minimum Vds value and invokes a special characterization method for small Vds bias to ensure continuation and meaningful characterization result.

If VDSMIN is not given, the same iVth characterization methodology is applied for all vds bias regions. If VDSMIN is not given, `VDSMIN=0.05`. If Vds is smaller than VDSMIN, then:

1. Simulate Vth_op(Vdsmin) and Vth_ivth(Vdsmin) where: Vth_op() is the threshold voltage acquired from model formulation, and vth_ivth() is the threshold voltage acquired from iVth method.
2. Calculate DeltaVth = Vth_op(Vdsmin) - Vth_ivth(Vdsmin)
3. Simulate Vth_op(Vds)
4. Calculate Vth_ivth(Vds) = Vth_op(Vds) - DeltaVth

Multiple ivth commands can be added in a netlist to invoke characterization of different models.

Command Group

Library Management

Examples

```
.ivth nch Ivth0=1.5e-7 DW=2e-8 DL=1e-8 VDSMIN=0.06
.ivth pch Ivth0=1e-7 DW=2e-8 DL=1e-8 VDSMIN=0.06
```

In OP analysis, a constant current based vth is reported in the OP output. In addition, the element region operation check and Vod output are based on the new `vth`.

During transient or DC analysis, template output of `LX142(m*)` or `ivth(m*)` could be used for the new `vth` output.

.LAYERSTACK

Defines a stack of dielectric or metal layers.

Syntax

```
.LAYERSTACK sname [BACKGROUND=mname]
+ [LAYER=(mname,thickness) ...]
```

Argument	Description
sname	Layer stack name.
mname	Material name.
BACKGROUND	Background dielectric material name. By default, the field solver assumes AIR for the background.
thickness	Layer thickness.

Description

Use this command to define a stack of dielectric or metal layers. You must associate each transmission line system with *only* one layer stack. However, you can associate a single-layer stack with many transmission line systems.

In the layer stack:

- Layers are listed from bottom to top.
- Metal layers (ground planes) can be located only at the bottom, only at the top, or both at the top and bottom.
- Layers are stacked in the y-direction; the bottom of a layer stack is at y=0.
- All conductors must be located above y=0.
- Background material must be dielectric.

The following limiting cases apply to the `.LAYERSTACK` command:

- Free space without ground:

  ```
  .LAYERSTACK mystack
  ```

- Free space with a (bottom) ground plane where a predefined metal name = perfect electrical conductor (PEC):

  ```
  .LAYERSTACK halfSpace PEC 0.1mm
  ```

Command Group

Field Solver

See Also

.FSOPTIONS
.MATERIAL
.SHAPE
Transmission (W-element) Line Examples

.LIB

Creates and reads from libraries of commonly used commands, device models, subcircuit analyses, and commands.

Syntax

Use the following syntax for library calls:

```
.LIB '[file_path] file_name' entry_name
```

Use the following syntax to define library files:

```
.LIB entry_name1
. $ ANY VALID SET OF HSPICE STATEMENTS
.ENDL entry_name1
.LIB entry_name2
.
. $ ANY VALID SET OF HSPICE STATEMENTS
.ENDL entry_name2
.LIB entry_name3
.
. $ ANY VALID SET OF HSPICE STATEMENTS
.ENDL entry_name3
```

Argument	Description
file_path	Path to a file. Used where a computer supports tree-structured directories. When the LIB file (or alias) is in the same directory where you run HSPICE you do not need to specify a directory path; the netlist runs on any machine. Use "../" syntax in the file_path to designate the parent directory of the current directory.

Argument	Description
entry_name	Entry name for the section of the library file to include. The first character of an entry_name cannot be an integer. If more than one entry with the same name is encountered in a file, only the first one is loaded.
file_name	Name of a file to include in the data file. The combination of filepath plus file_name can be up to 256 characters long, structured as any filename that is valid for the computer's operating system. Enclose the file path and file name in single or double quotation marks. Use "../" syntax in the filename to designate the parent directory of the current directory.

Description

Use the .LIB call command to read from libraries of commonly used commands, device models, subcircuit analyses, and commands (library calls) in library files. Note that as HSPICE encounters each .LIB call name in the main data file, it reads the corresponding entry from the designated library file, until it finds an .ENDL command.

You can also place a .LIB call command in an .ALTER block.

To build libraries (library file definition), use the .LIB command in a library file. For each macro in a library, use a library definition command (.LIB *entry_name*) and an .ENDL command. The .LIB command begins the library macro and the .ENDL command ends the library macro. The text after a library file entry name must consist of HSPICE commands. Library calls can call other libraries (nested library calls) if they are different files. You can nest library calls to any depth. Use nesting with the .ALTER command to create a sequence of model runs. Each run can consist of similar components by using different model parameters without duplicating the entire input file.

The simulator uses the .LIB command and the .INCLUDE command to access the models and skew parameters. The library contains parameters that modify .MODEL commands.

You must enclose the file path and file name in single or double quotation marks. Otherwise, an error message is generated. Any file name following a .LIB command is case sensitive. To terminate the .LIB command use .ENDL or .ENDL *entry_name*.

This command can be used as part of a compressed (.gzip) netlist file.

Command Group

Library Management

Examples

Example 1 is a simple library call.

```
* Library call
.LIB 'MODELS' cmos1
```

Example 2 shows the syntax of using any valid set of advanced analog commands.

```
.LIB MOS7
$ Any valid set of HSPICE commands
.
.
.
.ENDL MOS7
```

Example 3 is an example of *illegal* nested `.LIB` commands for the `file3` library.

```
.LIB MOS7
...
.LIB 'file3' MOS7 $ This call is illegal in MOS7 library
...
.ENDL
```

Example 4 is a `.LIB` call command of model skew parameters and features both worst-case and statistical distribution data. The statistical distribution median value is the default for all non-Monte Carlo analyses. The model is in

the /usr/meta/lib/cmos1_mod.dat include file.

```
.LIB TT
$TYPICAL P-CHANNEL AND N-CHANNEL CMOS LIBRARY
$ PROCESS: 1.0U CMOS, FAB7
$ following distributions are 3 sigma ABSOLUTE GAUSSIAN
.PARAM TOX=AGAUSS(200,20,3)   $ 200 angstrom +/- 20a
+ XL=AGAUSS(0.1u,0.13u,3)   $ polysilicon CD
+ DELVTON=AGAUSS(0.0,.2V,3)   $ n-ch threshold change
+ DELVTOP=AGAUSS(0.0,.15V,3)
   $ p-ch threshold change
.INC '/usr/meta/lib/cmos1_mod.dat'
   $ model include file
.ENDL TT
.LIB FF
$HIGH GAIN P-CH AND N-CH CMOS LIBRARY 3SIGMA VALUES
.PARAM TOX=220 XL=-0.03 DELVTON=-.2V
+ DELVTOP=-0.15V
.INC '/usr/meta/lib/cmos1_mod.dat'
   $ model include file
.ENDL FF
```

In example 5, the .MODEL keyword (left side) equates to the skew parameter (right side). A .MODEL keyword can be the same as a skew parameter.

```
.MODEL NCH NMOS LEVEL=2 XL=XL TOX=TOX
+ DELVTO=DELVTON .....
.MODEL PCH PMOS LEVEL=2 XL=XL TOX=TOX
+ DELVTO=DELVTOP .....
```

See Also

.ALTER
.ENDL
.INCLUDE / INC / INCL

.LIN

Extracts noise and linear transfer parameters for a general multiport network.

Syntax

Multiport Syntax

```
.LIN [sparcalc=[1|0] [type=s|y] [modelname = modelname]]
+ [filename = filename]
+ [format=selem|citi|touchstone | touchstone2]
```

```
+ [noisecalc=[1|0] [gdcalc=[1|0]]
+ [mixedmode2port=dd|dc|ds|cd|cc|cs|sd|sc|ss]
+ [dataformat=ri|ma|db]
```

Two-Port Syntax

```
.LIN [sparcalc=1|0 [type=s|y] [modelname = modelname]]
+ [filename = filename]
+ [format=selem|citi|touchstone | touchstone2]
+ [noisecalc=1|0] [gdcalc=1|0]
+ [mixedmode2port=dd|dc|ds|cd|cc|cs|sd|sc|ss]
+ [dataformat=ri|ma|db] [FREQDIGIT=x] [SPARDIGIT=x]
+ [listfreq=(frequencies|none|all|freq1 freq2...)]
+ [listcount=num] [listfloor=val] [listsources=1|0|yes|no]
```

Argument	Description
sparcalc	If 1 (default), extract S- or Y- parameter data. The value of the `type` argument determines whether S- or Y-parameter data is generated.
type	Specify this argument value as `y` to generate Y-parameter data to a Touchstone format file. Otherwise, specify the value as `s` (default) to generate S-parameter data.
modelname	Model name to be listed in the .MODEL command in the .sc# model output file.
filename	Output file name (The default is netlist name).
format	Output file format: ■ selem: S-element `.sc#` format, which you can include in the netlist. ■ citi:CITIfile format. ■ touchstone and touchstone2:TOUCHSTONE v1.0 and v2.0 format, respectively.
noisecalc	Specifies level of N-port noise wave correlation matrix extraction. If 1, extract noise parameters (perform 2-port noise analysis). The default is 0.
gdcalc	If 1, extract group delay (perform group delay analysis). The default is 0.

Argument	Description
mixedmode2port	The mixedmode2port keyword describes the mixed-mode data map of output mixed mode S-parameter matrix. The availability and default value for this keyword depends on the first two port (P-element) configuration as follows: ■ case 1: p1=p2=single (standard mode P element) available: ss default: ss ■ case 2: p1=p2=balanced (mixed mode P element) available: dd, cd, dc, cc default: dd ■ case 3: p1=balanced p2=single available: ds, cs default: ds ■ case 4: p1=single p2=balanced available: sd, sc default: sd
dataformat	The dataformat keyword describes the data format output to the `.sc#/touchstone1.0|2.0/citi` file. ■ dataformat=RI, real-imaginary. This is the default for the .sc#/citi file. ■ dataformat=MA, magnitude-phase. This is the default format for touchstone file. ■ dataformat=DB, DB(magnitude)-phase. HSPICE uses six digits for both frequency and S-parameters in HSPICE generated data files (.sc#/ touchstone/citifile). The number of digits for noise parameters are five in .sc# and Touchstone files and six in CITIfiles. **Note**: The lower limit of DB output is -300.
FREQDIGIT	Sets the numerical precision (number of digits) for frequency output in Touchstone, Citi, or `sc#` files. The default is 6.
SPARDIGIT	Sets the numerical precision (number of digits) for S parameter output in Touchstone, Citi, or `sc#` files. The default is 6.

Argument	Description

listfreq= (none|all|freq1req2....)	Dumps the element noise figure contribution to the total NF in the `*.lis` file. You can specify at which frequencies HSPICE dumps the element noise figure contribution. The elements that contribute the largest noise figure are dumped first. The frequency values can be specified by the NONE or ALL keyword, which either dumps no frequencies or every frequency defined in the AC sweep.
	■ ALL: Output all of the frequency points (default, if LIST* is required).
	■ NONE - Do not output any of the frequency points.
	■ freq1 freq2...: Output the information on the specified frequency points.
	For example:
	`listfreq=none`
	`listfreq=all`
	`listfreq=1.0G`
	`listfreq=1.0G 2.0G`

listcount=*num*	Outputs the first few noise elements that make the biggest contribution to NF. The number is specified by *num*. The default is to output all of the noise element contribution to NF. The NF contribution is calculated with the source impedance equal to the Zo of the first port.
listfloor=*val*	Lists elements whose noise contribution to NF (in dB) are higher than value specified in dB to `.lis` file. Default is `0`.
listsources=[1|0|yes|no]	Defines whether or not to output the contribution of each noise source of each noise element. Default is `no/0`.

Description

Use this command to extract noise and linear transfer parameters for a general multiport network.

When used with P- (port) element(s) and `.AC` commands, `.LIN` makes available a broad set of linear port-wise measurements:

- standard and mixed-mode multiport S- (scattering) parameters
- standard and mixed-mode multiport Y/Z parameters
- standard mode multiport H-parameter

- standard mode two-port noise parameters
- standard and mixed-mode group delays
- standard mode stability factors
- standard mode gain factors
- standard mode matching coefficients

The .LIN command computes the S-(scattering), Y-(admittance), Z-(impedance) parameters directly, and H-(hybrid) parameters directly based on the location of the port (P) elements in your circuit, and the specified values for their reference impedances. The .LIN command also supports mixed-mode transfer parameters calculation and group delay analysis when used together with mixed-mode P elements.

To calculate the insertion and return loss for the high speed differential signal on my PCB board you can use the .LIN command with a port (P) element at input and output, where Port=1 defines the input and Port=2 defines the output. The return loss in dB is |S111(DB)| and the insertion loss in dB is |S21(DB)|.

By default, the .LIN command creates a .sc# file with the same base name as your netlist. This file contains S-parameter, noise parameter, and group delay data as a function of the frequency. You can use this file as model data for the S-element. Noise contributor tables are generated for every frequency point and every circuit device. The last four arguments allow users to better control the output information. If the LIST* arguments are not set, .LIN 2port noise analysis will output to .lis file with the older format. If any of the LIST* arguments is set, the output information follows the syntax noted in the arguments section.

Command Group

Analysis

Examples

This example extracts linear transfer parameters for a general multiport network, performs a 2-port noise analysis and a group-delay analysis for a model named my_custom_model. The output is in the mydesign Touchstone format output file. The data format in the Touchstone file is real-imaginary.

```
.LIN sparcalc=1 modelname=my_custom_model
+ filename=mydesign format=touchstone noisecalc=1
+ gdcalc=1 dataformat=ri
```

See Also

Filters Examples, `fbpnet.sp`, for a bandpass LCR filter demo using the `.LIN` command

.LOAD

Uses the operating point information of a file previously created with a `.SAVE` command (Not valid for advanced analog functions).

Syntax

`.LOAD [FILE=`*`load_file`*`] [RUN=PREVIOUS|CURRENT]`

Argument	Description
load_file	Name of the file in which `.SAVE` saved an operating point for the circuit under simulation.The format of the file name is *design*.ic#. Default is *design*.ic0, where *design* is the root name of the design.
RUN	The format of file name is *design*.ic#. Used only outside of `.ALTER` commands in a netlist that contains `.ALTER` commands. ▪ `PREVIOUS`: Each `.ALTER` uses the saved operating point from the previous `.ALTER` run in the current simulation run. ▪ `CURRENT`: Each `.ALTER` uses the saved operating point from the corresponding `.ALTER` run in the previous simulation run.

Description

Use this command to input the contents of a file that you stored using the `.SAVE` command. Files stored with the `.SAVE` command contain operating point information for the point in the analysis at which you executed `.SAVE`.

Do not use the `.LOAD` command for concatenated netlist files.

`.LOAD` is not supported with `.ALTER` and `.load run=previous` commands.

This command can be used as part of a compressed (`.gzip`) netlist file.

Command Group

Setup and Library Management

Examples

Example 1 loads a file name *design.ic0*, which you previously saved using a .SAVE command.

Example 1

```
.SAVE FILE=design.ic0
.LOAD FILE=design.ic0
                $load--design.ic0 save--design.ic0
.alter
...             $load--none   save--design.ic1
.alter
...             $load--none   save--design.ic2
.end
```

Example 2 runs a previously saved and loaded design.

Example 2

```
.SAVE FILE=design.ic
.LOAD FILE=design.ic RUN=PREVIOUS
               $load--none   save--design.ic0
.alter
...            $load--design.ic0 save--design.ic1
.alter
...            $load--design.ic1 save--design.ic2
.end
```

Example 3 runs the current design.

Example 3

```
.SAVE FILE=design.ic
.LOAD FILE=design.ic RUN=CURRENT
              $load--design.ic0 save--design.ic0
.alter
...           $load--design.ic1 save--design.ic1
.alter
...           $load--design.ic2 save--design.ic2
.end
```

See Also

.ALTER
.SAVE

.LPRINT

Produces output in VCD (Value Change Dump) file format from transient analysis in HSPICE.

Syntax

```
.LPRINT (v1,v2) output_varable_list
```

Argument	Description
v1, v2	Threshold values for digital output. Values less than v1 are output as digital 0. Values greater than 1 are output as digital 1.
output_varable_list	Output variables to .PRINT. These are variables from a DC, AC, TRAN, or NOISE analysis).

Description

Use this command to produce output in VCD (Value Change Dump) file format from transient analysis.

Command Group

Analysis

Examples

In this example, the .LPRINT command sets threshold values to 0.5 and 4.5, and the voltage level at voltage source VIN.

```
.LPRINT (0.5,4.5) v(VIN)
```

See Also

.PRINT

.LSTB

Invokes linear loop stability analysis.

Syntax

```
Vxxx drv fbk 0
.LSTB mode=[single|diff|comm]
+ vsource=[vlstb|vlstbp,vlstbn]
.PRINT|PROBE AC
```

```
+ LSTB|LSTB(DB)|LSTB(M)|LSTB(P)|LSTB(R)|LSTB(I)
```

Argument	Description
V*xxx*	The 0V voltage source(s) indicating the insertion point of test circuit. Note that the direction of *Vxxx* is of significance in diff/comm mode analysis. ▪ drv: Driving node (i.e., input of amplifier) ▪ fbk: Feedback node (i.e., output of amplifier)
mode	▪ Single: (default) single-ended test. Single mode analysis is used to deal with feedback circuit with only one single signal path. ▪ Diff: differential mode test. ▪ Comm: common mode test. If the feedback loop has a differential amplifier, then there are two signal paths. In this situation, diff and comm mode should be used, respectively, to calculate the differential and common mode loop gain.
Vsource	▪ Vlstb: The only one vsource for single-ended mode test. ▪ Vlstbp: One of the two vsources for differential or common mode test. ▪ Vlstpn: The other one of the two vsources for differential or common mode test.
LSTB	Output all results: dB, magnitude, phase, real and imaginary part of loop gain.
LSTB(x)	▪ x=DB: Output the dB values of loop gain. ▪ X=M: Output magnitude of loop gain. ▪ X=P: Output phase of loop gain. ▪ X=R: Output real part of loop gain. ▪ X=I: Output imaginary part of loop gain.

Description

The `.LSTB` command measures the loop gain by successive injection (Middlebrook's Technique). A 0V voltage source is placed in series in the loop: one pin of the voltage loop must be connected to the loop input, the other pin to the loop output. The orientation of inserted voltage sources in differential and common-mode testing is significant. It is required that the positive terminal of both voltage sources go to the input of amplifier or go to the output of amplifier. The first 3 characters of the `mode` type are effective (*sin*, *dif* or *com*). For single-ended (default mode) test: place one 0V DC voltage source in series and specify its name in the loop of interest, then add the `.LSTB` statement and specify `single` as `mode`. For differential and common-mode loop analysis, set

diff or comm as the mode and specify the names of two 0V DC voltage sources.

.MEASURE statements are supported similar to any ac output variables. The feature can be used with .ALTER to generate multiple loop analyses. (See examples below.)

The outputs for loop stability analysis are as follows:

- The gain margin (GM), phase margin (PM), unity gain frequency (FU) and gain at minimum frequency (ADC) are reported in the *.lis file.
- The Loop Gain is reported to the *.cx# file, which is always produced for .LSTB analysis. The *.cx# file is a general file for all the complex number outputs. It contains the data for waveforms as complex vectors.
- If you specify .probe ac lstb(db) lstb(mag) lstb(real) lstb(imag) lstb(phase), the specific format of loop gain goes to the *.ac# file for viewing.
- If an *.ac# file is produced with .probe ac lstb, then both *.ac# and *.cx# file could be used to view magnitude, phase, real, and imaginary versus frequency as complex vectors.

Considerations regarding loop stability analysis include the following:

- .LSTB analysis is based on a linearized circuit at a given DC operating point. It does not guarantee a stable condition for large signal condition. As a final stability check, designers should perform transient analysis; i.e.,inject a slow sinusoid superimposed with a series of fast pulses into the loop; the amount of ringing indicates the degree of stability for the circuit.
- All other independent AC voltage sources are disabled automatically when .LSTB is enabled.
- .OPTION UNWRAP is set to 1 and if phase wrapping is found, the phase is corrected by 180 degrees.
- If phase/gain margin is not found in the given ac analysis frequency range, a warning message is issued.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION UNWRAP	Displays phase results for AC analysis in unwrapped form.

Command Group

Analysis

Examples

Example 1 *This example shows a sample portion of a netlist where the first two lines are the 0 voltage sources indicating the insertion point of circuit under test; line 3 sets the .LSTB analysis using the differential mode and specifies the two vsources; line 4 sets the .AC analysis, and the last three lines specify post-processing (printing, plotting, and measurements).*

```
V1 n1 n2 0
V2 n3 n4 0
.LSTB mode=diff vsource=v1,v2
.AC DEC 10 1K 1MEG
.PRINT AC LSTB(DB) LSTB(M) LSTB(P) LSTB(R) LSTB(I)
.PROBE AC LSTB(DB) LSTB(M) LSTB(P) LSTB(R) LSTB(I)
.MEASURE AC phase_margin FIND LSTB(P) when LSTB(DB)=0
```

Example 2 *The .MEASURE statement is supported such as any common ac output variable.*

```
.measure ac phase_margin FIND lstb(P) when lstb(db)=0
.measure ac integ1 INTEGRAL lstb(P) FROM=1k TO=100k
```

Example 3 *In this example, the lstb scalars are measured in which lstb is the type name, out1-out4 are names for output, followed by scalar variable keywords:*

```
.measure lstb out1 gain_margin
.measure lstb out2 phase_margin
.measure lstb out3 unity_gain_freq
.measure lstb out4 loop_gain_minifreq
```

Example 4 *A series of loop stability analyses are supported by the .alter command.*

```
V3 n3 n4 0
.lstb mode=single vsource=V3
.alter
V4 n5 n6 0
V5 n7 n8 0
.lstb mode=common vsource=v4, v5
```

See Also

.AC
.ALTER
.MEASURE LSTB
.PRINT

.PROBE
Using .LSTB for Loop Stability Analysis

.MACRO

Defines a subcircuit in your netlist.

Syntax

```
.MACRO subckt_namen1 [n2n3...] [parnam=val]
.EOM
```

Argument	Description
subckt_nam	reference name for the subcircuit model call.
n1 ...	Node numbers for external reference; cannot be the ground node (zero). Any element nodes that are in the subcircuit, but are not in this list strictly local with three exceptions: ■ Ground node (zero). ■ Nodes assigned using BULK=node in MOSFET or BJT models. ■ Nodes assigned using the .GLOBAL command.
parnam	Parameter name set to a value. Use only in the subcircuit. To override this value, assign it in the subcircuit call or set a value in a .PARAM command.
SubDefaultsList	*SubParam1=Expression* [*SubParam2=Expression*...]

Description

Use this command to define a subcircuit in your netlist (effectively the same as the .SUBCKT command). You can create a subcircuit description for a commonly used circuit and include one or more references to the subcircuit in your netlist. Use the .EOM command to terminate a .MACRO command.

Command Group

Subcircuits

Examples

Example 1 defines two subcircuits: SUB1 and SUB2. These are resistor divider networks, whose resistance values are parameters (variables). The X1, X2,

and X3 commands call these subcircuits. Because the resistor values are different in each call, these three calls produce different subcircuits.

Example 1

```
*FILE SUB2.SP TEST OF SUBCIRCUITS
.OPTION LIST ACCT
   V1 1 0 1
.PARAM P5=5 P2=10
.SUBCKT SUB1 1 2 P4=4
   R1 1 0 P4
   R2 2 0 P5
   X1 1 2 SUB2 P6=7
   X2 1 2 SUB2
.ENDS
*
.MACRO SUB2 1 2 P6=11
   R1 1 2 P6
   R2 2 0 P2
.EOM
   X1 1 2 SUB1 P4=6
   X2 3 4 SUB1 P6=15
   X3 3 4 SUB2
*
.MODEL DA D CJA=CAJA CJP=CAJP VRB=-20 IS=7.62E-18
+ PHI=.5 EXA=.5 EXP=.33
.PARAM CAJA=2.535E-16 CAJP=2.53E-16
.END
```

Example 2 implements an inverter that uses a *Strength* parameter. By default, the inverter can drive three devices. Enter a new value for the *Strength* parameter in the element line to select larger or smaller inverters for the application.

Example 2

```
.SUBCKT Inv a y Strength=3
   Mp1 <MosPinList> pMosMod L=1.2u W='Strength * 2u'
   Mn1 <MosPinList> nMosMod L=1.2u W='Strength * 1u'
.ENDS
...
xInv0 a y0 Inv         $ Default devices: p device=6u,
         $ n device=3u
xInv1 a y1 Inv Strength=5         $ p device=10u, n device=5u
xInv2 a y2 Inv Strength=1         $ p device= 2u, n device=1u
...
```

See Also

.ENDS

.EOM
.SUBCKT

.MALIAS

Assigns an alias to a diode, BJT, JFET, or MOSFET model that you defined in a .MODEL command.

Syntax

.MALIAS *model_name=alias_name1* [*alias_name2* ...]

Argument	Description
model_name	Model name defined in the .MODEL card
alias_name1...	Alias that an instance (element) of the model references

Description

Use this command to assign an alias (another name) to a diode, BJT, JFET, or MOSFET model that you defined in a .MODEL command.

.MALIAS differs from .ALIAS in two ways:

- A model can define the alias in an .ALIAS command, but not the alias in a .MALIAS command. The .MALIAS command applies to an element (an instance of the model), not to the model itself.
- The .ALIAS command works only if you include .ALTER in the netlist. You can use .MALIAS without .ALTER.

You can use .MALIAS to alias to a model name that you defined in a .MODEL command or to alias to a subcircuit name that you defined in a .SUBCKT command. The syntax for .MALIAS is the same in either usage.

Note: The .MALIAS command is supported for diode, BJT, JFET, and MOSFET models in .Global_Variation and .Local_Variation blocks.

Command Group

Model and Variation

Examples

- `zendef` is a diode model
- `zen` and `zend` are its aliases.
- The `zendef` model points to both the `zen` and `zend` aliases.

```
*file: test malias statement
.OPTION acct tnom=50 list gmin=1e-14 post
.temp 0.0 25
.tran .1 2
vdd 2 0 pwl 0 -1 1 1
d1 2 1 zend dtemp=25
d2 1 0 zen dtemp=25
* malias statements
.malias zendef=zen zend
* model definition
.model zendef d (vj=.8 is=1e-16 ibv=1e-9 bv=6.0 rs=10
+ tt=0.11n n=1.0 eg=1.11 m=.5 cjo=1pf tref=50)
.end
```

See Also

.ALIAS
.MODEL

.MATERIAL

Specifies material to be used with the HSPICE field solver.

Syntax

```
.MATERIAL mname METAL|DIELECTRIC [ER=val]
+ [UR=val] [CONDUCTIVITY=val] [LOSSTANGENT=val]
+ ROUGHNESS=val
```

Argument	Description
mname	Material name.
METAL|DIELECTRIC	Material type: METAL or DIELECTRIC.
ER	Dielectric constant (relative permittivity).
UR	Relative permeability.

Argument	Description
CONDUCTIVITY	Static field conductivity of conductor or lossy dielectric (S/m).
LOSSTANGENT	Alternating field loss tangent of dielectric (tan δ).
ROUGHNESS	RMS surface roughness height, used when scaling the field solver.

Description

The field solver assigns the following default values for metal: `CONDUCTIVITY=-1` (perfect conductor), `ER=1`, `UR=1`.

`PEC` (perfect electrical conductor) is a predefined metal name. You cannot redefine its default values.The field solver assigns default values for dielectrics:

- `CONDUCTIVITY=0` (lossless dielectric)
- `LOSSTANGENT=0` (lossless dielectric)
- `ER=1`
- `UR=1`

`AIR` is a predefined dielectric name. You cannot redefine its default values. Because the field solver does not currently support magnetic materials, it ignores `UR` values.

Command Group

Field Solver

See Also

.LAYERSTACK
.FSOPTIONS
Transmission (W-element) Line Examples

.MEASURE / MEAS

Modifies information to define the results of successive simulations.

Syntax

See the links below for the various syntaxes.

Description

Use this command to modify information and to define the results of successive HSPICE simulations. The .MEASURE command prints user-defined electrical specifications of a circuit. Optimization uses .MEASURE commands extensively. You can shorten the command name to .MEAS. The specifications include:

- Propagation
- Delay
- RIse time
- Fall time
- Peak-to-peak voltage
- Minimum and maximum voltage over a specified period
- Other user-defined variables

You can also use .MEASURE with either the error function (ERRfun) or GOAL parameter to optimize circuit component values, and to curve-fit measured data to model parameters.

The .MEASURE command can use several different formats, depending on the application. You can use it for DC sweep, and AC or transient analyses.

Note: If a .measure command uses the result of previous .meas command, then the calculation starts when the previous result is found. Until the previous result is found, it outputs zero.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION NCWARN	Allows turning on a switch to report a warning message for negative conductance on MOSFETs.
.OPTION MEASFAIL	Specifies where to print the failed measurement output.
.OPTION MEASFILE	Controls whether measure information outputs to single or multiple files when an .ALTER command is present in the netlist.
.OPTION MEASOUT	Outputs .MEASURE / MEAS command values and sweep parameters into an ASCII file.

Command Group

Output Porting

Examples

To measure the difference between two different nodes in a dc analysis:

```
.MEAS dc V1 MAX V(1)
.MEAS dc V2 MAX V(2)
.MEAS VARG PARAM="(V2 - V1)"
```

See Also

.MEASURE (Rise, Fall, Delay, and Power Measurements)
.MEASURE (FIND and WHEN)
.MEASURE (Equation Evaluation/Arithmetic Expression)
.MEASURE (AVG, EM_AVG, INTEG, MIN, MAX, PP, and RMS)
.MEASURE (Multiple Measure Windows for MIN or MAX)
.MEASURE (Integral Function)
.MEASURE (Derivative Function)
.MEASURE (Error Function)
.MEASURE (Pushout Bisection)
.MEASURE (ACMATCH)
.MEASURE (DCMATCH)
.MEASURE FFT
.MEASURE LSTB
.AC
.DC
.DCMATCH
.DOUT
.PRINT
.PROBE
.STIM
.TRAN
Measuring Total Noise
Measuring the Value of MOSFET Model Card Parameters

.MEASURE (Rise, Fall, Delay, and Power Measurements)

Measures independent-variable differentials such as rise time, fall time, and slew rate.

Syntax

The following are parameters for the TRIG and TARG subcommands.

Trigger and Target Subcommands

```
.MEASURE [DC|AC|TRAN] ResultName TRIG TrigSpec TARG TargSpec
+ [GOAL=val] [MINVAL=val] [WEIGHT=val] [PRINT 0|1] [FROM=val]
+ [TO=val]
```

For example:

```
.MEASURE TRAN TCLK2BL7R_1 TRIG V(CLK)='VAL50' FALL=2
+ TARG V(XI0.BL7_bot_L_E)='VAL50' RISE=1 FROM=TBR1 TO=TBR2
```

The input syntax for delay, rise time, and fall time in HSPICE is:

```
.MEASURE [TRAN] varname TRIG_SPECTARG_SPEC
```

In this syntax, *varname* is the user-defined variable name for the measurement (the time difference between TRIG and TARG events). The input syntax for *TRIG_SPEC* and *TARG_SPEC* is:

```
TRIG var VAL=val [TD=time] [CROSS=c|LAST]
+ [RISE=r|LAST] [FALL=f|LAST] [TRIG AT=time]
TARG var VAL=val [TD=time-delay] [CROSS=c|LAST|PREVIOUS]
+ [RISE=r|LAST|PREVIOUS] [FALL=f|LAST|PREVIOUS]
+ [REVERSE] [TARG AT=time]
```

Argument	Description
DC | AC | TRAN	Analysis type of the measurement. If you omit this parameter, HSPICE uses the last analysis mode that you requested.
result	Name associated with the measured value in the HSPICE output, can be up to 16 characters long. This example measures the independent variable, beginning at the trigger and ending at the target: ▪ Transient analysis measures time. ▪ AC analysis measures frequency. ▪ DC analysis measures the DC sweep variable. If simulation reaches the target before the trigger activates, the resulting value is negative.Do not use DC, TRAN, or AC as the *result* name.
TRIG	Beginning of trigger specifications.

Argument	Description
TARG	Beginning of the target specification.
TrigSpec	*OutputVar* VAL={*Number*|'*Expression*'} [TD={*Numeric*|'*Expression*'}] where: *NumericExpression*={*FloatingPointNumber*|'*AlgebraicExpression*'} See Using Algebraic Expressions for information on algebra in output statements.
TargSpec	*OutputVar* VAL={*Numeric*|'*Expression*'} [TD={*Number*|'*Expression*'}] where: *NumericExpression*:={*FloatingPointNumber*|'*AlgebraicExpression*'} See Using Algebraic Expressions for information on algebra in output statements. If a time-delay is not specified for the Target, the TD is inherited from the Trigger value.
GOAL=val	Desired measure value in ERR calculation for optimization. To calculate the error, the simulation uses the equation: $ERRfun = (GOAL - result)/GOAL$.
MINVAL	If the absolute value of GOAL is less than MINVAL, the MINVAL replaces the GOAL value in the denominator of the ERRfun expression. Used only in ERR calculation for optimization. The default is 1.0e-12.
WEIGHT	Multiplies the calculated error by the weight value. Used only in ERR calculation for optimization. The default is 1.0.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file
FROM... TO...	Allows adding single XRANGE conditions for TRIG/TARG measurements.
trig_var	Value of *trig_var*, which increments the counter by one for crossings, rises, or falls. See Using Algebraic Expressions for information on algebra in output statements.

Argument	Description
trig_var	Specifies the name of the output variable that determines the logical beginning of a measurement. If HSPICE reaches the target before the trigger activates, .MEASURE reports a negative value. See Using Algebraic Expressions for information on algebra in output statements.
PREVIOUS	Use the PREVIOUS keyword as an alternative to targ xnumber. If PREVIOUS is set, the last possible target event previous to the trigger event is computed.
REVERSE	The `REVERSE` keyword is used to reverse the direction of the measure. For any measure where `RISE`, `FALL` or `CROSS` is used, the `REVERSE` keyword allows the measure to start at the end of the simulation time and end at `time=0` or the delay time defined by TD.
TD	Amount of simulation time that must elapse before HSPICE enables the measurement. Simulation counts the number of crossings, rises, or falls only after the *time_delay* value. Default trigger delay is zero. If a time-delay is not specified for the Target, the TD is inherited from the Trigger value.
AT=val	Special case for trigger specification. *val* is: ▪ Time for TRAN analysis. ▪ Frequency for AC analysis. ▪ Parameter for DC analysis. ▪ SweepValue from .DC mismatch analysis. The trigger determines where measurement takes place.

Description

Use the Rise, Fall, and Delay form of the `.MEASURE` command to measure independent-variable (time, frequency, or any parameter or temperature) differentials such as rise time, fall time, slew rate, or any measurement that requires determining independent variable values. This format specifies `TRIG` and `TARG` subcommands. These two commands specify the beginning and end of a voltage or current amplitude measurement.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions.

Command Group

Output Porting

Examples

Example 1 *HSPICE automatically measures T_prop using the .MEASURE command. This reference file contains .MEAS commands for rising edge and falling edge measurements. The time delay is measured and saved during simulation in an *.mt0 file. Note that if a falling edge simulation is run, the rising edge measurements are invalid. Similarly, if a rising edge simulation is run, the falling edge measurements are invalid. (Remember this when referring to the *.mt0 file after a simulation.) In this sample file, .MEASURE statements are provided to measure T_prop from the ref_50pf waveform to each of ten loads. Since each load is measured, the worst-case T_prop for a given configuration can be quickly determined by finding the largest value. The .MEASURE commands work by "triggering" on the ref_50pf signal as it crosses 1.5 volts, and ending the measurement when the "target" waveform, crosses the specified voltage for the last time. For rising edge measurements, this value is 2.0 Volts. For falling edge measurements, the value is 0.8 Volt. Examples from a sample file are listed here.*

```
*************************************************************
*              Rising edge T_prop measurements              *
*************************************************************
.MEAS tran tr1_val TRIG V(ref_50pf) val=1.5v td='per/2' cross=1
+ TARG V(load1) val=2.0v rise=last
.MEAS tran tr2_val TRIG B(ref_50pf) val=1.5v td='per/2' cross=1
+TARG V(load2) val=2.0v rise=last
.
.
.
.MEAS tran tr10_val TRIG V(ref_50pf) val=1.5v td='per/2 cross=1
+ TARG V(load10) val=2.0v rise=last
*************************************************************
*              Falling edge T_prop measurements             *
*************************************************************
.MEAS tran tf1_val TRIG V(ref_50pf) val=1.5v td='per/2' cross=1
+TARG V(load1) val=0.8v fall=last
.
.
```

```
.
.MEAS tran tf10_vasl TRIG V(ref_50pf) vbal=1.5v td='per/2' cross=1
+ TARFG V(load10) val=0.8v fall=last
```

Example 2 *Measures the propagation delay between nodes 1 and 2 for a transient analysis. HSPICE measures the delay from the second rising edge of the voltage at node 1 to the second falling edge of node 2. Measurement begins when the second rising voltage at node 1 is 2.5 V and ends when the second falling voltage at node 2 is 2.5 V. The TD=10n parameter counts the crossings after 10 ns have elapsed. HSPICE prints results as tdlay=value.*

```
* Example of rise/fall/delay measurement
.MEASURE TRAN tdlay TRIG V(1) VAL=2.5 TD=10n
+ RISE=2 TARG V(2) VAL=2.5 FALL=2
```

Example 3 *TRIG AT=10n starts measuring time at t=10 ns in the transient analysis. The TARG parameters terminate time measurement when V(IN) = 2.5 V on the third crossing. pwidth is the printed output variable. If you use the .TRAN analysis command with a .MEAS command, do not use a non-zero start time in the .TRAN command to avoid incorrect .MEAS results.*

```
.MEASURE TRAN riset TRIG I(Q1) VAL=0.5m RISE=3
+ TARG I(Q1) VAL=4.5m RISE=3
* Rise/fall/delay measure with TRIG and TARG specs
.MEASURE pwidth TRIG AT=10n TARG V(IN) VAL=2.5
+ CROSS=3
```

Example 4 *This example shows a target delayed until the trigger time before the target counts the edges.*

```
.MEAS TRAN TDEL12 TRIG V(signal1) VAL='VDD/2'
+ RISE=10 TARG V(signal2) VAL='VDD/2' RISE=1 TD=TRIG
```

Example 5 *This example uses the cross keyword to calculate the final settled value when you do not know how many times the signal crosses the final value.*

```
.meas tran tim2 when v(out)='final_value' cross=last
```

Example 6 *In this example, print=0 prevents the printing of Vmax to the *.mt0 and *.lis files. Delay is output into *.mt# file and *.lis file.*

```
.meas tran Vmax max v(out) print=0
.meas tran delay trig V(in) val='vmax/2' rise=1 targ v(out)
+ val='vmax/2' rise=1
```

Example 7 *This example shows the next occurrence of the target in the range set by to and from and is delayed until the trigger time is computed.*

```
.MEAS TRAN delay_ls_hl TRIG V(2)=2.5 RISE=3
+ TARG V(1)=0 fall=1 td=trig from=100n to=200n
```

See Also

Filters Examples, `fbp_1.sp`, for a bandpass LCR filter measurement demo netlist

.MEASURE (FIND and WHEN)

Measures independent and dependent variables (as well as derivatives of dependent variables if a specific event occurs).

Syntax

```
.MEASURE [DC|AC|TRAN] result WHEN out_var=val [TD=val]
+ [FROM=val] [TO=val]
+ [RISE=r|LAST][FALL=f|LAST][CROSS=c|LAST][REVERSE]
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=val] [WEIGHT=val]
+ [PRINT 0|1]

.MEASURE [DC|AC|TRAN] result
+ WHEN out_var1=out_var2 [TD=val] [RISE=r|LAST]
+ [FALL=f|LAST] [CROSS=c|LAST]
+ [[GOAL=val] [GOALMAX|GOALMIN] [MINVAL=val]
+ [WEIGHT=val] [PRINT 0|1]

.MEASURE [DC|AC|TRAN] result FIND out_var1
+ WHEN out_var2=val [TD=val] [FROM=val] [TO=val]
+ [RISE=r|LAST][FALL=f|LAST] [CROSS=c|LAST] [REVERSE]
+ [[GOAL=val]|GOALMAX|GOALMIN][MINVAL=val] [WEIGHT=val]
+ [PRINT 0|1]

.MEASURE [DC|AC|TRAN] result FIND out_var1
+ WHEN out_var2=out_var3 [TD=val]
+ [RISE=r|LAST] [FALL=f|LAST] [REVERSE] [CROSS=c|LAST]
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=val] [WEIGHT=val]
+ [PRINT 0|1]

.MEASURE [DC|AC|TRAN] result FIND out_var1
+ AT=val [FROM=val] [TO=val]
+[[GOAL=val]|GOALMAX|GOALMIN][MINVAL=val]
+[WEIGHT=val] [PRINT 0|1]
```

Argument	Description
DC | AC | TRAN	Analysis type of the measurement. If you omit this parameter, HSPICE uses the last analysis mode that you requested.
result	Name of a measured value in the HSPICE output.
WHEN	WHEN function.
out_var(1,2,3)	Variables that establish conditions to start a measurement.
TD	Time at which measurement starts.
FROM... TO...	Allows adding multiple trigger conditions to some WHEN measurements.
CROSS=c RISE=r FALL=f	Numbers indicate which CROSS, FALL, or RISE event to measure. For example: `.meas tran tdlay trig v(1) val=1.5 td=10n + rise=2 targ v(2) val=1.5 fall=2` In this example, rise=2 specifies the measure of the v(1) voltage only on the first two rising edges of the waveform. The value of these first two rising edges is 1. However, trig v(1) val=1.5 indicates to trigger when the voltage on the rising edge voltage is 1.5, which never occurs on these first two rising edges. So the v(1) voltage measurement never finds a trigger. RISE=r, the WHEN condition is met and measurement occurs after the designated signal has risen *r* rise times. FALL =f, measurement occurs when the designated signal has fallen *f* fall times. A crossing is either a rise or a fall so for CROSS=*c*, measurement occurs when the designated signal has achieved a total of *c* crossing times as a result of either rising or falling. For TARG, the LAST keyword specifies the last event.

Argument	Description
LAST	HSPICE measures when the last CROSS, FALL, or RISE event occurs. ▪ CROSS=LAST, measurement occurs the last time the WHEN condition is true for a rising or falling signal. ▪ FALL=LAST, measurement occurs the last time the WHEN condition is true for a falling signal. ▪ RISE=LAST, measurement occurs the last time the WHEN condition is true for a rising signal. LAST is a reserved word; you cannot use it as a parameter name in the above .MEASURE commands.
REVERSE	The `REVERSE` keyword is used to reverse the direction of the measure. For any measure where `RISE`, `FALL` or `CROSS` is used, the `REVERSE` keyword allows the measure to start at the end of the simulation time and end at `time=0` or the delay time defined by TD.
GOAL=val	Desired .MEASURE value. Optimization uses this value in ERR calculation. The following equation calculates the error: $ERRfun = (GOAL - result)/GOAL$ In HSPICE output you cannot apply .MEASURE to waveforms generated from another .MEASURE command in a parameter sweep.
GOALMAX | GOALMIN	Use bisection method to get maximum/minimum measure value.
MINVAL	If the absolute value of GOAL is less than MINVAL, then MINVAL replaces the GOAL value in the denominator of the ERRfun expression. Used only in ERR calculation for optimization. The default is 1.0e-12.
WEIGHT	Calculated error multiplied by the weight value. Used only in ERR calculation for optimization. The default is 1.0.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Argument	Description
FIND	FIND function.
AT=val	Special case for trigger specification. *val* is: ▪ Time for TRAN analysis. ▪ Frequency for AC analysis. ▪ Parameter for DC analysis. ▪ SweepValue from .DC mismatch analysis. The trigger determines where measurement takes place.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

The `FIND` and `WHEN` functions of the `.MEASURE` command measure:

- Any independent variables (time, frequency, parameter).
- Any dependent variables (voltage or current, for example).
- A derivative of a dependent variable if a specific event occurs.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all `TRIG-TARG`, `FIND-WHEN`, and `FROM-TO` measure functions.

Command Group

Output Porting

Examples

Example 1 Calculating Voltage: Here, the first measurement, TRT, calculates the difference between V(3) and V(4) when V(1) is half the voltage of V(2) at the last rise event. The second measurement, STIME, finds the time when V(4) is 2.5V at the third rise-fall event. A CROSS event is a rising or falling edge.

```
* MEASURE statement using FIND/WHEN
.MEAS TRAN TRT FIND PAR('V(3)-V(4)')
+ WHEN V(1)=PAR('V(2)/2') RISE=LAST
.MEAS STIME WHEN V(4)=2.5 CROSS=3
```

Example 2 Using a DC Sweep Variable: By adding par() to the sweep variable it can be used in a .MEASURE command.

```
* sweep measure
v0 1 0 3
r0 1 0 x
.dc x 1 5 1
.meas res find par(x) when i(r0)=2
.end
```

Example 3 This example calculates capacitance from node to node.

```
.meas tran pct_5 when v(out)='vddr*0.05' rise=1
.meas tran pct_95 when v(out)='vddr*0.95' rise=1
.meas tran avg_rout_n avg par('v(out)/i(xinv.mn)')
+ from=pct_5 to=pct_95
```

.MEASURE (Continuous Results)

Measures continuous results for TRIG-TARG, FIND-WHEN, Equation, and PARAM Evaluation functions.

Syntax

```
.MEASURE [DC_CONT|AC_CONT|TRAN_CONT] result TRIG … TARG …
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=val]
+ [WEIGHT=val][PRINT 0|1]

.MEASURE [DC_CONT|AC_CONT|TRAN_CONT] result
+ WHEN out_var=val [TD=val]
+ [RISE=r | LAST] [FALL=f| LAST][CROSS=c | LAST]
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=val]
+ [WEIGHT=val] [PRINT 0|1]
```

```
.MEASURE [DC_CONT|AC_CONT|TRAN_CONT] result
+ WHEN out_var1=out_var2 [TD=val]
+ [RISE=r | LAST] [FALL=f | LAST] [CROSS=c|LAST]
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=val] [WEIGHT=val]

.MEASURE [DC_CONT|AC_CONT|TRAN_CONT] result FIND out_var1
+ WHEN out_var2=val [TD=val] [RISE=r | LAST]
+ [FALL=f|LAST] [CROSS=c|LAST] [[GOAL=val]|GOALMAX|GOALMIN]
+ [MINVAL=val] [WEIGHT=val] [PRINT 0|1]

.MEASURE [DC_CONT|AC_CONT|TRAN_CONT] result FIND out_var1
+ WHEN out_var2=out_var3 [TD=val] [RISE=r | LAST]
+ [FALL=f|LAST] [CROSS=c|LAST] [[GOAL=val]|GOALMAX|GOALMIN]
+ [MINVAL=val] [WEIGHT=val] [PRINT 0|1]

.MEASURE [DC_CONT|AC_CONT|TRAN_CONT] result
+ PARAM='expression'
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=val][PRINT 0|1]
```

Argument	Description
DC_CONT AC_CONT TRAN_CONT	Analysis type of the continuous measurement.
result	Name of a measured value in the HSPICE output.
TRIG...	Beginning of trigger specifications.
TARG...	Beginning of the target specification.
GOAL=val	Desired .MEASURE value. Optimization uses this value in ERR calculation. The following equation calculates the error: $ERRfun = (GOAL - result)/GOAL$ In HSPICE output you cannot apply `.MEASURE` to waveforms generated from another `.MEASURE` command in a parameter sweep.
GOALMAX | GOALMIN	Use bisection method to get maximum/minimum measure value.

Argument	Description
MINVAL	If the absolute value of GOAL is less than MINVAL, then MINVAL replaces the GOAL value in the denominator of the ERRfun expression. Used only in ERR calculation for optimization. The default is 1.0e-12.
WEIGHT	Calculated error multiplied by the weight value. Used only in ERR calculation for optimization. The default is 1.0.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file
WHEN	WHEN function.
out_var(1,2,3)	Variables that establish conditions to start a measurement.
TD	Time at which measurement starts.
CROSS=c RISE=r FALL=f	Numbers indicate which CROSS, FALL, or RISE event to measure. For example: `.meas tran tdlay trig v(1) val=1.5 td=10n + rise=2 targ v(2) val=1.5 fall=2` In this example, rise=2 specifies the measure of the v(1) voltage only on the first two rising edges of the waveform. The value of these first two rising edges is 1. However, trig v(1) val=1.5 indicates to trigger when the voltage on the rising edge voltage is 1.5, which never occurs on these first two rising edges. So the v(1) voltage measurement never finds a trigger.RISE=r, the WHEN condition is met and measurement occurs after the designated signal has risen *r* rise times.FALL =f, measurement occurs when the designated signal has fallen *f* fall times.A crossing is either a rise or a fall so for CROSS=*c*, measurement occurs when the designated signal has achieved a total of *c* crossing times as a result of either rising or falling. For TARG, the LAST keyword specifies the last event.

Argument	Description
LAST	HSPICE measures when the last CROSS, FALL, or RISE event occurs. ▪ CROSS=LAST, measurement occurs the last time the WHEN condition is true for a rising or falling signal. ▪ FALL=LAST, measurement occurs the last time the WHEN condition is true for a falling signal. ▪ RISE=LAST, measurement occurs the last time the WHEN condition is true for a rising signal. LAST is a reserved word; you cannot use it as a parameter name in the above .MEASURE commands.
FIND	FIND function.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file
PARAM	**Arithmetic expression that uses results from other prior continues commands. Note:** When accessing other continuous measure results, the `equation` option, has the following limitation: The continuous measure is order dependent. The continuous measure results used in `.measure` PARAM must be defined before this `.MEASURE` statements. See Example 3 on page 203 and Example 4 on page 203.

Description

Enables HSPICE to give multiple results during the measurement of DC, AC, and transient analysis data. For example, it gives all the time points at which two signals cross each other. The standalone measure utility also supports this feature. The continuous measurement feature only applies to TRIG-TARG and FIND-WHEN and Equation Evaluation functions. Results of continuous measurement are only written to `*.mt`, `*.ms`, or `*.ma` files (*not* to the `*.lis` file).

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions.

Command Group

Output Porting

Examples

Example 1 *The .measure statement continuously reports the voltage out1 when the voltage value of node a1 reaches 2.5 starting from the first falling edge.*

```
.measure tran_cont vout1 find v(out1) when v(a1)=2.5 fall=1
```

Example 2 *The .measure statement continuously reports the time when the voltage value of node a1 reaches 2.5V, starting from the second falling edge.*

```
.measure tran_cont cont_vout1 when v(a1)=2.5 fall=2
```

Example 3 *The following example shows a correct .measure statement.*

```
.measure tran_cont PERIOD
+ TRIG v(out) VAL =VDD/2 RISE=1
+ TARG v(out) VAL =VDD/2 RISE=2
 .measure  tran_cont FREQUENCY   PARAM=1/PERIOD
```

Example 4 *The following example shows an incorrect .measure statement.*

```
.measure tran_cont_FREQUENCY PARAM=1/PERIOD
.measure tran_cont PERIOD
+ TRIG v(out) VAL =VDD/2 RISE=1
+ TARG v(out) VAL =VDD/2 RISE=2
```

.MEASURE (Equation Evaluation/Arithmetic Expression)

Evaluates an equation that is a function of the results of previous .MEASURE commands.

Syntax

```
.MEASURE [DC|TRAN|AC] result PARAM='equation'
```

```
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=val] [PRINT 0|1]
.MEASURE TRAN varname PARAM="expression"
```

Argument	Description
DC | AC | TRAN	Analysis type of the measurement. If you omit this parameter, HSPICE uses the last analysis mode that you requested.
result	Name of a measured value in the HSPICE output.
PARAM='equation'	Equation wrapped in single quotes, a function of the results of previous .MEASURE commands.
GOAL=val	Desired .MEASURE value. In HSPICE output you cannot apply .MEASURE to waveforms generated from another .MEASURE command in a parameter sweep.
GOALMAX | GOALMIN	Use bisection method to get maximum/minimum measure value.
MINVAL	If the absolute value of GOAL is less than MINVAL, then MINVAL replaces the GOAL value in the denominator of the ERRfun expression. Used only in ERR calculation for optimization. The default is 1.0e-12.
TRAN	Transient analysis results.
varname	Name of variable to be used in evaluation.
PARAM="expression"	Arithmetic expression that uses results from other prior .MEASURE commands.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

Use the Equation Evaluation form of the .MEASURE command to evaluate an equation that is a function of the results of previous .MEASURE commands. The equation must not be a function of node voltages or branch currents.

The *expression* option is an arithmetic expression that uses results from other prior .MEASURE commands.

Expressions used in arithmetic expression must not be a function of node voltages or branch currents. Expressions used in all other .MEASURE commands can contain either node voltages or branch currents, but must not use results from other .MEASURE commands.

When using formulas in a .MEAS command, use the PAR( ) keyword to designate the formula.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions.

Command Group

Output Porting

Examples

In Example 1, he first two measurements, V3MAX and V2MIN, set up the variables for the third .MEASURE command.

- V3MAX is the maximum voltage of V(3) between 0 and 100 ns of the simulation.
- V2MIN is the minimum voltage of V(2) during that same interval.
- VARG is the mathematical average of the V3MAX and V2MIN measurements.

Example 1

```
.MEAS TRAN V3MAX MAX V(3) FROM=0NS TO=100NS
.MEAS TRAN V2MIN MIN V(2) FROM=0NS TO=100NS
.MEAS VARG PARAM='(V2MIN + V3MAX)/2'
```

Example 2 illustrates use of the par() keyword to measure the integral of a formula.

Example 2

```
.meas i1 integ par('v(a)+v(b)')
```

.MEASURE (AVG, EM_AVG, INTEG, MIN, MAX, PP, and RMS)

Reports statistical functions of the output variable (voltage, current, or power).

Syntax

```
.MEASURE [DC|AC|TRAN] result func out_var
+ [FROM=val] [TO=val] [[GOAL=val]|GOALMAX|GOALMIN]
+ MINVAL=val] [WEIGHT=val] [PRINT 0|1]
```

Argument	Description
DC|AC|TRAN	Analysis type for the measurement. If you omit this parameter, HSPICE defaults to the last analysis mode that you requested.
result	Name of the measured value in the output, can be up to 16 characters long. The value is a function of the variable (*out_var*) and *func*.
func	Indicates one of the following measure function types: ■ AVG (average): Calculates the area under the out_var, divided by the periods of interest. ■ INTEG (Integral function): Reports the integral of an output variable over a specified period. ■ MIN (minimum): Reports the minimum value of the out_var over the specified interval. ■ MAX (maximum): Reports the maximum value of the out_var over the specified interval. ■ PP (peak-to-peak): Reports the maximum value, minus the minimum value of the out_var over the specified interval. ■ RMS (root mean squared): Calculates the square root of the area under the out_var2 curve, divided by the period of interest. ■ EM_AVG: Calculates the average electromigration current. For a symmetric bipolar waveform, the current is: I_avg (0, T/2) - R*Iavg (T/2, T), where R is the recovery factor specified using `.option em_recovery`. Wildcards are also supported during this measurement.

Argument	Description
out_var	Name of any output variable whose function (*func*) the simulation measures (voltage, current, power, or source power). An output variable can be any dependent variable (voltage, current, power, or source power).
FROM	Initial value for the INTEG calculation.
TO	End of the INTEG calculation.
GOAL=val	.MEASURE value. Optimization uses this value for ERR calculation. This equation calculates the error: $ERRfun = (GOAL - result)/GOAL$ In HSPICE simulation output you cannot apply .MEASURE to waveforms generated from another .MEASURE command in a parameter sweep.
GOALMAX | GOALMIN	Use bisection method to get maximum/minimum measure value.
WEIGHT	Calculated error multiplied by the weight value. Used only in ERR calculation for optimization. The default is 1.0.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

Average (AVG), EM_AVG, RMS, MIN, MAX, and peak-to-peak (PP) measurement modes report statistical functions of the output variable, rather than analysis values. Output variables are voltage, current, or power. Wildcards are supported for the From-To functions for AVG, EM_AVG, RMS, MIN, MAX and PP measurement (unlike other measurement functions).

AVG, RMS, and INTEG have no meaning in a DC data sweep so if you use them, HSPICE issues a warning message.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions.
.OPTION EM_RECOVERY	Provides a coefficient value for measuring “recovered” average current such as electro-migration for bipolar currents.

Command Group

Output Porting

Examples

Example 1 *Calculates the average nodal voltage value for node 10 during the transient sweep from the time 10ns to 55ns. It prints out the result as avgval*

```
.MEAS TRAN avgval AVG V(10) FROM=10ns TO=55ns
```

Example 2 *Finds the maximum voltage difference between nodes 1 and 2 for the time period from 15 ns to 100 ns.*

```
.MEAS TRAN MAXVAL MAX V(1,2) FROM=15ns  TO=100ns
```

Example 3 *The first command finds the minimum voltage difference between nodes 1 and 2 over the time period 15 ns to 100 ns. The second command measures the peak to peak current through transistor M1 from 10ns to 100ns.*

```
.MEAS TRAN MINVAL MIN V(1,2) FROM=15ns TO=100ns
.MEAS TRAN P2PVAL PP I(M1)  FROM=10ns TO=100ns
```

Example 4 *The coefficient value is set by .option em_recovery=val. The electromagnetic migration average is measured from 5 ns to 10.2 ns.*

```
.option em_recovery=0.2
.measure tran vout_1 EM_AVG v(5) from=5ns to=10.2ns
```

Example 5 *These commands measure result parameter currents over specified ranges.*

```
.measure tran em1 em_avg i(rload) from=1n to=3.5n
.measure tran em2 em_avg i(rload) from=4n to=9n
```

Example 6 *Finds the average of all the positive currents (Ipos_avg) from 5ns to 50ns.*

```
.MEASURE TRAN EM_AVG I(OUT) FROM=5N TO=50N
```

Example 7 The .MEASURE command calculates the RMS voltage of the OUT node from 0ns to 10ns. It then labels the result RMSVAL.

```
.MEAS TRAN RMSVAL RMS V(OUT) FROM=0NS TO=10NS
```

Example 8 The .MEASURE command finds the maximum current of the VDD voltage supply between 10ns and 200ns. The result is called MAXCUR.

```
.MEAS MAXCUR MAX I(VDD) FROM=10NS TO=200NS
```

Example 9 The .MEASURE command uses the ratio of V(OUT) and V(IN) to find the peak-to-peak value in the interval of 0ns to 200ns.

```
.MEAS P2P PP PAR('V(OUT)/V(IN)') FROM=0NS TO=200NS
```

Example 10 Power measurement supplied by source vdd

```
.MEAS P(VDD)
```

Example 11 Three commands measuring power

```
.MEAS TRAN avg_cur avg par('-I(vh)')
.MEAS TRAN total_cur integ par('-I(vh)') from=0n to=3n
.MEAS TRAN total_pwr PARAM='total_cur*V(vdda)'
```

Example 12 Measuring source power and dissipated power

```
.measure tran sourcep integ src_pwr
.measure tran avgp avg power
```

.MEASURE (Multiple Measure Windows for MIN or MAX)

Specifies multiple measure windows within a .MEASURE command for MIN or MAX.

Syntax

```
.MEASURE [DC|AC|TRAN]
+ measure_result MAX|MIN
+ measure_variable XRANGE=(xlow1 xhigh1
+                          xlow2 xhigh2
+                          ...
+                          xlown xhighn)
```

Argument	Description
DC|AC|TRAN	Analysis type for the measurement. If you omit this parameter, HSPICE defaults to the last analysis mode that you requested.
measure_result	Name of the measured value in the output.
measure_variabe	Name of the variable that holds the XRANGE values.
XRANGE	Keyword for an explicit partition of the measurement interval into subintervals. Default is that the whole interval between starting point and endpoint is taken.
xlowk, xhighk, (k=1,...,kmax)	Pairs for lower and upper limit of the valid subintervals. Looking for the maximum or minimum value as well as performing the measurement itself is only done in the subintervals xlowk...xhighk (k=1,...,kmax); the other parts are not taken into account. The number kmax of subintervals is arbitrary. However, xlow1<xhigh1<xlow2<...< xhighk must be valid.

Command Group

Output Porting

Examples

Example 1 Computes the global minimum of the difference of v(1) and v(2) in the time interval between 10nsec...20nsec and 40nsec...50nsec.

```
.MEASURE TRAN noisemargin MIN 'v(1)-v(2)' XRANGE=(10n 20n 40n 50n)
```

The user will only get one measurement result: the global minimum of both intervals and not a minimum for each interval.

.MEASURE (Integral Function)

Reports the real time integration (instantaneous time integral) of an output variable over a specified period.

Syntax

```
.MEASURE [DC|AC|TRAN] result INTEG[RAL] out_var
+ [FROM=val] [TO=val] [[GOAL=val]|GOALMAX|GOALMIN]
```

```
+ [MINVAL=val] [WEIGHT=val] [PRINT 0|1]
```

Argument	Description
DC | AC | TRAN	Analysis type of the measurement. If you omit this parameter, HSPICE uses the last analysis mode that you requested.
result	Name of a measured value in the HSPICE output.
INTEG	Integral function to find an output variable over a specified period.
outvar	Name of any output variable whose function the simulation measures.
FROM	Initial value for the *func* calculation. For transient analysis, this value is in units of time.
TO	End of the *func* calculation.
GOAL=val	Desired `.MEASURE` value. In HSPICE output you cannot apply `.MEASURE` to waveforms generated from another `.MEASURE` command in a parameter sweep.
GOALMAX | GOALMIN	Use bisection method to get maximum/minimum measure value.
MINVAL	If the absolute value of GOAL is less than MINVAL, then MINVAL replaces the GOAL value in the denominator of the ERRfun expression. Used only in ERR calculation for optimization. The default is 1.0e-12.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

The `INTEGRAL` function reports the integral of an output variable over a specified period. The `INTEGRAL` function uses the same syntax as the `AVG` (average), `RMS`, `MIN`, `MAX` and peak-to-peak (`PP`) measurement modes.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions.

Command Group

Output Porting

Examples

This example calculates the integral of `I(cload)` from 10ns to 100ns.

```
.MEAS TRAN charge INTEG I(cload) FROM=10ns TO=100ns
```

The following `.MEASURE` command calculates the integral of `I(R1)` from `50ns` to `200ns`.

```
.MEASURE TRAN integ_i INTEGRAL I(r1) FROM=50ns TO=200ns
```

.MEASURE (Derivative Function)

Provides the derivative of an output signal or sweep variable.

Syntax

```
.MEASURE [DC|AC|TRAN result DERIV[ATIVE] ('out_var')
+ [FROM=val] [TO=val] AT=val [[GOAL=val]|GOALMAX|GOALMIN]
+ [MINVAL=val] [WEIGHT=val] [PRINT 0|1]

.MEASURE [DC|AC|TRAN] result DERIV[ATIVE] ('out_var')
+ [FROM=val TO=val] WHEN var2=val [RISE=r|LAST]
+ [FALL=f|LAST] [CROSS=c|LAST] [TD=tdval]
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=minval] [WEIGHT=val]
+ [PRINT 0|1]

.MEASURE [DC|AC|TRAN] result DERIV[ATIVE] ('out_var')
+ [FROM=val] [TO=val] WHEN var2=var3 [RISE=r|LAST]
+ [FALL=f|LAST] [CROSS=c|LAST] [TD=tdval]
+ [[GOAL=val]|GOALMAX|GOALMIN] [MINVAL=val] [WEIGHT=val]
+ [PRINT 0|1]
```

Argument	Description
DC | AC | TRAN	Analysis type of the measurement. If you omit this parameter, HSPICE uses the last analysis mode that you requested.
result	Name of the measured value in the output.
DERIVATIVE	Derivative function (measure of how a function changes as its input changes).
out_var	Output signal variable for which HSPICE finds the derivative.
FROM=*val* TO=*val*	Specifies a range to measure, such as time window.
var(2,3)	Variables establish the conditions to start a measurement.
AT=*val*	Value of *out_var* at which the derivative is found.
GOAL=val	Specifies the desired .MEASURE value. Optimization uses this value for ERR calculation. This equation calculates the error: $ERRfun = (GOAL - result)/GOAL$ In HSPICE output you cannot apply `.MEASURE` to waveforms generated from another .MEASURE command in a parameter sweep.
GOALMAX | GOALMIN	Use bisection method to get maximum/minimum measure value.
MINVAL	If the absolute value of GOAL is less than MINVAL, MINVAL replaces the GOAL value in the denominator of the ERRfun expression. Used only in ERR calculation for optimization. The default is 1.0e-12.
WEIGHT	Calculates the error between result and GOAL by multiplied by the weight value. Used only in ERR calculation for optimization. The default is 1.0.
WHEN	WHEN function.

Argument	Description
RISE=r FALL=f CROSS=c	Numbers indicate which occurrence of a CROSS, FALL, or RISE event starts a measurement. ▪ For RISE=r when the designated signal has risen r rise times, the WHEN condition is met and measurement starts. ▪ For FALL=f, measurement starts when the designated signal has fallen f fall times. ▪ A crossing is either a rise or a fall so for CROSS=c, measurement starts when the designated signal has achieved a total of c crossing times as a result of either rising or falling.
LAST	Last CROSS, FALL, or RISE event. ▪ CROSS=LAST, measures the last time the WHEN condition is true for a rising or falling signal. ▪ FALL=LAST, measures the last time WHEN is true for a falling signal. ▪ RISE=LAST, measures the last time WHEN is true for a rising signal. LAST is a reserved word; do not use it as a parameter name in the above .MEASURE commands.
TD	Time when measurement starts.
PRINT	▪ print=0 prevents the printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

The `DERIV` function provides the derivative of:

- An output variable signal at a specified time or frequency.
- Any sweep variable, depending on the type of analysis.
- A specified output variable when some specific event occurs.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions.

Command Group

Output Porting

Examples

Example 1 Calculates the derivative of V(out) at 25 ns.

```
.MEAS TRAN slew rate DERIV ('V(out)') AT=25ns
```

Example 2 Calculates the derivative of VP(output)/360.0 when the frequency is 10 kHz.

```
.MEAS AC delay DERIV ('VP(output)/360.0') AT=10khz
```

Example 3 Measures the derivative of a nodal waveform.

```
.meas tran Marg_r_far_left
+ FIND PAR('v(x1.xi0.bit)-v(x1.xi0.xi1.net021)')
+ WHEN DERIV ('i3(x1.xi0.xi1.xmm1.main)')= 0  TD=15ns
```

Example 4 If you plot result from the command you get the dV(out)/dTemperature vs Temperature plot.

```
.MEAS DC result deriv v(out) …
```

Example 5 Measures and finds when the maximum derivative of a signal occurs. The example shows (1) a probe of the derivative of the signal, (2) the maximum value of the derivative, and (3) when the maximum value of the derivative occurred.

```
.probe dt=deriv("v(out)")
.meas m0 max par(dt)
.meas m1 when par(dt)=m0
```

.MEASURE (Error Function)

Reports the relative difference between two output variables.

Syntax

```
.MEASURE [DC|AC|TRAN] result
+ ERRfun meas_varcalc_var
+ [MINVAL=val] [IGNOR|YMIN=val]
+ [YMAX=val] [WEIGHT=val] [FROM=val] [TO=val] [PRINT 0|1]
```

Argument	Description
DC|AC|TRAN	Analysis type for the measurement. If you omit this parameter, HSPICE defaults to the last analysis mode requested.
result	Name of the measured result in the output.
ERRfun	Error function to use: ERR, ERR1, ERR2, or ERR3.
meas_var	Name of any output variable or parameter in the data command. `M` denotes the *meas_var* in the error equation.
calc_var	Name of the simulated output variable or parameter in the .MEASURE command to compare with *meas_var*. `C` is the *calc_var* in the error equation.
MINVAL	If the absolute value of *meas_var* is less than *MINVAL*, *MINVAL* replaces the meas_var value in the denominator of the *ERRfun* expression. Used only in ERR calculation for optimization. Default: 1.0e-12.
IGNOR|YMIN	If the absolute value of *meas_var* is less than the *IGNOR* value, then the *ERRfun* calculation does not consider this point. Default: 1.0e-15.
YMAX	If the absolute value of *meas_var* is greater than the *YMAX* value, then the *ERRfun* calculation does not consider this point. Default: 1.0e+15.
WEIGHT	Calculates error multiplied weight value. Used only in ERR calculation for optimization. The default is 1.0.
FROM	Specifies the beginning of the ERRfun calculation. For transient analysis, the *FROM* value is in units of time. Defaults to the first value of the sweep variable.
TO	End of the *ERRfun* calculation. Default is last value of the sweep variable.

Argument	Description
PRINT	▪ print=0 prevents printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

The relative error function reports the relative difference between two output variables. You can use this format in optimization and curve-fitting of measured data. The relative error format specifies the variable to measure and calculate from the `.PARAM` variable. To calculate the relative error between the two, HSPICE uses the `ERR`, `ERR1`, `ERR2`, or `ERR3` functions. With this format you can specify a group of parameters to vary to match the calculated value and the measured data.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all `TRIG-TARG`, `FIND-WHEN`, and `FROM-TO` measure functions.

Command Group

Output Porting

Examples

```
.measure ac comp1 err1 par(s11m) s11(m)
.measure tran re1 err1 par(out2) v(out) from=1u to=2u
```

.MEASURE PHASENOISE

Enables measurement of phase noise at various frequency points in HSPICE.

Syntax

FIND-WHEN ... Phase Noise

```
.MEASURE PHASENOISE result FIND phnoise At = IFB_value
+ [PRINT 0|1]
.MEASURE PHASENOISE result WHEN phnoise=value [PRINT 0|1]
```

RMS, average, min, max, and peak-to-peak Phase Noise

```
.MEASURE PHASENOISE result funcphnoise + [FROM = IFB1] [TO
   = IFB2] [PRINT 0|1]
```

Integral Evaluation of Phase Noise

```
.MEASURE PHASENOISE result INTEGRAL phnoise + [FROM = IFB1]
   [TO = IFB2] [PRINT 0|1]
```

Derivative Evaluation of Phase noise

```
.MEASURE PHASENOISE result DERIV[ATIVE] phnoise AT = IFB1
+ [PRINT 0|1]
```

Amplitude modulation noise

```
.MEASURE phasenoise result AM[NOISE] phnoise
+ [FROM = IFB1] [TO = IFB2] [PRINT 0|1]
```

Phase modulation noise

```
.MEASURE phasenoise result PM[NOISE] phnoise
+ [FROM = IFB1] [TO = IFB2] [PRINT 0|1]
```

Argument	Description
FIND	Selects the FIND function
result	Name of the measured result in the output.
phnoise	.MEASURE PHASENOISE value for phase noise
WHEN	Selects the WHEN function
IFB_value	Input frequency band point value
func	Indicates one of the measure command types: ▪ AVG (average): Calculates the phase noise over the frequency range. ▪ MAX (maximum): Reports the maximum value of the phase noise over the specified frequency range. ▪ MIN (minimum): Reports the minimum value of the phase noise over the specified frequency range. ▪ PP (peak-to-peak): Reports the maximum value, minus the minimum value of the phase noise over the specified frequency range. ▪ RMS (root mean squared): Calculates the square root of the phase noise over the specified frequency range.

Argument	Description
FROM...TO	Optional range for input frequency bands (IFB)
INTEGRAL	Integrates the phase noise value from the first to the second IFB frequency points
DERIVATIVE	Finds the derivative of the phase noise at the first IFB frequency point
PM[NOISE]	Measures the phase modulation noise from the specified first to the second IFB frequency points (when `.OPTION PHASENOISEAMPM=1`)
AM[NOISE]	Measures the amplitude modulation noise from the specified first to the second IFB frequency points (when `.OPTION PHASENOISEAMPM=1`)
PRINT	▪ print=0 prevents printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

This command enables measurement of phase noise at various frequency points in HSPICE.

The `.MEASURE PHASENOISE` syntax supports yielding the following phase noise instances in dbc/Hz:

- Yields the phase noise using FIND or WHEN functions: at a specified input frequency band (FIND), or phase noise found at a specified input frequency point (WHEN).
- Yields the average, RMS, minimum, maximum, or peak-to-peak value of the phase noise from frequency `IFB1` to frequency `IFB2`, where the value of `func` can be RMS, AVG, MIN, MAX or PP. If `FROM` and `TO` are not specified, the value will be calculated over the frequency range specified in the `.PHASENOISE` command.
- Integrates the phase noise value from the IFB1 frequency to the IFB2 frequency.
- Finds the derivative of phase noise at the IFB1 frequency point.

Note: The `.MEASURE PHASENOISE` command cannot contain an expression that uses a phase noise variable as an argument. You also cannot use `.MEASURE PHASENOISE` for error measurement and expression evaluation of `PHASENOISE`.

The HSPICE optimization flow can read the measured data from a `.MEASURE PHASENOISE` analysis. This flow can be combined in the HSPICE optimization routine with a `.MEASURE HBTR` analysis.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION PHNOISEAMPM	Allows you to separate amplitude modulation and phase modulation components in a phase noise simulation.
.OPTION AUTOSTOP / AUTOST	Stops a transient analysis in HSPICE after calculating all `TRIG-TARG`, `FIND-WHEN`, and `FROM-TO` measure functions.

Command Group

Output Porting

Examples

Example 1 *The FIND keyword yields the result of a variable value at a specific input frequency band (IFB) point.*

```
.MEASURE PHASENOISE np1 find PHNOISE at=100K
```

Example 2 *The WHEN keyword yields the input frequency point at a specific phase noise value.*

```
.MEASURE PHASENOISE fcorn1 WHEN PHNOISE=-120
```

Example 3 *The following sample command find functions such as the RMS, AVG, MIN, MAX, or PP over the frequency range.*

```
.measure PHASENOISE rn1 RMS phnoise
.measure PHASENOISE agn1 AVG phnoise from=100k to=10meg
.measure PHASENOISE nmin MIN phnoise
```

Example 4 *The INTEGRAL command integrates the phase noise across the two specified Input frequency band points.*

```
.measure PHASENOISE inns1 INTEGRAL phnoise
.measure PHASENOISE rns1 INTEGRAL phnoise from=50k to 500k
```

Example 5 *These DERIV sample commands find the derivative of the phase noise at one input frequency band point.*

```
.measure PHASENOISE dnf1 DERIVATIVE phnoise at=100k
.measure PHASENOISE fdn1 DERIVATIVE phnoise at=10meg
```

Example 6 *These AM/PM sample commands find the amplitude modulation (AM) and phase modulation (PM) noise across the specified input frequency range.*

```
.measure PHASENOISE amp1 AM phnoise from=100k to=400k
.measure PHASENOISE pmp1 PM phnoise from=10meg to=30meg
```

See Also

.PHASENOISE
.MEASURE PTDNOISE
.MEASURE (FIND and WHEN)
.MEASURE (AVG, EM_AVG, INTEG, MIN, MAX, PP, and RMS)
.MEASURE (Integral Function)
.MEASURE (Derivative Function)
Measuring Phase Noise with .MEASURE PHASENOISE
.HB
.OPTION PHNOISEAMPM
.OPTION AUTOSTOP / AUTOST

.MEASURE PTDNOISE

Allows for the measurement of integrated phase noise, time-point, tdelta-value, slewrate, and strobed jitter parameters in HSPICE.

Syntax

```
.MEASURE PTDNOISE meas_name STROBEJITTER onoisefreq_sweep
+[PRINT 0|1]
```

Argument	Description
strobed jitter	Calculated from the noise voltage (integrated over the frequency range specified by *frequency_range*), divided by the slewrate at the same node(s), at the time point specified by *time_value*. While only STROBEJITTER can be specified, all of the parameters listed below are also output to the `*.msnptn#` file. Unit: sec
integptdnoise	Unit: V
timepoint	Unit: sec
tdelta-value	Unit: sec

Argument	Description
slewrate	Unit: V/sec
PRINT	▪ print=0 prevents printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

Use to obtain strobed jitter or other parameters in large signal periodic time-dependent noise analysis. For more information, see the *HSPICE User Guide: Advanced Analog Simulation and Analysis* section on Periodic Time-Dependent Noise Analysis (.PTDNOISE).

Command Group

Output Porting

Examples

Example 1 *Using measure results for the time value: The first line of this example measures the first crossing of the output; the second line uses the measured value, edge, as the time point.*

```
.measure sn edge when v(div1out)='v(vdddiv)/2' cross=1
.ptdnoise v(div1out) time=edge dec 10 100 100e6
```

See Also

.PTDNOISE
.MEASURE Syntax and File Format

.MEASURE (Pushout Bisection)

Specifies a maximum allowed pushout time to control the distance from failure in bisection analysis.

Syntax

Absolute Pushout Syntax

```
.MEASURE TRAN result MeasureClause PUSHOUT=time
+ [lower|upper] [POSITIVE|NEGATIVE] [PRINT 0|1]
```

Relative Pushout Syntax

```
.MEASURE TRAN result MeasureClause
```

```
+ [PUSHOUT=[pushout_min,] pushout_max]
+ PUSHOUT_PER=percentage [lower|upper]
+ [POSITIVE|NEGATIVE] [PRINT 0|1]
```

Argument	Description
result	Name associated with the measured value in the HSPICE output, can be up to 16 characters long.
MeasureClause	Measurement type; can be either TARG-TRIG or WHEN. For GOAL you can specify GOAL=*val*|GOALMAX|GOALMIN.
PUSHOUT=time	The absolute time to obtain the pushout result. PUSHOUT in the absolute pushout syntax is not unitless, it is in the unit of time.
PUSHOUT=pushout_min, pushout_max	Set the min and max value for pushout value given by PUSHOUT_PER. i.e. | measresult-goldmeas | < Max(pushout_min, Min(pushout_max, pushout_per*goldmeas)).
PUSHOUT_PER=percentage	Relative error. If you specify a 0.1 relative error, the T_lower or T_upper and T_pushout have more than a 10% difference in value. This causes the iteration to stop and output the optimized parameter.
lower|upper	(Optional) Parameter boundary values for pushout comparison. If the parameter is defined as `.PARAM ParamName= OPTxxx(Initial, min, max)` then "lower" means the lower bound "min", and "upper" means the upper bound "max". Default: lower.
POSITIVE	Pushout constraints only take effect when the measured results are larger than the golden measure.
NEGATIVE	Pushout constraints only take effect when the measured results are smaller than the golden measure.
PRINT 0|1	▪ print=0 prevents printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

Pushout is used only in bisection analysis. Instead of finding the last point just before failure, you specify a maximum pushout time to control the distance from

failure. To limit the range, add both absolute and relative pushout together. Note the comma-separated syntax.

For example:

```
.Measure Tran pushout When v(D_Output)='vih/2'
+ rise=1 pushout=20p,50p pushout_per=0.1
```

The final measure result for the preceding example should be in the range of:

```
| measresult-goldmeas | < Min (pushout_max, pushout_per*goldmeas)
```

...or, the final measure result should satisfy,

```
Max(pushout_per*goldmeas, pushout_min)
```

Command Group

Output Porting

Examples

Example 1 *Delaytime is set for optimization; the evaluation goal is setup_prop. pushout=1.5n lower specifies the setup_prop of the final solution is not 1.5n far from the setup_prop of the lower bound of the parameter (0.0n).*

```
.Param DelayTime=Opt1 ( 0.0n, 0.0n , 5.0n )
.Tran 1n 8n Sweep Optimize=Opt1 Result=setup_prop Model=OptMod
.Measure Tran setup_prop Trig v(data)
+ Val='v(Vdd) 2' fall=1 Targ v(D_Output)
+ Val='v(Vdd)' rise=1 pushout=1.5n lower
```

Example 2 *The differences between the setup_prop of the final solution and that of the lower bound of the parameter (0.0n) is not more than 10%.*

```
.Measure Tran setup_prop Trig v(data) Val='v(Vdd)/2' fall=1
+ Targ v(D_Output) Val='v(Vdd)' rise=1 pushout_per=0.1 lower
```

Example 3 *Pushout constraints only take effect when the measuring results are larger than the golden measure.*

```
.MEASURE TRAN result MeasureClause pushout=time
+ pushout_per 0.01 POSITIVE
```

Example 4 *Pushout constraints only take effect when the measuring results are smaller than the golden measure.*

```
.MEASURE TRAN delay When v(D_Output)='vih/2' rise=1
+ pushout_per 0.01n NEGATIVE
```

See Also

Pushout Bisection Methodology

.MEASURE (ACMATCH)

Introduces special keywords to access results for ACMatch analysis.

Syntax

```
.MEASURE AC result [MAX][ACM_Total|ACM_Global|
+ ACM_Global(par)|ACM_Local|ACM_Local(dev)] [PRINT 0|1]
```

Argument	DescriptionDescription
results	Name associated with the measured values in the HSPICE output, can be up to 16 characters long.
MAX	Sample function; Instead of “MAX” other functions can be used which select one out of multiple results.
ACM_Total	Output sigma due to global, local, and spatial variations.
ACM_Global	Output sigma due to global variations.
ACM_Global(par)	Contribution of parameter (*par*) to output sigma due to global variations.
ACM_Local	Output sigma due to local variations.
ACM_Local(dev)	Contribution of device (*dev*) to output sigma due to local variations.
PRINT	▪ print=0 prevents printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

ACMatch analysis saves results using `.MEASURE` commands, with AC type (M,P,R,I) for an output variable, as specified on the `.ACMatch` command. If you specify multiple output variables the command issues a result for the last one only. You must specify an AC sweep to produce these kinds of outputs; a single point sweep is sufficient. ACMatch uses the special keywords shown above to access the results from the different variation types. For usable keywords with the `.PROBE` command, see Output from .PROBE and .MEASURE Commands for ACMatch in the *HSPICE User Guide: Basic Simulation and Analysis*.

Command Group

Output Porting

See Also

.AC
.MEASURE (ACMATCH)
.PROBE

.MEASURE (DCMATCH)

Introduces special keywords to access the different types of results for DCMatch analysis in HSPICE.

Syntax

```
.MEASURE DC result [MAX] [DCM_Total | DCM_global |
+ DCM_Global(par) | DCM_Local | DCM_Local(dev) |
+ DCM_Spatial | DCM_Spatial(par)] [PRINT 0|1]
```

Argument	Description
result	Name associated with the measured values in the HSPICE output, can be up to 16 characters long.
MAX	Sample function. Instead of “MAX,” other functions can be used which select one out of multiple results.
DCM_Total	Output sigma due to global, local, and spatial variations.
DCM_Global	Output sigma due to global variations.
DCM_Global(par)	Contribution of parameter (*par*) to output sigma due to global variations.
DCM_Local	Output sigma due to local variations.
DCM_Local(dev)	Contribution of device (*dev*) to output sigma due to local variations.
DCM_Spatial	Output sigma due to local variations.
DCM_Spatial(par)	Contribution of parameter (*par*) to output sigma due to spatial variations.
PRINT	▪ print=0 prevents printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

DCMatch analysis uses special keywords to access the different types of results. You can save the different results produced by a DCMatch analysis using the `.MEASURE` command for the output variable specified on the `.DCMatch` command. For keywords to be used with the `.PROBE` command, see Syntax for .PROBE Command for DCMatch in the *HSPICE User Guide: Basic Simulation and Analysis*. If you specify multiple output variables, the command produces a result for the last one only. You must specify a DC sweep to produce these kinds of outputs; a single point sweep is sufficient.

Command Group

Output Porting

Examples

In this example, the result `systoffset` reports the systematic offset of the amplifier; the result `matchoffset` reports the variation due to mismatch; and the result `maxoffset` reports the maximum (3-sigma) offset of the amplifier.

```
.MEAS DC systoffset avg V(inp,inn)
.MEAS DC matchoffset avg DCm_local
.MEAS DC maxoffset
param='abs(systoffset)+3.0*matchoffset'
```

See Also

.DC
.PROBE

.MEASURE FFT

Specifies measurement of FFT results.

Syntax

Syntax #1

```
.MEASURE FFT result
+ Find [vm|vp|vr|vi|vdb|im|ip|ir|ii|idb](signal) AT=freq
+ [PRINT 0|1]
```

Syntax #2

```
.MEASURE FFT result THD signal_name [nbharm=num]
 [PRINT 0|1]
```

Syntax #3

```
.MEASURE FFT result[SNR|SNDR|ENOB] signal_name
+ [nbharm=num|maxfreq=val] [BINSIZ=num] [PRINT 0|1]
```

Syntax #4

```
.MEASURE FFT result SFDR signal_name
+ [minfreq=val][maxfreq=val] [PRINT 0|1]
```

Argument	Description
result	Name associated with the measured values in the FFT output, can be up to 16 characters long.
Find	FIND function.
At	Value of the *frequency* at which the component frequency and signal are found.
signal	Can be any of the following: vm|vp|vr|vi|vdb|im|ip|ir|ii|idb.
freq	Specified frequency
THD	Total harmonic distortion
signal_name	User-supplied name of signal
nbharm	Harmonic up to which to carry out the measurement. All the frequency components above this harmonic will be considered as noise. Default: highest harmonic in FFT result.
maxfreq	Higher limit of frequency range to carrying out the measurement. All the frequency component above this harmonic will be considered as noise. Default: maximum frequency in an FFT result.
minfreq	Lower limit of frequency range to calculate SFDR.
SNR	Signal to noise ratio.
SNDR	Signal to noise-plus-distortion ratio.
ENOB	Effective number of bits.

Argument	Description
BINSIZ	Filters out noise component within the bin; the noise component is calculated from the index of “fundamental_freq_idx+BINSIZ+1”. Default=0.
SFDR	Spurious free dynamic range.
PRINT	▪ print=0 prevents printing a measure result into the measure output file ▪ print=1 (Default) prints the measure result into the output file

Description

Four syntaxes are provided for finding measurements of several types for FFT results.

See examples below for sample usage.

- Syntax #1: Measures a frequency component at certain frequency.
- Syntax #2: Measures THD of a signal spectrum up to a specified harmonic; Default: `nbharm`=maximum harmonic in FFT result
- Syntax # 3: Measures SNR/SNDR/ENOB of a signal up to a specified frequency; Defaults: `nbharm`=maximum harmonic in FFT result; `maxfreq`=maximum frequency in FFT result; `BINSIZ=0`.
- Syntax # 4: Measures SFDR of a signal from `minfreq` to `maxfreq`; searches the frequency component with maximum magnitude from `minfreq` to `maxfreq`.

An embedded `.MEASURE FFT` command in a measure file can be called to perform FFT measurements from previous simulation results as follows:

```
HSPICE -i *.tr0 -meas measure_file
```

Command Group

Output Porting

Examples

Example 1 Measures frequency component at certain frequency.

```
.meas FFT v12 Find vm(1,2)at=20k
```

Example 2 Measures THD of a signal spectrum up to a specified harmonic.

```
.meas FFT thd56 THD V(node5, node6) nbharm=10
```

Example 3 *Measures SNR/SNDR/ENOB of a signal up to a specified frequency.*

```
.meas FFT snr12 SNDR V(node1, node2) maxfreq=1G
```

Example 4 *Measures SFDR of a signal from minfreq to maxfreq and searching the frequency component with maximum magnitude from minfreq to maxfreq.*

```
.meas FFT sfdr9 SFDR V(node9)
```

Example 5 *Filters out the noise component within the bin.*

```
.meas fft snrsrc SNR v(out) BINSIZ=10
```

Example 6 *This extended example measures the spectral energy in the fft across a frequency band.*

```
*
.FFT v(outp,outn) np=32768
.measure fft tone1 find vdb(outp,outn) at=169950
.measure fft tone2 find vdb(outp,outn) at=192000
.measure fft tone3 find vdb(outp,outn) at=200000
.measure fft tone_3.072e06_500e06_1 integ vdb(outp,outn)
+ from=169950 to=191980
.measure fft tone_3.072e06_500e06_2 integ vdb(outp,outn)
+ from=361950 to=383980
.measure fft tone_tot_3.072e06_500e06_1
+ param='tone_3.072e06_500e06_1'
.measure fft tone_tot_3.072e06_500e06_2
+ param='tone_3.072e06_500e06_2 + tone_tot_3.072e06_500e06_1
.end
```

See Also

.FFT
Spectrum Analysis

.MEASURE LSTB

Enables the measurement of lstb output variables similar to any other common ac variable.

Syntax

```
.MEASURE AC Result FIND LSTB(x) WHEN LSTB(x)=val
.MEASURE AC Result LSTB(x) FROM=val TO=val [PRINT 0|1]
```

Argument	Description
AC	AC analysis result
`Result`	Result name of an .AC .LSTB analysis
`LSTB`	Output loop gain as complex numbers
`LSTB(x)`	▪ x=DB: Output the dB values of loop gain ▪ x=M: Output magnitude of loop gain ▪ x=P: Output phase of loop gain ▪ x=R: Output real part of loop gain ▪ x=I: Output imaginary part of loop gain
`FIND...WHEN`	Selects the Find and When functions
`FROM...TO`	Selects the range of measurement
PRINT	▪ print=0 prevents printing a measure result into the measure output file. ▪ print=1 (default) prints the measure result into the output file.

Description

Use the `.MEASURE LSTB` statement to measure linear loop stability outputs in a similar manner to any common ac output variable. Measure phase margin, gain margin, unity gain frequency, dc gain, etc... from the return ratio waveform that is generated in the `.LSTB` analysis. The `lstb` scalars can be measured as follows:

```
.measure lstb out1 gain_margin
.measure lstb out2
.measure lstb out3 phase_margin_freq
.measure lstb out4 loop_gain_at_minifreq
.measure lstb out5 gain_margin_freq
```

in which `out1` - `out4` are names for measured output, `lstb` is the type name, and `gain_margin`, `gain_margin_freq`, `phase_margin`, `phase_margin_freq`, and `loop_gain_at_minifreq` are keywords of scalar variables.

Command Group

Output Porting

Examples

Example 1 *Finds the measurement for the output phase of loop gain of phase margin when the decibel output is 0.*

```
.MEASURE AC PHASE_MARGIN FIND LSTB(P) WHEN LSTB(DB)=0
```

Example 2 *Measures the first output phase of loop gain Integral across a range of 1 to 100k.*

```
.MEASURE AC INTEG1 INTEGRAL LSTB(P) FROM=1k TO=100k
```

See Also

.LSTB

.MODEL

Includes an instance of a predefined HSPICE model in an input netlist.

Syntax

Passive and active device model syntax

```
.MODEL mname type [level=num]
+ [pname1=val1pname2=val2 ...]
```

See specific element type for supported model parameter information.

Optimization model syntax

```
.MODEL mname OPT [METHOD=BISECTION|PASSFAIL] [close=num]
+ [max] [cut=val] [difsiz=val] [grad=val] [parmin=val]
+ [relin=val] [relout=val] [absout=val)
+ [itrop=val] [absin=val]
+ [DYNACC=0|1] [cendif=num]
```

Syntax used for a Monte Carlo analysis

```
.MODEL mname ModelType ([level=val]
+ [keyword1=val1][keyword2=val2]
+ [keyword3=val3][LOT distribution value]
+ [DEV distribution value]...)
```

Syntax used for model reliability analysis

```
.model mname mosra
+ level|mosralevel value
+ [relmodelparam]
```

Argument	Description
mname	Model name reference. Elements must use this name to refer to the model. If model names contain periods (.), the automatic model selector might fail. When used with `.MOSRA` it is the user-defined MOSFET reliability model name.
type	Model type. Must be one of the following.: ■ AMP—operational amplifier model ■ C—capacitor model ■ CORE—magnetic core model ■ D—diode model ■ L—inductor model or magnetic core mutual inductor model ■ NJF—n-channel JFET model ■ NMOS—n-channel MOSFET model ■ NPN—npn BJT model ■ OPT—optimization model ■ PJF—p-channel JFET model ■ PLOTQ—plot model for the .GRAPH command (obsolete) ■ PMOS—p-channel MOSFET model ■ PNP—pnp BJT model ■ R—resistor model ■ U—lossy transmission line model (lumped) ■ W—lossy transmission line model ■ S—S-parameter ■ TMI—TMI Dummy model

Argument	Description
level	Model level. ■ For optimization model, LEVEL=1 specifies the Modified Levenberg-Marquardt method. Use this setting with multiple optimization parameters and goals. ■ Only Level=1 is available in HSPICE. **See below:** This argument is ignored when METHOD has been specified. ■ LEVEL=2 (advanced analog function) specifies the BISECTION method in HSPICE. You would use this setting with one optimization parameter. ■ LEVEL=3 (advanced analog function) specifies the PASSFAIL method. You would use this setting with two optimization parameters. ■ For transistors, diodes, and some passive element models, see the HSPICE Reference Manual, Elements and Device Models. ■ For MOSFET Models, see the HSPICE Reference Manual: MOSFET Models. ■ To use custom MOSRA models and for discussion of LEVEL values, refer to the *HSPICE User Guide: Implementation of MOSRA API*. Contact your Synopsys technical support team for more information.
pname1 ...	Parameter name. Assign a model parameter name (*pname1*) from the parameter names for the appropriate model type. Each model section provides default values. For legibility, enclose the parameter assignment list in parentheses and use either blanks or commas to separate each assignment. Use a plus sign (+) to start a continuation line.
OPT	Keyword to indicate the definition model is for optimization analysis.

Argument	Description
METHOD	Specifies an optimization method. ▪ METHOD=BISECTION specifies the Bisection method. When the difference between the two latest test input values is within the error tolerance and the latest measured value exceeds the goal, bisection has succeeded and then ends. This process reports the optimized parameter that corresponded to the test value that satisfies this error tolerance and this goal (passes). ▪ METHOD=PASSFAIL specifies the PASSFAIL method. When the difference between the last two optimization parameter test values is less than the error tolerance and the associated goal measurement fails for one of the values and passes for the other, bisection has succeeded and then ends. The process reports the optimization parameter test value associated with the last passing measurement. “Pass” is defined as a condition in which the associated goal measurement can produce a valid result. “Fail” is defined as a condition in which the associated goal measurement is unable to produce a valid result. You can also monitor multiple measurement results and find the parameter value at which all measurements begin to succeed. For example: `.tran 1p 100n sweep optimize=opt1 result=delq,delqn model=optmod`
close	(Optimization) Initial estimate of how close parameter initial value estimates are to the solution. The close argument multiplies changes in new parameter estimates. If you use a large close value, the optimizer takes large steps toward the solution. For a small value, the optimizer takes smaller steps toward the solution. You can use a smaller value for close parameter estimates and a larger value for rough initial guesses. The default is 1.0. ▪ If close is greater than 100, the steepest descent in the Levenburg-Marquardt algorithm dominates. ▪ If close is less than 1, the Gauss-Newton method dominates. For more details, see L. Spruiell, “Optimization Error Surfaces,” *Meta-Software Journal*, Volume 1, Number 4, December 1994.
max	(Optimization) Upper limit on close. Use values > 100. The default is 6.0e+5.

Argument	Description
cut	(Optimization) Modifies close, depending on how successful iterations are toward the solution. If the last iteration succeeds, descent toward the close solution decreases by the cut value. That is, close=close / cut If the last iteration was not a successful descent to the solution, close increases by cut squared. That is, close=close * cut * cut. Cut drives close up or down, depending on the relative success in finding the solution. The cut value must be > 1. The default is 2.0.
difsiz	(Optimization) Increment change in a parameter value for gradient calculations ($\Delta x = DIFSIZ \cdot MAX(x, 0.1)$). If you specify delta in a .PARAM command, then Δx=delta. The default is 1e-3.
grad	(Optimization) Represents possible convergence if the gradient of the RESULTS function is less than GRAD. Most applications use values of 1e-6 to 1e-5. Too large a value can stop the optimizer before finding the best solution. Too small a value requires more iterations. The default is 1.0e-6.
parmin	(Optimization) Allows better control of incremental parameter changes during error calculations. The default is 0.1. This produces more control over the trade-off between simulation time and optimization result accuracy. To calculate parameter increments, HSPICE uses the relationship: Δpar_val=ΔIFSIZ · MAX(par_val, PARMIN)
relin	(Optimization) Relative input parameter (delta_par_val / MAX(par_val,1e-6)) for convergence. If all optimizing input parameters vary by no more than RELIN between iterations, the solution converges. RELIN is a relative variance test so that a value of 0.001 implies that optimizing parameters vary by less than 0.1% from one iteration to the next. The default is 0.001.
relout	(Optimization) Relative tolerance to finish optimization. For relout=0.001: if the relative difference in the RESULTS functions from one iteration to the next is less than 0.001, then optimization is finished. The default is 0.001.
absout	(Bisection) Absolute tolerance to finish bisection. For absout=0.001, if the absolute difference in the RESULTS functions from one iteration to the next, is less than 0.001, then bisection is completed. The default is 0.0, which means inactive, and use relout.

Argument	Description
itropt	(Optimization) Maximum number of iterations. Typically, you need no more than 20-40 iterations to find a solution. Too many iterations can imply that the relin, grad, or relout values are too small. The default is 20.
absin	(Optimization) Overrides relin parameter and ignores relout and itropt; there is no default value
DYNACC	(Optimization) Dynamic accuracy tolerance setting to accelerate bisection simulation. The default is 0. When DYNACC=1, if HSPICE is in accuracy mode, it uses reduced accuracy simulations to narrow the bisection window, then switches to the original accuracy algorithm to refine the solution. This method reduces simulation time by doing the majority of simulations at lower accuracy, which run faster by taking fewer time steps.
cendif	(Optimization) Point at which more accurate derivatives are desired.
keyword	(Monte Carlo) Model parameter keyword.
distribution	(Monte Carlo) The distribution function name, which must be specified as GAUSS, AGAUSS, LIMIT, UNIF, or AUNIF. If you do not set the distribution function, the default distribution function is used. The default distribution function is UNIFORM distribution.
DEV	(Monte Carlo) DEV tolerance, which is independent (each device varies independently).
LOT	(Monte Carlo) The LOT tolerance, which requires all devices that refer to the same model use the same adjustments to the model parameter.
mosra	Keyword to indicate the definition model is for MOSRA analysis.

Argument	Description

level (alias: mosralevel)	To use the Synopsys MOSRA model, set LEVEL=1. For compatibility with HSIM, in the .MODEL statement, 'LEVEL=' can be replaced with 'MOSRALEVEL='. HSPICE will consider them equivalent. Example: The following two lines will be interpreted the same by HSPICE.
	`.MODEL my_mod MOSRA LEVEL=1`
	`.MODEL my_mod MOSRA MOSRALEVEL=1`
	To use custom MOSRA models and for discussion of LEVEL values, refer to the HSPICE Application Note: Unified Custom Reliability Modeling API (MOSRA API). Contact your Synopsys technical support team for more information.

RelMode	HSPICE reliability mode level; selects whether a simulation accounts for both HCI and NBTI effects or either one of them. If the RelMode in the .MOSRA command is defined as 1 or 2, it takes higher priority and applies to all MOSRA models. If RelMode in the .MOSRA command is not set or set to 0, then the RelMode inside individual MOSRA models take precedence for that MOSRA model only; the rest of the MOSRA models take the RelMode value from the .MOSRA command. If any other value is set, except 0, 1, or 2, a warning is issued, and RelMode is automatically set to the default value 0. ■ 0: both HCI and NBTI, Default. ■ 1: HCI only ■ 2: NBTI only
relmodelparam	Model parameter for HCI or BTI, when doing a reliability MOSFET device analysis. See Level 1 MOSRA BTI and HCI Model Parameters in the *HSPICE User Guide: Basic Simulation and Analysis* for listing of HCI and NBTI parameters. Contact Synopsys Technical Support for access to the MOSRA API.

Description

Use this command to include an instance (element) of a predefined HSPICE model in your input netlist.

For each optimization within a data file, specify a .MODEL command. HSPICE can then execute more than one optimization per simulation run. The .MODEL optimization command defines:

- Convergence criteria: (Bisection accuracy is controlled by the parameters: relin, relout, absin, and itropt. The relin parameter (default 1e-3) times the bisection window size is the goal accuracy. This goal accuracy is

also influenced by `relout` (default 1e-3, the difference ratio between last two iterations) and `itropt` (default 20 iterations). To keep the same bisection accuracy, these three parameters need to change accordingly with a changing bisection window size. You can override the `relin` value by using the `absin` option which has no default (see .OPTION ABSIN.) The `absin` parameter also ignores `itropt` and `relout`.

- Number of iterations
- Derivative methods

Command Group

Subcircuits, Model and Variation

Examples

Example 1 A standard .model statement.

```
.MODEL MOD1 NPN BF=50 IS=1E-13 VBF=50 AREA=2 PJ=3 N=1.05
```

Example 2 Shows the addition of the DYNACC=1 option in an optimization model card to invoke bisection speedup.

```
.MODEL optmod OPT METHOD=BISECTION ITROPT=20 dynacc=1 relout=1e20
```

Example 3 Model command used for a Monte Carlo analysis.

```
.model m1 nmos level=6 bulk=2 vt=0.7 dev/2 0.1
+ tox=520 lot/gauss 0.3 a1=.5 a2=1.5 cdb=10e-16
+ csb=10e-16 tcv=.0024
```

Example 4 Transistors M1 through M3 have the same random vto model parameter for each of the five Monte Carlo runs through the use of the LOT construct.

```
...
.model mname nmos level=53 vto=0.4 LOT/agauss 0.1 version=3.22
M1 11 21 31 41 mname W=20u L=0.3u
M2 12 22 32 42 mname W=20u L=0.3u
M3 13 23 33 43 mname W=20u L=0.3u
...
.dc v1 0 vdd 0.1 sweep monte=5
.end
```

Example 5 Transistors M1 through M3 have different values of the vto model parameter for each of the Monte Carlo runs through the use of the DEV construct.

```
...
.model mname nmos level=54 vto=0.4 DEV/agauss 0.1
M1 11 21 31 41 mname W=20u L=0.3u
M2 12 22 32 42 mname W=20u L=0.3u
M3 13 23 33 43 mname W=20u L=0.3u
...
.dc v1 0 vdd 0.1 sweep monte=5
.end
```

Example 6 Establishes a MOS reliability model card.

```
.model NCH_RA mosra
+ level=1
+ a_hci=1e-2
+ n_hci=1
```

See Also

Cell Characterization Examples for demo files of `.MODEL opt Method=bisection` or `passfail`
BJT and Diode Examples for all listed `*.sp` files in the demo group which use the `.MODEL` command for npn transistors.

.MODEL_INFO

Enables printout of all or specified MOSFET model parameters for each simulation.

Syntax

`.MODEL_INFO ALL | instance_name1, instance_name2, …,`

Argument	Description
`ALL`	Prints all MOSFET instances.
`intance_name1... instance_name2`	Specific MOSFET instance. If the MOSFET instance is in a `.SUBCKT` command, it must be written in the full hierarchical path, e.g.: `x1.x2.main`.

Description

This command generates a text format file with the suffix `*.model_info#`.

Note: If the arguments `ALL` and `instance_name` are specified together, `ALL` will take higher priority.

Command Group

Library Management

Examples

Example 1 Prints all MOSFET instances' model parameters.

```
.MODEL_INFO ALL
```

Example 2 Prints the model parameters for devices.

```
.model_info main x1.m1 x2.m2
```

Example 3 Prints all MOSFET instances' model parameters. (“ALL” takes higher priority over instances.)

```
.MODEL_INFO ALL x1.m1
```

See Also

Using .MODEL_INFO to Print Model Parameters

.MODULE

Helps you create a 3D-IC netlist to simulate multiple facets when two or more layers of active electronic components are integrated both vertically and horizontally into a single circuit.

Syntax

```
.MODULE label [BASE=base_module_label]
```

Argument	Description
label	Can be: ■ File inclusion commands, such as .LIB and .INCLUDE. ■ .SUBCKT constructs that contain legal netlist commands. ■ .HDL (Verilog-A) commands. ■ .PARAM commands. ■ .MODEL commands. ■ .OPTION SCALE and .OPTION GEOSHRINK - Scaling control options that define the device scaling factor for each IC module such that all instances below the subckts carry these properties. ■ .TEMP and .OPTION TNOM - These commands define the simulation temperature for each IC module such that all instances below the subcircuit carry these properties. ■ .GLOBAL command - Defines the global node for each IC module. Thus, all nodes below the subckts carry this node definition connected to this node within the IC module. For example, if .GLOBAL defines a node within the .MODULE construct, only the instances inside the subckts (defined within the same .MODULE construct) and subsequent nodes below the subckts can connect to the defined node without connecting through subckt ports. **Note:** Even though the .GLOBAL nodes are defined for each IC module, HSPICE only limits its reference within the IC module. The nodes can be referenced from top level through the following syntax: *instance_name.global_node_label*

Argument	Description
label	▪ .OPTION PARHIER=[global|local]- When you specify this option inside the .MODULE command, it defines the parameter passing-scheme for all the instances below the subckt which carry this option. Thus, .OPTION PARHIER defines the top level instance parameter passing-scheme outside the .MODULE and .MODULEVAR constructs, or by the netlist default. The definition inside the .MODULEVAR overrides the option that is defined inside the .MODULE construct. ▪ .OPTION MACMOD=[1|2|3|0]- If you declare this option inside the .MODULE command, it defines the MOS device recognition with either a leading "X" or "M" character such that all the subckts defined inside the .MODULE construct are controlled by this option setup. ▪ .IVTH: If you declare this command inside the .MODULE block, it applies to the model card defined within the same .MODULE construct only.

Argument	Description
[BASE=*base_module_label*]	The base_module_label argument allows you to define and inherit all of the content of the base module in the derived IC module without any IC module label. The derived IC module content can overwrite the base IC module content. You can connect the module based global nodes explicitly at the top level such that, all instances instantiated with the IC module top subckt could have different top level connection. For more information on accessing the global node inside a module from the top level, see .CONNECT command. **Note:** 1. Multiple base inheritance is not allowed. Only one base module can be specified with the BASE= argument. 2. The referenced IC module label must be defined before referenced by any new IC module construct with the BASE= argument. 3. Multiple level inheritance is not allowed. 4. The .CONNECT command is not supported inside of a subckt definition.

Description

The .MODULE command enables you to define the unique IC module entities without name labels or circuit properties and thus avoid collision between different IC modules. You can define the model reference static scope unique for the given IC module and define the unique IC module default entities and circuit properties. The module block begins with the .MODULE command and ends with the .ENDMODULE command.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION TNOM	Sets the reference temperature for the simulation.
.OPTION SCALE	Sets the element scaling factor for HSPICE.

Option	Description
.OPTION GEOSHRINK	Element scaling factor used with .OPTION SCALE.

Command Group

3D-IC

Examples

In this example, default control and parameters and default single IC memory properties are drawn from the `memory.lib` “TT” section. Models for the circuit elaborations in the memory circuit are drawn from the `memory.lib` file “models” section. Netlist definitions from the original single IC circuit are drawn from the included `memory.sp` file.

```
.module 1GMem
     .lib "memory.lib" TT

     .temp 25
      …
      .lib "memory.lib" models
      .include "memory.sp"
.endmodule 1GMem
```

In this example, the `xtop1.x1.m1` instance will take the device length as `3e-6` from IC module `tmod` instead of the `2e-6` in the base IC module `bmod`. Also, the model card referenced by the `xtop1.x1.m1` would be the one defined in the `tmod`.

```
Xtop1 … tmod::top1
.module bmod
     .param ptop=2e-6
     .subckt top1 …
     X1 … inv
     …
     .ends
.endmodule bmod
.module tmod base=bmod
     .param ptop=3e-6
     .subckt inv
          M1 … mmod l="ptop" w=2.7e-6
          …
          .ends
.endmodule tmod
```

In this example, the `xtop1` and `xtop2` reference to different `top` subckt inside the IC module `tmod1` and `tmod2` respectively. This example uses the

`xtop1.vdd` and `xtop2.vdd` to reference each IC module global node separately for the `r1` connection at the top level.

```
Xtop1 … tmod1::top
Xtop2 … tmod2::top
R1 xtop1.vdd  xtop2.vdd  r=10
.module tmod1
     .global vdd
     .subckt top
     …
     .ends
.endmodule
.module tmod2
     .global vdd
     .subckt top
     …
     .ends
.endmodule
```

See Also

Multi-Technology Simulation of 3D Integrated Circuit
.ALTER
.MODULEVAR
.DEL MODULE
.DEL MODULEVAR
.ENDMODULE
.ENDMODULEVAR
.LIB
.INCLUDE / INC / INCL
.PARAM / PARAMETER / PARAMETERS
.MODEL
.SUBCKT
.GLOBAL
.TEMP / TEMPERATURE
.OPTION TNOM
.HDL
.IVTH
.OPTION SCALE
.OPTION GEOSHRINK

.MODULEVAR

The .modulevar and .endmodulevar block enables you to define the unique IC module entities for each top-level instance instantiation.

Syntax

.MODULEVAR *label*

Description

Use the .MODULEVAR command when you need to reference unique IC module entities specifications such as parameters, include and library file values, temperature, and so forth for your simulation.

The .modulevar label can only be referenced by the modulevar= parameter as part of the "X*instance_name*" statement.

Valid .MODULEVAR *label* argument(s) are legal netlist statements and constructs, such as:

- .PARAM
- .OPTION
- .TEMP
- .LIB and .INCLUDE to include files containing legal statements inside the .MODULEVAR construct

The overall circuit properties reference precedence is the following order:

1. Defined inside the .modulevar construct.
2. Defined inside the .module construct.
3. Defined at the top-level netlist (outside any .module construct).
4. Any circuit properties not defined inside the lower precedence scope, are treated as additional circuit properties for the referenced IC module.

The top-level IC module instance can overwrite any circuit properties with predefined a .modulevar construct label.

Command Group

3D-IC

Examples

Example 1: This netlist shows top-down parameter passing (`.option parhier=global`) of the following properties:

Instance	Nominal Temperature	Device Length
xtop1.m1	25	3e-008
xtop2.m1	25	5e-008
xtop3.m1	40	5e-008
xtop4.m1	40	1e-008
xtop5.m1	25	1e-008
xtop6.m1	25	8e-008
xtop7.m1	10	4e-008
xtop8.m1	10	8e-008

And the bottom-up parameter passing of the following properties using `.OPTION PARHIER=local`.

Instance	Nominal Temperature	Device Length
xtop1.m1	25	8e-008
xtop2.m1	25	4e-008
xtop3.m1	40	8e-008
xtop4.m1	40	6e-008
xtop5.m1	25	7e-008
xtop6.m1	25	2e-008
xtop7.m1	10	7e-008
xtop8.m1	10	9e-008

```
xtop1 … tmod::top modulevar="top-inst"
xtop2 … tmod::top modulevar="top-inst"
+ ptop=4e-008
xtop3 … tmod::top
```

```
xtop4 … tmod::top ptop=6e-008

xtop5 … top modulevar="top-inst"
xtop6 … top modulevar="top-inst"
+ ptop=2e-008
xtop7 … top
xtop8 … top ptop=9e-008

.temp 10
.param ptop=1e-008

.module tmod
    .temp 40
    .param ptop=3e-008

    .subckt top …
    .param ptop=8e-008
    m1 … nmod l="ptop" w=2.7e-006 …
    .ends top
.endmodule tmod

.modulevar top-inst
    .temp 25
    .param ptop=5e-008
.endmodulevar top-inst

.subckt top …
.param ptop=7e-008
m1 … nmod l="ptop" w=3.7e-006 …
.ends top
```

Example 2: References instance-specific properties as follows:

Instance	Nominal Temperature	Device Length
`xtop1.m1`	25	5e-008
`xtop2.m1`	40	3e-008
`xtop3.m1`	25	5e-008
`xtop4.m1`	10	1e-008

```
xtop1 … tmod::top modulevar="top-inst"
xtop2 … tmod::top
xtop3 … top modulevar="top-inst"
xtop4 … top
```

```
.temp 10
.param ptop=1e-008
.module tmod
   .temp 40
   .param ptop=3e-008

    .subckt top …
    m1 … nmod l="ptop" w=2.7e-006 …
    .ends top
.endmodule tmod

.modulevar top-inst
    .temp 25
    .param ptop=5e-008
.endmodulevar top-inst
```

See Also

.MODULE
.ENDMODULEVAR

.MOSRA

Starts HSPICE HCI and/or BTI reliability analysis for HSPICE.

Syntax

```
.MOSRA RelTotalTime=time_value
+ [RelStartTime=time_value] [DEC=value] [LIN=value]
+ [RelStep=time_value] [RelMode=0|1|2] SimMode=[0|1|2|3]
+ [AgingStart=time_value] [AgingStop=time_value]
+ [AgingPeriod=time_value] [AgingWidth=time_value]
+ [AgingInst="inst_name"]
+ [Integmod=0|1|2] [Xpolatemod=0|1|2]
+ [Tsample1=value] [Tsample2=value]
+ [Agethreshold=value] [DegradationTime=value]
+ [MosraLlife=degradation_type_keyword] [DegF=value]
+ [DegFN=value] [DegFP=value]
+ [Frequency=value]
+ [hci=0|1] [bti=0|1] [tddb=0|1]
+ [circuit_report=0|1] [trelax=value] [area_scaling=value]
```

Argument	Description
RelTotalTime	Final reliability test time to use in post-stress simulation phase. Required argument where *time_value* can be in units of: ▪ sec (default with no unit entry required) ▪ min ▪ hr ▪ day ▪ yr
RelStartTime	Time point of the first post-stress simulation. Default is 0.
DEC	Specifies number of post-stress time points simulated per decade.
LIN	Linear post-stress time points from RelStartTme to RelTotalTime.
RelStep	Post-stress simulation phase on time= RelStep, 2* RelStep, 3* RelStep, … until it achieves the RelTotalTime; the default is equal to RelTotalTime. Value is ignored if DEC or LIN value is set.
RelMode	HSPICE reliability model mode selects whether a simulation accounts for both HCI and BTI effects or either one of them. If the RelMode in the .MOSRA command is defined as 1 or 2, it takes higher priority and applies to all MOSRA models. If RelMode in the .MOSRA command is not set or set to 0, then the RelMode inside individual MOSRA models take precedence for that MOSRA model only; the rest of the MOSRA models take the RelMode value from the .MOSRA command. If any other value is set, except 0, 1, or 2, a warning is issued, and RelMode is automatically set to the default value 0. ▪ 0: both HCI and BTI, Default ▪ 1: HCI only ▪ 2: BTI only

Argument	Description
SimMode	▪ 0: Select pre-stress simulation only ▪ 1: Select post-stress simulation only ▪ 2: Select both pre- and post-stress simulation, Default ▪ 3: Select continual degradation integration through .ALTERs When SimMode=1 ▪ HSPICE reads in the *.radeg0 file and uses it to update the device model for reliability analysis; new transient output is generated in a *.tr1 waveform file. ▪ The *.radeg file and input netlist must be in the same directory. ▪ The netlist stimuli could be different from the SimMode=0 netlist that generated the *.radeg file. When SimMode=3 ▪ If you do not specify .option radegfile in the top level netlist, the simulation does not start from a fresh device. ▪ If you specify .option radegfile in the top level netlist, HSPICE reads in the last suite degradation to the radeg file, and continues the degradation integration/extrapolation from the corresponding circuit time in the radeg file. ▪ In consecutive alters, HSPICE reads in the radeg generated from the previous .ALTER run. **Note**: You can use the command-line option -mrasim to overwrite the value of SimMode in a .MOSRA command card. Possible values are: ▪ 0: Selects pre-stress simulation only ▪ 1: Selects post-stress simulation only ▪ 2: Selects both pre- and post-stress simulation ▪ 3: Selects continual degradation integration through .ALTERs
AgingStart	Optionally defines time when HSPICE starts stress effect calculation during transient simulation. Default is 0.0.
AgingStop	Optionally defines time when HSPICE stops stress effect calculation during transient simulation. Default is tstop in .TRAN command.
AgingPeriod	Stress period. Scales the total degradation over time.

Argument	Description
AgingWidth	The AgingWidth (circuit time “on”) argument works with the AgingPeriod argument. For example: if you specify AgingPeriod=1.0s and AgingWidth=0.5s, then the circuit is turned on for 0.5s, and turned off for 0.5s. (The period is 1.0s.)
AgingInst	Selects MOSFET devices to which HSPICE applies HCI and/or BTI analysis. The default is all MOSFET devices with reliability model appended. The name must be surrounded by quotes. Multiple names allowed/wildcards supported.
Integmod	The flag is used to select the integration method and function. ■ 0 (default): User-defined integration function in MOSRA API ■ 1: Linearized integration method (support non-constant n coefficient) ■ 2: True derivation and integration method
Xpolatemod	The flag is used to select the extrapolation method and function. ■ 0 (default): User-defined extrapolation function in MOSRA API ■ 1: Linearization extrapolation method (support non-constant n coefficient) ■ 2: Two-point fitting extraction and extrapolation method
Tsample1	First simulation time point of stress_total sampling for Xpolatemod=2
Tsample2	Second simulation time point of stress_total sampling for Xpolatemod=2
Agethreshold	Only when the degradation value >= Agethreshold, the MOSFET information is printed in the MOSRA output file `*.radeg` or `*.cvs` file. Default is 0.
DegradationTime	If you specify this argument, the MOSRA API calculates the degradation at the degradation time, and generates a `.degradation` output file.
MosraLife	Argument to compute device lifetime for the degradation type specified. This argument has the same function as `.OPTION MOSRALIFE`. If `.OPTION MOSRALIFE` is specified, it takes precedence over `.MOSRA MOSRALIFE`.

Argument	Description
DegF	Sets the MOSFET's failure criteria for lifetime computation. This argument has the same function as `.option degf`. If `.option degf` is specified, it takes precedence over `.MOSRA DegF`.
DegFN	Sets the NMOS's failure criteria for lifetime computation. This argument has the same function as `.option degfn`. If `.option degfn` is specified, it takes precedence over `.mosra degfn`.
DegFP	Sets the PMOS's failure criteria for lifetime computation. This argument has the same function as `.option degfp`. If `.option degfp` is specified, it takes precedence over `.mosra degfp`.
Frequency	User-specified frequency of the signal for BTI frequency-dependent recovery effect calculus. If not specified, the value will be automatically calculated.
`hci`	Control flag to invoke HCI model in API. ■ 0 (Default): HCI off ■ 1: on
bti	Control flag to invoke BTI model in API. ■ 0 (Default): BTI off ■ 1: on
tddb	Control flag to invoke TDDB model in API. ■ 0 (Default): TDDB off ■ 1: on
circuit_report	Control flag to indicate if there is user defined aging report to be generated in the model in API. ■ 0 (Default): no report ■ 1: yes
`trelax`	User-defined relaxation time for models in API. Default is 0.0.
area_scaling	User-defined area scaling coefficient for models in API. Default is 1.0.

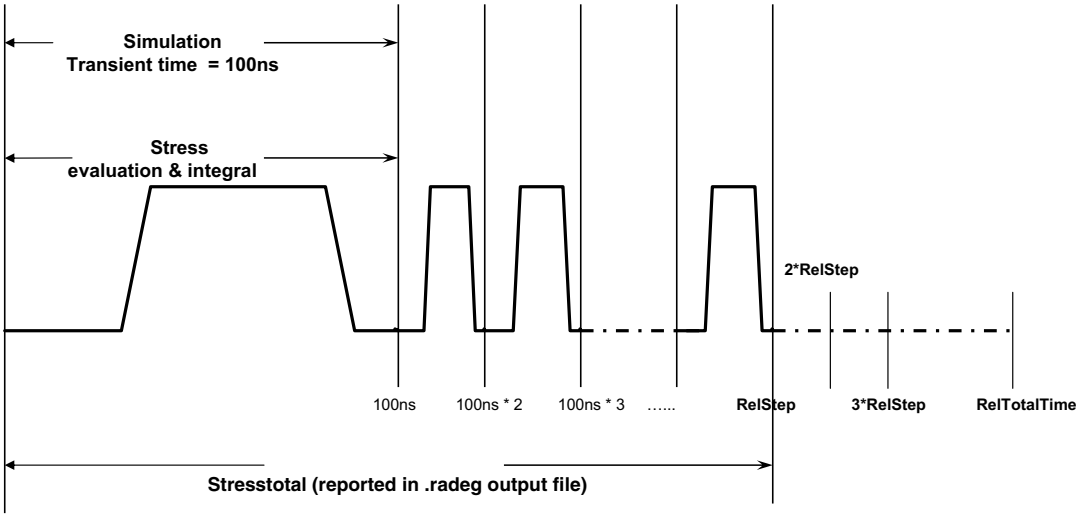
Description

Use the .MOSRA command to initiate HCI and BTI analysis for the following models: Level 49, Level 53, Level 54, Level 57, Level 62, Level 66, Level 69, Level 70, Level 71, Level 72, Level 73, Level 76, and external CMI MOSFET models. This is a two-phase simulation, the fresh simulation phase and the post stress simulation phase. During the fresh simulation phase, HSPICE computes the electron age/stress of selected MOS transistors in the circuit based on circuit behavior and the HSPICE built-in stress model including HCI and/or BTI effect. During the post stress simulation phase, HSPICE simulates the degradation effect on circuit performance, based on the stress information produced during the fresh simulation phase.

If you specify either DEC or LIN, the API ignores the RelStep value. See the following figure for an illustration of the .MOSRA command/syntax.

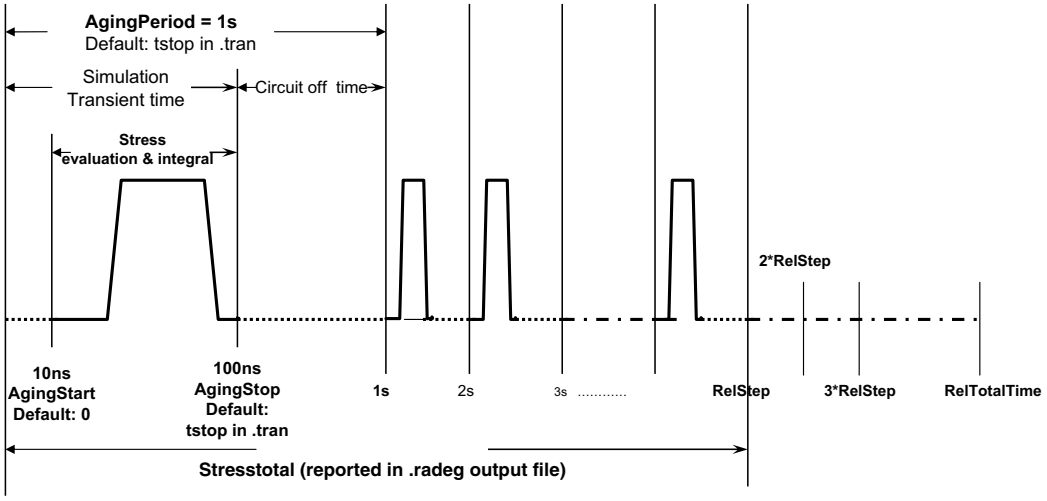
For a full description, refer to the *HSPICE User Guide: Basic Simulation and Analysis*: MOSFET Model Reliability Analysis (MOSRA).

Command/syntax for HSPICE reliability simulation (1/3)



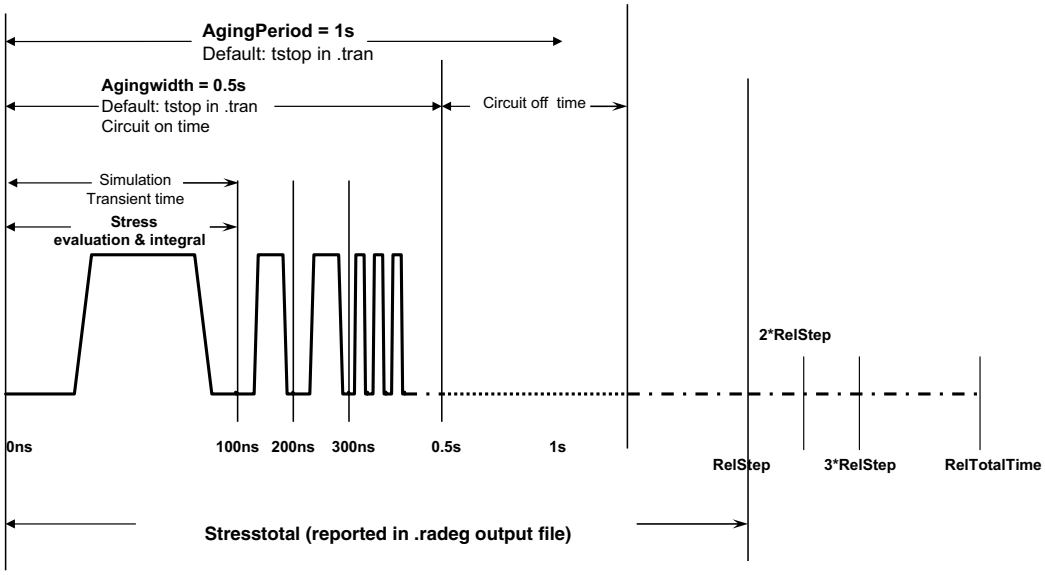
.MOSRA Reltotaltime = 1e+9 RelStep= 1e+8
.Tran 1n 100ns

Command/syntax for HSPICE reliability simulation (2/3)



.MOSRA Reltotaltime = 1e+9 RelStep= 1e+8 AgingStart=10ns AgingStop=100nS AgingPeriod=1s
.Tran 1n 100ns

Command/syntax for HSPICE reliability simulation (3/3)



.MOSRA Reltotaltime = 1e+9 RelStep= 1e+8
+ AgingPeriod=1s Agingwidth= 0.5s
.Tran 1n 100ns

Figure 9 Graphic Illustration of MOSRA Command/Syntax

Command Group

Model and Variation

Examples

Example 1 Basic reliability test.

```
.mosra reltotaltime=6.3e+8 relstep=6.3e+7
+ agingstart=5n agingstop=100n
+ aginginst="x1.*"
```

*Example 2 Full example showing how for general MOSRA, the degradation is printed in *.radeg or *.csv files when >=agethreshold.*

```
* test circuit using demo MOSRA API model
.temp 27
.option runlvl=6 bypass=0 accurate=1 delmax=1p
vdd 1 0 pvdd
mp1 3 2 1 1 p1 l=0.1u w=10u ad=5p pd=6u as=5p ps=6u
mn1 3 2 0 0 n1 l=0.1u w=5u ad=5p pd=6u as=5p ps=6u
mp2 4 3 1 1 p1 l=0.1u w=10u ad=5p pd=6u as=5p ps=6u
mn2 4 3 0 0 n1 l=0.1u w=5u ad=5p pd=6u as=5p ps=6u
mp3 2 4 1 1 p1 l=0.1u w=10u ad=5p pd=6u as=5p ps=6u
mn3 2 4 0 0 n1 l=0.1u w=5u ad=5p pd=6u as=5p ps=6u
c1 2 0 .1p

.ic v(2)=pvdd
.include ./mosramodel.inc
.tran 1n 10n
.options post
*.option mraext=1
* mosra command
.mosra reltotaltime=5yr Aginginst='*' relstep=2.5yr
+ agethreshold = 2.7E-02
.option radegoutput=csv
*.param hsimradegoutput=csv
.alter
.mosra reltotaltime=5yr Aginginst='*' relstep=2.5yr
+ agethreshold = 0
.alter
.mosra reltotaltime=5yr agethreshold = -0.1
.alter
.mosra reltotaltime=5yr agethreshold = 0.1
.end
```

See Also

.APPENDMODEL
.MODEL

.MOSRA_SUBCKT_PIN_VOLT

When a MOSFET is wrapped by a subckt-based macro model, this command specifies the subckt terminal voltages used by MOSRA model evaluation.

Syntax

`.MOSRA_SUBCKT_PIN_VOLT` *subckt_name1, subckt_name2,...*

Description

Use this command to specify subckt-based macro terminal voltages HSPICE will use for MOSRA model evaluation.

`subckt`: The subcircuit name whose terminal voltages to be used for MOSRA model evaluation.

Note: There is a limitation to this capability. The subckt-based macro model can contain only one MOSFET, and the number and definition of subckt terminals must be consistent with HSPICE MOSFET terminal number and definition.

Command Group

Subcircuits

Examples

In this example, HSPICE will use subckt sub1's terminal voltages `v(d)/v(g)/v(s)/v(b)`, instead of the MOSFET M1's terminal voltages, v(d1)/v(g1)/v(s1)/v(b1), `v(d1)/v(g1)/v(s1)/v(b)` for MOSRA model evaluation.

```
.subckt sub1 d g s b ...
M1 d1 g1 s1 b ...
Rd d d1 1k
Rs s s1 1k
Rg g g1 1k
.model ...
.ends
.mosra_subckt_pin_volt sub1
...
.end
```

.MOSRAPRINT

Provides `.PRINT/.PROBE` capability for the electrical degradation elements.

Syntax

```
.MOSRAPRINT output_nameoutput_type(element_name, vds=exp1,
   vgs=exp2, vbs=exp3)
```

Argument	Description
output_name	User-defined output variable; this output_name@element_name is used as the as output variable name in the output file.
output_type	One of the following output variable types: vth, gm, gds, ids, dids or dvth
element_name	The element name that the .MOSRAPRINT command applies.

Description

The .MOSRAPRINT command supports the following models: B3SOI, B4SOI, PSP, BSIM3, BSIM4, TFT, HVMOS, HiSIM-HV, UTSOI, BSIM-CMG, and Custom CMI MOSFETS.

This command provides access to device degradation information. The vds, vgs and vbs are user-specified bias conditions used to characterize the device electrical property as specified by the output type. There is no order requirement for vds, vgs, and vbs. Wildcards '?' and '*' are supported in element_name. The output variable dids reports the percent change of ids between post-stress simulation and fresh-simulation. dvth reports the change of vth between post-stress simulation and fresh-simulation. The output file format is the same as the measurement file format with file extension *.ra. You can use .OPTION MEASFORM with this command to produce *.cvs files suitable for Microsoft Excel output.

.MOSRAPRINT does approximate calculation to get the ids.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION MEASFORM	Enables writing of measurement output files to Excel or HSIM formats, as well as the traditional HSPICE *.mt# format.

Command Group

Model and Variation

Examples

The following syntax prints the `ids` value of the MOSFET `m1`, when `vds = 5vgs=5`, `vbs=0`, at each reltime point.

```
.MOSRA reltotaltime=5e+7 relstep=1e+7
.MOSRAPRINT ids(m1, vds=5, vgs=5, vbs=0)
```

See Also

.MOSRA

.NODESET

Initializes specified nodal voltages for DC operating point analysis and corrects convergence problems in DC analysis.

Syntax

```
.NODESET V(node1)=val1 V(node2)=val2 ... [subckt=sub_name]
-or-
.NODESET node1val1node2val2 [subckt=sub_name]
```

Argument	Description
node1 ...	Node numbers or names can include full paths or circuit numbers.
val1	Voltages.
subckt=*sub_name*	Initial condition is set to the specified node name(s) within all instances of the specified subcircuit name. This subckt setting is equivalent to placing the `.NODESET` command within the subcircuit definition.

Description

Use the `.NODESET` command to set a seed value for the iterative DC convergence algorithm for all specified nodal voltages. Use this to correct convergence problems in DC analysis. How it behaves depends on whether the `.TRAN` analysis command includes the UIC parameter.

Forcing circuits are connected to the `.NODESET` nodes for the first iteration of DC convergence. To increase the number of held iterations, see .OPTION DCHOLD. The forcing circuits are then removed and Newton Raphson iterations continued until DC convergence is obtained. The `.NODESET` nodes can move to their true DC operating points. For this reason, `.NODESET` should

be used to provide initial guesses to either speed up convergence, aid non-convergence, or to set the preferred DC state of multi-stable nodes. If the DC operating voltage of a .NODESET node is appreciably different than the voltage in the .NODESET command you should investigate the circuit to determine why. It is a likely error condition.

Note: In nearly all applications you should use .NODESET to ensure a true DC operating point. Set intentionally floating (or very high impedance) nodes to a known good voltage using .IC.

If you do not specify the UIC parameter in the .TRAN command then use .NODESET to set seed values for an initial guess for DC operating point analysis. If the node value is close to the DC solution then you will enhance convergence of the simulation.

If you specify the UIC parameter in the .TRAN command, HSPICE does not calculate the initial DC operating point, but directly enters transient analysis. When you use .TRAN UIC, the .TRAN node values (at time zero) are determined by searching for the first value found in this order: from .IC value, then IC parameter on an element command, then .NODESET value, otherwise use a voltage of zero.

Note that forcing a node value of the DC operating point might not satisfy KVL and KCL. In this event you might see activity during the initial part of the simulation. This might happen if you use UIC and do not specify some node values, when you specify too many conflicting .IC values, or when you force node values and topology changes. Forcing a node voltage applies a fixed equivalent voltage source during DC analysis and transient analysis removes the voltage sources to calculate the second and later time points.Therefore to correct DC convergence problems use .NODESETs (without .TRAN UIC) liberally (when a good guess can be provided) and use .ICs sparingly (when the exact node voltage is known).

In addition, you can use wildcards in the .NODESET command. See Using Wildcards on Node Names in the *HSPICE User Guide: Basic Simulation and Analysis*.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION DCHOLD	Specifies how many iterations to hold a node at the .NODESET voltage values.

Command Group

Setup

Examples

Example 1

```
.NODESET V(5:SETX)=3.5V V(X1.X2.VINT)=1V
.NODESET V(12)=4.5 V(4)=2.23
.NODESET 12 4.5 4 2.23 1 1
```

Example 2 All settings in this statement are applied to subckt my_ff.

```
.NODESET V(in)=0.9 subckt=my_ff
```

See Also

.DC
.IC
.TRAN

.NOISE

Controls the noise analysis of the circuit.

Syntax

```
.NOISE v(out) vin [interval|inter=x]
+ [listckt=[1|0]]
+ [listfreq=frequencies|none|all]
+ [listcount=num] [listfloor=val]
+ [listsources=1|0|yes|no]]
```

Argument	Description
v(out)	Nodal voltage or branch current output variable. Defines the node or branch at which HSPICE sums the noise.
vin	Independent voltage source to use as the noise input reference
interval | inter	Interval at which HSPICE prints a noise analysis summary. `inter` specifies how many frequency points to summarize in the AC sweep. If you omit `inter` or set it to zero, HSPICE does not print a summary. If `inter` is equal to or greater than one, HSPICE prints summary for the first frequency, and once for each subsequent increment of the interval frequency. The noise report is sorted according to the contribution of each node to the overall noise level. If any of the `LIST*` arguments below are specified, the output information will follow the format required by `LIST*`, and `interval` does not influence the output information for later sweeps.
listckt= [1|0]	■ 1: The contribution of each subcircuit is listed in the `.lis` file and you can view the subcircuit noise contribution curve in WaveView. ■ 0: (default) HSPICE does not list the noise contribution of any subcircuits.
listfreq= (none|all|freq1 freq2....)	Dumps the element noise figure value to the `.lis` file. You can specify which frequencies the element phase noise value dumps. The frequencies must match the sweep_frequency values defined in the parameter_sweep, otherwise they are ignored. In the element phase noise output, the elements that contribute the largest phase noise are dumped first. The frequency values can be specified with the NONE or ALL keyword, which either dumps no frequencies or every frequency defined in the parameter_sweep. ■ ALL: output all of the frequency points (default, if LIST* is required.) ■ NONE: do not output any of the frequency points ■ freq1 freq2...: output the information on the specified frequency points Frequency values must be enclosed in parentheses. For example: `listfreq=(none)listfreq=(all)listfreq=(1.0G)listfreq=(1.0G, 2.0G)`

Argument	Description
listcount=*num*	Outputs the first few noise elements that make the biggest contribution to NF. The number is specified by *num*. The default is to output all of the noise element contribution to NF. The NF contribution is calculated with the source impedance equal to the Zo of the first port.
listfloor=*val*	Contribution to the output noise power greater than the value specified by LISTFLOOR. Default is to output all the noise elements. The unit of LISTFLOOR is V^2/hz
listsources=[1|0|yes|no]	Defines whether or not to output the contribution of each noise source of each noise element. Default is no/0.

Description

Use this command and .AC commands to control the noise analysis of the circuit. You can use this command only with an .AC command. Noise contributor tables are generated for every frequency point and every circuit device. The last four arguments allow users to better control the output information.

Command Group

Analysis

Examples

Example 1 This example sums the output noise voltage at the node 5 by using the voltage source VIN as the noise input reference and prints a noise analysis summary every 10 frequency points.

```
.NOISE V(5) VIN 10
```

Example 2 Sums the output noise current at the r2 branch by using the voltage source VIN as the noise input reference and prints a noise analysis summary every 5 frequency points.

```
.NOISE I(r2) VIN 5
```

Example 3 Shows the list subcircuit option turned on and sample results:

```
**********************************************************
subcircuit squared noise voltages (sq v/hz)
 x1 total 1.90546e-20
 x7 total 7.14403e-19
 x1.x3 total 1.90546e-20
**********************************************************
```

See Also

.AC

.OP

Calculates the DC operating point of the circuit; saves circuit voltages at multiple time steps.

Syntax

```
.OP format time format time... [interpolation]
...
.op voltage time1 time2...
```

Argument	Description
format	Any of the following keywords. Only the first letter is required. The default is ALL ■ ALL: Full operating point, including voltage, currents, conductances, and capacitances. This parameter outputs voltage/current for the specified time. ■ BRIEF: One-line summary of each element's voltage, current, and power. Current is stated in milliamperes and power in milliwatts. ■ CURRENT: Voltage table with a brief summary of element currents and power. ■ DEBUG: Usually invoked only if a simulation does not converge. Debug prints the non-convergent nodes with the new voltage, old voltage, and the tolerance (degree of non-convergence). It also prints the non-convergent elements with their tolerance values. ■ NONE: Inhibits node and element printouts, but performs additional analysis that you specify. ■ VOLTAGE: Voltage table only. The preceding keywords are mutually-exclusive; use only one at a time.
time	Time at which HSPICE prints the report.

Argument	Description
interpolation	Interpolation method for .OP time points during transient analysis or no interpolation. Only the first character is required; that is, typing **i** has the same effect as typing **interpolation**. Default is not active.If you specify *interpolation*, all of the time points in the .OP command (except time=0) use the interpolation method to calculate the OP value during the transient analysis. If you use this keyword, it must be at the end of the .OP command. HSPICE ignores any word after this keyword.

Description

Use this command to calculate the DC operating point of the circuit. You can also use the .OP command to produce an operating point during a transient analysis. You can include only one .OP command in a simulation.

If an analysis requires calculating an operating point you do not need to specify the .OP command; HSPICE calculates an operating point. If you use a .OP command and if you include the UIC parameter in a .TRAN analysis command, then simulation omits the time=0 operating point analysis and issues a warning in the output listing.

Use .OP to output circuit node voltages at different time steps to *.ic0 files. You can replace use of the .SAVE command to save node voltages. The *.ic0 files are identical to those created by the .SAVE command. (Remove .SAVE commands to avoid conflict with the .OP command used to save node voltages.)

If you want to generate *.dp# files for your transient simulations, use .OPTION OPFILE in your netlist.

Note: The following notes apply to the .OP command.

1. Without .OP in the netlist, HSPICE does not create an *.op0 file.
2. Operating point information is printed in *.lis, *.op0 and .psf format files.
3. With the F-2011.09 release you can use .PRINT/ .PROBE to output operating point data.
4. HICUM level 0 information is also supported.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION OPFILE	Outputs the operating point information to a file.

Command Group

Analysis

Examples

Example 1 calculates:

- Operating point at .5ns.
- Currents at 10 ns for the transient analysis.
- Voltages at 17.5 ns, 20 ns and 25 ns for the transient analysis.

Example 1

```
.OP .5NS CUR 10NS VOL 17.5NS 20NS 25NS
```

Example 2 calculates a complete DC operating point solution.

Example 2

```
.OP
```

See Also

.TRAN

.OPTION / OPTIONS

Modifies various aspects of an HSPICE simulation; individual options for HSPICE commands are described in Chapter 3, HSPICE Simulation Control Options Reference.

Syntax

```
.OPTION opt1 [opt2 opt3 ...]
```

Argument	Description
opt1 ...	Input control options. Many options are in the form *opt*=*x*, where *opt* is the option name and `x` is the value assigned to that option.

Description

Use this command to modify various aspects of an HSPICE simulation, including:

- output types
- accuracy
- speed
- convergence

You can set any number of options in one `.OPTION` command, and you can include any number of `.OPTION` commands in an input netlist file. Most options default to `0` (OFF) when you do not assign a value by using either `.OPTION` *`opt=val`* or the option with no assignment: `.OPTION` *`opt`*.

To reset options, set them to `0` (`.OPTION` *`opt`*`=0`). To redefine an option, enter a new `.OPTION` command; HSPICE uses the last definition.

You can use the following types of options with this command. For detailed information on individual options, see Chapter 3, HSPICE Simulation Control Options Reference.

Note: Option values cannot be parameterized. In other words, the following is *illegal* and generates an error:

```
.param cmin = 1f
.option CSHUNT = 'cmin'
```

For instructions on how to use options that are relevant to a specific simulation type, see the appropriate analysis chapters in the *HSPICE User Guide: Basic Simulation and Analysis* for:

- Initializing DC-Operating Point Analysis
- Pole-Zero Analysis
- Spectrum Analysis
- Transient Analysis
- AC Small-Signal and Noise Analysis
- Linear Network Parameter Analysis

- Timing Analysis Using Bisection
- Monte Carlo - Traditional Flow Statistical Analysis
- Variability Analysis Using the Variation Block
- Monte Carlo Analysis — Variation Block Flow
- Mismatch Analyses
- Optimization
- RC Reduction and Post-Layout Simulation
- MOSFET Model Reliability Analysis (MOSRA)

Command Group

Setup

.PARAM / PARAMETER / PARAMETERS

Defines parameters in HSPICE.

Syntax

Simple parameter assignment:

```
.PARAM ParamName=RealNumber
```

Algebraic parameter assignments:

```
.PARAM ParamName='AlgebraicExpression'
.PARAM ParamName1=ParamName2
```

User-defined functions:

```
.PARAM ParamName(pv1[pv2])='Expression'
```

Redefined analysis functions—Variability definitions (see .PARAM Distribution Function):

```
.PARAM ParamName=DistributionFunction(Arguments)
```

Optimization parameter assignment:

```
.PARAM ParamName=OPTxxx (initial_guess, low_limit,
+ upper_limit)
.PARAM ParamName=OPTxxx (initial_guess, low_limit,
+ upper_limit, delta)
```

String parameter assignment, including subcircuits and models:

```
.PARAM ParamName=str('string')
```

Argument	Description
parameter	Parameter to vary. ▪ Initial value estimate. ▪ Lower limit. ▪ Upper limit. If the optimizer does not find the best solution within these constraints, it attempts to find the best solution without constraints.
OPT*xxx*	Optimization parameter reference name. The associated optimization analysis references this name. Must agree with the *OPTxxx* name in the analysis command associated with an OPTIMIZE keyname.
delta	The final parameter value is the initial guess ± (*n*·*delta*). If you do not specify *delta*, the final parameter value is between *low_limit* and *upper_limit*. For example, you can use this parameter to optimize transistor drawn widths and lengths, which must be quantized.

Description

Use this command to define parameters. Parameters in HSPICE are names that have associated numeric values.

Note: A `.PARAM` statement with no definition is illegal.

A parameter definition always uses the last value found in the input netlist (subject to global parameter rules).

Use any of the following methods to define parameters:

- A simple parameter assignment is a constant real number. The parameter keeps this value unless a later definition changes its value or an algebraic expression assigns a new value during simulation. HSPICE does not warn you if it reassigns a parameter.
- An algebraic parameter (equation) is an algebraic expression of real values, a predefined or user-defined function or circuit or model values. Enclose a complex expression in single quotes to invoke the algebraic processor, *unless* the expression begins with an alphabetic character and contains no spaces. A simple expression consists of a single parameter name. To use an algebraic expression as an output variable in a `.PRINT`, or `.PROBE` command, use the `PARAM` keyword.

- A user-defined function assignment is similar to an algebraic parameter. HSPICE extends the algebraic parameter definition to include function parameters, used in the algebraic that defines the function. You can nest user-defined functions up to three levels deep.
- A predefined analysis function. HSPICE provides several specialized analysis types, which require a way to control the analysis:
  - Temperature functions (fn)
  - Optimization guess/range

HSPICE also supports the following predefined parameter types:

- Frequency
- Time
- Monte Carlo functions

Note: To print the final evaluated values of all `.PARAM` commands in the netlist, use `.OPTION LIST`. This helps you avoid seeing the same value for every time point if you run a transient analysis.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION LIST	Prints a list of netlist elements, node connections, and values for components, voltage and current sources, parameters, and more.

Command Group

Setup

Examples

Example 1 Examples 1-3 illustrate predefined analysis function

```
.PARAM mcVar=Agauss(1.0,0.1,1)
```

Example 2 In this example, uox and vtx are the variable model parameters, which optimize a model for a selected set of electrical specifications. The estimated initial value for the vtx parameter is 0.7 volts. You can vary this value within the limits of 0.3 and 1.0 volts for the optimization procedure. The optimization parameter reference name (OPT1) references the associated optimization analysis command (not shown).

```
PARAM vtx=OPT1(.7,.3,1.0) uox=OPT1(650,400,900)
```

Example 3

```
.PARAM fltmod=str('bpfmodel')
s1 n1 n2 n3 n_ref fqmodel=fltmod zo=50 fbase=25e6 fmax=1e9
```

Example 4 Simple parameter assignment

```
.PARAM power_cylces=256
```

Example 5 Numerical parameter assignment

```
.PARAM TermValue=1g
   rTerm Bit0 0 TermValue
   rTerm Bit1 0 TermValue
...
```

Example 6 Parameter assignment using expressions

```
.PARAM Pi            ='355/113'
.PARAM Pi2            ='2*Pi'
.PARAM npRatio         =2.1
.PARAM nWidth          =3u
.PARAM pWidth          ='nWidth * npRatio'
Mp1   ... pModelName W=pWidth
Mn1   ... nModelName W=nWidth
...
```

Example 7 Algebraic parameter

```
.param x=cos(2)+sin(2)
```

Example 8 String to parametrize .TEMP

```
.PARAM T1=30
.TEMP  T1 '10+T1' '10+T1*2'
```

Example 9 Algebraic expression as an output variable

```
.PRINT DC v(3) gain=PAR('v(3)/v(2)')
+ PAR('V(4)/V(2)')
```

Example 10 User-defined functions

```
.PARAM MyFunc( x, y )='Sqrt((x*x)+(y*y))'
.PARAM CentToFar (c)                ='(((c*9)/5)+32)'
.PARAM F(p1,p2)              ='Log(Cos(p1)*Sin(p2))'
.PARAM SqrdProd (a,b)               ='(a*a)*(b*b)'
```

Example 11 Undefined .PARAM statement results in a warning requesting parameter variables with their respective values or expressions.

```
.PARAM $ Illegal as a standalone netlist command.
```

.PAT

Specifies predefined pattern names to be used in a pattern source; also defines new pattern names.

Syntax

```
.PAT PatName=data [RB=val][R=int]
.PAT patName=[component 1... component n] [RB=val]
+ [R=repeat]
```

[or]

```
.PAT PatName=data [RB=param_expr1] [R=param_expr2]
.PAT patName=[component 1 ... component n] [RB=param_expr1]
+ [R=param_expr2]
```

Argument	Description
data	String of 1, 0, M, or Z that represents a pattern source. The first letter must be B to represent it as a binary bit stream. This series is called b-string. A 1 represents the high voltage or current value, and a 0 is the low voltage or current value. An M represents the value that is equal to 0.5*(vhi+vlo), and a Z represents the high impedance state (only for voltage source).
PatName	Pattern name that has an associated b-string or nested structure.
component	Elements that make up a nested structure. Components can be b-strings or a patname defined in other .PAT commands.
RB=val	Starting component of a repetition. The repeat data starts from the component or bit indicated by RB. RB must be an integer. If RB is larger than the length of the NS or b-string, an error is issued. If it is less than 1, it is automatically set to 1.
R=repeat	Specifies how many times the repeating operation is executed. With no argument, the source repeats from the beginning of the nested structure or b-string. If R=-1, the repeating operation continues infinitely. The R must be an integer. If it is less than -1, it is automatically set to 0.

Description

When the .PAT command is used in an input file, some *patnames* are predefined and can be used in a pattern source. Patnames can associate a b-string or nested structure, two different types of pattern sources. In this case, a b-string is a series of 1, 0, m, and z states. The nested structure is a combination of a b-string and another netlisted structure defined in the .PAT command. The .PAT command can also be used to define a new patname, which can be a b-string or nested structure.

Avoid using a predefined patname to define another patname to lessen the occurrence of a circular definition for which HSPICE issues an error report.

Nested structures must use brackets "[ ]", but HSPICE does not support using multiple brackets in one command. If you need to use another nested structure as a component, define it in a new .PAT command.

Command Group

Analysis

Examples

Example 1 Shows eight instances of the .PAT command used for a b-string.

```
.PAT a1=b1010 r=1 rb=1
.PAT a1=b10101010
.PAT a1=b1010 b0011 r=1 rb=2
.PAT a1=b1010 b0011011
.PAT a1=b1010 r=1 rb=1 b0011 r=1 rb=2
.PAT a1=b10101010 b0011011
.PAT a1=b1010 b0011 r=2 rb=2
.PAT a1=b1010 b0011011011
```

Example 2 Shows four instances of how an existing patname is used to define a new patname:

```
.PAT a1=b1010 r=1 rb=1
.PAT a2=a1
.PAT a1=b1010 r=1 rb=1
.PAT a2=b1010 r=1 rb=1
```

Example 3 Shows a nested structure:

```
.PAT a1=[b1010 r=1 rb=2 b1100]
```

Example 4 Shows several instances of how a predefined nested structure is used as a component in a new nested structure:

```
.PAT a1=[b1010 r=1 rb=2 b1100] r=1 rb=1
.PAT a2=[a1 b0m0m] r=2 rb=1
.PAT a1=[b1010 r=1 rb=2 b1100] r=1 rb=1
.PAT a2=a1 b0m0m a1 b0m0m a1 b0m0m
.PAT a1=b1010 r=1 rb=2 b1100 b1010 r=1 rb=2 b1100
.PAT a2=b1010 r=1 rb=2 b1100 b1010 r=1 rb=2 b1100 b0m0m
+ b1010 r=1 rb=2 b1100 b1010 r=1 rb=2 b1100 b0m0m
+ b1010 r=1 rb=2 b1100 b1010 r=1 rb=2 b1100 b0m0m
```

Example 5 Shows several instances of how a predefined nested structure is used as a component in a new nested structure:

```
.PAT a1=[b1010 r=1 rb=2 b1100] r=1 rb=2
.PAT a2=[a1 b0m0m] r=2 rb=2
.PAT a1=[b1010 r=1 rb=2 b1100] r=1 rb=2
.PAT a2=a1 b0m0m b0m0m b0m0m
.PAT a1=b1010 r=1 rb=2 b1100 b1100
.PAT a2=b1010 r=1 rb=2 b1100 b1100 b0m0m b0m0m b0m0m
```

.PHASENOISE

Performs phase noise analysis on autonomous (oscillator) circuits in HSPICE.

Syntax

```
.PHASENOISE output frequency_sweep [method=0|1|2]
+ [carrierindex=int] [listfreq=(frequencies|none|all)]
+ [listbin=f0,f1,...fN] [listcount=val] [listfloor=val]
+ [listsources=on|off] [spurious=0|1]
```

Argument	Description
output	Output node, pair of nodes, or 2-terminal element. HSPICE references phase noise calculations to this node (or pair of nodes). Specify a pair of nodes as V(n+,n-). If you specify only one node, V(n+), then HSPICE assumes that the second node is ground. You can also specify a 2-terminal element.

Argument	Description
frequency_sweep	Specifies the type, nsteps, and start and stop frequency or frequency points for each sweep type, where: ▪ type = frequency sweep type which can be OCT, DEC, LIN, POI or SWEEPBLOCK. ▪ nsteps = number of steps per decade or total number of steps. ▪ start = starting frequency. ▪ stop = ending frequency. ▪ p1, p2, ... pn = frequency points. The four parameters determine the offset frequency sweep about the carrier used for the phase noise analysis. ▪ LIN *nsteps start stop* ▪ OCT *nsteps start stop* ▪ DEC *nsteps start stop* ▪ POI *nsteps p1, p2, ...pn* ▪ SWEEPBLOCK sweepblock = *swblockname*
METHOD	▪ METHOD=0 selects the Nonlinear Perturbation (NLP) algorithm, which is used for low-offset frequencies. ▪ METHOD=1 (default) selects the Periodic AC (PAC) algorithm, which is used for high-offset frequencies. ▪ METHOD=2 selects the Broadband Phase Noise (BPN) algorithm, which you can use to span low and high offset frequencies. You can use *METHOD* to specify any single method.
carrierindex	Harmonic index of the carrier at which HSPICE computes the phase noise (optional). The phase noise output is normalized to this carrier harmonic. The default is 1.
listbin	Creates N contiguous frequency bins and outputs the total integrated phase noise and element contributions to the total over each of the N bins. The frequencies in `listbin` must also exist in the `listfreq` specified in the `.PHASENOISE` command. Note: If a `listbin` frequency is not also present in `listfreq`, it will be ignored

Argument	Description
listfreq	Element phase noise value written to the `.lis` file. You can specify which frequencies the element phase noise value dumps. The frequencies must match the sweep_frequency values defined in the parameter_sweep, otherwise they are ignored.In the element phase noise output, the elements that contribute the largest phase noise are dumped first. The frequency values can be specified with the NONE or ALL keyword, which either dumps no frequencies or every frequency defined in the parameter_sweep. Frequency values must be enclosed in parentheses. For example: listfreq=(none) listfreq=(all) listfreq=(1.0G) listfreq=(1.0G, 2.0G)The default value is the first frequency value.
listcount	Dumps the element phase noise value to the .lis file, which is sorted from the largest to smallest value. You do not need to dump every noise element; instead, you can define listcount to dump the number of element phase-noise frequencies. For example, listcount=5 means that only the top 5 noise contributors are dumped. The default value is 20.
listfloor	Dumps the element phase noise value to the .lis file and defines a minimum meaningful noise value (in dBc/Hz units). Only those elements with phase-noise values larger than the *listfloor* value are dumped. For example, listfloor=-200 means that all noise values below -200 (dbc/Hz) are not dumped. The default value is -300 dbc/Hz.
listsources	Writes the element phase-noise value to the `.lis` file. When the element has multiple noise sources, such as a level 54 MOSFET, which contains the thermal, shot, and 1/f noise sources. When dumping the element phase-noise value you can decide if you need to dump the contribution from each noise source. You can specify either ON or OFF: ON dumps the contribution from each noise source and OFF does not. The default value is OFF. When `listsources` is turned on, the element noise source contributions will also be output into the `*.pn#` file.

Argument	Description
spurious	Additional .HBAC analysis that predicts the spurious contributions to the phase noise. Spurs result from deterministic signals present within the circuit. In most cases, the spurs are very small signals and do not interfere with the steady-state operation of the oscillator but do add energy to the output spectrum of the oscillator. The energy that the spurs adds might need to be included in jitter measurements. 0 - No spurious analysis (default)1 - Initiates a spurious noise analysis

Description

Use this command to invoke phase noise analysis on autonomous (oscillator) circuits.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION PHNOISEAMPM	Allows you to separate amplitude modulation and phase modulation components in a phase noise simulation.
.OPTION BPNMATCHTOL	Determines the minimum required match between the NLP and PAC phase noise algorithms. An acceptable range is 0.05dB to 5dB. The default is 0.5dB.
.OPTION PHASENOISEKRYLOVDIM	Specifies the dimension of the Krylov subspace that the Krylov solver uses. This must be an integer greater than zero. The default is 500.
.OPTION PHASENOISEKRYLOVITR	Specifies the maximum number of Krylov iterations that the phase noise Krylov solver takes. Analysis stops when the number of iterations reaches this value. The default is 1000.
.OPTION PHASENOISETOL	Specifies the error tolerance for the phase noise solver. This must be a real number greater than zero. The default is 1e-8.
.OPTION PHNOISELORENTZ	Turns on a Lorentzian model for the phase noise analysis. ■ *val*=0: (default) uses a linear approximation to a Lorentzian model and avoids phasenoise values >0dB for low offsets ■ *val*=1: applies a Lorentzian model to all noise sources ■ *val*=2: applies a Lorentzian model to all non-frequency dependent noise sources ■ *val*=3: Lorentzian model applied to white noise source, Gaussian model applied to flicker noise sources.

Command Group

Analysis

See Also

.HB
.HBAC
.HBOSC
.SN
.SNAC
.SNOSC
.PRINT
.PROBE
Identifying Phase Noise Spurious Signals

.PKG

Provides the IBIS Package Model feature; automatically creates a series of W-elements or discrete R, L, and C components.

Syntax

```
.PKG pkgname
+ file = 'pkgfilename'
+ model = 'pkgmodelname'
+ rlclen = 0|1
```

Argument	Description
pkgname	Package card name
pkgfilename	Name of a `.pkg` or `.ibs` file that contains package models.
pkgmodelname	Working model in the `.pkg` file
rlclen	Sets the length of W element for R,L,C matrix based package model. Valid values are 0 (default) and 1. If `rlclen=0`, HSPICE creates lumped R,L,C instances for package with data from R,L,C matrixes in package model.

Description

The `.PKG` command provides the IBIS Package Model feature. It supports both sections and matrixes.

The .PKG command automatically creates a series of W-elements or discrete R, L and C components. The following nodes are referenced in the netlist:

- Nodes on the die side:

  *'pkgname'_'pinname'*_dia

- Nodes on the pin side:

  'pkgname'_'pinname'

See Example 2 for how pin1 is referenced.

- If package = 0 in the .IBIS card, then no package information is added.
- If package = 1 or 2, then the package information in the .ibs file is added.
- If package = 3, then the package information in the .pkg file is added.

Command Group

Input/Output Buffer Information Specification (IBIS)

Examples

Example 1 Illustrates a typical .PKG statement.

```
.pkg p_test
+ file='processor_clk_ff.ibs'
+ model='FCPGA_FF_PKG'
```

Example 2 Shows how pin1 is referenced.

```
p_test_pin1_dia and p_test_pin1
```

Example 3 The element name becomes:

```
w_p_test_pin1_? ? or r_p_test_pin1_? ? ...
```

See Also

.EBD
.IBIS

.PORT_INFO

Provides an all-inclusive card type with a sub-command to perform different and extensible annotations.

Syntax

```
.PORT_INFO port_type port_name1 port_name2 ...
```

Argument	Description
port_type	Tag of the subckt port. The value can be input, output, inout, supply, or power.
port_name1 ...	Name of subckt port.

Description

This command provides a syntax checked by the HSPICE parser for using an HSPICE netlist with non-simulation tools, such as routers. For example, this eliminates the need to use comments to annotate pin direction.

Command Group

Subcircuits

Examples

```
.subckt opamp vbias in_p in_n out vdd vss
.port_info input in_p in_n vdd vss
.port_info output out
.port_info inout vbias
.port_info supply vdd vss
...
.ends
```

.POWER

Prints a table containing the AVG, RMS, MAX, and MIN measurements for specified signals in HSPICE.

Syntax

```
.POWER signal [REF=vname FROM=start_time TO=end_time]
```

Argument	Description
signal	Signal name.
vname	Reference name.

Argument	Description
start_time	Start time of power analysis period. You can also use parameters to define time.
end_time	End time of power analysis period. You can also use parameters to define time.

Description

Use this command to print a table containing the AVG, RMS, MAX, and MIN measurements for every signal specified.

By default, the scope of these measurements are set from 0 to the maximum timepoint specified in the `.TRAN` command.

For additional information, see POWER Analysis in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION SIM_POWER_ANALYSIS	Prints a list of signals matching the tolerance setting at a specified point in time.
.OPTION SIM_POWER_TOP	Controls the number of hierarchy levels on which power analysis is performed.
.OPTION SIM_POWERPOST	Controls power analysis waveform dumping.
.OPTION SIM_POWERSTART	Specifies a default start time for measuring signals during simulation.
.OPTION SIM_POWERSTOP	Specifies a default stop time for measuring signals during simulation.

Command Group

Analysis

Examples

Example 1 *No simulation start and stop time is specified for the x1.in signal, so the simulation scope for this signal runs from the start (0ps) to the last .tran time (100ps).*

```
.power x1.in
.tran 4ps 100ps
```

Example 2 shows how you can use the FROM and TO times to specify a separate measurement start and stop time for each signal. In this example.

- The scope for simulating the x2.in signal is from 20ps to 80ps.
- The scope for simulating the x0.in signal is from 30ps to 70ps.

Example 2

```
.param myendtime=80ps
.power x2.in REF=a123 from=20ps to=80ps
.power x0.in REF=abc from=30ps to='myendtime - 10ps'
```

See Also

.TRAN

.POWERDC

Calculates the DC leakage current in the design hierarchy.

Syntax

.POWERDC *keywordsubckt_name1...*

Argument	Description
keyword	One of these keywords: ■ TOP – prints the power for top-level instances ■ ALL (default) – prints the power for all instances
subckt_name#	Prints the power of all instances in this subcircuit definition

Description

Use this command to calculate the DC leakage current in the design hierarchy.

This option prints a table containing the measurements for AVG, MAX, and MIN values for the current of every instance in the subcircuit. This table also lists the sum of the power of each port in the subcircuit.

For additional information, see POWER Analysis in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

You can use the `SIM_POWERDC_HSPICE` and `SIM_POWERDC_ACCURACY` options to increase the accuracy of the `.POWERDC` command.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION SIM_POWERDC_ACCURACY	Increases the accuracy of operating point calculations for POWERDC analysis.
.OPTION SIM_POWERDC_HSPICE	Increases the accuracy of operating point calculations for POWERDC analysis.

Command Group

Analysis

.PRINT

Prints the values of specified output variables.

Syntax

```
.PRINT antype ov1 [ov2 ... ][filter=pattern][level=val2]
   [print=0|1]
+ [isub(subcircuit_node_path)]
.PRINT antype ov1 [ov2 ...] subckt=subname*
```

Argument	Description
antype	Type of analysis for outputs. Can be one of the following types: DC, AC, TRAN, NOISE, OP, or DISTO. All HSPICE phase noise output files can be specified using the `.PRINT` command (see *HSPICE User Guide: Advanced Analog Simulation and Analysis*).

Argument	Description
ov1 ...	Output variables to print. These are voltage, current, power, source power, or element template variables from a DC, AC, TRAN, NOISE, OP, or DISTO analysis.
filter=*pattern*	When printing node voltage(s) and/or element current(s) that are specified by wildcard patterns such as: `.print v(x1.x2.*)`, nodes/elements that match the pattern specified in the filter clause are not printed. Each filter applies to all wildcard voltages/currents being printed on the `.print` statement. See Example 13 on page 288.
level=*val2*	This setting is effective only when the wildcard character is specified in the output variable. The level value val2 specifies the number of hierarchical depth levels when the wildcard node/element name matches. ■ val2 = 1: The wildcard match applies to the same depth level where the `.print` statement is located. ■ val2 = 2: Applies to the same level and to one level below the current level where `.print` is located. ■ val2 = -1: The wildcard match applies to all the depth levels below and including the current level of `.print` statement. The default value of val2 is -1
print	Setting this keyword value to 0 prevents the printing of output signals into waveform files (`*.tr#`, `*.ac#`, and `*.sw#`) and `*.lis` files. `print=1` (default) prints the output signals into waveform files and the `.lis` file.
isub()	Use to print/probe subcircuit currents. (Not valid for advanced analog functions)

Argument	Description
subckt=*subname**	Specifies subcircuit names. You can use wildcards to specify the subcircuit names. *subname** matches the same depth level where the .print is located. If HSPICE does not find any matching subcircuit name for *subname**, it displays a warning message and ignores the statement. **Note:** ▪ Do not use quotes to specify *subname**. ▪ Use only one subckt keyword in one .print statement. ▪ When you use the subckt keyword, antype cannot be any advanced analog analysis including ENV, HB, HBAC, HBLSP, HBNOISE, HBTR, HBXF, NOISE, or PHASENOISE analysis.

Description

Use this command to print the values of specified output variables. You can include wildcards in .PRINT commands. You can also use the iall keyword in a .PRINT command to print all branch currents of all diode, BJT, JFET, or MOSFET elements in your circuit design. By default, the .PRINT command prints out simulation data at a time interval of tstep of .TRAN command, so the number of points for this output data reported in the *.lis are the "# points" shown at the end of *.lis file.

Command Group

Output Porting

Examples

Example 1 *Three cases of invoking the print function:*
In Case 1, if you replace the .PRINT command with: .print TRAN v(din)i(mnx), then all three cases have identical .sw0 and .tr0 files.
If you replace the .print command with: .print DC v(din) i(mnx), then the .sw0 and .tr0 files are different.

```
* CASE 1
.print v(din) i(mxn18)
.dc vdin 0 5.0 0.05
.tran 1ns 60ns
* CASE 2
.dc vdin 0 5.0 0.05
.tran 1ns 60ns
```

```
.print v(din) i(mxn18)
* CASE 3
.dc vdin 0 5.0 0.05
.print v(din) i(mxn18)
.tran 1ns 60ns
```

Example 2 *Example 2 prints the results of a transient analysis for the nodal voltage named 4. It also prints the current through the voltage source named VIN. It also prints the ratio of the nodal voltage at the OUT and IN nodes.*

```
.PRINT TRAN V (4) I(VIN) PAR(`V(OUT)/V(IN)')
```

Example 3 *In Example 3:*
Depending on the value of the `ACOUT` *option, VM(4,2) prints the AC magnitude of the voltage difference, or the difference of the voltage magnitudes between nodes 4 and 2.*
VR(7) prints the real part of the AC voltage between node 7 and ground.
Depending on the ACOUT value, VP(8,3) prints the phase of the voltage difference between nodes 8 and 3, or the difference of the phase of voltage at node 8 and voltage at node 3.
II(R1) prints the imaginary part of the current through R1.

```
.PRINT AC VM(4,2) VR(7) VP(8,3) II(R1)
```

Example 4 *This example prints:*
The magnitude of the input impedance.
The phase of the output admittance.
Several S and Z parameters.

```
.PRINT AC ZIN YOUT(P) S11(DB) S12(M) Z11(R)
```

Example 5 *This example prints the DC analysis results for several different nodal voltages and currents through:*
The resistor named R1.
The voltage source named VSRC.
The drain-to-source current of the MOSFET named M1.

```
.PRINT DC V(2) I(VSRC) V(23,17) I1(R1) I1(M1)
```

Example 6 *Prints the equivalent input noise.*

```
.PRINT NOISE INOISE
```

Example 7 *Prints the magnitude of third-order harmonic distortion, and the dB value of the intermodulation distortion sum through the load resistor that you specify in the .DISTO command.*

```
.PRINT DISTO HD3 SIM2(DB)
```

Example 8 *The command in Example 8 includes NOISE, DISTO, and AC output variables in the same .PRINT statement.*

```
.PRINT AC INOISE ONOISE VM(OUT) HD3
```

Example 9 Prints the value of pj1 with the specified function. (HSPICE ignores .PRINT command references to nonexistent netlist part names, and prints those names in a warning.)

```
.PRINT pj1=par(‘p(rd) +p(rs)‘)
```

Example 10 The commands in Example 10 illustrate print statements for a derivative function and an integrative function. The parameter can be a node voltage or a reasonable expression.

```
.PRINT der=deriv('v(NodeX)')
.PRINT int=integ('v(NodeX)')
```

Example 11 Shows how you can use p1 and p2 as parameters in netlist. The p1 value is 3; the p2 value is 15. You can use p1 and p2 as parameters in netlist.

```
.param p1=3
.print par('p1')
.print p2=par("p1*5")
```

Example 12 Shows the syntax for outputting the length and width of a polygon in template format for the following models: BSIM3, BSIM4, BSIM3SOI, BSIM4SOI, and PSP.

```
.print ac wpoly() lpoly()
```

Example 13 Filter/pattern: This syntax example prints the voltages of all nodes in subckt x1.x2 that do not start with n or a, and the current of all elements in subckt x1.x2 that do not start with either n or a.

```
.print v(x1.x2.*) i(x1.x2.*) filter='x1.x2.n*' filter='x1.x2.a*'
```

Example 14 Printing subcircuit currents

```
.print isub(node1)
```

Example 15 Measuring source power

```
.print tran src_power
```

See Also

.AC
.DC
.DCMATCH
.DISTO
.DOUT
.MEASURE / MEAS
.NOISE
.PROBE
.STIM

.TRAN
Measuring the Value of MOSFET Model Card Parameters

.PROBE

Saves output variables to interface and waveform data files.

Syntax

```
.PROBE analysis_type ov1 [ov2 ...]
+ [filter=pattern] [level=val2] [print=0|1]
.PROBE analysis_type v(inst_name.subckt_port_name)
+ [isub()]
.PROBE analysis_type cpu_time [wall_time] [physical_memory]
.PROBE analysis_type ov1 [ov2 ...] subckt=subname*
```

Argument	Description
analysis_type	Type of analysis for the specified plots. Analysis types are: DC, OP, AC, TRAN, NOISE, or DISTO for HSPICE; ENV, HB, HBAC, HBLSP, HBNOISE, HBTR, HBXF, NOISE, or PHASENOISE for advanced analog analyses.
ov1...	Output variables to plot: voltage, current, power, source power, or element template (HSPICE-only variables from a DC, OP, DCMATCH, AC, ACMATCH, TRAN, NOISE, or DISTO analysis. .PROBE can include more than one output variable. HSPICE advanced analog analyses include: ENV, HB, HBAC, HBLSP, HBNOISE, HBTR, HBXF, NOISE, or PHASENOISE analysis.
filter=*pattern*	When printing node voltage(s) and/or element current(s) that are specified by wildcard patterns such as: `.probe v(x1.x2.*)`, nodes/elements that match the pattern specified in the filter clause are not probed. Each filter applies to all wildcard voltages/currents being probed on the `.probe` statement. See Example 4 on page 292.

Argument	Description
level=*val2*	This setting is effective only when the wildcard character is specified in the output variable. The level value val2 specifies the number of hierarchical depth levels when the wildcard node/element name matches. ■ val2 = 1: The wildcard match applies to the same depth level where the `.probe` statement is located. ■ val2 = 2: Applies to the same level and to one level below the current level where `.probe` is located. ■ val2 = -1 (default): The wildcard match applies to all the depth levels below and including the current level of `.probe` statement.
print	Setting this keyword value to 0 prevents the printing of output signals into waveform files (`*.tr#`, `*.ac#`, and `*.sw#`). `print=1` (default) prints the output signals into waveform files.
inst_name	Specifies instance name.
subckt_port_name	Specifies subcircuit port name.
isub()	Use to probe subcircuit current.
cpu_time	Dumps the CPU time versus the simulation time in the waveform file.
wall_time	Dumps the wall time versus the simulation time in the waveform file.
physical_memory	Dumps the peak physical memory versus the simulation time in the waveform file.

Argument	Description
subckt=*subname**	Specifies subcircuit names. You can use wildcards to specify the subcircuit names. *subname** matches the same depth level where the .probe is located. If HSPICE does not find any matching subcircuit name for *subname**, it displays a warning message and ignores the statement. **Note:** ▪ Do not use quotes to specify *subname**. ▪ Use only one subckt keyword in one .probe statement. ▪ When you use the subckt keyword, analysis_type cannot be any advanced analog analysis including ENV, HB, HBAC, HBLSP, HBNOISE, HBTR, HBXF, NOISE, or PHASENOISE analysis.

Description

Use this command to save output variables and print to interface and graph data files. Parameters can be node voltages, currents, elements, reasonable expressions, and node probe instances and ports. You can include wildcards in .PROBE commands. To save instance port nodes, you need to set .OPTION PROBE. The .PROBE command outputs the signals to waveform files no matter how .OPTION PROBE and .OPTION PUTMEAS are set. (See .OPTION PROBE for inportant notes.) For any .PROBE commands, however, you must specify the analysis type to generate waveforms if there is no analysis defined before the .PROBE command. For example, the following results in a warning message:

```
.PROBE v(out) v(gate)
.DC nd1 5 0 -1
.TRAN 10p 10n
```

To avoid such an occurrence, write your netlist command as follows:

```
.PROBE DC v(out) v(gate)
```

Note: For AC analysis in HSPICE, only the magnitude is saved to the waveform file unless a complex quantity is explicitly specified.

The parameters cpu_time, wall_time, and physical_memory dump the specified time type (either CPU time, wall time, or memory respectively) in the waveform output file on the Y axis (X axis being the usual transient simulation

time). This new wave is reported in the waveform output file in all the supported output file formats.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION PROBE	Limits post-analysis output to only variables specified in .PROBE and .PRINT commands for HSPICE.
.OPTION PUTMEAS	Controls the output variables listed in the .MEASURE / MEAS command.

Command Group

Output Porting

Examples

Example 1 Saves several node voltages and an expression.

```
.PROBE DC V(4) V(5) V(1) beta=PAR(`I1(Q1)/I2(Q1)')
```

Example 2 This syntax probes the voltage of the net connected with the Gate of XINST1.MN0.

```
PROBE  TRAN  V2(XINST1.MN0)
```

Example 3 Illustrates saving derivative and integrative functions.

```
* Derivative function
.PROBE der=deriv('v(NodeX)')
* Integrate function
.PROBE int=integ('v(NodeX)')
```

Example 4 Filter/pattern: This syntax example probes the voltages of all nodes in subckt x1.x2 that do not start with n or a, and the current of all elements in subckt x1.x2 that do not start with either n or a.

```
.probe v(x1.x2.*) i(x1.x2.*) filter='x1.x2.n*' filter='x1.x2.a*'
```

Example 5 Probes one level below x4 but does not probe names that have 'r2' in it.

```
.probe v(x12.x4.*) level=1 filter='r2'
```

Example 6 *Last section of a netlist to generate a NAND circuit, illustrating printing of subcircuit node instances and ports. Adding .OPTION POST PROBE limits the output to the *.lis file.*

```
...
.subckt nand0 data clk out vdd
mna n_mid data 0 0 n w=2u l=1u
mnb out clk n_mid 0 n w=2u l=1u
mpa out clk vdd vdd p w=2u l=1u
mpb out data vdd vdd p w=2u l=1u
.ends
xa data clk out vdd nand5
v1 vdd 0 3
vdata data 0 pwl 0 0 5n 0 5.01n 3
vclk clk 0 pwl 0 0 12n 0 12.01n 3
.tran 1p 200n
.probe tran v(xa.x5x4.x4x3.clk)
.probe tran v(xa.x5x1.x4x1.clk)
.probe tran v(xa.x5x1.x4x3.data)
.opt post probe lis_new
.end
```

Example 7 *The following syntax probes the dissipated power of the circuit:*

```
.probe tran power
```

Example 8 *Dumps the CPU and peak physical memory as Y-axis values, while the X-axis shows the transient time.*

```
.PROBE cpu_time physical_memory
```

See Also

.AC
.ACMATCH
.DC
.DCMATCH
.DISTO
.DOUT
.ENV
.HB
.HBAC
.HBLSP
.HBNOISE
.HBOSC
.HBXF
.MEASURE / MEAS
.NOISE

.PHASENOISE
.PRINT
.STIM
.TRAN
Measuring the Value of MOSFET Model Card Parameters

.PROTECT / PROT

Keeps models and cell libraries private as part of the encryption process in HSPICE.

Syntax

```
.PROTECT
```

Description

Use this command to designate the start of the file section to be encrypted when using Metaencrypt.

- Use `.UNPROTECT` to end the file section that will be encrypted.
- Any elements and models located between a `.PROTECT` and an `.UNPROTECT` command inhibit the element and model listing from the `LIST` option.
- The `.OPTION NODE` nodal cross-reference and the `.OP` operating point printout do not list any nodes that are contained between the `.PROTECT` and `.UNPROTECT` commands.

Note: If you use `.prot/.unprot` in a library or file that is not encrypted you will get warnings that the file is encrypted and the file or library is treated as a “black box.”

Note: To perform a complete bias check and print all results in the Outputs Biaschk Report, do not use `.protect/.unprotect` in the netlist for the part that is used in `.biaschk`. For example: If a model definition such as model `nch` is contained within `.prot/.unprot` commands, in the `*.lis` you'll see a warning message as follows: `**warning** : model nch defined in .biaschk cannot be found in netlist--ignored`

Usage Note: The `.prot/.unprot` feature is meant for the encryption process and *not* netlist echo suppression. Netlist and model echo suppression is on by

default. For a compact and better formatted output (`*.lis`) file, use `.OPTION LIS_NEW`

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION LIS_NEW	Enables streamlining improvements to the `*.lis` file.

Command Group

Encryption

See Also

.UNPROTECT / UNPROT

.PRUNE

Removes parasitics to speed up characterization flow by using the active-net file or inactive-net file.

Syntax

```
.PRUNE "post-layout_flat_netlist_file" "active_net_file"
```

or

```
.PRUNE DSPF_FILE="post-layout_flat_netlist_file"
+[ACTIVE_FILE="active_net_file"|
+ INACTIVE_FILE="inactive_net_file"]
```

Argument	Description
`post-layout_flat_netlist_file`	`*.DSPF` format file
`active-net_file`	Format defined by Star-RC or Star-RCXT
`inactive-net file`	Format defined by Star-RC or Star-RCXT

Description

This command enables you to create active (or inactive) net file and use it to remove parasitics *only* for all nets that are not part of active nets or a part of inactive nets.

The command allows removal of parasitic components in the active nets including:

- Resistors
- Capacitors (non-coupling and coupling)

  You can keep or remove coupling capacitors as follows:

  - Keep if connected to an active net
  - Remove if connected to an inactive net

Command Group

Exploration

Examples

```
.PRUNE "input.spf" "input.rcxt"

.PRUNE dspf_file="input.spf" active_file="act.rcxt"

.PRUNE dspf_file="input.spf" inactive_file="inact.rcxt"
```

See Also

Pruning Parasitics from a Post-Layout Flat Netlist in the *HSPICE User Guide: Basic Simulation and Analysis*.

.PTDNOISE

Calculates the noise spectrum and total noise at a point in time for HSPICE.

Syntax

```
.PTDNOISE output TIME=[val|meas|sweep]
+ [TDELTA=time_delta]
+ frequency_sweep
+ [listfreq=(frequencies|none|all)] [listcount=val]
+ [listfloor=val] [listsources=on|off]
```

Argument	Description
output	An output node, pair of nodes, or 2-terminal elements. HSPICE references the equivalent noise output to this node (or pair of nodes). Specify a pair of nodes as V(n+,n-); only one node as V(n+, n-). If you specify only one node, V(n+), then HSPICE assumes the second node is ground. You can also specify a 2-terminal element name that refers to an existing element in the netlist.
TIME	Time point at which time domain noise is evaluated. Specify either a time point explicitly, such as: TIME=value, where value is either numerical or a parameter name or a .MEASURE name associated with a time domain .MEASURE command located in the netlist. PTDNOISE uses the time point generated from the .MEASURE command to evaluate the noise characteristics. This is useful if you want to evaluate noise or jitter when a signal reaches some threshold value.
TDELTA	A time value used to determine the slew rate of the time-domain output signal. Specified as TDELTA=value. The signal slew rate is then determined by the output signal at TIME +/- TDELTA and dividing this difference by 2 x TDELTA. This slew rate is then used in the calculation of the strobed jitter. If this term is omitted a default value of 0.01 x the .SN period is assumed.
frequency_sweep	Specifies the type, nsteps, and start and stop frequency or frequency points for each sweep type, where: ■ type = frequency sweep type which can be OCT, DEC, LIN, POI or SWEEPBLOCK. ■ nsteps = number of steps per decade or total number of steps. ■ start = starting frequency. ■ stop = ending frequency. ■ p1, p2, ... pn = frequency points. The four parameters determine the offset frequency sweep about the carrier used for the phase noise analysis. ■ LIN *nsteps start stop* ■ OCT *nsteps start stop* ■ DEC *nsteps start stop* ■ POI *nsteps p1, p2, ...pn* ■ SWEEPBLOCK sweepblock = *swblockname*

Argument	Description
listfreq	Prints the element noise value to the `.lis` file. This information is only printed if a noise spectrum is requested in a PRINT or PROBE statement. (See PTDNOISE Output Syntax and File Format.) You can specify which frequencies the element noise is printed. The frequencies must match the sweep_frequency values defined in the *frequency_sweep*, otherwise they are ignored. In the element noise output, the elements that contribute the largest noise are printed first. The frequency values can be specified with the NONE or ALL keyword, which either prints no frequencies or every frequency defined in *frequency_sweep*. Frequency values must be enclosed in parentheses. For example: ▪ listfreq=(none) ▪ listfreq=(all) ▪ listfreq=(1.0) ▪ listfreq=(1.0G, 2.0G) The default value is NONE.
listcount	Prints the element noise value to the `.lis` file, which is sorted from the largest to smallest value. You do not need to print every noise element; instead, you can define `listcount` to print the number of element noise frequencies. For example, `listcount=5` means that only the top 5 noise contributors are printed. The default value is 1.
listfloor	Prints the element noise value to the `.lis` file and defines a minimum meaningful noise value (in $V/Hz^{1/2}$ units). Only those elements with noise values larger than `listfloor` are printed. The default value is 1.0e-14 $V/Hz^{1/2}$.
listsources	Prints the element noise value to the `.lis` file when the element has multiple noise sources, such as a MOSFET, which contains the thermal, shot, and 1/f noise sources. You can specify either ON or OFF: ON prints the contribution from each noise source and OFF does not. The default value is OFF. When `listsources` is turned on, the element noise source contributions will also be output into `*.snptn#` file.

Description

Periodic Time-Dependent noise analysis (`PTDNOISE`) calculates the noise spectrum and the total noise at a point in time. Jitter in a digital threshold circuit can then be determined from the total noise and the digital signal slew rate.

`.MEASURE PTDNOISE` allows for the measurement of these parameters: integnoise, time-point, tdelta-value, slewrate, and strobed jitter. See Periodic Time-Dependent Noise Analysis (.PTDNOISE) in the *HSPICE User Guide: Advanced Analog Simulation and Analysis* for details.

Command Group

Analysis

Examples

Example 1 *The following example does a time point sweep. Note that the dec 5 1e5 1e10 refers to the frequency sweep.*

```
.param f0 = 5.0e8
.sn tones=f0 nharms=4 trinit=10n
.PTDNOISE v(out1) TIME=lin 3 0 2n TDELTA=.1n   dec 5 1e5 1e10
+ listfreq=(1e6,1e8)
+ listcount=1
+ listsources=ON
...
```

Example 2 *Using measure results for the time value: The first line of this example measures the first crossing of the output; the second line uses the measured value, edge, as the time point.*

```
.measure sn edge when v(div1out)='v(vdddiv)/2' cross=1
.ptdnoise v(div1out) time=edge dec 10 100 100e6
```

See Also

.HBNOISE
.SNNOISE
.MEASURE PTDNOISE

.PZ

Performs pole/zero analysis.

Syntax

```
.PZ output input
.PZ ovsrcname
```

Argument	Description
input	Input source; the name of any independent voltage or current source.

Argument	Description
output	Output variables, which can be: ■ Any node voltage, V(*n*). ■ Any branch current, I(*branch_name*).
ov	Output variable: ■ a node voltage V(*n*), or a branch current I(*element*)
srcnam	Input source: ■ an independent voltage or a current source name

Description

Use to perform Pole/Zero analysis. You do not need to specify `.OP` because the simulator automatically invokes an operating point calculation. See Pole/Zero Analysis in the *HSPICE User Guide: Basic Simulation and Analysis* for complete information about pole/zero analysis.

Command Group

Analysis

Examples

```
.PZ V(10) VIN
.PZ I(RL) ISORC
```

- In the first pole/zero analysis, the output is the voltage for node 10 and the input is the `VIN` independent voltage source.
- In the second pole/zero analysis, the output is the branch current for the RL branch and the input is the `ISORC` independent current source.

See Also

.DC

Filters Examples, for full demo netlists using the `.PZ` command, including:

- `fbp_2.sp` (bandpass LCR filter, pole/zero)
- `ninth.sp` (active low pass filter using Laplace elements)
- `fhp4th.sp` (high-pass LCR, fourth-order Butterworth filter, pole-zero analysis)
- `fkerwin.sp` (pole/zero analysis of Kerwin's circuit)
- `flp5th.sp` (low-pass, fifth-order filter, pole-zero analysis)

- `flp9th.sp` (low-pass, ninth-order FNDR, with ideal op-amps, pole-zero analysis)

.SAMPLE

Analyzes data sampling noise.

Syntax

```
.SAMPLE FS=freq [TOL=val] [NUMF=val]
+ [MAXFLD=val] [BETA=0|1]
```

Argument	Description
FS=freq	Sample frequency in hertz.
TOL	Sampling-error tolerance: the ratio of the noise power (in the highest folding interval) to the noise power (in baseband). The default is 1.0e-3.
NUMF	Maximum number of frequencies that you can specify. The algorithm requires about ten times this number of internally-generated frequencies so keep this value small. The default is 100.
MAXFLD	Maximum number of folding intervals (The default is 10.0). The highest frequency (in hertz) that you can specify is: FMAX=MAXFLD · FS
BETA	Optional noise integrator (duty cycle) at the sampling node: ▪ BETA=0 no integrator ▪ BETA=1 simple integrator (default) If you clock the integrator (integrates during a fraction of the 1/FS sampling interval), then set BETA to the duty cycle of the integrator.

Description

Use this command to acquire data from analog signals. It is used with the `.NOISE` and `.AC` commands to analyze data sampling noise in HSPICE. The SAMPLE analysis performs a noise-folding analysis at the output node.

Command Group

Analysis

See Also

.AC
.NOISE

.SAVE

Stores the operating point of a circuit in a file that you specify in HSPICE (only).

Syntax

```
.SAVE [TYPE=type_keyword] [FILE=save_file]
+ [LEVEL=level_keyword] [TIME=save_time]
```

Argument	Description
TYPE= type_keyword	Storage method for saving the operating point. The type can be one of the following. Default is NODESET. ▪ NODESET: Stores the operating point as a NODESET command. Later simulations initialize all node voltages to these values if you use the .LOAD command. If circuit conditions change incrementally, DC converges within a few iterations. ▪ IC: Stores the operating point as an IC command. Later simulations initialize node voltages to these values if the netlist includes the .LOAD commands.
save_file	Name of the file that stores DC operating point data. The file name format is *save_file*.ic#. Default is *design*.ic0.
level_keyword	Circuit level at which you save the operating point. The level can be one of the following. ▪ ALL (default): Saves all nodes from the top to the lowest circuit level. This option offers the greatest improvement in simulation time. ▪ TOP: Saves only nodes in the top-level design. Does not save subcircuit nodes. ▪ SELECT: Enables you to select nodes that you would like to be reported using .PRINT or .PROBE statements. ▪ NONE: Does not save the operating point.
save_time	Time during transient analysis when HSPICE saves the operating point. HSPICE requires a valid transient analysis command to save a DC operating point. The default is 0.

Description

Use this command to store the operating point of a circuit in a file that you specify. For quick DC convergence in subsequent simulations, use the .LOAD command to input the contents of this file. HSPICE saves the operating point by default, even if the HSPICE input file does not contain a .SAVE command. To not save the operating point, specify .SAVELEVEL=NONE. You can save the operating point data as either an .IC or a .NODESET command. A parameter or temperature sweep saves only the first operating point.

The .SAVE command only saves one bias point to a file.

Note: To save multiple node voltages at different time steps, it is preferable to use the .OP command.

.SAVE is supported with DP.

Command Group

Setup

Examples

Example 1 *This example saves the operating point corresponding to .TEMP -25 to a file named my_design.ic0.*

```
.TEMP -25 0 25
.SAVE TYPE=NODESET FILE=my_design.ic0 LEVEL=ALL
+ TIME=0
```

Example 2 *In this example statement, only the four specified signals are printed in the test.ic0 file.*

```
.SAVE LEVEL=SELECT FILE='test.ic0'
.probe v(in) v(x1.clk) v(x1.xpll.4gout) v(out_n)
```

Example 3 *This example appears in a file where there are eight end's where there are .SAVE lines in every other .end (four total). The save_file flag is 6230_lrmf.ic'. The resultant files are:*
6230_lrmf.ic0
6230_lrmf.ic1
6230_lrmf.ic2
6230_lrmf.ic3

```
.SAVE TYPE=IC TIME=1.72323e-09 FILE='6230_lmrf.ic'
```

See Also

.IC
.LOAD
.NODESET

.OP
.PRINT
.PROBE

.SENS

Determines DC small-signal sensitivities of output variables for circuit parameters.

Syntax

```
.SENS ov1 [ov2 ...]
```

Argument	Description
ov1 ov2 ...	Branch currents or nodal voltage for DC component-sensitivity analysis

Description

Use this command to determine DC small-signal sensitivities of output variables for circuit parameters.

If the input file includes a `.SENS` command, HSPICE determines DC small-signal sensitivities for each specified output variable relative to every circuit parameter. The sensitivity measurement is the partial derivative of each output variable for a specified circuit element measured at the operating point and normalized to the total change in output magnitude. Therefore, the sum of the sensitivities of all elements is 100%. DC small-signal sensitivities are calculated for:

- resistors
- voltage sources
- current sources
- diodes
- BJTs (including Level 4, the VBIC95 model)
- MOSFETs (Level49 and Level53, Version=3.22).

Note: The only BSIM3 model version supported in sensitivity analysis is the BSIM3V3.22 model. BSIMV3.2, BSIM3V3.24, and BSIM3V3.3 models are not supported.

You can perform only one .SENS analysis per simulation. Only the last .SENS command is used in case more than one is present. The others are discarded with warnings. The amount of output generated from a .SENS analysis is dependent on the size of the circuit.

Command Group

Analysis

Examples

In Example 1, the .SENS v(2) command is used to find out how sensitive the voltage at node 2 is to change at any element value.

For sensitivity analysis only one element is changed at a time while all other element values are retained at their original value. The output of the .SENS v(2) command appears in the list file as follows:

Example 1

```
v1 1 0 1
r1 1 2 1k
r2 2 0 1k
.SENS v(2)
.end
```

In Example 2, the element sensitivity column lists the absolute change in V(2) when the element value is changed by unity. As shown, an element sensitivity of -250.0000u for element r1 indicates that v(2) decreases by 250uv when R1 is increased from 1000 ohms to 1001 ohms. Similarly, an element sensitivity of 500.0000m for element v1 indicates that v(2)increases by 500mv when v1 increases by 1V.

The normalized sensitivity column lists the absolute change in v(2) when the element value is increased by 1%. As shown for element r1, the normalized sensitivity of -2.5000m indicates that v(2) decreases by 2.5mv when the value of r1 is increased by 1%.

Example 2

```
dc sensitivities of output v(2)

 element element element normalized
 name value sensitivity sensitivity
 (volts/unit) (volts/percent)

 0:r1 1.0000k -250.0000u -2.5000m
 0:r2 1.0000k 250.0000u 2.5000m
 0:v1 1.0000 500.0000m 5.0000m
```

Note: In both columns, a negative sign indicates a decrease and a positive sign indicates an increase in the output variable (in this case, v(2)).

See Also

.DC

.SET_SAMPLE_TIME

Forces HSPICE to compute the data points with a fixed time step. It is available only for transient analysis.

Syntax

```
.SET_SAMPLE_TIME twindow start_time stop_time [[start_time
   stop_time]...] period period_value
```

Argument	Description
start_time	Sets the start time of the sampling point.
stop_time	Sets the stop time of the sampling point.
period_value	Sets the period between sampling points. If you specify multiple `start_time` and `stop_time` arguments, the period applies to all the `twindow` values.

Description

This command forces HSPICE to compute the data points with a fixed time step. This prevents any interpolation errors and maximizes the precision of waveform and measurement.

Command Group

Analysis

Examples

The following example starts the first sample at 10u, the end of the sampling time is 20u, and a sample point occurs at 10u, 10.1u, 10.2u, 10.3u, and so forth.

```
.SET_SAMPLE_TIME  twindow  10u  20u  period 100n
```

.SHAPE

Defines a shape to be used by the HSPICE field solver.

Syntax

```
.SHAPE snameShape_Descriptor
```

Argument	Description
sname	Shape name.
Shape_Descriptor	One of the following: ▪ Rectangle ▪ Circle ▪ Strip ▪ Polygon ▪ Trapezoid

Description

Use this command to define a shape. The field solver uses the shape to describe a cross-section of the conductor.

Command Group

Field Solver

See Also

.SHAPE (Rectangles)
.SHAPE (Circles)
.SHAPE (Polygons)
.SHAPE (Strip Polygons)
.SHAPE (Trapezoids)
.FSOPTIONS
.LAYERSTACK
.MATERIAL
Transmission (W-element) Line Examples

.SHAPE (Rectangles)

Defines a rectangle to be used by the HSPICE field solver.

Syntax

```
.SHAPE RECTANGLE WIDTH=val HEIGHT=val [NW=val] [NH=val]
```

Argument	Description
WIDTH	Width of the rectangle (size in the x-direction).
HEIGHT	Height of the rectangle (size in the y-direction).
NW	Number of horizontal (x) segments in a rectangle with a specified width.
NH	Number of vertical (y) segments in a rectangle with a specified height.

Description

Use this keyword to define a rectangle. Normally, you do not need to specify the NW and NH values because the field solver automatically sets these values, depending on the accuracy mode. You can specify both values or only one of these values and let the solver determine the other.

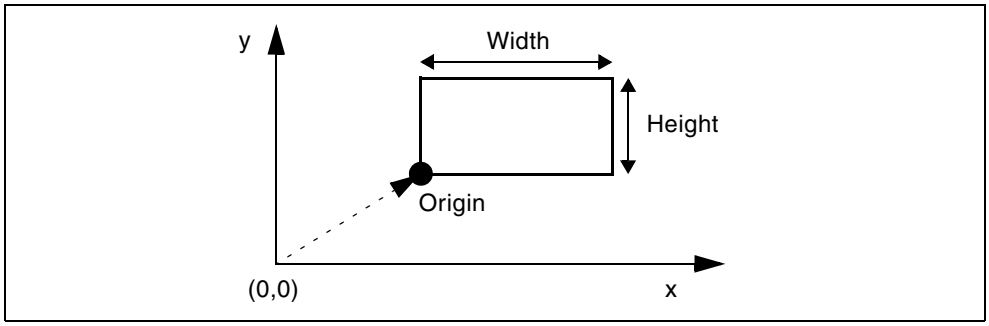


Figure 10 Coordinates of a Rectangle

Command Group

Field Solver

.SHAPE (Circles)

Defines a circle to be used by the HSPICE field solver.

Syntax

```
.SHAPE CIRCLE RADIUS=val [N=val]
```

Argument	Description
RADIUS	Radius of the circle.
N	Number of segments to approximate a circle with a specified radius.

Description

Use this keyword to define a circle in the field solver. The field solver approximates a circle as an inscribed regular polygon with *N* edges. The more edges, the more accurate the circle approximation is.

Do not use the `CIRCLE` descriptor to model actual polygons; instead use the `POLYGON` descriptor.

Normally, you do not need to specify the N value because the field solver automatically sets this value, depending on the accuracy mode. But you can specify this value if you need to

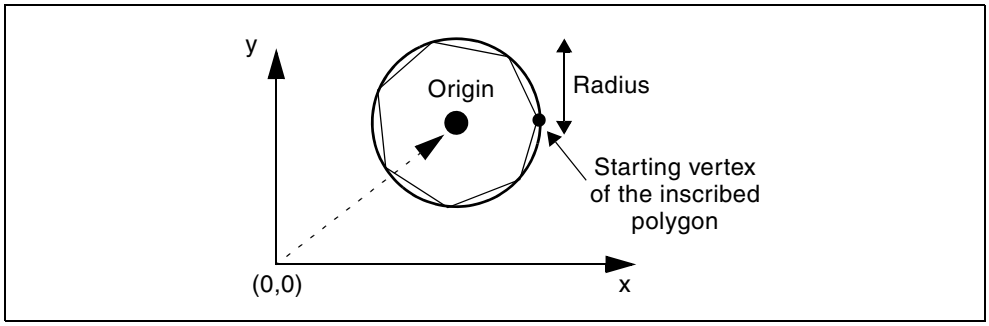


Figure 11 Coordinates of a Circle

Command Group

Field Solver

.SHAPE (Polygons)

Defines a polygon to be used by the HSPICE field solver.

Syntax

```
.SHAPE POLYGON VERTEX=(x1y1x2y2 ...)
+ [N=(n1,n2,...)]
```

Argument	Description
VERTEX	(*x*, *y*) coordinates of vertices. Listed either in clockwise or counter-clockwise direction.
N	Number of segments that define the polygon with the specified *x* and *y* coordinates. You can specify a different *N* value for each edge. If you specify only one *N* value, then the field solver uses this value for *all* edges.For example, the first value of *N, n1*, corresponds to the number of segments for the edge from (*x1 y1*) to (*x2 y2*).

Description

Use this command to define a polygon in a field solver. The specified coordinates are within the local coordinate with respect to the origin of a conductor.

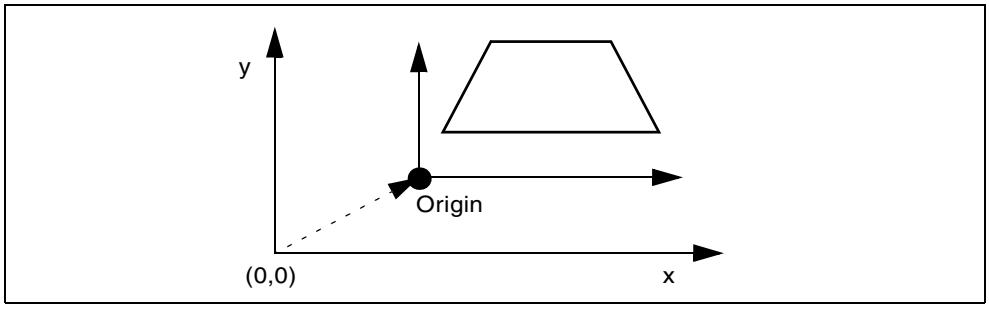


Figure 12 Coordinates of a Polygon

Command Group

Field Solver

Examples

Example 1 demonstrates a rectangular polygon using the default number of segments.

Example 1

```
.SHAPE POLYGON VERTEX=(1 10 1 11 5 11 5 10)
```

The rectangular polygon specified in Example 2 uses five segments for each edge.

Example 2

```
.SHAPE POLYGON VERTEX=(1 10 1 11 5 11 5 10)
+ N=5
```

Example 3 shows how rectangular polygon uses different number of segments for each edge.

Example 3

```
.SHAPE POLYGON VERTEX=(1 10 1 11 5 11 5 10)
+ N=(5 3 5 3)
```

.SHAPE (Strip Polygons)

Defines a strip polygon to be used by the HSPICE field solver.

Syntax

```
.SHAPE STRIP WIDTH=val [N=val]
```

Argument	Description
WIDTH	Width of the strip (size in the x-direction).
N	Number of segments that define the strip shape with the specified width.

Description

Use this command to define a strip polygon in a field solver. Normally, you do not need to specify the `N` value because the field solver automatically sets this value, depending on the accuracy mode. But you can specify this value if you need to.

The field solver (filament method) does not support this shape.

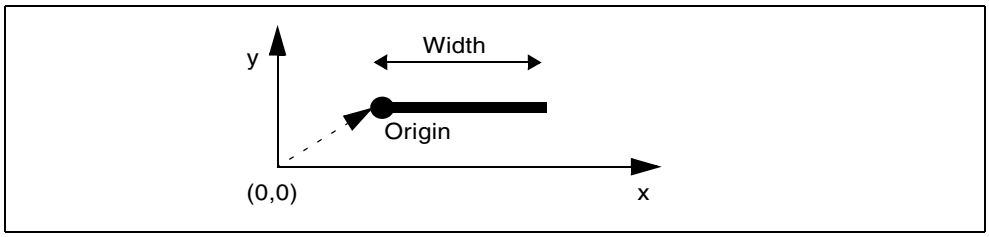


Figure 13 Coordinates of a Strip Polygon

Command Group

Field Solver

.SHAPE (Trapezoids)

Defines a trapezoid to be used by the HSPICE field solver.

Syntax

```
.SHAPE TRAPEZOID TOP=val BOTTOM=val HEIGHT=val
+ [NW=val] [NH=val]
```

Argument	Description
TOP	Top edge length of the trapezoid (size in the x-direction).
BOTTOM	Bottom edge length of the trapezoid (size in the x-direction).
HEIGHT	Height of the trapezoid (size in the y-direction).
NW	Number of horizontal (x) segments in a trapezoid with a specified top and bottom.
NH	Number of vertical (y) segments in a trapezoid with a specified height.

Description

Use this keyword to define a trapezoid. Normally, you do not need to specify the NW and NH values because the field solver automatically sets these values, depending on the accuracy mode. You can specify both values or only one of these values to let the solver determine the other.

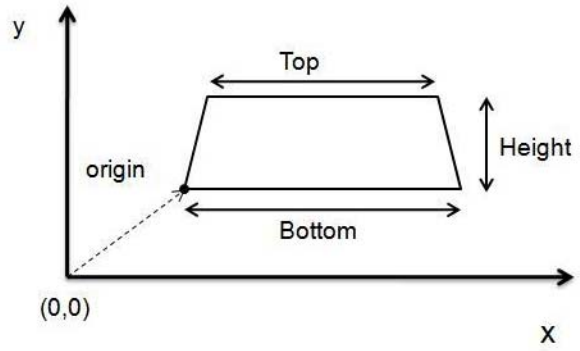


Figure 14 Coordinates of a Trapezoid

Command Group

Field Solver

.SN

In HSPICE, Shooting Newton provides two syntaxes. Syntax #1 is recommended when you are using/making Time Domain sources and measurements (for example, going from .TRAN to .SN). Syntax #2 effectively supports Frequency Domain sources and measurements (and should be used, for example, when going from .HB to .SN).

Syntax

Syntax #1

```
.SN TRES=Tr PERIOD=T [TRINIT=Ti]
+ [SWEEP parameter_sweep] [MAXTRINITCYCLES=integer]
+ [NUMPEROUT=val]
```

Syntax #2

```
.SN TONE=F1 NHARMS=N [TRINIT=Ti]
+ [SWEEP parameter_sweep] [MAXTRINITCYCLES=integer]
+ [NUMPEROUT=val]
```

Argument	Description
TRES	Time resolution to be computed for the steady-state waveforms (in seconds).

Argument	Description
PERIOD	Expected period T (seconds) of the steady-state waveforms. Enter an approximate value when using for oscillator analysis. The period of the steady-state waveform may be entered either as PERIOD or its reciprocal, TONE.
TONE	The fundamental frequency (in Hz).
NHARMS	Specifies the number of high-frequency harmonic components to include in the analysis. NHARMS defaults to PERIOD/TRES rounded to nearest integer. NHARMS is required to run subsequent SNAC, SNNOISE, SNXF, and PHASENOISE analyses. When using Syntax #1, NHARMS is computed automatically as NHARMS=Round(PERIOD/TRES).
TRINIT	Transient initialization time. If not specified, the transient initialization time will be equal to the period (for Syntax 1) or the reciprocal of the tone (for Syntax 2).
SWEEP	Parameter sweep. As in all main analyses in HSPICE such as .TRAN, .HB, and so forth, you can specify LIN, DEC, OCT, POI, SWEEPBLOCK, DATA, MONTE, or OPTIMIZE.
MAXTRINITCYCLES	SN stabilization simulation and frequency detection is stopped when the simulator detects that maxtrinitcycles have been reached in the oscnode signal, or when time=trinit, whichever comes first. Minimum cycles is 1.
NUMPEROUT	Allows you to dump more than one period of output to ease waveform viewing. (Your eye does not have to struggle in the viewer to connect the end of a waveform period to its beginning.) By default, SN analysis only dumps one period of output.

Description

Shooting-Newton adds analysis capabilities for PLL components, digital circuits/logic, such as ring oscillators, frequency dividers, phase/frequency detectors (PFDs), and for other digital logic circuits and advanced analog components that require steady-state analysis, but operate with waveforms that are more square wave than sinusoidal. Refer to the *HSPICE User Guide: Advanced Analog Simulation and Analysis*, Steady-State Shooting Newton Analysis.

Control Options

In addition to all .TRAN options, the following netlist control options are available for this command:

Option	Description
.OPTION LOADSNINIT	Loads the operating point saved at the end of SN initialization which is used as initial conditions for the Shooting-Newton method.
.OPTION SAVESNINIT	Saves the operating point at the end of SN initialization (sninit).
.OPTION SNACCURACY	Similar to the sim_accuracy definition in.TRAN, i.e., larger values of snaccuracy result in a more accurate solution but may require more time points. Because Shooting-Newton must store derivative information at every time point, the memory requirements may be significant if the number of time points is very large. Default is 10. The maximum integer value is 50.
.OPTION SNMAXITER	Sets the maximum number of iterations for a Shooting Newton analysis. Default is 40.
.OPTION SNCONTINUE	Specifies whether to use the sweep solution from the previous simulation as the initial guess for the present simulation. Default is 1. ■ SNCONTINUE=1 (default): Use solution from previous simulation as the initial guess. ■ HBCONTINUE=0: Start each simulation in a sweep from the DC solution.

Command Group

Analysis

See Also

.SNAC
.SNFT
.SNNOISE
.SNOSC
.SNXF

.SNAC

Runs a frequency sweep across a range for the input signal based on a Shooting Newton algorithm.

Syntax

```
.SNAC frequency_sweep
```

Argument	Description
frequency_sweep	Specifies the type, nsteps, and start and stop frequency or frequency points for each sweep type, where: ▪ type = frequency sweep type which can be OCT, DEC, LIN, POI or SWEEPBLOCK. ▪ nsteps = number of steps per decade or total number of steps. ▪ start = starting frequency. ▪ stop = ending frequency. ▪ p1, p2, ... pn = frequency points. The four parameters determine the offset frequency sweep about the carrier used for the phase noise analysis. ▪ LIN *nsteps start stop* ▪ OCT *nsteps start stop* ▪ DEC *nsteps start stop* ▪ POI *nsteps p1, p2, ...pn* ▪ SWEEPBLOCK sweepblock = *swblockname*

Description

The *frequency_sweep* runs across a range for the input signal based on a Shooting Newton algorithm. For more information, see Shooting Newton AC Analysis (.SNAC) in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Command Group

Analysis

Examples

```
VSRC node1 node2 0 SNAC 1 45
.SNAC DEC 10 1k 10K
```

See Also

.HBAC

.SN
.SNNOISE

.SNFT

Calculates the Discrete Fourier Transform (DFT) value used for Shooting Newton analysis. Numerical parameters (excluding string parameters) can be passed to the .SNFT command.

Syntax

Syntax # 1 Alphanumeric input

```
.SNFT output_var [START=value] [STOP=value]
+ [NP=value] [FORMAT=keyword]
+ [WINDOW=keyword] [ALFA=value]
+ [FREQ=value] [FMIN=value] [FMAX=value]
```

Syntax #2 Numerics and expressions

```
.SNFT output_var [START=param_expr1] [STOP=param_expr2]
+ [NP=param_expr3] [FORMAT=keyword]
+ [WINDOW=keyword] [ALFA=param_expr4]
+ [FREQ=param_expr5] [FMIN=param_expr6] [FMAX=param_expr7]
```

Argument	Description
output_var	Any valid output variable, such as voltage, current, or power.
START	Start of the output variable waveform to analyze. Defaults to the START value in the .SN command, which defaults to 0.
FROM	Alias for START in .SNFT commands.
STOP	End of the output variable waveform to analyze. Defaults to the TSTOP value in the .SN command.
TO	Alias for STOP, in .SNFT commands.
NP	Number of points to use in the SNFT analysis. NP must be a power of 2. If NP is not a power of 2, HSPICE automatically adjusts it to the closest higher number that is a power of 2. The default is 1024.

Argument	Description
FORMAT	Output format: ■ NORM= normalized magnitude (default) ■ UNORM=unnormalized magnitude
WINDOW	Window type to use: ■ RECT=simple rectangular truncation window (default). ■ BART=Bartlett (triangular) window. ■ HANN=Hanning window. ■ HAMM=Hamming window. ■ BLACK=Blackman window. ■ HARRIS=Blackman-Harris window. ■ GAUSS=Gaussian window. ■ KAISER=Kaiser-Bessel window.
ALFA	Parameter to use in GAUSS and KAISER windows to control the highest side-lobe level, bandwidth, and so on. 1.0 <= ALFA <= 20.0The default is 3.0
FREQ	Frequency to analyze. If FREQ is non-zero, the output lists only the harmonics of this frequency, based on FMIN and FMAX. HSPICE also prints the THD for these harmonics. The default is 0.0 (Hz).
FMIN	Minimum frequency for which HSPICE prints SNFT output into the listing file. THD calculations also use this frequency. T=(STOP-START) The default is 1.0/T (Hz).
FMAX	Maximum frequency for which HSPICE prints SNFT output into the listing file. THD calculations also use this frequency. The default is 0.5*NP*FM IN (Hz).

Description

Use this command to calculate the Discrete Fourier Transform (DFT) spectrum analysis values for Shooting Newton analysis. It uses internal time point values to calculate these values. A DFT uses sequences of time values to determine the frequency content of analog signals in circuit simulation. You can pass numerical parameters/expressions (but no string parameters) to the `.SNFT` command. The output goes to a file with extension `.snft#`.

You can specify only one output variable in an `.SNFT` command. The following is an incorrect use of the command because it contains two variables in one `.SNFT` command:

Command Group

Analysis

Examples

Example 1 Correctly designates the variables per .SNFT command.

```
.SNFT v(1)
.SNFT v(1,2) np=1024 start=0.3m stop=0.5m freq=5.0k
+ window=kaiser alfa=2.5
.SNFT I(rload) start=0m to=2.0m fmin=100k fmax=120k
+ format=unorm
.SNFT par('v(1) + v(2)') from=0.2u stop=1.2u
+ window=harris
```

Example 2 Generates a .snft0 file for the SNFT of v(1) and a .snft1 file for the SNFT of v(2).

```
.SNFT v(1) np=1024
.SNFT v(2) np=1024
```

See Also

.SN

.SNNOISE

Runs a periodic, time-varying AC noise analysis based on a Shooting Newton algorithm.

Syntax

```
.SNNOISE output insrc frequency_sweep
+[[n1, +/-1]]
+[listfreq=(frequencies|none|all)> [listcount=val]
+[listfloor=val] [listsources=on|off]
```

Argument	Description
output	Output node, pair of nodes, or 2-terminal element that the equivalent noise output references.
insrc	Input source.

Argument	Description
frequency_sweep	Specifies the type, nsteps, and start and stop frequency or frequency points for each sweep type, where: ■ type = frequency sweep type which can be OCT, DEC, LIN, POI or SWEEPBLOCK. ■ nsteps = number of steps per decade or total number of steps. ■ start = starting frequency. ■ stop = ending frequency. ■ p1, p2, ... pn = frequency points. The four parameters determine the offset frequency sweep about the carrier used for the phase noise analysis. ■ LIN *nsteps start stop* ■ OCT *nsteps start stop* ■ DEC *nsteps start stop* ■ POI *nsteps p1, p2, ...pn* ■ SWEEPBLOCK sweepblock = *swblockname*
`n1, +/-`	Index term defining the output frequency band at which the noise is evaluated. The output frequency is computed according to fout=|n1*f1 +/- fin|, where f1 is the fundamental tone (inverse of fundamental period) and fin is from the frequency sweep.
`listfreq`	Prints the element noise value to the `.lis` file; the default is none.
`listcount`	Prints the element noise value to the `.lis` file, sorted from the largest to smallest value.
`listfloor`	Prints the element noise value to the `.lis` file and defines a minimum meaningful noise value. Only those elements with noise values larger than listfloor are printed. The default value is 1.0e-14 V/sqrt(Hz).
`listsources`	Prints the element noise value to the `.lis` file when the element has multiple noise sources. The default is off. When `listsources` is turned on, the element noise source contributions will also be output into the`*.snpn#` file.

Description

The functionality for the .SNNOISE command to is similar to the Harmonic Balance (HBNOISE command) for periodic, time-varying AC noise analysis, but the Shooting Newton-based algorithm completes the analysis in a much faster run time with the same result.

Command Group

Analysis

Examples

```
.SNNOISE V(n1,n2) RIN DEC 10 1k 10k 0 -1
```

See Also

.HBNOISE
.SN
.SNAC

.SNOSC

Performs oscillator analysis on autonomous (oscillator) circuits. As with regular Shooting Newton analysis, input might be specified in terms of time or frequency values.

Syntax

Syntax #1

```
.SNOSC TONE=F1 NHARMS=H1 [TRINIT=Ti] OSCNODE=N1
+[MAXTRINITCYCLES=N][SWEEP PARAMETER_SWEEP]
```

Syntax #2

```
.SNOSC TRES=Tr PERIOD=Tp [TRINIT=Tr] OSCNODE=N1
+[MAXTRINITCYCLES=I] SWEEP PARAMETER_SWEEP
```

Argument	Description
TONE	Approximate value for oscillation frequency (Hz). The search for an exact oscillation frequency begins from this value.
NHARMS	Number of harmonics to be used for oscillator SN analysis.

Argument	Description
OSCNODE	Node used to probe for oscillation conditions. This node is automatically analyzed to search for periodic behavior near the TONE or PERIOD value specified.
TRINIT	Transient initialization time. If not specified, the transient initialization time is equal to the period (for Syntax 1) or the reciprocal of the tone (for Syntax 2). For oscillators we recommend specifying a transient initialization time since the default initialization time is usually too short to effectively stabilize the circuit.
MAXTRINITCYCLES	SN stabilization simulation and frequency detection is stopped when the simulator detects that MAXTRINITCYCLES have been reached in the `oscnode` signal, or when time=`trinit`, whichever comes first. Minimum cycles is 1.
TRES	Time resolution to be computed for the steady-state waveforms (in seconds). The period of the steady-state waveform may be entered either as `PERIOD` or its reciprocal, `TONE`.
PERIOD	Expected period T (seconds) of the steady-state waveforms. Enter an approximate value when using for oscillator analysis.
SWEEP	Type of sweep. You can sweep up to three variables. You can specify either LIN, DEC, OCT, POI, SWEEPBLOCK, DATA, OPTIMIZE, or MONTE. Specify the nsteps, start, and stop frequencies using the following syntax for each type of sweep: ▪ LIN *nsteps start stop* ▪ DEC *nsteps start stop* ▪ OCT *nsteps start stop* ▪ POI *nsteps freq_values* ▪ SWEEPBLOCK=*swblockname* ▪ DATA=*dataname* ▪ OPTIMIZE=OPT*xxx* ▪ MONTE=*val*

Description

Use this command to invoke oscillator analysis on autonomous (oscillator) circuits. The SNOSC command is very effective for ring oscillator circuits, and oscillators that operate with piecewise linear waveforms (HBOSC is superior for

sinusoidal waveforms). As with the Harmonic Balance approach, the goal is to solve for the additional unknown oscillation frequency. This is accomplished in Shooting Newton by considering the period of the waveform as an additional unknown, and solving the boundary conditions at the waveform endpoints that coincide with steady-state operation. As with regular Shooting Newton analysis, input might be specified in terms of time or frequency values. See the examples, below.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION HBFREQABSTOL	Specifies the maximum absolute change in frequency between solver iterations for convergence.
.OPTION HBFREQRELTOL	Specifies the maximum relative change in frequency between solver iterations for convergence.
.OPTION HBOSCMAXITER / HBOSC_MAXITER	Specifies the maximum number of outer-loop iterations for oscillator analysis.
.OPTION HBPROBETOL	Searches for a probe voltage at which the probe current is less than the specified value.
.OPTION HBTRANFREQSEARCH	Specifies the frequency source for the HB analysis of a ring oscillator.
.OPTION HBTRANINIT	Selects transient analysis for initializing all state variables for HB analysis of a ring oscillator.
.OPTION HBTRANPTS	Specifies the number of points per period for converting time-domain data results into the frequency domain for HB analysis of a ring oscillator.
.OPTION HBTRANSTEP	Specifies transient analysis step size for the HB analysis of a ring oscillator.

Command Group

Analysis

Examples

Example 1 *Performs an oscillator analysis searching for periodic behavior after an initial transient analysis of 10 ns. This example uses nine harmonics while searching for a oscillation at the gate node.*

```
.SNOSC tone=900Meg nharms=9 trinit=10n oscnode=gate
```

Example 2 *Performs an oscillator analysis searching for frequencies in the vicinity of 2.4 Ghz. This example uses 11 harmonics and a search at the drainP.*

```
.SNOSC tone=2400MEG nharms=11 trinit=20n oscnode=drainP
```

Example 3 *Presents another equivalent method to define the OSCNODE information through a zero-current source. Example 3 is identical to Example 2, except that the OSCNODE information is defined by a current source in the circuit. Only one such current source is needed and its current source must be 0.0 with the SNOSC OSCNODE identified by the SNOSCVPROBE keyword.*

```
ISRC drainP 0 SNOSCVPROBE
.SNOSC tone = 2.4 G nharms = 1 trinit=20n
```

See Also

.HB
.PRINT
.PROBE

.SNXF

Calculates the transfer function from the given source in the circuit to the designated output.

Syntax

`.SNXF` *`out_varfreq_sweep`*

Argument	Description
out_var	`I(2_`*`port_elem`*`)` or `V(`*`n1`*`<,`*`n2`*`>)`
freq_sweep	Sweep of type LIN, DEC, OCT, POI, or SWEEPBLOCK. Specify the nsteps, start, and stop times using the following syntax for each type of sweep: ▪ LIN *nsteps start stop* ▪ DEC *nsteps start stop* ▪ OCT *nsteps start stop* ▪ POI *nsteps freq_values* ▪ SWEEPBLOCK=*swblockname* Specify the frequency sweep range for the output signal. HSPICE determines the offset frequency in the input sidebands; for example,f1 = abs(fout - k*f0) s.t. f1<=f0/2The f0 is the steady-state fundamental tone and f1 is the input frequency.

Description

Use this command in HSPICE to calculate the transfer function from the given source in the circuit to the designated output. The functionality for the `.SNXF` command is similar to the Harmonic Balance (`.HBXF`) command for periodic, time-varying AC noise analysis, but the Shooting Newton based algorithm completes the analysis in a much faster run time with the same result.

Command Group

Analysis

Examples

In this example, the trans-impedance from `isrc` to `v(1)` is calculated based on the HB analysis.

```
.hb tones=1e9 nharms=4
.snxf v(1) lin 10 1e8 1.2e8
.print snxf tfv(isrc) tfi(n3)
```

See Also

.HB
.HBAC
.HBNOISE
.HBOSC
.PRINT
.PROBE

.STATEYE

Enables use of statistical eye diagram analysis.

Syntax

```
.STATEYE T=time_interval Trf=rise_fall_time
+ [Tr=rise_time] [Tf=fall_time]
+ Incident_port=idx1, [idx2, ... idxN]
+ Probe_port=idx1, [idx2, ... idxN]
+ [Tran_init=n_periods]
+ [V_low=val] [V_high=val]
+ [TD_In=val] [TD_Probe=val] [TD_Probe_AMI=val]
+ [TW_Reltol=val] [TW_Abstol=val] [ISI_depth=n]
+ [Initial_Low=val] [Initial_Zero=val]
+ [T_resolution=n] [AMI_T_resolution=n] [V_resolution=n]
+ [VD_range=val] [TD_NUI=n] [Edge=1|2|4|8]
```

```
+ [MAX_PATTERN=n] [Pattern_repeat=n]
+ [Save_tr=ascii] [Load_tr=ascii]
+ [Save_Dir=string] [Load_Dir=string]
+ [PTB_DATA=string]
+ [Ignore_Bits=n]
+ [AMIInit_Use_Impulse=0|1][Impulse_Norm=val]
+ [Xtalk_Type = SYNC|ASYNC|DDP|NO]
+ [MODE=EDGE|CONV|TRAN]
+ [TRAN_BIT_SEG=val]
+ [Unfold_Length=n]
```

Argument	Description
T	Time (in seconds) of single bit width of the incident signal, normally referred as Unit Interval (UI)
Trf	Single value (in seconds) to set both the rise and fall times of the incident pulse
Tr	Rise time (in seconds) of the incident port
Tf	Fall time (in seconds) of the incident port
Incident_port	An array of the index numbers of the incident port elements
Probe_port	An array of the index numbers of the probing port elements
V_low	Low voltage level of the incident pulse. The value is used when the voltage level is not specified in the incident port(s). Default: -1.0
V_high	High voltage level of the incident pulse. The value is used when the voltage level is not specified in the incident port(s). Default: 1.0
Tran_init	An integer number that specifies the numbers of unit intervals (T) that is used by the initial transient analysis to determine the response of the system. Default value is 60.
T_resolution	An integer number used to specify the probability density function (PDF) image resolution of the time axis. Default value is 200.

Argument	Description
AMI_T_resolution	An integer number used to specify the time point density (per unit interval) in IBIS-AMI filtering. By default, the `T_resolution` value is used.
`V_resolution`	An integer number used to specify the probability density function (PDF) image resolution of the voltage axis. Default value is 200.
`TD_In`	Applies specified time delay to the incident pulse/step in the initial transient analysis. Default value is 0 (no delay).
`TD_Probe`	When a positive time value is specified, StatEye only uses initial transient analysis waveforms after the specified time for the eye diagram generation. Default value is 0.
`TD_Probe_AMI`	Similar to `TD_Probe` keyword. StatEye only uses AMI filtered waveform after the specified time for the eye diagram generation. Default value is 0.
`TW_RELTOL`	Relative tolerance used to determine the output waveform transition time window. StatEye considers the output settled when the output voltage reaches the value of the maximum output swing multiplied by TW_RELTOL. Default is 0.01.
`TW_ABSTOL`	Absolute tolerance used to determine the output waveform transition time window. This value overrides `TW_RELTOL` based tolerance. By default, `TW_RELTOL` is used to determine the time window.
ISI_depth	An integer value to force time window as `time window=n×Unit Interval`. This value overrides `TW_RELTOL` and `TW_ABSTOL`. By default, StatEye automatically determines the time window. It is recommended not to specify this keyword unless you have a special need.

Argument	Description
Initial_Low	Forces all the edge input to begin at a low state for specified time. For edges which begin at a high state, the input ramps up to a high state at the specified time and then proceeds to the given edge shape. When this keyword is specified, TD_In defaults to 2*Initial_Low, so the edge transition begins after the specified Initial_Low period. TD_Probe and TD_Probe_AMI also default to TD_In, so the edge response during the Initial_Low period is ignored.
Initial_Zero	Similar to Initial_Low keyword, Initial_Zero=val forces all the edge inputs to begin at 0 V for a specified time. The input ramps up or down to the initial logic state at the specified time and then proceeds to the given edge shape. When this keyword is specified, TD_In defaults to 2*Initial_Zero, so the edge transition begins after the specified Initial_Zero period. TD_Probe and TD_Probe_AMI also default to TD_In, so the edge response during the Initial_Zero period is ignored.
VD_range	Specifies voltage display (output data) range. By default, the .StatEye analysis engine automatically determines the optimum voltage display range. Specifying VD_range can enlarge the display range.
TD_NUI	An integer number to specify time display range relative to the unit interval. Default value is 2 to display a single eye. TD_NUI value may be from 1 to 5. The higher value requires a larger data size.
EDGE	Number of edges to be used. ▪ 1: Conventional statistical eye generation using the single pulse response (default). ▪ 2: Double-edge mode. The rising and falling edges are evaluated separately. ▪ 4: Four edge patterns are modeled. Aids in increasing accuracy for transmission line systems' linear memory effect. ▪ 8: Eight edge patterns are modeled for greater accuracy in nonlinearity. As the number of edge patterns increases, higher nonlinearity can be modeled accurately.

Argument	Description
MAX_PATTERN=*n*	Limits the number of bits to be examined for a custom bit pattern specified with LFSR/PAT in incident Port-element(s). For example, if MAX_PATTERN=100 is specified, StatEye examines only the first 100 bits in the LFSR/PAT sources. This keyword is especially effective when LFSR is used with very high (over 20-bit) feedback tap(s) since it generates an extremely long bit stream. The default value of the MAX_PATTERN is 1000 when mode=tran is used and 2^{21} when the default mode=edge and edge=<n> are used where n=1 (default), 2, 4, or 8. When you specify MAX_PATTERN=0, StatEye examines all the given patterns.
PATTERN_REPEAT	When a positive number, *n*, is specified, .StatEye repeats pattern examination *n* times until the number of bits hits the MAX_PATTERN value. Default=0 (no repeats).
SAVE_TR=ascii	Saves initial transient data in text files.
LOAD_TR=ascii	Loads initial transient data from text files when available.
SAVE_DIR=*string*	Specifies a target directory other than the one specified by the -o command option for the SAVE_TR and LOAD_TR transient files. In saving initial transient result, HSPICE creates netlist.save0/ directory under the specified SAVE_DIR directory. For example, SAVE_DIR = *my_dir* is specified in my_netlist.sp, "my_dir/my_netlist.save0/" directory will be the target of SAVE_TR and LOAD_TR operations.
LOAD_DIR=*string*	LOAD_DIR works the same as SAVE_DIR but LOAD_DIR can be used to specify different directory target than SAVE_DIR for initial transient data read in. LOAD_DIR defaults to SAVE_DIR.
PTB_DATA=*string*	Specifies the name of directory that contains initial edge response data with arbitrary perturbation. StatEye takes differences between normal edge responses and perturbed edge responses. Then StatEye applies voltage-wise fluctuation at each voltage level of the resulting eye diagram. For more information on perturbation analysis, see the *HSPICE User Guide: Signal Integrity Modeling and Analysis*.

Argument	Description
`Ignore_Bits=`*n*	When a positive number is specified, StatEye's pattern-specific eye diagram generation process ignores the first *n* bits. The value is overridden by one specified in the AMI parameter file when one exists for each probe port.
`AMIInit_Use_Impulse=0|1`	Specifies the waveform input for the `AMI_Init` function: ■ 0: Edge (for example, pulse and step) responses are used for the `AMI_Init` function call. ■ 1: (default) StatEye extracts system impulse response from edge responses then uses it for the `AMI_Init` function call.
`Impulse_Norm`	Specifies normalization factor in channel impulse response generation. Area integration of the impulse response function will be normalized to this value. By default, the target channel's low frequency gain (Vout/Vin) will be used.
`Xtalk_Type`	Specifies type of crosstalk. ■ **SYNC**: (Default) Crosstalk aggressors and victims are in sync under single system clock. ■ **ASYNC**: Crosstalk noises are considered asynchronous. ■ **DDP:** Input data dependent crosstalk. This mode requires input bit patterns for both aggressor and victim lines. ■ **NO:** No crosstalk.
`MODE=EDGE|CONV|TRAN`	Specifies the StatEye simulation mode. By default, `MODE=EDGE` is used. ■ **EDGE:** StatEye performS edge superposition to generate eye diagrams. The number of edges to be used is specified by the `EDGE` keyword. ■ **CONV:** Based on the initial edge response, StatEye encapsulates the whole system into single linear transfer function (that is, impulse response) and performs convolution integral with the input bit stream to generate eye diagrams. The `EDGE` keyword is ignored when this convolution mode is specified. ■ **TRAN:** StatEye uses full non-linear transient analysis to generate eye diagrams. The `EDGE` keyword is ignored when this full transient analysis mode is specified.

Argument	Description
Tran_Bit_Seg=n	Specifies the number of bits per each eye diagram generation process. When AMI objects are used, AMI_GetWave is called at each Tran_Bit_Seg bits. For example, when a given pattern has 10,000 bits and Tran_Bit_Seg=1000, StatEye sequentially calls AMI_GetWave 10 times with stream waveform of 1000 bits. Also in MODE=TRAN mode, StatEye processes transient waveforms at each Tran_Bit_Seg bits. The default values are: 200 for MODE=TRAN mode and 1000 for MODE=EDGE mode. For more details about AMI_GetWave, see chapter 10 of the IBIS version 5.0 specification.
Unfold_Length=*n*	Specifies the bit pattern length of the unfold eye probe/print. Default value is 200.

Description

Use this command to perform statistical eye analysis to evaluate high-speed serial interfaces.

The statistical eye diagram is a fundamental performance metric for high-speed serial interfaces in the bit error rate (BER). When setting up a Statistical Eye Analysis, the Port element is used to designate the incident (input) and probe (output) ports for the system to be analyzed. Ports can be specified as single-ended or mixed mode. Random jitter can be applied to each incident and probe point in the system.Each incident port acts as random bit pattern source with specified voltage magnitude. If an incident port element does not have a time domain voltage magnitude specification, the default values, V_high=1.0, V_low=-1.0 are used.Probe ports are used as observation points where .PRINT, .PROBE, and .MEASURE commands can be defined.

Command Group

Analysis

Examples

```
.STATEYE T=400p Trf=20p
+ incident_port= 1, 2
+ probe_port= 3, 4
```

See Also

.MEASURE / MEAS

.PRINT
.PROBE
Statistical Eye Analysis

.STIM

Uses the results (output) of one simulation as input stimuli in a new simulation in HSPICE.

Syntax

General Syntax:

```
.STIM [tran|ac|dc] PWL|DATA|VEC
+ [filename=output_filename ...]
```

PWL Source Syntax (Transient Analysis Only)

```
.STIM   [tran] PWL [filename=output_filename]
+    [name1=] ovar1 [node1=n+] [node2=n-]
+    [[name2=]ovar2 [node1=n+] [node2=n-] ...]
+    [from=val] [to=val] [npoints=val]
.STIM   [tran] PWL [filename=output_filename]
+    [name1=] ovar1 [node1=n+] [node2=n-]
+    [[name2=]ovar2 [node1=n+] [node2=n-] ...]
+   indepvar=[()t1 [t2 ...())]
```

Data Card Syntax

```
.STIM   [tran|ac|dc] DATA [filename=output_filename]
+   dataname [name1=] ovar1
+    [[name2=]ovar2 ...] [from=val] [to=val]
+    [npoints=val] [indepout=val]
.STIM   [tran | ac | dc] DATA [filename=output_filename]
+   dataname [name1=] ovar1
+    [[name2=]ovar2 ...] indepvar=[()t1 [t2 ...())]
+    [indepout=val]
```

Digital Vector File Syntax (Transient Analysis Only)

```
.STIM [tran] VEC [filename=output_filename]
+   vth=val vtl=val [voh=val] [vol=val]
+ [name1=] ovar1 [[name2=] ovar2 ...]
+ [from=val] [to=val] [npoints=val]

.STIM [tran] VEC [filename=output_filename]
```

```
+   vth=val vtl=val [voh=val] [vol=val]
+ [name1=] ovar1 [[name2=] ovar2 ...]
+ indepvar=[()t1 [t2 ...])]]
```

Argument	Description
tran | ac | dc	Simulation type: transient, AC, or DC.
filename	Output file name. If you do not specify a file, HSPICE uses the input filename.
name1	PWL Source Name that you specify. The name must start with V (for a voltage source) or I (for a current source). Or—Name of a parameter of the data card to generate.
ovar1	Output variable that you specify. *ovar* can be: ▪ Node voltage. ▪ Element current. ▪ Parameter string. If using a parameter string you must specify *name1*. For example: v(1), i(r1), v(2,1), par('v(1)+v(2)')
dataname	Name of the data card to generate.
node1	Positive terminal node name.
node2	Negative terminal node name.
from	Time to start output of simulation results. For transient analysis, it uses the time units that you specified. Cannot use with indepvar.
npoints	Number of output time points or independent-variable points.
to	Time to terminate output of simulation results. For transient analysis, it uses the time units that you specified. The *from* value can be greater than the *to* value. Cannot use with indepvar.
indepvar	Dispersed (independent-variable) time points. Specify dispersed time points in increasing order. Replaces the "from" and "to" construct.

Argument	Description
indepout	Indicates whether to generate the independent variable column. ■ indepout, indepout=1, or on, produces the independent variable column. You can specify the independent-variables in any order. ■ indepout= 0 or off (default) does not create an independent variable column. You can place the indepout field anywhere after the ovar1 field.
vth	High voltage threshold.
vtl	Low voltage threshold.
voh	Logic-high voltage for each output signal.
vol	Logic-low voltage for each output signal.

Description

Use this command to reuse the results (output) of one simulation as input stimuli in a new simulation.

The `.STIM` command specifies:

- Expected stimulus (PWL Source, DATA CARD, or VEC FILE).
- Signals to transform.
- Independent variables.

One `.STIM` command produces one corresponding output file.

For additional information, see Reusing Simulation Output as Input Stimuli in the *HSPICE User Guide: Basic Simulation and Analysis*.

Command Group

Output Porting

Examples

In Example 1, the `.STIM` command creates a file "`test.pwl0_tr0`", having a voltage source "v0" applied between nodes neg and 0 (ground). It has a PWL source function based on the voltage of node n0 during the time 0.0 to 5.0 ns with 10 points.

Example 1

```
.stim tran pwl filename=test v0=v(n0) node1=neg
+ node2=0 from=0.0ns to=5ns npoints=10
```

Example 2: In this example the “from and to” construct is used:

```
.stim tran data filename=new PWL v(2) from=start to=end
```

Example 3: In this example, the indepvar construct replaces “from and to”; using both constructs results in an error.

```
.stim tran pwl filename=new v(2) indepvar=(2n 3n 4n)
```

See Also

.DOUT
.MEASURE / MEAS
.PRINT
.PROBE

.STORE

Starts a store operation to create checkpoint files describing a running process during transient analysis.

Syntax

```
.STORE [TYPE=IC|NODESET|MEMDUMP]
+       [FILE=save_file_prefix]
+       [TIME=time1] [TIME=time2] ... [TIME=timeN]
+       [REPEAT=period]
+       [TRANTIME=0/1]
+       [SAVE_ON_KILL=0/1]
```

Argument	Description
TYPE=IC | NODESET | MEMDUMP	Stores checkpoint data to either an `IC` / `NODESET` type or a memory dump file. If unspecified, the default checkpoint file is of the `TYPE=IC` and the name prefix is same as the HSPICE output file. ▪ `TYPE=IC`: Stores the operating point as an `IC` command. Later simulations initialize node voltages to these values if you use the `-RESTORE` command to start simulation from the stored time point. ▪ `TYPE=NODESET`: Stores the operating point as a `NODESET` command. Later simulations initialize all node voltages to these values if you use the `-RESTORE` command to start simulation from the stored time point. If circuit conditions change incrementally, the first restored time point converges within a few iterations.
`FILE=save_file_prefix`	Changes the prefix of the output file names.
TIME=time1,time2,...timeN	Collects checkpoint data beginning at *time1* after the start of transient analysis. It then updates the checkpoint data every 21,600 wall-clock seconds if no checkpoint period is specified.
REPEAT=period	If you specify a nonzero period, new checkpoint data is collected at every period, starting at transient time=0 and overwriting previous interval checkpoint data. If a nonzero time1 is specified, checkpoint data is collected at time1 + period * n, where n is an integer. Period is always calculated based on time1. If repeat=0, the store operation is disabled. If you set both time=0 and repeat=0, checkpoint data is saved at transient time=0 only.
TRANTIME=0/1	▪ If set to 0, time1 and period are taken as wall-clock time. ▪ If set to 1, time1 and period are transient times or times is smaller than TSTOP. **Note:** If TYPE=MEMDUMP, TRANTIME is ignored.
SAVE_ON_KILL=0/1	If set to 1, the checkpoint data is saved on kill and halts the simulation.

Description

Use this command in a netlist to trigger a restore operation by creating checkpoint files describing a running process during transient analysis; the operating system can later reconstruct the process from the contents of this file. This feature is not supported in when HSPICE advanced analog functions are used.

The shortest repeat period for a checkpoint period is 7,200 seconds, anything shorter than that defaults to 7,200 seconds automatically.

If the netlist contains more than one `.store` statement, only the last statement takes effect.

The restore operation is done on the command-line with the `-restore` keyword. See Chapter 1, HSPICE Commands Introduction for more information. For usage requirements and additional information, see Storing and Restoring Checkpoint Files in the *HSPICE User Guide: Basic Simulation and Analysis*.

Types of output files with TYPE=IC

The following output files are generated with `TYPE=IC`:

Contains node voltage and inductor current data in ASCII format:

```
Test.<time>.ic# or Test.save.ic#
```

Contains node dv/dt voltage and di/dt for inductor current ASCII format:

```
Test.<time>.ic#.sup or Test.save.ic#.sup
```

If TIME or REPEAT is specified:

```
test.<time>.ic# and .sup files
```

If SAVE_ON_KILL or wall time is specified:

```
Test.save.ic# and .sup files
```

If a .alter/sweep exists in the simulation:

```
Test.<sweepNum>.ic<alterNum>
```

If a VA instance exists in the simulation:

```
Test.<time>.ic#.pva and test.<time>.ic.pvaoff
*.ic#.pva   $ Contains all pVA rtl flags, state values of DIS,
I/O buffer and so on in binary format.
*.ic#.pvaoff $ Contains saved instance names and file-positions
in ASCII format. It is necessary since pVA might not have the
exact instance order during the restore phase.
```

Command Group

Output Porting

Examples

```
$ Transient seconds since lower than tstop value.
.STORE [TYPE=IC] TIME=45n

$ Wall seconds since higher than tstop value.
.STORE [TYPE=IC] TIME='60*60*3'

$ Wall seconds since lower than tstop value.
.STORE [TYPE=IC] REPEAT=50n

$ Transient seconds since higher than tstop value.
.STORE [TYPE=IC] REPEAT='60*60*3'

$ Repeat every 100ns, starting at 45ns (ignoring the other time
entries).
.STORE TIME=45n TIME=66n REPEAT=100n

$ Save every 10ns, starting at 0.
.STORE REPEAT=10n

$ Save starting at 10ns, ending at 90ns.
.STORE TIME=10n TIME=20n… TIME=90n

$ generate file named hsp_save_file.8e-09.ic0.
.STORE TIME=80n FILE=”hsp_save_file”
```

See Also

.TRAN

.SUBCKT

Defines a subcircuit in a netlist.

Syntax

Nodes and Parameters

```
.SUBCKT subnam n1 n2 n3 ... [param=val]
.ENDS
.SUBCKT SubNamePinList [SubDefaultsList]
.ENDS
```

Parameter String

```
.SUBCKT subnam n1 n2 n3 ... [param=str('string')]
.ENDS
```

Isomorphic Analyses

```
.SUBCKT analyses_sb [start=p1 stop=p2 steps=p3]
.DC …
.AC …
.TRAN …
.ENDS analyses_sb
```

...followed by

```
x1 analyses_sb [start=a1] [stop=a2] [steps=a3]
x2 analyses_sb [start=b1] [stop=b2] [steps=b3]
```

Argument	Description
subnam	Reference name for the subcircuit model call.
n1...	Node numbers for external reference; cannot be the ground node (0, gnd, ground, gnd!). Any element nodes that are in the subcircuit, but are not in this list are strictly local with three exceptions: ▪ Ground node (0, gnd, ground, gnd!). ▪ Nodes assigned using BULK=node in MOSFET or BJT models. ▪ Nodes assigned using the .GLOBAL command.
parnam	Parameter name set to a value. Use only in the subcircuit. To override this value, assign it in the subcircuit call or set a value in a .PARAM command.
SubDefaultsList	*SubParam1=Expression* [*SubParam2=Expression*...]
analysis_sb	Reference name for the isomorphic analyses that can be run in a subckt block.

Argument	Description
p1...p2...p3	Parameters specified for the start, stop, and number of steps.

Description

Use this command to define a subcircuit in your netlist. You can create a subcircuit description for a commonly used circuit and include one or more references to the subcircuit in your netlist.

When you use hierarchical subcircuits, you can pick default values for circuit elements in a .SUBCKT command. You can use this feature in cell definitions to simulate the circuit with typical values.

The isomorphic analyses feature enables you to run unrelated analyses (.DC, .AC, and .TRAN) many times during a simulation by grouping the set of analyses into a subcircuit, which performs multiple analyses in one simulation with calls to the subcircuit. The usage model is: Specify the analyses commands within the subckt definition block and then instantiate the subckt to perform the analyses. Each call of the subcircuit is treated as an individual analysis with its own set of parameters.

In cases where you have multiple subcircuits in your design and would like to define a model for one instance at the top level you can define a model that is specific to only one subcircuit. You can define the models inside of a subcircuit using .INCLUDE statements and using .OPTION PARHIER=LOCAL. See Example 5 for more information.

Use the .ENDS command to terminate a .SUBCKT command.

Note: Using -top subck_name on the command line effectively eliminates the need for the .subckt *subckt_name* and .ends *subckt_name*.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION LIST	Prints a list of netlist elements, node connections, and values for components, voltage and current sources, parameters, and more.
.OPTION PARHIER / PARHIE	Specifies scoping rules for netlist parameters.

Command Group

Subcircuits

Examples

Example 1 *Defining two subcircuits: SUB1 and SUB2. These are resistor-divider networks, whose resistance values are parameters (variables). The X1, X2, and X3 commands call these subcircuits. Because the resistor values are different in each call, these three calls produce different subcircuits.*

```
*FILE SUB2.SP TEST OF SUBCIRCUITS
.OPTION LIST ACCT
   V1 1 0 1
.PARAM P5=5 P2=10
.SUBCKT SUB1 1 2 P4=4
   R1 1 0 P4
   R2 2 0 P5
   X1 1 2 SUB2 P6=7
   X2 1 2 SUB2
.ENDS
*
.MACRO SUB2 1 2 P6=11
   R1 1 2 P6
   R2 2 0 P2
.EOM
   X1 1 2 SUB1 P4=6
   X2 3 4 SUB1 P6=15
   X3 3 4 SUB2
*
.MODEL DA D CJA=CAJA CJP=CAJP VRB=-20
   IS=7.62E-18
+ PHI=.5 EXA=.5 EXP=.33
.PARAM CAJA=2.535E-16 CAJP=2.53E-16
.END
```

Example 2 Implementing an inverter that uses a Strength parameter. By default, the inverter can drive three devices. Enter a new value for the Strength parameter in the element line to select larger or smaller inverters for the application.

```
.SUBCKT Inv a y Strength=3
   Mp1 MosPinList pMosMod L=1.2u
   W='Strength * 2u'
   Mn1 MosPinList nMosMod L=1.2u
   W='Strength * 1u'
.ENDS
...
xInv0 a y0 Inv   $ Default devices: p device=6u,
      $ n device=3u
xInv1 a y1 Inv Strength=5   $ p device=10u,
   n device=5u
xInv2 a y2 Inv Strength=1   $ p device= 2u,
   n device=1u
...
```

Example 3 Implementing an IBIS model (in HSPICE only) that uses string parameters to specify the IBIS file name and IBIS model name.

```
* Using string parameters
.subckt IBIS vccq vss out in
+ IBIS_FILE=str('file.ibs')
+ IBIS_MODEL=str('ibis_model')
ven en 0 vcc
B1 vccq vss out in en v0dq0 vccq vss
+ file= str(IBIS_FILE) model=str(IBIS_MODEL)
.ends
```

Example 4 Specifying Isomorphic Analyses

```
.subckt analyses_sb start_dc=-25 stop_dc=25 steps_dc=5
+ steps_tran=1n stop_tran=10n
.DC TEMP start_dc stop_dc steps_dc
.TRAN steps_tran stop_tran
.ends analyses_sb
...
x1 analyses_sb start_dc=25 stop_dc=75 steps_dc=10
x2 analyses_sb steps_tran=2n
x3 analyses_sb
```

Example 4 specifies both `.DC` and `.TRAN` analyses within the subckt. To invoke these analyses you can call the subckts.

- Each subckt call will perform DC and Transient analysis.
- Parameters defined in the subcircuit calls will override the default values specified in the subcircuit definition.
- If parameters are not defined in the subckt calls they will take the default values given in the subcircuit.

Example 5 *If you have multiple subcircuits in your design and would like to define a model for one instance at the top level. You can define a model that is specific to only one subcircuit as follows: Define the models inside of a subcircuit using .INCLUDE statements. The parameters defined in the included models are global by default but you want any parameters defined in the included file to be local to the subcircuit. This means that you will also need to set .OPTION PARHIER=LOCAL so that parameter scoping rules are correct for this case.*

```
...
.option PARHIER=LOCAL
.subckt INV IN OUT
.include 'weak_ model.inc'
M1 ...
M2 ...
.ends INV
...
X1 IN OUT INV
...
```

See Also

.ENDS
.EOM
.MACRO
.MODEL
.PARAM / PARAMETER / PARAMETERS
.INCLUDE / INC / INCL
Isomorphic Analyses in Subckt Blocks

.SURGE

Automatically detects and reports a current surge that exceeds the specified surge tolerance in HSPICE.

Syntax

`.SURGE` *surge_thresholdsurge_widthnode1* [*node2 ...noden*]

Argument	Description
surge_threshold	Minimum absolute surge current.
surge_width	Defines the minimum duration of a surge.
noden	Any valid node name at current or lower subcircuit level.

Description

Use this command to automatically detect and report a current surge that exceeds the specified surge tolerance. The command reports any current surge that is greater than *surge_threshold* for a duration of more than *surge_width*.

Surge current is defined as the current flowing into or out of a node to the lower subcircuit hierarchy.

Note: This option is active only when HSPICE advanced analog functions are used.

Command Group

Analysis

Examples

In this example, the .SURGE command detects any current surge that has an absolute amplitude of more than 1 mA, and that exceeds 100 ns, x(xm.x1.a), x(xm.x2.c), and x(xn.y).

```
.SUBCKT sa a b
...
.ENDS
.SUBCKT sb c d
...
.ENDS
.SUBCKT sx x y
x1 x y sa
x2 x a sb
.ENDS
xm 1 2 sx
xn 2 a sx
.SURGE 1mA 100ns xm.x1.a xm.x2.c xn.y
```

.SWEEPBLOCK

Creates a sweep whose set of values is the union of a set of linear, logarithmic, and point sweeps when HSPICE advanced analog functions are used.

Syntax

```
.SWEEPBLOCK swblockname sweepspec [sweepspec
+ [sweepspec [...]]]
```

Argument	Description
swblockname	Assigns a name to SWEEPBLOCK.
sweepspec	You can specify an unlimited number of *sweepspec* parameters. Each `sweepspec` can specify a linear, logarithmic, or point sweep by using one of the following forms:*start stop increment* lin *npoints start stop* dec *npoints start stop* oct *npoints start stop* poi *npoints p1 p2 ...*

Description

Use this command to create a sweep whose set of values is the union of a set of linear, logarithmic, and point sweeps.

You can use this command to specify DC sweeps, parameter sweeps, AC, and HBAC frequency sweeps, or wherever HSPICE accepts sweeps.

For additional information, see "SWEEPBLOCK in Sweep Analyses" in the *HSPICE User Guide: Basic Analog Simulation and Analysis*.

Command Group

Analysis

Examples

The following example specifies a logarithmic sweep from 1 to 1e9 with more resolution from 1e6 to 1e7:

```
.sweepblock freqsweep dec 10 1 1g dec 1000 1meg 10meg
```

See Also

.AC
.DC
.ENV
.HB
.HBAC
.HBLSP

.HBNOISE
.HBOSC
.HBXF
.PHASENOISE
.TRAN

.TEMP / TEMPERATURE

Specifies the circuit temperature for an HSPICE simulation.

Syntax

```
.TEMP t1 [t2t3 ...]
```

Argument	Description
t1 t2	Temperatures in ×C at when HSPICE simulates the circuit.

Description

Use this command to specify the circuit temperature for an HSPICE simulation. You can use either the .TEMP command or the TEMP parameter in the .DC, .AC, and .TRAN commands. HSPICE compares the circuit simulation temperature against the reference temperature in the TNOM option. HSPICE uses the difference between the circuit simulation temperature and the TNOM reference temperature to define derating factors for component values.

When using HSPICE advanced analog functions, only one .TEMP command in a netlist is supported. If you use multiple .TEMP commands, only the last one will be used.

Note: HSPICE allows multiple .TEMP commands in a netlist and performs multiple DC, AC or TRAN analyses for each temperature. If you are not using .ALTER blocks, make sure that the netlist does not contain two .TEMP commands as it causes the simulation to run twice with the same result. HSPICE allows multiple .TEMP commands in a netlist and performs any specified analysis for each temperature. If you have multiple .TEMP commands that set the same temperature the simulation results will be identical. See .OPTION USE_TEMP for simulation flexibility.

When you use multiple temperature values in a .TEMP command, and use advanced analog commands, HSPICE performs multiple HB, SN, PHASENOISE, and other analyses for each temperature. The simulation results for the different temperature values saved use a file naming convention consistent with .ALTER commands.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION TNOM	Sets the reference temperature for the simulation.
.OPTION USE_TEMP	Checks the values of the temperature when a netlist contains multiple defined .TEMP / TEMPERATURE statements.

Command Group

Alter Block, Analysis, and Simulation Runs

Examples

In Example 1, the .TEMP command sets the circuit temperatures for the entire circuit simulation. To simulate the circuit by using individual elements or model temperatures, HSPICE uses:

- Temperature as set in the .TEMP command.
- .OPTION TNOM setting (or the TREF model parameter).
- DTEMP element temperature.

Example 1

```
.TEMP -55.0 25.0 125.0
```

In Example 2:

- The .TEMP command sets the circuit simulation temperature to 100^0C.
- You do not specify .OPTION TNOM so it defaults to 25^0C.
- The temperature of the diode is 30^0C above the circuit temperature as set in the DTEMP parameter.

That is:

- D1temp=100^{0}C + 30^{0}C=130^{0}C.
- HSPICE simulates the D2 diode at 100^{0}C.
- R1 simulates at 70^{0}C.

Because the diode model command specifies `TREF` at 60^{0}C, HSPICE derates the specified model parameters by:

- 70^{0}C (130^{0}C – 60^{0}C) for the D1 diode.
- 40^{0}C (100^{0}C – 60^{0}C) for the D2 diode.
- 45^{0}C (70^{0}C – TNOM) for the R1 resistor.

Example 2

```
.TEMP 100
D1 N1 N2 DMOD DTEMP=30
D2 NA NC DMOD
R1 NP NN 100 TC1=1 DTEMP=-30
.MODEL DMOD D IS=1E-15 VJ=0.6 CJA=1.2E-13
+ CJP=1.3E-14 TREF=60.0
```

In Example 3, parameterized `.TEMP` is also supported.

Example 3

```
.param mytemp =0
.temp '105 + 3*mytemp'
```

See Also

.AC
.DC
.TRAN

.TF

Calculates small-signal values for transfer functions for both DC and AC simulations.

Syntax

Input Syntax for DC Analysis

```
.TF ov srcnam
```

Input Syntax for AC Analysis

```
.TF AC outval
```

Output Syntax for AC Analysis

```
.print ac tfv(Voltage_source_name) tfi(node_name)
.probe ac tfv(Voltage_source_name) tfi(node_name)
.meas ac results_name max|min|avg tfv(XXX) tfi(XXX)
```

Argument	Description
AC	Analysis type
outval	Small-signal output variable for AC analysis. Specify i(Vsrco) branch current or V(n1<, n2>) nodal voltage output variable
ov	Small-signal output variable DC analysis.
srcnam	Small-signal input source DC analysis.
Voltage_source_name	Small-signal input variable, independent voltage source is used as input reference for AC analysis. User-defined voltage source.
Node_name	HSPICE calculates the effects as transfer functions to output from the current which puts into this node.

Description

Use this command to calculate either the DC or AC small-signal values for transfer functions (ratio of output variable to input source). You do not need to specify `.OP`.

You can also use this command to compute the transfer functions in AC analysis; the frequency sweep is controlled by `.AC` command.

The `.TF` command defines small-signal output and input for AC or DC small-signal analysis. When you use this command, HSPICE computes:

- AC or DC small-signal value of the transfer function (output/input)
- Input resistance
- Output resistance

The ac transfer functions output format:

- Output Voltage –input Voltage: GAIN(Vsource)
- Output Voltage –input Current: Y(node)
- Output Current –input Voltage: Z(Vsource)
- Output Current –input Current: GAIN(node)

Command Group

Analysis

Examples

Example 1 DC transfer function

```
.TF V(5,3) VIN
```

In this example, HSPICE computes the ratio of V(5,3) to `VIN`. This is the ratio of small-signal input resistance at VIN to the small-signal output resistance (measured across nodes 5 and 3).

Note: If you specify more than one `.TF` command in a single simulation, HSPICE runs only the last `.TF` command.

Example 2 AC transfer function

```
.TF AC V (n1,n2)
.probe ac tfv(vsrci)
```

In this example, HSPICE computes the ratio of V(n1,n2) to V(srci) using the command tfv(Vsrci) and the ratio of V(n1,n2) to I(nd) using the command Vtfi(nd).

Other types of extent tfv and tfi functions include:

```
.probe ac tfvm(Vsrci) tfvdb(…)  tfvp(…) tfvr(…) tfvi(…)
.probe ac tfim(nd) tfidb(…)  tfip(…) tfir(…) tfiv(…)
```

The `.TF` command combine with `.probe ac` outputs data to an `*.ac0` output file. With `.meas ac`, the command outputs data to a `*.ma0` file.

See Also

.AC
.DC

.TITLE

Sets the simulation title.

Syntax

`.TITLE` *`string_of_up_to_73_characters`*

Or, if `.TITLE` is not used

`string_of_up_to_80_characters`

Argument	Description
string	Any character string up to 73 (or 80 if `.TITLE` is omitted) characters long.

Description

Use this command to set the simulation title in the first line of the input file. This line is read and used as the title of the simulation, regardless of the line's contents. The simulation prints the title verbatim in each section heading of the output listing file.

To set the title you can place a `.TITLE` command on the first line of the netlist. However, the `.TITLE` syntax is not required.

In the second form of the syntax, the string is the first line of the input file. The first line of the input file is always the implicit title. If any command appears as the first line in a file, simulation interprets it as a title and does not execute it.

An `.ALTER` command does not support using the `.TITLE` command. To change a title for a `.ALTER` command, place the title content in the `.ALTER` command itself.

Command Group

Setup, Simulation Runs

Examples

```
.TITLE my-design_netlist
```

See Also

.ALTER

.TRAN

Starts a transient analysis that simulates a circuit at a specific time.

Syntax

Syntax for Single-Point Analysis:

```
.TRAN tstep1 tstop1 [START=val] [UIC]
```

Syntax for Double-Point Analysis:

```
.TRAN tstep1 tstop1 [tstep2 tstop2]
+ [START=val] [UIC] [SWEEP var type np pstart pstop]
.TRAN tstep1 tstop1 [tstep2 tstop2]
+ [START=val] [UIC] [SWEEP var START="param_expr1"
+ STOP="param_expr2" STEP="param_expr3"]
.TRAN tstep1 tstop1 [tstep2 tstop2] [START=val] [UIC]
+ [SWEEP var start_expr stop_expr step_expr]
.TRAN tstep1 tstop1 [tstep2 tstop2]
+ [START=val] [UIC] [SWEEP var SWEEPBLOCK=swblockname]
```

Syntax for Multipoint Analysis:

```
.TRAN tstep1 tstop1 [tstep2 tstop2 ...tstepN tstopN]
+ RUNLVL =(time1 runlvl1 time2 runlvl2...timeN runlvlN)
+ [START=val] [UIC] [SWEEP var type np pstart pstop]
.TRAN tstep1 tstop1 [tstep2 tstop2 ...tstepN tstopN]
+ [START=val] [UIC] [SWEEP var START="param_expr1"
+ STOP="param_expr2" STEP="param_expr3"]
+ [START=val] [UIC]
+ [SWEEP var start_expr stop_expr step_expr]
```

Syntax for Interval-based Generic RUNLVL setting:

```
.TRAN tstep tstop [RUNLVL=(time1 runlvl1...timeN runlvlN)]
```

Syntax for Interval-based Sub-Circuit/Instance RUNLVL setting:

```
.TRAN tstep tstop [RUNLVL=(time1 runlvl1...timeN runlvlN)]
+ [INST inst_expression RUNLVL=(time1 runlvl1...timeN
   runlvlN)]
.TRAN tstep tstop [RUNLVL=(time1 runlvl1...timeN runlvlN)]
```

```
+ [SUBCKT subckt_expression RUNLVL=(time1 runlvl1...timeN
   runlvlN)]
.TRAN tstep tstop [RUNLVL=(time1 runlvl1...timeN runlvlN)]
+ [INST inst_expression SUBCKT subckt_expression
+ RUNLVL=(time1 runlvl1...timeN runlvlN)]
.TRAN tstep tstop [RUNLVL=(time1 runlvl1...timeN runlvlN)]
+ [SUBCKT subckt_expression INST inst_expression
+ RUNLVL=(time1 runlvl1...timeN runlvlN)]
```

Syntax for Temperature Sweep:

```
.TRAN tstep tstop [tempvec=(t1 Temp1 t2 Temp2 t3 Temp3...)
+[tempstep=val]]
```

Syntax for Data-Driven Sweep:

```
.TRAN DATA=datanm
.TRAN tstep1 tstop1 [tstep2 tstop2 ...tstepN tstopN]
+ [START=val] [UIC] [SWEEP DATA=datanm(Nums)]
.TRAN DATA=datanm [SWEEP var type np pstart pstop]
.TRAN DATA=datanm [SWEEP var START="param_expr1"
+ STOP="param_expr2" STEP="param_expr3"]
.TRAN DATA=datanm
+ [SWEEP var start_expr stop_expr step_expr]
```

Syntax for Monte Carlo Analysis, Corner Analysis:

```
.TRAN tstep1 tstop1 [tstep2 tstop2 ...tstepN tstopN]
+ [START=val] [UIC] [SWEEP MONTE=MCcommand]
.TRAN tstep1 tstop1 [tstep2 tstop2 ...tstepN tstopN]
+ [START=val] [UIC] [SWEEP MONTE = dc_corner]
+ MONTE = dc_corner
```

Syntax for Optimization:

```
.TRAN DATA=datanm OPTIMIZE=opt_par_fun
+ RESULTS=measnames MODEL=optmod
.TRAN  [DATA=filename] SWEEP OPTIMIZE=OPTxxx
+ RESULTS=ierr1 ... ierrn MODEL=optmod
```

Argument	Description
DATA=*datanm*(*Nums*)	Data name, referenced in the .TRAN command from a .DATA command.

Argument	Description
MONTE= *MCcommand*	Where MCcommand can be any of the following: ▪ *val* Specifies the number of random samples to produce. ▪ *val* firstrun=*num* Specifies the sample number on which the simulation starts. ▪ list num Specifies the sample number to execute. ▪ list(*num1:num2 num3 num4:num5*) Samples from *num1* to *num2*, sample *num3*, and samples from *num4* to *num5* are executed (parentheses are optional). ▪ dc_corner is keyword only for Monte Carlo simulation; it works with the transient Monte Carlo command only. With this option, HPSICE reuses corners generated in the DC Monte Carlo and runs transient analysis with these random values.
np	Number of points or number of points per decade or octave, depending on what keyword precedes it.
param_expr...	Expressions you specify: *param_expr1...param_exprN*.
pincr	Voltage, current, element, or model parameter; or any temperature increment value. If you set the *type* variation, use *np* (number of points), not *pincr*.
pstart	Starting voltage, current, or temperature; or any element or model parameter value. If you set the *type* variation to POI (list of points), use a list of parameter values, instead of *pstart pstop*.
pstop	Final value: voltage, current, temperature; element or model param.
START	Time when printing or plotting begins. Caution: If you use .TRAN with a .MEASURE command, a non-zero START time can cause incorrect .MEASURE results. Do not use non-zero START times in .TRAN commands when you also use .MEASURE.
SWEEP	Indicates that .TRAN specifies a second sweep.

Argument	Description
tstep1...	Printing or plotting increment for printer output and the suggested computing increment for post-processing. This argument is always a positive value.
tstop1...	Time when a transient analysis stops incrementing by the first specified time increment (*tstep1*). If another tstep-tstop pair follows, analysis continues with a new increment. This argument is always a positive value.
INST *inst_expression* + RUNLVL=(*time1 runlvl1...timeN runlvlN*)	Instance names matching the *inst_expression* will use the designated time-runlvl pairs.
SUBCKT *subckt_expression* + RUNLVL=(*time1 runlvl1...timeN runlvlN*)	Subcircuit instances using subcircuit definition *subckt_expression* will use the designated time-runlvl pairs.
INST *inst_expression* SUBCKT *subckt_expression* + RUNLVL=(*time1 runlvl1...timeN runlvlN*)] or SUBCKT *subckt_expression* INST *inst_expression* + RUNLVL=(*time1 runlvl1...timeN runlvlN*)]	Inside subcircuit instances using subcircuit definition *subckt_expression*, any instance names matching the *inst_expression* will use the designated time-runlvl paris. The order INST and SUBCKT are irrelevant. Wildcard "*" and "?" can be used on *inst_expression* and *subckt_expression*. Runlvl values specified in .TRAN have the highest priority. Any global option setting using .option RUNLVL will be ignored. When conflicting runlvl values are applied for the same instance or subcircuit, the higher runlvl value will be used.

Argument	Description
RUNLVL	Sets different RUNLVL values in the user-defined simulation periods. **Note:** ▪ If RUNLVL is not specified anywhere in the netlist, the default value is 3. ▪ The .option RUNLVL<=value> overrides the default RUNLVL=3 if different. ▪ The last .option RUNLVL is considered when multiple RUNLVL options are specified. ▪ When .option ACCURATE exists, it increases the RUNLVL to 5 if the RUNLVL option value is lower than 5. This is independent of the netlist order. ▪ RUNLVL values defined for a specific transient periods in a .TRAN command overrides the RUNLVL value set by the .option RUNLVL or .option ACCURATE.
tempvec=(*t1 Temp1 t2 Temp2 t3 Temp3...*)	Sets different temperature change values (Temp1, Temp2,...) at the user-defined time points (t1, t2,...).
tempstep	Defines time interval of temperature update. If tempstep=1n, temperature will be updated at following timepoints: t1, t1+1n, … ,t1+1n*N, t2, t2+1n, …, t2+1n*M, t3, …, and the corresponding temperature value are given by linear interpolation. To probe temperature changes in transient simulation, add the following lines: .param ckt_temp=temper .probe tran par(ckt_temp)

Argument	Description
UIC	If you specify the UIC parameter in the .TRAN command, HSPICE does not calculate the initial DC operating point, but directly enters transient analysis. When you use .TRAN UIC, the .TRAN node values (at time zero) are determined by searching for the first value found in this order: from .IC value, then IC parameter on an element command, then .NODESET value, otherwise use a voltage of zero. Note that forcing a node value of the DC operating point might not satisfy KVL and KCL. In this event you might see activity during the initial part of the simulation. This might happen if you use UIC and do not specify some node values, when you specify too many (conflicting) .IC values are specified, or when you force node values and the topology changes. Forcing a node voltage applies a fixed equivalent voltage source during DC analysis and transient analysis removes the voltage sources to calculate the second and later time points. Therefore, to correct DC convergence problems use .NODESETs (without .TRAN UIC) liberally (when a good guess can be provided) and use .ICs sparingly (when the exact node voltage is known).
type	Any of the following keywords: ▪ DEC – decade variation. ▪ OCT – octave variation (the value of the designated variable is eight times its previous value). ▪ LIN – linear variation. ▪ POI – list of points.
var	Name of an independent voltage or current source, any element or model parameter, or the TEMP keyword (indicating a temperature sweep). You can use a source value sweep, referring to the source name (SPICE style). However, if you specify a parameter sweep, a .DATA command, or a temperature sweep you must choose a parameter name for the source value and subsequently refer to it in the .TRAN command. The parameter must not start with TEMP and should be defined in advance using the .PARAM command.

Argument	Description
firstrun	MONTE=*val* value specifies the number of Monte Carlo iterations to perform. This argument specifies the desired number of iterations. HSPICE runs from num1 to num1+val-1.
list	Iterations at which HSPICE performs a Monte Carlo analysis. You can write more than one number after *list*. The colon represents “from... to...”. Specifying only one number makes HSPICE run at only the specified point.
OPTIMIZE	When used with .TRAN and SWEEP, this argument is either opt_par_fun or OPTxxx for a bisection/Monte Carlo analysis in HSPICE.
RESULTS	Specifies the measure names used for optimization in the .MEASURE statements.

Description

Use to start a transient analysis that simulates a circuit at a specific time.

For single-point analysis, the values of the tstep, tstop, and START arguments should obey the following rules:

```
START < tstop
tstep <= tstop - START
```

For double-point analysis, the values of the tstep1, tstop1, tstep2, tstop2, and START arguments should obey the following rules:

```
START < tstop < tstop2
tstep1 <= tstop1 - START
tstep2 <= tstop2 - tstop1
```

In double-point analysis, if tstep2 < tstop1, tstop2 < tstop1, and START is not explicitly set, the command is interpreted as:

```
.TRAN tstep tstop start delmax
```

There can be three different “DELMAX” values involved in a .TRAN command:

- .OPTION DELMAX (value specified with this .OPTION)
- delmax (value that can be specified with the .TRAN command)
- “auto” DELMAX (value that is computed automatically)

When column 4 is interpreted as `delmax`, this command has a higher priority than the `DELMAX` option. The maximum internal time step taken by HSPICE during transient analysis is referred to as Δt_{max}. Its value is normally computed automatically based on several time step control settings. If you wish to override the automatically computed value, and force the maximum step size to be a specific value, you can do so with `.OPTION DELMAX`, or by specifying a `delmax` value with the `.TRAN` command. If not specified, HSPICE automatically computes a `DELMAX` "auto" value based on the `RUNLVL` algorithm setting. (For a complete list of time step control factors, see Transient Control Options in the *HSPICE User Guide: Basic Simulation and Analysis*.)

For multipoint analysis, the values of the `tstep1`, `tstop1`,..., `tstepN`, `tstopN`, and `START` arguments should obey the following rules:

```
START < tstop < tstop2 < ... < tstopN

tstep1 <= tstop1 - START

tstep2 <= tstop2 - tstop1

...

tstepN <= tstopN - tstop(N-1)
```

The following syntax shows multiple time step increments in HSPICE transient analysis:

```
.tran tstep1 tstop1 tstep2 tstop2 tstep3 tstop3 ...
```

or:

```
.tran tstep tstop tstart delmax
```

The following limitation applies for HSPICE:

The ratio between `tstop` and `tstep` must be less than or equal to `1e09`. For example, `.TRAN 8n 8` is permissible, but `.TRAN 0.1n 8` is not.

You can initiate a store/restore operation that creates checkpoint files describing a running process during transient analysis; the operating system can later reconstruct the process from the contents of this file. This function is available in HSPICE only on Redhat Linux/SuSE Linux platforms for the current release.

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION DELMAX	Sets the maximum allowable step size of the time steps taken during transient analysis in HSPICE.

Command Group

Analysis

Examples

Example 1 *Changes the temperature during the transient analysis.*

```
.TRAN 1n 100n tempvec=(0n 25 50n 50 100n 100) tempstep = 10n
```

Example 2 *Prints the transient analysis every 1 ns for 100 ns.*

```
.TRAN 1NS 100NS
```

Example 3 *Calculates every 0.1 ns for the first 25 ns; and then every 1 ns until 40 ns. Printing and plotting begin at 10 ns.*

```
.TRAN .1NS 25NS 1NS 40NS START=10NS
```

Example 4 *Calculates every 0.1 ns for 25 ns; and then every 1 ns for 40 ns; and then every 2 ns until 100 ns. Printing and plotting begin at 10 ns.*

```
.TRAN .1NS 25NS 1NS 40NS 2NS 100NS START = 10NS
```

Example 5 *Calculates every 10 ns for 1 μs. This example bypasses the initial DC operating point calculation. It uses the nodal voltages specified in the .IC command (or by IC parameters in element commands) to calculate the initial conditions.*

```
.TRAN 10NS 1US UIC
```

Example 6 *Increases the temperature by 10^0C through the range -55^0C to 75^0C. It also performs transient analysis for each temperature.*

```
.TRAN 10NS 1US UIC SWEEP TEMP -55 75 10
```

Example 7 *Analyzes each load parameter value at 1 pF, 5 pF, and 10 pF.*

```
.TRAN 10NS 1US SWEEP load POI 3 1pf 5pf 10pf
```

Example 8 *Uses a data file as the sweep input. If the parameters in the data command are controlling sources, then a piecewise linear specification must reference them.*

```
.TRAN data=dataname
```

Example 9 *Calculates every 10 ns for 1 μs from the 11th to 20th Monte Carlo trials.*

```
.TRAN 10NS 1US SWEEP MONTE=10 firstrun=11
```

Example 10 *Calculates every 10 ns for 1 μs at the 10th trial, then from the 20th to the 30th trial, followed by the 35th to the 40th trial and finally at the 50th Monte Carlo trial.*

```
.TRAN 10NS 1US SWEEP MONTE=list(10 20:30 35:40 50)
```

Example 11 *Sets runlvl to 3 starting from t = 0 s to 1 ms, then runlvl to 5 starting from 1 ms.*

```
.tran 1n 10m RUNLVL=(0 3 1m 5)
```

Example 12 *For subcircuit "addr", sets runlvl to 3 starting from t=0 s to 1 ms, then runlvl to 5 starting from 1 ms.*

```
 .tran 1n 10m SUBCKT=addr RUNLVL=(0 3 1m 5)
```

Example 13 *For instance "x1" inside subcircuit "addr", sets runlvl to 3 starting from t = 0 s to 1 ms then runlvl to 5 starting from 1 ms.*

```
 .tran 1n 10m SUBCKT=addr INST=x1 RUNLVL=(0 3 1m 5)
```

Example 14 *Sets runlvl to 6 globally. For subcircuit "addr", sets runlvl to 3 starting from t = 0 s to 1 ms, then runlvl to 5 starting from 1 ms.*

```
 .tran 1n 10m RUNLVL=(0 6) SUBCKT=addr RUNLVL=(0 3 1m 5
```

Example 15 *Sets runlvl to 3 starting from t=0 s to 5 ms, then runlvl to 5 starting from 5 ms. Subcircuits with names beginning with “bias” will use runlvl 5; all the MOSFETs inside these subcircuits will use runlvl=6.*

```
.TRAN 1n 5.5m RUNLVL=(0 3 5m 5)
+ subckt “bias*” RUNLVL=(0 5)
+ inst “m*” subckt “bias*” RUNLVL=(0 6)
```

See Also

.DC
.IC
.NODESET
.STORE
Timing Analysis Using Bisection
Transient Analysis
Corner Analysis - DC Monte Carlo/Transient Analysis

Signal Integrity Examples for netlists using .TRAN including iotran.sp, qa8.sp, and qabounce.sp. See also ipopt.sp for an optimization example using .TRAN.
Behavioral Application Examples for the path to the demo file invb_op.sp demonstrating use of .TRAN with OPTIMIZE to optimize a CMOS macromodel inverter.

.TRANNOISE

Activates transient noise analysis to compute the additional noise variables over a standard .TRAN analysis. **Important**: FMAX has a dramatic effect on TRANNOISE, since it controls the amount of energy each noise source can emit. Huge values of FMAX (such as 100G) can result in huge instantaneous noise levels. FMIN sets the low frequency limit for flicker noise, and therefore controls the energy in flicker noise sources. You can expect some significant differences with FMAX and FMIN changes: Noise power will increase linearly with FMAX; Flicker noise power can scale as 1/FMIN.

Syntax

Monte Carlo Single Sample Approach

```
.TRANNOISE output [METHOD=MC] [SEED=val] [START=val]
+ [FMIN=val] [FMAX=val|auto] [SCALE=val]
+ [AUTOCORRELATION=0|1|2|off|on]
+ [PHASENOISE=0|1|2]
+ [JITTER=0|1|2]
+ [REF=srcName]
```

Monte Carlo Multi-Sample Approaches

```
.TRANNOISE output [METHOD=MC] SAMPLES=val [SEED=val]
+ [START=val] [FMIN=val][FMAX=val|auto][SCALE=val]
+ [AUTOCORRELATION=0|1|2|off|on]
+ [PHASENOISE=0|1|2]
+ [JITTER=0|1|2]
+ [REF=srcName]
```

or:

```
.TRANNOISE output [METHOD=MC] [SAMPLES=List(…)]
+ [START=val][FMIN=val][FMAX=val|auto][SCALE=val]
+ [AUTOCORRELATION=0|1|2|off|on]
+ [PHASENOISE=0|1|2]
```

```
+ [JITTER=0|1|2]
+ [REF=srcName]
```

Input Syntax—SDE Approach

```
.TRANNOISE output METHOD=SDE
+ [TIME=all|val]
+ [FMIN=val] [FMAX=val|auto] [SCALE=val]
```

Argument	Description
output	(Required) Output node, pair of nodes, or 2-terminal element. Noise calculations are referenced to this node (or node pair). Specify a pair of nodes as V(n+,n-). If you specify only one node, V(n+), then HSPICE reads the second node as ground. If you specify a 2-terminal element, the noise voltage across this element is treated as the output.
METHOD= MC | SDE	Specifies Monte Carlo or SDE transient noise analysis method. The default, or, if METHOD is not specified, is the single-sample Monte Carlo method. Specifying METHOD=SDE is required to select the transient noise analysis SDE method. METHOD=MC | SDE is position independent.
SEED=*val*	(Optional) Specifies the beginning simulation sample. Default=2, if value for SEED is not specified. Setting SEED=1 causes a noiseless simulation to be performed.
SAMPLES=*val*	Specifies the number of Monte Carlo samples to use for the analysis. The default, or if SAMPLES is not specified, is 1, the single-sample Monte Carlo method. For the multi-sample Monte Carlo method, SAMPLES must be specified as greater than 1.
SAMPLES=List(...)	Where List can be of the form: ▪ LIST (num1, num2, num3, …) A list of sample SEED values to execute. ▪ LIST(<*num1*:*num2*><*num3*><*num4*:*num5*>) A list of sample SEED value ranges; for example: from num1 to num2, sample num3, and samples from num4 to num5 are executed.
START	(Default=0) Start time during transient analysis when noise sources are activated.

Argument	Description
TIME	(Optional) Used to specify additional time points (breakpoints) where time-domain noise should be evaluated in addition to those time points that will be evaluated as part of the normal time-stepping algorithm.Use this parameter to force noise evaluation at important time points of interest (such as rising/falling edges). TIME=all: (default) causes time-domain noise ONOISE values to be computed and available for output at all time points selected by the .TRAN command time-step algorithm.TIME=val: Specifies a single additional time point at which time domain noise is measured. The value can be numeric or a parameter. A .TRAN analysis at this time point will be forced. Note that time-domain noise calculations require an accompanying .TRAN analysis at each time point. The TIME parameter may therefore add transient analysis time-points (breakpoints) as needed while values given outside the range of the .TRAN command constraints are ignored.
FMIN	(Optional) Base frequency used for modeling frequency dependent noise sources. Sets bandwidth for contributing noise sources. (Default: 1/TSTOP) See important note above.
FMAX	(Optional) Maximum frequency used for modeling frequency dependent noise sources. Sets bandwidth for contributing noise sources. Default: 1/TSTEP. When `FMAX=auto`, HSPICE picks this frequency value automatically. See important note above.
SCALE	Scale factor that can be applied to uniformly amplify the intensity of all device noise sources to exaggerate their contributions. Default: 1.0
AUTOCORRELATION	(Optional for MC approaches) Used to enable the autocorrelation function calculation at the specified output. ▪ AUTOCORRELATION=0 (OFF) - (default) Does not calculate autocorrelation function. ▪ AUTOCORRELATION=1 (ON) - Calculates autocorrelation function at the specified output. ▪ AUTOCORRELATION=2 - Calculates autocorrelation function at the specified output, with normalization applied over the simulation interval.

Argument	Description
PHASENOISE=0|1|2	▪ PHASENOISE=0: (default) Phase noise calculations are disabled. ▪ PHASENOISE=1: Uses Delay-Line measurement approach to compute phase noise. ▪ PHASENOISE=2: Uses Phase Detector method for phase noise calculations.
JITTER=0|1|2	▪ JITTER=0: (default) Phase noise calculations are disabled. ▪ JITTER=1: Use phase noise method to compute jitter. ▪ JITTER=2: Use phase detector method to compute jitter.
REF=*srcName*	Where *srcName* can be either: ▪ AUTO (default): Detected automatically. ▪ SIN: A SIN voltage or current source. ▪ PULSE: A PULSE voltage or current source. The rises edges of the SIN or PULSE source are used to establish the phase reference for jitter calculations.

Description

Use to analyze time-variant noise for circuits driven with non-periodic waveforms. Transient noise analysis requires an accompanying .TRAN analysis to determine the time-sampling, matrix solutions, and deterministic output waveforms. .TRANNOISE activates transient noise and computes the additional noise variables. This is consistent with how .NOISE computes additional noise outputs when added to an .AC analysis. The Monte Carlo approach can capture very nonlinear noise behaviors. This is useful when the responses of circuits with noise are known to have non-Gaussian variations about their noiseless simulations. For details, see Transient Noise Analysis in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Command Group

Analysis

Examples

Example 1 *Generates 30 Monte Carlo noise simulations beginning with a noiseless (index=1) simulation.*

```
.TRANNOISE v(out) METHOD=MC SAMPLES=30
```

Example 2 *Generates 20 Monte Carlo noise simulations starting with the seed value (i.e., index) of 31 for the first simulation.*

```
.TRANNOISE v(out) METHOD=MC SAMPLES=20 SEED=31
```

Example 3 *Generates a single noise simulation, with seed value of 50, with all noise sources amplified by a factor of 10.*

```
.TRANNOISE v(out) SEED=50 SCALE=10.0
```

Example 4 *Generates six Monte Carlo transient noise simulations with seed values of 1, 3, 4, 5, 9 and 10. Normalized autocorrelation is computed for each v(out) output.*

```
.TRANNOISE v(out) SAMPLES=LIST(1,3:5,9:10) AUTOCORRELATION=2
```

Example 5 *Activates SDE noise analysis, and dumps the ONOISE output to the *.tr0 file:*

```
.TRANNOISE v(out)METHOD=SDE
.PROBE TRANNOISE ONOISE
```

Example 6 *Activates SDE noise analysis, placing a lower bound on flicker noise to be 10kHz, and an upper bound on all noise power at 100MHz:*

```
.TRANNOISE v(out) METHOD=SDE FMIN=10k FMAX=100MEG
```

Example 7 *Starts .TRANNOISE analysis at 200n of the transient simulation.*

```
****************
* .Tran Setup
*
.option wl post accurate
.tran 10p 250n
*.trannoise v(fout) SWEEP MONTE=1 FIRSTRUN=2 FMAX=50G $ FIRSTRUN=2
* this not working for single run:
*.trannoise v(fout) SAMPLES=1 SEED=2 FMAX=50G START=200n
.trannoise v(lfin) SAMPLES=1 SEED=2 FMAX=50G START=200n
.probe tran v(fin) v(lfin) v(fb) v(xin) v(fout)
.probe trannoise onoise
********************************
```

See Also

.TRAN
.NOISE
.PTDNOISE
.OPTION MCBRIEF
.OPTION MACMOD
.OPTION MODMONTE
.OPTION MONTECON

.OPTION RANDGEN
.OPTION SEED
Transient Noise Analysis

.UNPROTECT / UNPROT

Restores normal output functions previously restricted by a `.PROTECT` command as part of the encryption process in HSPICE.

Syntax

```
.UNPROTECT
```

Description

Use this command to restore normal output functions previously restricted by a `.PROTECT` command.

- Any elements and models located between `.PROTECT` and `.UNPROTECT` commands, inhibit the element and model listing from the `LIST` option.
- Neither the `.OPTION NODE` cross-reference, nor the `.OP` operating point printout list any nodes within the `.PROTECT` and `.UNPROTECT` commands.
- The `.UNPROTECT` command is encrypted during the encryption process.

Note: The following are usage notes:

- If you use `.prot/.unprot` in a library or file that is not encrypted warnings are issued that the file is encrypted and the file or library is treated as a “black box.”
- To perform a complete bias check and print all results in the Outputs Biaschk Report, do not use `.protect/.unprotect` in the netlist for the part that is used in `.biaschk`. For example: If a model definition such as model `nch` is contained within `.prot/.unprot` commands, in the `*.lis` you'll see a warning message as follows: `**warning** : model nch defined in .biaschk cannot be found in netlist--ignored`

- The `.prot/.unprot` feature is meant for the encryption process and *not* netlist echo suppression. Netlist and model echo suppression is on by default. For a compact and better formatted output (`*.lis`) file, use `.OPTION LIS_NEW`

Control Options

The following netlist control options are available for this command:

Option	Description
.OPTION LIS_NEW	Enables streamlining improvements to the `*.lis` file.

Command Group

Encryption

See Also

.PROTECT / PROT

.VARIATION

Specifies global and local variations on model parameters in HSPICE.

Syntax

```
.Variation
   Define options
   Define common parameters that apply to all subblocks
   .Global_Variation
      Define the univariate independent random variables
      Define additional random variables through
      transformation
      Define variations of model parameters
   .End_Global_Variation
   .Local_Variation
      Define the univariate independent random variables
      Define additional random variables through
      transformation
      Define variations of model parameters
      .Element_Variation
         Define variations of element parameters
      .End_Element_Variation
```

```
    .End_Local_Variation
    .Spatial_Variation
        Define the univariate independent random variables
        Define additional random variables through
        transformation
        Define variations of model parameters
    .End_Spatial_Variation
.End_Variation
```

Description

Use this command to specify global, local, and spatial variations on model parameters, resulting from variations in materials and manufacturing. If a Variation Block is read as part of .ALTER processing, then the contents are treated as additive. If the same parameters are redefined, HSPICE considers this an error.

The following are parameters and options available to the Variation Block:

- **Constant parameter**—definition which can be referenced anywhere within the Variation Block:

  ```
  parameter PARAM=val
  ```

- **Univariate Independent Random Variable** normal, uniform, and cumulative distributions below, respectively:

  ```
  parameter IVarName=N()
  parameter IVarName=U()
  parameter IVarName=CDF(xn,yn)
  ```

- **Transformed Random Variable**

  ```
  parameter TVarName=expression(IVarNameIVarName)
  ```

- **Variation Definition for Model Parameter**

  ```
  modelType modelName paramName=Expression_For_Sigma
  ```

- **Variation Definition for Element Parameter**

  ```
  modelType paramName=Expression_For_Sigma
  modelType(condition) paramName=Expression_For_Sigma
  ```

- **Expression_For_Sigma**

Referencing a previously defined Random Variable	
`perturb('expression(IVarName|TVarNameIVarName TVarName)')`	absolute

Referencing a previously defined Random Variable	
`perturb('expression(`*`IVarName`*`|`*`TVarNameIVarName TVarName`*`)') %`	relative

Referencing a previously defined Random Variable	
`perturb('expression(`*`IVarName`*`|`*`TVarNameIVarName TVarName`*`)')`	absolute
`perturb('expression(IVarName|TVarName`*`IVarName TVarName`*`)') %`	relative

- **Access Function**

For element parameter (for example w, l, x, y):
`get_E(elementParameter)`

For netlist parameter (for example .param vdd, temper):
`get_P(Parameter)`

For model parameter (for example Get_M(u0)):
`get_M(Model_Parameter)`

- **Options**: For a detailed description of the Variation Block and usage examples, see Variability Analysis Using the Variation Block in the *HSPICE User Guide: Basic Simulation and Analysis* and for Variation Block options, see Control Options and Syntax.

Command Group

Model and Variation

.VEC

Calls a digital vector file from an HSPICE netlist.

Syntax

`.VEC '`*`digital_vector_file`*`'`

Description

Use this command to call a digital vector file from an HSPICE netlist. A digital vector file consists of three sections:

- Vector Pattern Definition
- Waveform Characteristics
- Tabular Data

The `.VEC` file must be a text file. If you transfer the file between UNIX/Linux and Windows, use text mode.

Command Group

Digital Vector

Examples

This is a fragment from a netlist with a call to a digital vector file.

```
*file: mos2bit_v.sp - adder - 2 bit all-nand-gate binary adder
*uses digital vector input
.options post nomod
.option opts fast
*
.tran .5ns 60ns
*
.vec 'digstim.vec'
...
```

CHECK_WINDOW

Defines a time window around the vector strobe time or user-defined first_time such that the output comparison, for signals specified as output in the `.IO` statement, is checked over this time window.

Syntax

```
CHECK_WINDOW start_offset stop_offset steady 0|1|
+ [mask_name]
```

or

```
CHECK_WINDOW start_offset stop_offset steady 2|3
+ period_time first_time [mask_name]
```

Description

In the first syntax statement, the values specified by `start_offset` and `stop_offset` define the time window as [`t-start_offset`, `t+stop_offset`] where `t` is the vector stop time. The unit of time for `start_offset` and `stop_offset` is nanosecond. When you specify `steady` as `1`, the comparison check passes if the output state matches the expected state throughout the time window period. When you specify steady as `0`, the output comparison passes as long as the output state ever reaches the expected state at any time within the window. `mask_name` is optional. When you specify a `mask_name`, `check_window` applies to the signals defined under `mask_name` only.

In the second syntax statement , the values you specify for `start_offset` and `stop_offset` define the time window as [`t-start_offset`, `t+stop_offset`] where `t` (in nanoseconds) is the first time. The checking is repeated every `period_time`. The unit of time for `start_offset`, `stop_offset`, `period_time`, and `first_time` is nanosecond. When you specify `steady` as `3`, the comparison check passes if the output state matches the expected state throughout the time window period.

When you specify `steady` as `2`, the, output comparison passes as long as the output state reaches the expected state at any time within the time window.

The `mask_name` keyword is optional. When you specify `mask_name`, `check_window` applies to the signals defined under `mask_name` only.

Command Group

Digital Vector

Examples

Example 1

```
signal a b c d
radix 1 1 1 1
io i o o i
check_window 1.5 2.0 1
1 1 0 1
```

Example 2 *The output comparison on signal D2 passes if the logic state of D2 is 0 between 3.8 ns to 4.2 ns, and the logic state of D2 is 1 between 13.8 ns to 14.2 ns, and so on.*

```
signal clk D2 D3
radix 1 1 1
io i o o
mask m1 D2
```

```
check_window 0.2 0.2 3 10 4 m1
0 0 X X
5 1 0 1
6.5 1 1 1
8 1 0 0
10 0 0 1
10.2 0 1 0
15 1 1 0
15.2 1 0 1
17.3 1 1 1
18.6 1 0 0
20 0 0 0
. . . .
```

See Also

IO

ENABLE

Specifies the controlling signal(s) for bidirectional signals.

Syntax

ENABLE *controlling_signalname mask*

Argument	Description
controlling_signalname	Controlling signal for bidirectional signals. Must be an input signal with a radix of 1. The bidirectional signals become output when the controlling signal is at state 1 (or high). To reverse this default control logic, start the control signal name with a tilde (~).
mask	Defines the bidirectional signals to which ENABLE applies.

Description

Use this command to specify the controlling signal(s) for bidirectional signals. All bidirectional signals require an ENABLE command. If you specify more than one ENABLE command, the last command overrides the previous command and HSPICE issues a warning message:

```
[Warning]:[line 6] resetting enable signal to WENB for
bit 'XYZ'
```

Command Group

Digital Vector

Examples

```
radix 144
io ibb
vname a x[[3:0]] y[[3:0]]
enable a 0 F 0
enable ~a 0 0 F
```

In this example, the *x* and *y* signals are bidirectional as defined by the *b* in the *io* line.

- The first enable command indicates that *x* (as defined by the position of *F*) becomes output when the *a* signal is 1.
- The second enable specifies that the *y* bidirectional bus becomes output when the *a* signal is 0.

IDELAY

Defines an input delay time for both input and bidirectional signals.

Syntax

IDELAY *delay_value* [*mask*]

Argument	Description
delay_value	Time delay to apply to the signals.
mask	Signals to which the delay applies. If you do not provide a *mask* value, the delay value applies to all signals.

Description

Use this command to define an input delay time for input and bidirectional signals relative to the absolute time of each row in the Tabular Data section. HSPICE ignores IDELAY settings on output signals and issues a warning message.

You can specify more than one TDELAY, IDELAY, or ODELAY command.

- If you apply more than one TDELAY (IDELAY, ODELAY) command to a signal, the last command overrides the previous commands and HSPICE issues a warning.
- If you do not specify the signal delays in a TDELAY, IDELAY, or ODELAY command, HSPICE defaults to zero.

Command Group

Digital Vector

Examples

```
RADIX 1 1 4 1234 11111111
IO i i o iiib iiiiiiii
VNAME V1 V2 VX[[3:0]] V4 V5[[1:0]] V6[[0:2]] V7[[0:3]]
+ V8 V9 V10 V11 V12 V13 V14 V15
TDELAY 1.0
TDELAY -1.2 0 1 F 0000 00000000
TDELAY 1.5 0 0 0 1370 00000000
IDELAY 2.0 0 0 0 000F 00000000
ODELAY 3.0 0 0 0 000F 00000000
```

This example does not specify the TUNIT command so HSPICE uses the default, ns, as the time unit for this example. The first TDELAY command indicates that all signals have the same delay time of 1.0ns. Subsequent TDELAY, IDELAY, or ODELAY commands overrule the delay time of some signals.

- The delay time for the V2 and Vx signals is -1.2.
- The delay time for the V4, V5[0:1], and V6[0:2] signals is 1.5.
- The input delay time for the V7[0:3] signals is 2.0, and the output delay time is 3.0.

See Also

ODELAY
TDELAY
TUNIT

IO

Defines the type for each vector: input, bidirectional, output, or unused.

Syntax

```
IO I | O | B | U     [I | O | B | U ...]
```

Argument	Description
i	Input that HSPICE uses to stimulate the circuit.
o	Expected output that HSPICE compares with the simulated outputs.
b	Bidirectional vector.
u	Unused vector that HSPICE ignores.

Description

Use this command to define the type for each vector. The line starts with the `IO` keyword followed by a string of i, b, o, or u definitions. These definitions indicate whether each corresponding vector is an input (i), bidirectional (b), output (o), or unused (u) vector.

- If you do not specify the `IO` command, HSPICE assumes that all signals are input signals.
- If you define more than one `IO` command, HSPICE issues an error message.

Command Group

Digital Vector

Examples

```
io i i i bbbb iiiioouu
```

MASK

Allows a mask value to be assigned to variable and that variable can used in place of a mask value.

Syntax

```
MASK mask_name dddd dddd ...
```

```
MASK mask_name node1 [node2 ... ]
```

Description

Use this command when signals require values other than the globally defined ones. You can specify the mask pattern to define those selected signals. The mask command defines the mask name to represent the mask pattern.

The statement starts with a keyword MASK, followed by a mask name and then the mask pattern. The mask pattern can be specified by either the values or the signal nodes. If the signal nodes are used to describe the mask pattern, a logic 1 is set to each signal node at the corresponding column location. Any unspecified column is defaulted to logic 0.

Command Group

Digital Vector

Examples

Example 1 The following specifies that both m1 and m2 have a mask pattern of 0101.

```
signal a b c d
mask m1 01 0 1
mask m2 b d
```

Example 2 For those statements which take an optional mask pattern, you can specify the pattern by either the values or the predefined mask name. The following defines the logic 1 voltage for signals a, d, e[0-7] and e[12-15] as 3.0V. The logic 1 voltage for b[0-3] is 2.5V. The logic 1 voltage for signals c and e[8-11] is 2.8V. The mask pattern for m3 is 001000f0.

```
signal a b[0-3] c d e[0-15]
radix 14114444
logichv 3.0
logichv 2.5 0f000000
logichv 2.8 m3
```

ODELAY

Defines an output delay time for ouput and bidirectional signals.

Syntax

ODELAY *delay_value* [*mask*]

Argument	Description
delay_value	Time delay to apply to the signals.
mask	Signals to which the delay applies. If you do not provide a *mask* value, the delay value applies to all signals.

Description

Use this command to define an output delay time for output and bidirectional signals relative to the absolute time of each row in the Tabular Data section.

HSPICE ignores ODELAY settings on input signals and issues a warning message.

You can specify more than one TDELAY, IDELAY, or ODELAY command.

- If you apply more than one TDELAY (IDELAY, ODELAY) command to a signal, the last command overrides the previous commands and HSPICE issues a warning.
- If you do not specify the signal delays in a TDELAY, IDELAY, or ODELAY command, HSPICE defaults to zero.
- When TDELAY, IDELAY, and ODELAY are all specified, IDELAY and ODELAY have a higher priority than TDELAY.

Command Group

Digital Vector

Examples

```
RADIX 1 1 4 1234 11111111
IO i i o iiib iiiiiiii
VNAME V1 V2 VX[[3:0]] V4 V5[[1:0]] V6[[0:2]] V7[[0:3]]
+ V8 V9 V10 V11 V12 V13 V14 V15
TDELAY 1.0
TDELAY -1.2 0 1 F 0000 00000000
TDELAY 1.5 0 0 0 1370 00000000
IDELAY 2.0 0 0 0 000F 00000000
ODELAY 3.0 0 0 0 000F 00000000
```

This example does not specify the TUNIT command so HSPICE uses the default, ns, as the time unit for this example. The first TDELAY command indicates that all signals have the same delay time of 1.0 ns. Subsequent TDELAY, IDELAY, or ODELAY commands overrule the delay time of some signals.

- The delay time for the V2 and Vx signals is -1.2.
- The delay time for the V4, V5[0:1], and V6[0:2] signals is 1.5.
- The input delay time for the V7[0:3] signals is 2.0 and the output delay time is 3.0.

See Also

IDELAY

TDELAY
TUNIT

OUT / OUTZ

Specifies output resistance for each signal for which the mask applies. OUT and OUTZ are equivalent.

Syntax

OUT *output_resistance* [*mask*]

Argument	Description
output_resistance	Output resistance for an input signal. The default is 0.
mask	Signals to which the output resistance applies. If you do not provide a *mask* value, the output resistance value applies to all input signals.

Description

The OUT and OUTZ keywords are equivalent: use these commands to specify output resistance for each signal (for which the mask applies). OUT or OUTZ applies to input signals only.

- If you do not specify the output resistance of a signal in an OUT (or OUTZ) command, HSPICE uses the default (zero).
- If you specify more than one OUT (or OUTZ) command for a signal, the last command overrides the previous commands and HSPICE issues a warning message.

The OUT (or OUTZ) commands have no effect on the expected output signals.

Command Group

Digital Vector

Examples

```
OUT 15.1
OUT 150 1 1 1 0000 00000000
OUTZ 50.5 0 0 0 137F 00000000
```

The first OUT command in this example creates a 15.1 ohm resistor to place in series with all vector inputs. The next OUT command sets the resistance to 150

ohms for vectors 1 to 3. The OUTZ command changes the resistance to 50.5 ohms for vectors 4 through 7.

PERIOD

Defines the time interval for the Tabular Data section.

Syntax

```
PERIOD time_interval
```

Argument	Description
time_interval	Time interval for the Tabular Data.

Description

Use this command to define the time interval for the Tabular Data section. You do not need to specify the absolute time at every time point. If you use a PERIOD command without the TSKIP command, the Tabular Data section contains only signal values, not absolute times. The TUNIT command defines the time unit of the PERIOD.

Command Group

Digital Vector

Examples

```
radix 1111 1111
period 10
1000 1000
1100 1100
1010 1001
```

- The first row of the tabular data (1000 1000) is at time 0ns.
- The second row (1100 1100) is at 10ns.
- The third row (1010 1001) is at 20ns.

See Also

TSKIP
TUNIT

RADIX

Specifies the number of bits associated with each vector.

Syntax

```
RADIX number_of_bits [number_of_bits...]
```

Argument	Description
number_of_bits	Specifies the number of bits in one vector in the digital vector file. You must include a separate *number_of_bits* argument in the RADIX command for each vector listed in the file.

Description

Use this command to specify the number of bits associated with each vector. Valid values for the number of bits range from 1 to 4.

A digital vector file must contain only one `RADIX` command and it must be the first non-comment line in the file.

Table 1 Valid Values for the RADIX command

# bits	Radix	Number System	Valid Digits
1	2	Binary	0, 1
2	4	–	0 – 3
3	8	Octal	0 – 7
4	16	Hexadecimal	0 – F

Command Group

Digital Vector

Examples

```
; start of Vector Pattern Definition section
RADIX 1 1 4 1234 1111 1111
VNAME A B C[[3:0]] I9 I[[8:7]] I[[6:4]] I[[3:0]] O7 O6 O5 O4
+ O3 O2 O1 O0
IO I I I IIII OOOO OOOO
```

This example illustrates two 1-bit signals followed by a 4-bit signal, followed by one each 1-bit, 2-bit, 3-bit, and 4-bit signals, and finally eight 1-bit signals.

SLOPE

Specifies the rise/fall time for the input signal.

Syntax

SLOPE [*input_rise_time* | *input_fall_time*] [*mask*]

Argument	Description
input_rise_time	Rise time of the input signal.
input_fall_time	Fall time of the input signal.
mask	Name of a signal to which the SLOPE command applies. If you do not specify a *mask* value, the SLOPE command applies to all signals.

Description

Use this command to specify the rise/fall time for the input signal. Use the TUNIT command to define the time unit for this command.

- If you do not specify the SLOPE command, the default slope value is 0.1 ns.
- If you specify more than one SLOPE command, the last command overrides the previous commands and HSPICE issues a warning message.

The SLOPE command has no effect on the expected output signals. You can specify the optional TRISE and TFALL commands to overrule the rise time and fall time of a signal.

Command Group

Digital Vector

Examples

In the following example, the rising and falling times of all signals are 1.2 ns.

Example 1

```
SLOPE 1.2
```

In the following example, the rising/falling time is 1.1 ns for the first, second, sixth, and seventh signals.

Example 2

```
SLOPE 1.1 1100 0110
```

See Also

TFALL
TRISE
TUNIT

STOP_AT_ERROR

Stop circuit simulation if output comparisons are performed resulting in mismatched outputs.

Syntax

```
STOP_AT_ERROR
```

Description

Use `STOP_AT_ERROR` to stop circuit simulation whenever output comparisons are performed and mismatched outputs occur.

Command Group

Digital Vector

See Also

CHECK_WINDOW

TDELAY

Defines the delay time for both input and output signals in the Tabular Data section.

Syntax

```
TDELAY delay_value [mask]
```

Argument	Description
delay_value	Time delay to apply to the signals.
mask	Signals to which the delay applies. If you do not provide a *mask* value, the delay value applies to all signals.

Description

Use this command to define the delay time of both input and output signals relative to the absolute time of each row in the Tabular Data section.

You can specify more than one TDELAY, IDELAY, or ODELAY command.

- If you apply more than one TDELAY (IDELAY, ODELAY) command to a signal, the last command overrides the previous commands and HSPICE issues a warning.
- If you do not specify the signal delays in a TDELAY, IDELAY, or ODELAY command, HSPICE defaults to zero.

Command Group

Analysis

Examples

```
RADIX 1 1 4 1234 11111111
IO i i o iiib iiiiiiii
VNAME V1 V2 VX[[3:0]] V4 V5[[1:0]] V6[[0:2]] V7[[0:3]]
+ V8 V9 V10 V11 V12 V13 V14 V15
TDELAY 1.0
TDELAY -1.2 0 1 F 0000 00000000
TDELAY 1.5 0 0 0 1370 00000000
IDELAY 2.0 0 0 0 000F 00000000
ODELAY 3.0 0 0 0 000F 00000000
```

This example does not specify the TUNIT command so HSPICE uses the default, ns, as the time unit for this example. The first TDELAY command indicates that all signals have the same delay time of 1.0ns. Subsequent TDELAY, IDELAY, or ODELAY commands overrule the delay time of some signals.

- The delay time for the V2 and Vx signals is -1.2.
- The delay time for the V4, V5[0:1], and V6[0:2] signals is 1.5.
- The input delay time for the V7[0:3] signals is 2.0, and the output delay time is 3.0.

See Also

IDELAY
ODELAY
TUNIT

TFALL

Specifies the fall time of each input signal for which the mask applies.

Syntax

```
TFALL input_fall_time [mask]
```

Argument	Description
input_fall_time	Fall time of the input signal.
mask	Name of a signal to which the TFALL command applies. If you do not specify a *mask* value, the TFALL command applies to all input signals.

Description

Use this command to specify the fall time of each input signal for which the mask applies. The TUNIT command defines the time unit of TFALL.

- If you do not use any TFALL command to specify the fall time of the signals, HSPICE uses the value defined in the *slope* command.
- If you apply more than one TFALL command to a signal, the last command overrides the previous commands and HSPICE issues a warning message.

TFALL commands have no effect on the expected output signals.

Command Group

Digital Vector

Examples

In Example1, the TFALL command assigns a fall time of 0.5 time units to all vectors.

Example 1

```
TFALL 0.5
```

In the following example, the TFALL command assigns a fall time of 0.3 time units overriding the older setting of 0.5 to vectors 2, 3, and 4 to 7.

Example 2

```
TFALL 0.3 0 1 1 137F 00000000
```

In the following example, the TFALL command assigns a fall time of 0.9 time units to vectors 8 through 11.

```
TFALL 0.9 0 0 0 0000 11110000
```

See Also

TRISE
TUNIT

TRISE

Specifies the rise time of each input signal for which the mask applies.

Syntax

TRISE *input_rise_time* [*mask*]

Argument	Description
input_rise_time	Rise time of the input signal.
mask	Name of a signal to which the TRISE command applies. If you do not specify a *mask* value, the TRISE command applies to all input signals.

Description

Use this command to specify the rise time of each input signal for which the mask applies. The TUNIT command defines the time unit of TRISE.

- If you do not use any TRISE command to specify the rising time of the signals, HSPICE uses the value defined in the *slope* command.
- If you apply more than one TRISE command to a signal, the last command overrides the previous commands and HSPICE issues a warning message.

TRISE commands have no effect on the expected output signals.

Command Group

Digital Vector

Examples

In this example, the TRISE command assigns a rise time of 0.3 time units to all vectors.

Example 1

```
TRISE 0.3
```

In this example, the TRISE command assigns a rise time of 0.5 time units overriding the older setting of 0.3 in at least some of the bits in vectors 2, 3, and 4 through 7.

Example 2

```
TRISE 0.5 0 1 1 137F 00000000
```

In Example 3, the TRISE command assigns a rise time of 0.8 time units to vectors 8 through 11.

Example 3

```
TRISE 0.8 0 0 0 0000 11110000
```

See Also

TFALL
TUNIT

TRIZ

Specifies the output impedance when the signal for which the mask applies is in tristate.

Syntax

```
TRIZ output_impedance [mask]
```

Argument	Description
output_impedance	Output impedance of the input signal.
mask	Name of a signal to which the TRIZ command applies. If you do not specify a *mask* value, the TRIZ command applies to all input signals.

Description

Use this command to specify the output impedance when the signal (for which the mask applies) is in *tristate*; `TRIZ` applies only to the input signals.

- If you do not specify the tristate impedance of a signal, in a `TRIZ` command, HSPICE assumes 1000M.
- If you apply more than one `TRIZ` command to a signal, the last command overrides the previous commands and HSPICE issues a warning.

`TRIZ` commands have no effect on the expected output signals.

Command Group

Digital Vector

Examples

```
TRIZ 15.1Meg
TRIZ 150Meg 1 1 1 0000 00000000
TRIZ 50.5Meg 0 0 0 137F 00000000
```

- The first `TRIZ` command sets the high impedance resistance globally at 15.1 Mohms.
- The second `TRIZ` command increases the value to 150 Mohms for vectors 1 to 3.
- The last `TRIZ` command increases the value to 50.5 Mohms for vectors 4 through 7.

TSKIP

Causes HSPICE to ignore the absolute time field in the tabular data.

Syntax

`TSKIP` *`absolute_time tabular_data ...`*

Argument	Description
absolute_time	Absolute time.
tabular_data	Data captured at *absolute_time*.

Description

Use this command to cause HSPICE to ignore the absolute time field in the tabular data. You can then keep, but ignore, the absolute time field for each row in the tabular data when you use the .PERIOD command.

You might do this, for example, if for testing reasons the absolute times are not perfectly periodic. Another reason might be that a path in the circuit does not meet timing, but you might still use it as part of a test bench. Initially, HSPICE writes to the vector file using absolute time. After you fix the circuit, you might want to use periodic data.

Command Group

Digital Vector

Examples

```
radix 1111 1111
period 10
tskip
11.0 1000 1000
20.0 1100 1100
33.0 1010 1001
```

HSPICE ignores the absolute times 11.0, 20.0, and 33.0, but HSPICE does process the tabular data on the same lines as those absolute times.

See Also

PERIOD

TUNIT

Defines the time unit for PERIOD, TDELAY,IDELAY, ODELAY, SLOPE, TRISE, TFALL, and absolute time.

Syntax

```
TUNIT [fs|ps|ns|us|ms]
```

or:

```
TUNIT constant_number
```

or:

```
TUNIT [1e-15|1e-12|1e-9|1e-6|1e-3]
```

For example, the `TUNIT constant_number` can be exponential format (`1e-9`) or engineering key letter format (`1n`).

Argument	Description
fs	femtosecond
ps	picosecond
ns	nanosecond (default)
us	microsecond
ms	millisecond

Description

Use this command to define the time unit in the digital vector file for PERIOD, TDELAY, IDELAY, ODELAY, SLOPE, TRISE, TFALL, and absolute time.

- If you do not specify the `TUNIT` command, the default time unit value is ns.
- If you define more than one `TUNIT` command, the last command overrides the previous command.

Command Group

Digital Vector

Examples

The `TUNIT` command in this example specifies that the absolute times in the Tabular Data section are 11.0ns, 20.0ns, and 33.0ns.

```
TUNIT ns
11.0 1000 1000
20.0 1100 1100
33.0 1010 1001
```

The following are legal ways to write the time values.

```
tunit 999ns
tunit .99ps
tunit .99e+6ps
tunit 999 ns
tunit .99 ps
```

The following are examples of wrong syntax which will result in an error message:

```
tunit .99eps
tunit .99 e+6ps
tunit .99 eps
```

See Also

IDELAY
ODELAY
PERIOD
SLOPE
TDELAY
TFALL
TRISE

VCHK_IGNORE

Causes HSPICE to ignore checking for all nodes specified when yoiu use the optional mask between times specified by `t1` and `t2`.

Syntax

`VCHK_IGNORE t1 t2 [`*`mask`*`]`

Description

If `mask` is not specified, HSPICE ignores all signals between t1 and t2. To ignore selected signals over the entire time period, specify the t1 start and t2 ending times. This command can be repeated for cumulative effect.

Command Group

Digital Vector

Examples

This example applies t2 to the specified mask from 0 to 2 ns.

```
vchk_ignore 0 2 0101
```

VIH

Specifies the logic-high voltage for each input signal to which the mask applies.

Syntax

```
VIH logic-high_voltage [mask]
```

Argument	Description
logic-high_voltage	Logic-high voltage for an input signal. The default is 3.3.
mask	Name of a signal to which the VIH command applies. If you do not specify a *mask* value, the VIH command applies to all input signals.

Description

Use this command to specify the logic-high voltage for each input signal to which the mask applies.

- If you do not specify the logic high voltage of the signals in a `VIH` command, HSPICE assumes 3.3.
- If you use more than one `VIH` command for a signal, the last command overrides previous commands and HSPICE issues a warning.

`VIH` commands have no effect on the expected output signals.

Command Group

Digital Vector

Examples

```
VIH 5.0
VIH 3.5 0 0 0 0000 11111111
```

- The first `VIH` command sets all input vectors to 5V when they are high.
- The last `VIH` command changes the logic-high voltage from 5V to 3.5V for the last eight vectors.

See Also

VIL
VOH
VOL
VTH

VIL

Specifies the logic-low voltage for each input signal to which the mask applies.

Syntax

```
VIL logic-low_voltage [mask]
```

Argument	Description
logic-low_voltage	Logic-low voltage for an input signal. The default is 0.0.
mask	Name of a signal to which the VIL command applies. If you do not specify a *mask* value, the VIL command applies to all input signals.

Description

Use this command to specify the logic-low voltage for each input signal to which the mask applies.

- If you do not specify the logic-low voltage of the signals in a `VIL` command, HSPICE assumes 0.0.
- If you use more than one `VIL` command for a signal, the last command overrides previous commands and HSPICE issues a warning.

`VIL` commands have no effect on the expected output signals.

Command Group

Digital Vector

Examples

```
VIL 0.0
VIL 0.5 0 0 0 0000 11111111
```

- The first `VIL` command sets the logic-low voltage to 0V for all vectors.
- The second `VIL` command changes the logic-low voltage to 0.5V for the last eight vectors.

See Also

VIH
VOH
VOL
VTH

VNAME

Defines the name of each vector.

Syntax

VNAME *vector_name* [[*starting_index*:*ending_index*]]

Argument	Description
vector_name	Name of the vector, or range of vectors.
starting_index	First bit in a range of vector names.
ending_index	Last bit in a range of vector names. You can associate a single name with multiple bits (such as bus notation). The opening and closing brackets and the colon are required; they indicate that this is a range. The vector name must correlate with the number of bits available. You can nest the bus definition inside other grouping symbols, such as { }, ( ), [ ], and so on. The bus indices expand in the specified order

Description

Use this command to define the name of each vector. If you do not specify VNAME, HSPICE assigns a default name to each signal: V1, V2, V3, and so on. If you define more than one VNAME command, HSPICE uses the vector names from the first VNAME command.

Command Group

Digital Vector

Examples

Auto-defined names for each signal.

Example 1

```
RADIX 1 1 1 1 1 1 1 1 1 1 1 1
VNAME V1 V2 V3 V4 V5 V6 V7 V8 V9 V10 V11 V12
```

Example 2 represents a0, a1, a2, and a3, in that order. HSPICE does not reverse the order to make a3 the first bit. The bit order is MSB:LSB, which means most significant bit to least significant bit. For example, you can represent a 5-bit bus such as: {a4 a3 a2 a1 a0}, using this notation: a[[4:0]]. The high bit is a4, which represents 2^4. It is the largest value and therefore is

the MSB.

Example 2

```
VNAME a[[0:3]]
```

HSPICE generates voltage sources with the following names:

```
VA0 VA1 VB4 VB3 VB2 VB1
```

- *VA0* and *VB4* are the MSBs.
- *VA1* and *VB1* are the LSBs.

Example 3

```
RADIX 2 4
VNAME VA[[0:1]] VB[[4:1]]
```

For Example 4, HSPICE generates voltage sources with the following names:
`VA[0] VA[1] VB<4> VB<3> VB<2> VB<1>`

Example 4

```
VNAME VA[[0:1]] VB<[4:1]>
```

Example 5 specifies a single bit of a bus. This range creates a voltage source named `VA [2]`.

Example 5

```
VNAME VA[[2:2]]
```

Example 6 generates signals named A0, A1, A2, ... A23.

Example 6

```
RADIX 444444
VNAME A[[0:23]]
```

VOH

Specifies the logic-high threshold voltage for each output signal to which the mask applies.

Syntax

VOH *logic-high_threshold_voltage* [*mask*]

Argument	Description
logic-high_threshold_voltage	Logic-high threshold voltage for an output vector. The default is 2.66.
mask	Name of a signal to which the VOH command applies. If you do not specify a *mask* value, the VOH command applies to all output signals.

Description

Use this command to specify the logic-high threshold voltage for each output signal to which the mask applies.

- If you do not specify the logic-high threshold voltage in a VOH command, HSPICE assumes 2.64.
- If you apply more than one VOH command to a signal, the last command overrides the previous commands and HSPICE issues a warning.

VOH commands have no effect on input signals.

Command Group

Digital Vector

Examples

```
VOH 4.75
VOH 4.5 1 1 1 137F 00000000
VOH 3.5 0 0 0 0000 11111111
```

- The first line tries to set a logic-high threshold output voltage of 4.75V, but it is redundant.
- The second line changes the voltage level to 4.5V for the first seven vectors.
- The last line changes the last eight vectors to a 3.5V logic-high threshold output.

These second and third lines completely override the first VOH command.

If you do not define either VOH or VOL, HSPICE uses VTH (default or defined).

See Also

VIH
VIL
VOL
VTH

VOL

Specifies the logic-low threshold voltage for each output signal to which the mask applies.

Syntax

VOL *logic-low_threshold_voltage* [*mask*]

Argument	Description
logic-low_voltage	Logic-low threshold voltage for an output vector. The default is 0.64.
mask	Name of a signal to which the VOL command applies. If you do not specify a *mask* value, the VOL command applies to all output signals.

Description

Use this command to specify the logic-low threshold voltage for each output signal to which the mask applies.

- If you do not specify the logic-low threshold voltage in a VOL command, HSPICE assumes 0.66.
- If you apply more than one VOL command to a signal, the last command overrides the previous commands and HSPICE issues a warning.

Command Group

Digital Vector

Examples

```
VOL 0.0
VOL 0.2 0 0 0 137F 00000000
VOL 0.5 1 1 1 0000 00000000
```

- The first VOL command sets the logic-low threshold output to 0V.
- The second VOL command sets the output voltage to 0.2V for the fourth through seventh vectors.
- The last command increases the voltage further to 0.5V for the first three vectors.

These second and third lines completely override the first VOL command.

If you do not define either VOH or VOL, HSPICE uses VTH (default or defined).

See Also

VIH
VIL
VOH
VTH

VREF

Specifies the name of the reference voltage for each input vector to which the mask applies.

Syntax

`VREF` *`reference_voltage`*

or:

`VREF` *`reference_voltage_node`* `[mask]`

Argument	Description
reference_voltage	Reference voltage for each input vector. The default is 0.
reference_voltage_node	Reference voltage node for each input vector. The default is 0 (gnd).
mask	Signals to which the VREF applies. If you do not provide a mask value, the VREF value applies to all input signals

Description

Use this command to specify the name of the reference voltage for each input vector to which the mask applies. Similar to the `TDELAY` command, the `VREF` command applies only to input signals.

- If you do not specify the reference voltage name of the signals in a `VREF` command, HSPICE assumes 0.
- If you apply more than one `VREF` command, the last command overrides the previous commands and HSPICE issues a warning.

`VREF` commands have no effect on the output signals.

Command Group

Digital Vector

Examples

```
VNAME v1 v2 v3 v4 v5[[1:0]] v6[[2:0]] v7[[0:3]] v8 v9 v10
VREF 0
VREF 0 111 137F 000
VREF vss 0 0 0 0000 111
```

When HSPICE implements these commands into the netlist, the voltage source realizes *v1*:

```
v1 V1 0 pwl(......)
```

as well as *v2*, *v3*, *v4*, *v5*, *v6*, and *v7*.

However, *v8* is realized by

```
V8 V8 vss pwl(......)
```

v9 and *v10* use a syntax similar to v8.

See Also

TDELAY

VTH

Specifies the logic threshold voltage for each output signal to which the mask applies.

Syntax

VTH *logic-threshold_voltage*

Argument	Description
logic-threshold_voltage	Logic-threshold voltage for an output vector. The default is 1.65.

Description

Use this command to specify the logic threshold voltage for each output signal to which the mask applies. It is similar to the TDELAY command. The threshold voltage determines the logic state of output signals for comparison with the expected output signals.

- If you do not specify the threshold voltage of the signals in a VTH command, HSPICE assumes 1.65.
- If you apply more than one VTH command to a signal, the last command overrides the previous commands and HSPICE issues a warning.

VTH commands have no effect on the input signals.

Command Group

Digital Vector

Examples

```
VTH 1.75
VTH 2.5 1 1 1 137F 00000000
VTH 1.75 0 0 0 0000 11111111
```

- The first VTH command sets the logic threshold voltage at 1.75V.
- The next line changes that threshold to 2.5V for the first 7 vectors.
- The last line changes that threshold to 1.75V for the last 8 vectors.

All of these examples apply the same vector pattern and both output and input control commands, so the vectors are all bidirectional.

See Also

TDELAY
VIH
VIL
VOH
VOL

3

HSPICE Simulation Control Options Reference

Presents simulation control options you can set using various forms of the .OPTION command.

You can set HSPICE simulation control options using the .OPTION command. This chapter provides the list of simulation control options in an alphabetical order, followed by detailed descriptions of the individual options. In a few instances, an option has different functionality, depending on which mode (HSPICE) has been invoked. The description of the command notes the differences.

Control Option	Description	Category	Associated Command
.DESIGN_EXPLORATION	Several options can be applied when doing .DESIGN_EXPLORATION analysis. Note that no leading period is allowed with variation control options:	Exploration	.DESIGN_EXPLORATION
.OPTION (X0R,X0I)	The first of three complex starting-trial points in the Muller algorithm used in Pole/Zero analysis.	Analysis	.PZ
.OPTION (X1R,X1I)	The second of three complex starting-trial points in the Muller algorithm used in Pole/Zero analysis.	Analysis	.PZ
.OPTION (X2R,X21)	The third of three complex starting-trial points in the Muller algorithm used in Pole/Zero analysis.	Analysis	.PZ

Control Option	Description	Category	Associated Command
.OPTION ABSI	Sets the absolute error tolerance for branch currents in diodes, BJTs, and JFETs during DC and transient analysis.	Error Tolerance	.AC .TRAN
.OPTION ABSIN	Convergence criteria for bisection/pass/fail optimization.	Error Tolerance	.MODEL
.OPTION ABSMOS	Specifies the current error tolerance for MOSFET devices in DC or transient analysis.	Error Tolerance	.DC .TRAN
.OPTION ABSTOL	Sets the absolute error tolerance for branch currents in DC and transient analysis.	Error Tolerance	.DC .TRAN
.OPTION ABSVDC	Sets the minimum voltage for DC and transient analysis.	Error Tolerance	.DC .TRAN
.OPTION ACCURATE	Selects a time algorithm for circuits such as high-gain comparators.	Speed and Accuracy	-
.OPTION ALTCC	Sets onetime reading of the input netlist for multiple .ALTER commands.	Netlist Parser	.ALTER .LIB
.OPTION ALTCHK	Disables (or re-enables) topology checking in redefined elements (in altered netlists).	Netlist Parser	.ALTER
.OPTION ALTER_SELECT	Enables selection of one or more alters from a list of alters.	Netlist Parser	-
.OPTION APPENDALL	Allows the top hierarchical level to use the .APPENDMODEL command even if the MOSFET model is embedded in a subcircuit.	Model Analysis	.APPENDMODEL .MODEL .MOSRA
.OPTION ARTIST	Enables the Cadence Virtuoso Analog Design Environment interface.	Interface Control	-
.OPTION ASPEC	Sets HSPICE to ASPEC-compatibility mode.	Model Analysis	-

Control Option	Description	Category	Associated Command
.OPTION AUTO_INC_OFF	Suppresses automatic search for model/subckt.inc files when they are not explicitly included.	Transient Control Limit	-
.OPTION AUTOSTOP	Stops a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions.	Transient Control Limit	.MEASURE (Rise, Fall, Delay, and Power Measurements) .MEASURE (FIND and WHEN) .MEASURE (Continuous Results) .MEASURE (AVG, EM_AVG, INTEG, MIN, MAX, PP, and RMS) .MEASURE (Integral Function) .MEASURE (Derivative Function) .MEASURE (Error Function) .MEASURE PHASENOISE
.OPTION BA_ACTIVE	Specifies the active net file name(s) selective net back-annotation.	Back Annotation	-
.OPTION BA_ACTIVEHIER	Annotate full hierarchical net names that are specified for BA_ACTIVE files.	Back Annotation	-
.OPTION BA_ADDPARAM	Specifies extra parameters to be scaled by .OPTION BA_SCALE / .OPTION BA_GEOSHRINK.	Back Annotation	-
.OPTION BA_COUPLING	Controls how to treat cutoff coupling capacitors when invoking selective net back-annotation.	Back Annotation	-
.OPTION BA_DPFPFX	Removes the prefix of the instance names in the post-layout file (DSPF) when running back annotation.	Back Annotation	-
.OPTION BA_DPF_ELEM_ENABLE	Enables or disables back-annotation of instance section in all ba_files.	Back Annotation	-

Control Option	Description	Category	Associated Command
.OPTION BA_DPF_ELEM_TYPE	Controls the element types you want to annotate during back-annotation.	Back Annotation	-
.OPTION BA_ERROR	Mode for handling error on nets.	Back Annotation	-
.OPTION BA_FILE	Launches DPF parasitic back-annotation.	Back Annotation	-
.OPTION BA_FINGERDELIM	Explicitly specifies the delimiter character used for finger devices and subcircuit instances.	Back Annotation	-
.OPTION BA_GEOSHRINK	Element scaling factor used with .OPTION BA_SCALE option.	Back Annotation	-
.OPTION BA_HIERDELIM	Specifies the hierarchical separator in the DPF file.	Back Annotation	-
.OPTION BA_IDEALPFX	Instructs HSPICE to prefix the instance names in the post-layout file (DSPF) with the specified string while running back annotation.	Back Annotation	-
.OPTION BA_INST	Specifies the scope of a back-annotation file to a particular subckt or instance.	Back Annotation	-
.OPTION BA_MERGEPORT	Controls whether to merge net ports into one node.	Back Annotation	-
.OPTION BA_NETFMT	Specifies the format of Active Net file.	Back Annotation	-
.OPTION BA_PRINT	Controls whether to output nodes and resistors/capacitors introduced by back-annotation.	Back Annotation	-
.OPTION BA_SCALE	Sets the element scaling factor for instances in the DPF file separately.	Back Annotation	-
.OPTION BA_TERMINAL	Specifies mapping characters for back annotation terminal name.	Back Annotation	-

Control Option	Description	Category	Associated Command
.OPTION BADCHR	Generates a warning on finding a non-printable character in an input file.	Netlist Parser	-
.OPTION BDFATOL	Sets the absolute tolerance for the global accuracy control of the Backward Differentiation Formulae integration method.	Speed and Accuracy	-
.OPTION BDFRTOL	Sets the relative tolerance for the global accuracy control of the Backward Differentiation Formulae integration method.	Speed and Accuracy	-
.OPTION BEEP	Enables or disables audible alert tone when simulation returns a message.	Input/Output	-
.OPTION BIASFILE	Sends .BIASCHK command results to a specified file.	BIASCHK	.BIASCHK
.OPTION BIASFMT	Controls the format of `.BIASCHK` command results.	BIASCHK	.BIASCHK
.OPTION BIASINTERVAL	Controls the level of information output during transient analysis.	BIASCHK	.BIASCHK
.OPTION BIASNODE	Specifies whether to use node names or port names in element commands.	BIASCHK	.BIASCHK
.OPTION BIASPARALLEL	Controls whether .BIASCHK sweeps the parallel elements being monitored.	BIASCHK	.BIASCHK
.OPTION BIAWARN	Controls whether HSPICE outputs warning messages when local max bias voltage exceeds limit during transient analysis.	BIASCHK	.TRAN
.OPTION BINPRNT	Outputs the binning parameters of the CMI MOSFET model.	Input/Output	-
.OPTION BPNMATCHTOL	Determines the minimum required match between the NLP and PAC phase noise algorithms in HSPICE.	Phase Noise Analysis	.PHASENOISE

Control Option	Description	Category	Associated Command
.OPTION BSIM4PDS	Flag to control the BSIM4 Ps_{eff} (effective source perimeter) and Pd_{eff} (effective drain perimeter) model equation calculation.	Model Analysis	-
.OPTION BYPASS	Bypasses model evaluations if the terminal voltages stay constant.	Bypass	-
.OPTION BYTOL	Sets a voltage tolerance at which a MOSFET, MESFET, JFET, BJT, or diode becomes latent.	Bypass	-
.OPTION CAPTAB	Adds up all the capacitances attached to a node and prints a table of single-plate node capacitances.	Output Listing	-
.OPTION CFLFLAG	Activates the Compiled Function Library (CFL) feature in HSPICE.	Custom Models	.CFL_PROTOTYPE .PARAMETER
.OPTION CMIFLAG	Loads and links the dynamically linked Common Model Interface (CMI) library.	Custom Models	-
.OPTION CMIMCFLAG	Restricted: for specified users only. Enables model memory allocation for each element.	Custom Models	-
.OPTION CMIPATH	Enables automatic selection of correct Custom CMI. For information on the HSPICE CMI, contact your Synopsys technical support team.	Custom Models	-
.OPTION CMIUSRFLAG	Flag to control.OPTION SCALE parsing into the External Common Model Interface (CMI).	Custom Models	-
.OPTION CMIVTH	For Custom CMI MOSFET model only, invokes one additional CMI model function call when convergence criteria is met.	Custom Models	-
.OPTION CONVERGE	Invokes various methods for solving nonconvergence problems.	Error Tolerance	-
.OPTION CPTIME	Sets the maximum CPU time allotted for a simulation.	Analysis	-

Control Option	Description	Category	Associated Command
.OPTION CSCAL	Sets the capacitance scale for Pole/Zero analysis.	Analysis	-
.OPTION CSDF	Selects the Common Simulation Data Format (Viewlogic-compatible graph data file format).	Interface Control	-
.OPTION CSHDC	Adds capacitance from each node to ground; used only with the CONVERGE option.	Analysis	-
.OPTION CSHUNT	Adds capacitance from each node to ground.	Speed and Accuracy	-
.OPTION CUSTCMI	Turns on gate direct tunneling current modeling and additional instance parameter support.	Custom Models	-
.OPTION CVTOL	Changes the number of numerical integration steps when calculating the gate capacitor charge for a MOSFET.	Speed and Accuracy	-
.OPTION D_IBIS	Specifies the directory containing the IBIS files.	Input/Output	-
.OPTION DCAP	Specifies equations used to calculate depletion capacitance for Level 1 and 3 diodes and BJTs.	Model Analysis	-
.OPTION DCCAP	Generates C-V plots.	Output Listing	.DC
.OPTION DCFOR	Sets the number of iterations to calculate after a circuit converges in the steady state.	Analysis	.DC .NODESET
.OPTION DCHOLD	Specifies how many iterations to hold a node at the .NODESET voltage values.	Analysis	.DC .NODESET
.OPTION DCIC	Specifies whether to use or ignore .IC commands in the netlist.	Analysis	.IC .DC
.OPTION DCON	Aids in the autoconvergence routines; can also disable auto-converge routines when set to =-1.	Convergence	-

Control Option	Description	Category	Associated Command
.OPTION DCTRAN	Invokes different methods to solve non-convergence problems.	Convergence	-
.OPTION DEF_GROUND	Connects nodes to ground.	Model Analysis	-
.OPTION DEFAD	Sets the default MOSFET drain diode area.	Model Analysis	-
.OPTION DEFAS	Sets the default MOSFET source diode area.	Model Analysis	-
.OPTION DEFL	Sets the default MOSFET channel length.	Model Analysis	-
.OPTION DEFNRD	Sets the default number of squares for the drain resistor on a MOSFET.	Model Analysis	-
.OPTION DEFNRS	Sets the default number of squares for the source resistor on a MOSFET.	Model Analysis	-
.OPTION DEFPD	Sets the default MOSFET drain diode perimeter.	Model Analysis	-
.OPTION DEFPS	Sets the default MOSFET source diode perimeter.	Model Analysis	-
.OPTION DEFSA	Sets the default BSIM4 MOSFET SA parameter in HSPICE.	Model Analysis	-
.OPTION DEFSB	Sets the default BSIM4 MOSFET SB parameter.	Model Analysis	-
.OPTION DEFSD	Sets default for BSIM4 MOSFET SD parameter.	Model Analysis	-
.OPTION DEFW	Sets the default MOSFET channel width.	Model Analysis	-
.OPTION DEGF	Sets the device's failure criteria for lifetime computation when using the MOSRA API if no values are set for .OPTION DEGFN or .OPTION DEGFP.	Model Analysis	-
.OPTION DEGFN	Sets the NMOS's failure criteria for lifetime computation when using the MOSRA API.	Model Analysis	-

Control Option	Description	Category	Associated Command
.OPTION DEGFP	Sets the PMOS's failure criteria for lifetime computation when using the MOSRA API.	Model Analysis	-
.OPTION DELMAX	Sets the maximum allowable step size of the time steps taken during transient analysis in HSPICE.	Speed and Accuracy	.TRAN
.OPTION DIAGNOSTIC	Logs the occurrence of negative model conductances.	Netlist Parser	-
.OPTION DLENCSDF	Specifies how many digits to include in scientific notation (exponents) or to the right of the decimal point when using Common Simulation Data Format.	Interface Control	-
.OPTION DP_FAST	When turned on (=Yes) sets `MC_Fast=Yes` and uses several other options to reduce the number and size of the output files.	Analysis	-
.OPTION DUMPCFL	Prints all the internal variables for HSPICE-CFL simulations.	Output Listing	.DC .TRAN
.OPTION DV	Specifies maximum iteration to iteration voltage change for all circuit nodes in both DC and transient analyses.	Analysis	.DC .TRAN
.OPTION DYNACC	(Optimization) Dynamic accuracy tolerance setting to accelerate bisection simulation.	Speed and Accuracy	.MODEL
.OPTION EM_RECOVERY	Provides a coefficient value for measuring “recovered” average current such as electro-migration for bipolar currents.	Error Tolerance	.MEASURE (AVG, EM_AVG, INTEG, MIN, MAX, PP, and RMS)
.OPTION EPSMIN	Specifies the smallest number a computer can add or subtract.	Error Tolerance	-
.OPTION EQN_ANALYTICAL_DERIV	Enables analytical derivative computation for expression-based element evaluations in HPP analysis and advanced analog analyses.	HB Options	-

Control Option	Description	Category	Associated Command
.OPTION ETMIAGECHK	Controls TMI aging forbidden behaviors.	Custom Models	-
.OPTION ETMIUSRINPUT	Point to the location of TMI *.so (compiled library). Multiple etmiUsrInput options can be specified in a netlist.	Custom Models	-
.OPTION EXPLI	Enables the current-explosion model parameter.	Diode and BJT	-
.OPTION EXPMAX	Specifies the largest exponent that you can use for an exponential before overflow occurs.	Diode and BJT	-
.OPTION EXTEND_BISECTION_WINDOW	Specifies the times of extending bisection window.	Variation	-
.OPTION EXTERNAL_FILE	Avoids read-in of entire external block at front end.	Variation	-
.OPTION EXT_OP	Enable additional OP information output in HSPICE	Output Listing	-
.OPTION FFT_ACCURATE	Produces a computed time point at each FFT sampling time location. The FFT measurement is calculated based on the computed time points. Any post-processing utility such as WaveView can also use these time points for FFT measurement.	Spectral Analysis Controls	-
.OPTION FFTOUT	Prints 30 harmonic fundamentals.	Spectral Analysis Controls	.FFT
.OPTION FMAX	Sets the maximum frequency value of angular velocity, for poles and zeros.	Analysis	.PZ
.OPTION FROM_TO	Measures functions when .option AUTOSTOP is set, but the value of TO is not given.		
.OPTION FSCAL	Sets the frequency scale for Pole/ Zero analysis	Analysis	.PZ

Control Option	Description	Category	Associated Command
.OPTION FSDB	Enables HSPICE to output a transient waveform file (`*.tr#`) in FSDB format.	Output Listing	-
.OPTION GDCPATH	Adds conductance to nodes having no DC path to ground.	Analysis	-
.OPTION GEN_CUR_POL	Enables specifying that the generic current polarity maintain backward compatibility with HSPICE simulation files.	Analysis	-
.OPTION GENK	Automatically computes second-order mutual inductance for several coupled inductors.	Inductor and Mutual Inductors	-
.OPTION GEOCHECK	Checks MOSFET geometry range in global models.	Model Analysis	-
.OPTION GEOSHRINK	Element scaling factor used with .OPTION SCALE.	Model Analysis	-
.OPTION GMAX	Specifies the maximum conductance in parallel with a current source for .IC and .NODESET initialization circuitry.	Analysis	.TRAN .NODESET
.OPTION GMB_CLAMP	Disables negative conductance clamping.	Analysis	-
.OPTION GMIN	Specifies the minimum conductance added to all PN junctions for a time sweep in transient analysis for HSPICE.	Speed and Accuracy	-
.OPTION GMINDC	Specifies conductance in parallel for PN junctions and MOSFET nodes in DC analysis.	Analysis	.DC
.OPTION GRAMP	Specifies a conductance range over which DC operating point analysis sweeps GMINDC.	Analysis	.DC
.OPTION GSCAL	Sets the conductance scale for Pole/Zero analysis.	Analysis	.PZ
.OPTION GSHDC	Adds conductance from each node to ground when calculating the DC operating point of the circuit.	Analysis	-

Control Option	Description	Category	Associated Command
.OPTION GSHUNT	Adds conductance from each node to ground.	Analysis	-
.OPTION HB_GIBBS	Option to minimize Gibbs' phenomena.	HB Options	-
.OPTION HBACKRYLOVDIM	Specifies the dimension of the Krylov subspace used by the Krylov solver.	HB Options	.HB
.OPTION HBACKRYLOVITER	Specifies the number of GMRES solver iterations performed by the HB engine.	HB Options	.HBAC
.OPTION HBACTOL	Specifies the absolute error tolerance for determining convergence.	HB Options	.HB
.OPTION HBCONTINUE	Specifies whether to use the sweep solution from the previous simulation as the initial guess for the present simulation.	HB Options	.HB
.OPTION HBFREQABSTOL	Specifies the maximum absolute change in frequency between solver iterations for convergence.	HB Options	.HBOSC
.OPTION HBFREQRELTOL	Specifies the maximum relative change in frequency between solver iterations for convergence.	HB Options	.HBOSC
.OPTION HBJREUSE	Controls when to recalculate the Jacobson matrix.	HB Options	.HB
.OPTION HBJREUSETOL	Determines when to recalculate Jacobian matrix if HBJREUSE=1.0.	HB Options	.HB
.OPTION HBKRYLOVDIM	Specifies the dimension of the subspace used by the Krylov solver.	HB Options	.HB
.OPTION HBKRYLOVMAXITER	Specifies the maximum number of GMRES solver iterations performed by the HB engine.	HB Options	.HB
.OPTION HBKRYLOVTOL	Specifies the error tolerance for the Krylov solver.	HB Options	.HB

Control Option	Description	Category	Associated Command
.OPTION HBLINESEARCHFAC	Specifies the line search factor.	HB Options	.HB
.OPTION HBMAXITER	Specifies the maximum number of Newton-Raphson iterations performed by the HB engine.	HB Options	.HB
.OPTION HBOSCMAXITER	Specifies the maximum number of outer-loop iterations for oscillator analysis.	HB Options	.HBOSC
.OPTION HBPROBETOL	Searches for a probe voltage at which the probe current is less than the specified value.	HB Options	.HBOSC
.OPTION HBSOLVER	Specifies a pre-conditioner for solving nonlinear circuits.	HB Options	.HBOSC
.OPTION HBTOL	Specifies the absolute error tolerance for determining convergence.	HB Options	.HB
.OPTION HBTRANFREQSEARCH	Specifies the frequency source for the HB analysis of a ring oscillator.	HB Options	.HB .HBOSC
.OPTION HBTRANINIT	Selects transient analysis for initializing all state variables for HB analysis of a ring oscillator.	HB Options	.HB .HBOSC
.OPTION HBTRANPTS	Specifies the number of points per period for converting time-domain data results into the frequency domain for HB analysis of a ring oscillator.	HB Options	.HB .HBOSC
.OPTION HBTRANSTEP	Specifies transient analysis step size for the HB analysis of a ring oscillator.	HB Options	.HB .HBOSC
.OPTION HBTROUT	Turn-on or turn-off generation of HBTRANINIT initialization output.	HB Options	.HB .HBOSC
.OPTION HIER_DELIM	Replaces the caret delimiter with a period (for output control only) when used for HSPICE/ADE only.	Model Control	-
.OPTION HIER_SCALE	Uses the parameter S to scale subcircuits.	Model Control	-

Control Option	Description	Category	Associated Command
.OPTION IC_ACCURATE	Improves the accuracy of the .IC command.	Speed and Accuracy	.IC
.OPTION ICSWEEP	Saves the current analysis result of a parameter or temperature sweep as the starting point in the next analysis.	Speed and Accuracy	-
.OPTION INGOLD	Controls whether HSPICE prints `*.lis` file output in exponential form or engineering notation in HSPICE.	Output Listing	-
.OPTION INTERP	Limits output to only the .TRAN time step intervals for post-analysis tools.	Input/Output	.TRAN
.OPTION IPROP	Controls whether to treat all of the circuit information as IP protected.	Speed and Accuracy	-
.OPTION ITL1	Specifies the maximum DC iteration limit.	Speed and Accuracy	.DC
.OPTION ITL2	Specifies the iteration limit for the DC transfer curve.	Speed and Accuracy	.DC
.OPTION ITL5	Sets an iteration limit for transient analysis.	Speed and Accuracy	.TRAN
.OPTION ITLPTRAN	Controls iteration limit used in the final try of the pseudo-transient method.	Speed and Accuracy	.DC .OP
.OPTION ITLPZ	Sets the iteration limit for pole/zero analysis.	Speed and Accuracy	.PZ
.OPTION ITRPRT	Enables printing of output variables at their internal time points.	Input/Output	-
.OPTION IVDMARGIN	Helps characterize Vd_{margin} using terminal I-V at MOSFET external nodes.	3D-IC	.IVDMARGIN
.OPTION IVTH	Invokes a constant-current threshold voltage probing and characterization function.	3D-IC	-

Control Option	Description	Category	Associated Command
.OPTION IVTH_MODEL	Foundry defined constant-current threshold voltage probing and characterization function for BSIM-CMG models.	3D-IC	-
.OPTION KCLTEST	Activates the KCL (Kirchhoff's Current Law) test.	Error Tolerance	-
.OPTION KLIM	Sets the minimum mutual inductance.	Inductor and Mutual Inductors	-
.OPTION LA_FREQ	Specifies the upper frequency for which accuracy must be preserved.	RC Reduction	-
.OPTION LA_MAXR	Specifies the maximum resistance for linear matrix reduction.	RC Reduction	-
.OPTION LA_MINC	Specifies the minimum capacitance for linear matrix reduction.	RC Reduction	-
.OPTION LA_SPLC	Helps reduce RC post-processing time.	RC Reduction	-
.OPTION LA_TIME	Specifies the minimum time for which accuracy must be preserved.	RC Reduction	-
.OPTION LA_TOL	Specifies the error tolerance for the PACT algorithm.	RC Reduction	-
.OPTION LENNAM	Specifies maximum name length for printing operating point analysis results.	Output Listing	-
.OPTION LIMPTS	Specifies the number of points to print in AC analysis.	Output Listing	.AC .DC .TRAN
.OPTION LIMTIM	Specifies the amount of CPU time reserved to generate prints.	Output Listing	-
.OPTION LIS_NEW	Enables streamlining improvements to the *.lis file.	Output Listing	.LIB .NOISE .OP

Control Option	Description	Category	Associated Command
.OPTION LISLVL	Controls whether of not HSPICE suppresses the circuit number to circuit hierarchy information in the listing file.	Output Listing	-
.OPTION LIST	Prints a list of netlist elements, node connections, and values for components, voltage and current sources, parameters, and more.	Output Listing	-
.OPTION LOADHB	Loads state variable information from a specified file.	HB Options	.HB
.OPTION LOADSNINIT	Loads the operating point saved at the end of Shooting Newton analysis initialization.	Shooting Newton	-
.OPTION LSCAL	Sets the inductance scale for Pole/Zero analysis.	Analysis	.PZ
.OPTION MACMOD	Enables HSPICE to access the subcircuit definition for MOSFETs, diodes, and BJTs, when there is no matching model reference; also enables an HSPICE X-element to access the model reference when there is no matching subcircuit definition.	Model Control	-
.OPTION MAXAMP	Sets the maximum current through voltage-defined branches.	Error Tolerance	-
.OPTION MAXORD	Specifies the maximum order of integration for the GEAR method.	Transient Control Integration	-
.OPTION MAXWARNS	Specifies maximum number of safe operating area (SOA) warning messages.	Transient Control Integration	-
.OPTION MC_FAST	Helps reduce size of output files when distributed processing (-DP) includes Monte Carlo simulation.	Analysis	-
.OPTION MCBRIEF	Controls how HSPICE outputs Monte Carlo parameters.	Output Listing	-

Control Option	Description	Category	Associated Command
.OPTION MEASDGT	Formats the .MEASURE command output of significant digits in both the listing file and the `.MEASURE` output files.	.MEAS Options	.MEASURE
.OPTION MEASFAIL	Specifies where to print the failed measurement output.	.MEAS Options	.MEASURE
.OPTION MEASFILE	Controls whether measure information outputs to single or multiple files when an .ALTER command is present in the netlist.	.MEAS Options	.ALTER .MEASURE
.OPTION MEASFORM	Enables writing of measurement output files to Excel or HSIM formats, as well as the traditional HSPICE `*.mt#` format.	.MEAS Options	.MEASURE
.OPTION MEASOUT	Outputs .MEASURE / MEAS command values and sweep parameters into an ASCII file.	.MEAS Options	.ALTER .MEASURE .TEMPERATURE
.OPTION MESSAGE_LIMIT	Limits how many times a certain type warning can appear in the output listing based on the message index.	Output Listing	-
.OPTION METHOD	Sets the numerical integration method for a transient analysis for HSPICE.	Transient Control Integration	-
.OPTION MINVAL	Provides flexibility in changing values from defaults for specified options in a netlist.	Transient Control Integration	-
.OPTION MIN_HSPICE_VER	Specifies the minimum HSPICE version that will be respected by the tool.	Warning/Error Messages	-
.OPTION MIN_VER_ABORT	Checks the minimum HSPICE version to either print a warning message and continue processing, or to print an error message and abort processing.	Warning/Error Messages	-
.OPTION MIXED_NUM_FORMAT	Enables use of mixed exponential and engineering key letter number format.	Transient Control Integration	-

Control Option	Description	Category	Associated Command
.OPTION MODMONTE	Controls how random values are assigned to parameters with Monte Carlo definitions.	Model Control	.MODEL
.OPTION MODPARCHK	Determines whether HSPICE aborts a simulation if it encounters fatal-errors in model side parameter checking.	Model Control	-
.OPTION MODPRT	Invokes model pre-processing and parameter flattening.	Model Control	-
.OPTION MONTECON	Continues a Monte Carlo analysis in HSPICE by retrieving the next random value, even if nonconvergence occurs.	Input/Output	-
.OPTION MOSRALIFE	Invokes the MOSRA “lifetime” computation.	Model Control	-
.OPTION MOSRASORT	Enables the descending sort for reliability degradation (RADEG) output.	Model Control	.MOSRA
.OPTION MRA0xPATH	These options support file path access in MOSRA API functions.	Model Control	-
.OPTION MRAAPI	Loads and links the dynamically linked MOSRA API library.	Model Control	-
.OPTION MRADTEMPBA	Controls whether to back-annotate temperature change calculated by MOSRA during post-simulation.	Model Control	-
.OPTION MRAEXT	Enables access to MOSRA API extension functions.	Model Control	-
.OPTION MRAPAGED	Enables the MOSRA API to enable two modes of model parameter degradation.	Model Control	-
.OPTION MTTHRESH	Reduces the default active device limit for multithreading.	Multithreading Option	-
.OPTION MU	Defines the integration method coefficient.	Transient Control Integration	-

Control Option	Description	Category	Associated Command
.OPTION MULT_LESS_1	Controls the HSPICE simulator to either accept M-factor less than 1 in X element or issue a warning.	Model Analysis	-
.OPTION NCFILTER	Filters negative conductance warning messages according to the setting value.	Transient Control Integration	-
.OPTION NCWARN	Allows turning on a switch to report a warning message for negative conductance on MOSFETs.	Model Analysis	-
.OPTION NEWTOL	Calculates one or more iterations past convergence for every calculated DC solution and time point circuit solution.	Speed and Accuracy	-
.OPTION NODE	Prints a node cross-reference table.	Output Listing	-
.OPTION NOELCK	Bypasses element checking to reduce preprocessing time for very large files.	Netlist Parser	-
.OPTION NOISEMINFREQ	Specifies the minimum frequency of noise analysis in HSPICE.	AC/Noise	-
.OPTION NOISUM	Control the noise summary table output format.	Output Listing	-
.OPTION NOMOD	Suppresses the printout of model parameters.	Netlist Parser	-
.OPTION NOPIV	Controls whether HSPICE automatically switches to pivoting matrix factors.	Netlist Parser	-
.OPTION NOTOP	Suppresses topology checks to increase preprocessing speed.	Netlist Parser	-
.OPTION NOWARN	Suppresses parameter conflict warning messages.	Netlist Parser	.ALTER
.OPTION NUMDGT	Controls the listing printout accuracy.	Output Listing	-

Control Option	Description	Category	Associated Command
.OPTION NUMERICAL_DERIVATIVES	Diagnostic-only option for checking a problem with the device models.	Output Listing	-
.OPTION NXX	Stops echoing (print back) of the data file to stdout.	Output Listing	-
.OPTION OFF	Initializes terminal voltages to zero for active devices not initialized to other values.	Output Listing	.DC .IC .NODESET
.OPTION OFF_OUTPUT	Controls whether HSPICE creates `*.pa#` files.	Output Listing	-
.OPTION OP_AUTOSTOP	Controls the printing of op at autostop time.		
.OPTION OPFILE	Outputs the operating point information to a file.	Input/Output	.OP
.OPTION OPTCON	Continues running a bisection analysis (with multiple .ALTER commands) even if optimization failed.	Analysis	.ALTER
.OPTION OPTLST	Outputs additional optimization information.	Output Listing	-
.OPTION OPTPARHIER	Specifies scoping rules to options.	Output Listing	.SUBCKT
.OPTION OPTS	Prints current settings for all control options.	Output Listing	-
.OPTION PARHIER	Specifies scoping rules for netlist parameters.	Netlist Parser	.SUBCKT
.OPTION PATHNUM	Prints subcircuit path numbers instead of path names; overrides 8-character model name limitation.	Output Listing	-
.OPTION PCB_SCALE_FORMAT	Extends support for using a scaling factor in place of the decimal point for PCB part number formats during case-sensitive simulation.	Output Listing	-

Control Option	Description	Category	Associated Command
.OPTION PHASENOISEKRYLOVDIM	Specifies the dimension of the Krylov subspace that the Krylov solver uses.	Phase Noise Analysis	.PHASENOISE
.OPTION PHASENOISEKRYLOVITR	Specifies the maximum number of Krylov iterations that the phase noise Krylov solver takes.	Phase Noise Analysis	.PHASENOISE
.OPTION PHASENOISETOL	Specifies the error tolerance for the phase noise solver.	Phase Noise Analysis	.PHASENOISE
.OPTION PHASETOLI	For HB output, aids in reporting when magnitude of phase current is very small.	Phase Noise Analysis	.HB .HBAC .HBLIN .HBLSP .HBNOISE .HBOSC .HBXF
.OPTION PHASETOLV	For HB output, aids in reporting when magnitude of phase voltage is very small.	Phase Noise Analysis	.HB .HBAC .HBLIN .HBLSP .HBNOISE .HBOSC .HBXF
.OPTION PHD	Facilitates fast OP convergence for BSIM4 test cases.	Phase Noise Analysis	-
.OPTION PHNOISEAMPM	Allows you to separate amplitude modulation and phase modulation components in a phase noise simulation.	Phase Noise Analysis	.PHASENOISE
.OPTION PHNOISELORENTZ	Turns on a Lorentzian model for the phase noise analysis.	Phase Noise Analysis	.PHASENOISE
.OPTION PIVOT	Selects a pivot algorithm.	Model Control	-
.OPTION PIVTOL	Sets the absolute minimum value for which HSPICE accepts a matrix entry as a pivot.	Model Control	-

Control Option	Description	Category	Associated Command
.OPTION POST	Saves simulation results for viewing by an interactive waveform viewer.	Input/Output	-
.OPTION POST_VERSION	Specifies the post-processing output version for HSPICE.	Input/Output	-
.OPTION POSTLVL	Limits the data written to your waveform file to a specified level of nodes.	Input/Output	-
.OPTION POSTTOP	Limits the data written to the waveform file to data from only the top n level nodes.	Input/Output	-
.OPTION PROBE	Limits post-analysis output to only variables specified in .PROBE and .PRINT commands for HSPICE.	Input/Output	.PRINT
.OPTION PSF	Specifies whether the output is binary (Parameter Storage Format) or ASCII.	Interface Control	-
.OPTION PURETP	Specifies the integration method to use for reversal time point in HSPICE.	Transient Control Integration	-
.OPTION PUTMEAS	Controls the output variables listed in the .MEASURE command.	.MEAS Options	.MEASURE
.OPTION PZ_METHOD	Selects the method for pole and zero analysis.		
.OPTION PZ_NUM	Sets the maximum allowable number of poles and zeros that will be output to log file.		
.OPTION PZABS	Sets absolute tolerances for poles and zeros.	Analysis	-
.OPTION PZTOL	Sets the relative tolerance for poles and zeros.	Analysis	-
.OPTION RADEGFILE	Use to specify a MOSRA degradation file name to be used with SIMMODE=1.	Output Listing	.MOSRA

Control Option	Description	Category	Associated Command
.OPTION RADEGOUTPUT	Outputs the MOSRA degradation information to the Word Excel CSV format.	Output Listing	-
.OPTION RANDGEN	Specifies the random number generator used in traditional Monte Carlo analysis.	Error Tolerance	-
.OPTION REDEFMODEL	Allows redefinition of a model in a netlist.	Error Tolerance	-
.OPTION REDEFSUB	Allows redefinition of a subckt in a netlist.	Error Tolerance	-
.OPTION RELIN	(Optimization) Relative input parameter (`delta_par_val / MAX(par_val,1e-6)`) for convergence.	Error Tolerance	.MODEL
.OPTION RELMOS	Sets the relative error tolerance for drain-to-source current from iteration to iteration.	Error Tolerance	-
.OPTION RELVDC	Sets the relative error tolerance for voltages from iteration to iteration.	Error Tolerance	-
.OPTION REPLICATES	Runs replicates of the Latin Hypercube samples.	Error Tolerance	-
.OPTION RES_BITS	Tightens tolerances when using HSPICE Precision Parallel (HPP) in transient simulations.	Error Tolerance	-
.OPTION RESMIN	Specifies the minimum resistance for all resistors.	Resistance	-
.OPTION RISETIME	Specifies the smallest signal rise time to be supported in elements and analyses that are sensitive to frequency bandwidth and time scale constraints.	Speed and Accuracy	.MODEL
.OPTION RITOL	Sets the minimum ratio value for the (real/imaginary) or (imaginary/real) parts of the poles or zeros.	Speed and Accuracy	.PZ

Control Option	Description	Category	Associated Command
.OPTION RM_CMAX	Enables you to set a value above which HSPICE removes capacitors from the circuit.	Speed and Accuracy	-
.OPTION RM_CMIN	Enables you to set a value below which HSPICE ignores capacitors.	Speed and Accuracy	-
.OPTION RM_CNEG	Removes all negative capacitors.	Speed and Accuracy	-
.OPTION RM_RMAX	Enables you to set a value above which HSPICE removes resistors from the circuit.	Speed and Accuracy	-
.OPTION RM_RMIN	Enables you to set a value below which HSPICE ignores resistors.	Speed and Accuracy	-
.OPTION RM_RNEG	Resets all negative resistors to .OPTION RESMIN setting.	Speed and Accuracy	-
.OPTION RUNLVL	Controls runtime speed and simulation accuracy.	Speed and Accuracy	.TRAN
.OPTION SAMPLING_METHOD	Enables use of advanced sampling methods with traditional Gaussian Monte Carlo trials.	Speed and Accuracy	-
.OPTION SAVEHB	Saves the final-state variable values from an HB simulation.	HB Options	.HB
.OPTION SAVESNINIT	Saves the operating point at the end of Shooting Newton initialization.	Shooting Newton	.SN
.OPTION SCALE	Sets the element scaling factor for HSPICE.	Scaling	-
.OPTION SCALM	Sets the model scaling factor.	Scaling	.MODEL
.OPTION SEARCH	Automatically accesses a library, Verilog-A, or individual vendor files.	Netlist Parser	-
.OPTION SEED	Specifies the starting seed for the random-number generator in Monte Carlo analysis.	Model Control	-

Control Option	Description	Category	Associated Command
.OPTION SET_MISSING_VALUES	Sub-option to `SAMPLING_METHOD=External` option, limits reporting of missing independent random variables.	Model Control	-
.OPTION SHRINK	Scales the final constant capacitance value (only works with `.OPTION CMIUSRFLAG=3`).	Model Control	-
.OPTION SI_SCALE_SYMBOLS	Controls whether the scale factors are HSPICE attributes or International System of Units (SI) when case sensitivity is invoked.	Model Control	-
.OPTION SIM_ACCURACY	Sets and modifies the size of time steps.	Transient Accuracy Options	-
.OPTION SIM_DELTAI	Sets the selection criteria for current waveforms in WDB and NW format.	DSPF Options	-
.OPTION SIM_DELTAV	Sets the selection criteria for current waveforms in WDB and NW format.	DSPF Options	-
.OPTION SIM_DSPF	Runs simulation with standard DSPF expansion of all nets from one or more DSPF files.	DSPF Options	-
.OPTION SIM_DSPF_ACTIVE	Runs simulation with selective DSPF expansion of active nets from one or more DSPF files.	DSPF Options	-
.OPTION SIM_DSPF_INSERROR	Skips unmatched instances.	DSPF Options	-
.OPTION SIM_DSPF_LUMPCAPS	Connects a lumped capacitor with a value equal to the net capacitance for instances missing in the hierarchical netlist.	DSPF Options	-
.OPTION SIM_DSPF_MAX_ITER	Specifies the maximum number of simulation runs for the second selective DSPF expansion pass.	DSPF Options	-
.OPTION SIM_DSPF_RAIL	Controls whether power-net parasitics are back-annotated	DSPF Options	-

Control Option	Description	Category	Associated Command
.OPTION SIM_DSPF_SCALEC	Scales the capacitance values in a DSPF file for a standard DSPF expansion flow.	DSPF Options	-
.OPTION SIM_DSPF_SCALER	Scales the resistance values in a DSPF file for a standard DSPF expansion flow.	DSPF Options	-
.OPTION SIM_DSPF_VTOL	Specifies multiple DSPF active thresholds.	DSPF Options	-
.OPTION SIM_LA	Activates linear matrix (RC) reduction for HSPICE.	RC Reduction	-
.OPTION SIM_LA_FREQ	Specifies the upper frequency for which accuracy must be preserved.	RC Network Reduction	-
.OPTION SIM_LA_MAXR	Specifies the maximum resistance for linear matrix reduction.	RC Network Reduction	-
.OPTION SIM_LA_MINC	Specifies the minimum capacitance for linear matrix reduction.	RC Network Reduction	-
.OPTION SIM_LA_TIME	Specifies the minimum time for which accuracy must be preserved.	RC Network Reduction	-
.OPTION SIM_LA_TOL	Specifies the error tolerance for the PACT algorithm.	RC Network Reduction	-
.OPTION SIM_ORDER	Controls the amount of Backward-Euler (BE) method to mix with the Trapezoidal (TRAP) method for hybrid integration.	Transient Accuracy Options	-
.OPTION SIM_OSC_DETECT_TOL	Specifies the tolerance for detecting numerical oscillations.	Transient Accuracy Options	-
.OPTION SIM_POSTAT	Specifies waveform output to nodes in the specified subcircuit instance only.	Simulation Output	-
.OPTION SIM_POSTDOWN	Limits waveform output to nodes in the specified subcircuit instance and their children.	Simulation Output	-

Control Option	Description	Category	Associated Command
.OPTION SIM_POSTSCOPE	Specifies the signal types to probe from within a scope.	Simulation Output	-
.OPTION SIM_POSTSKIP	Causes the SIM_POSTTOP option to skip subckt_definition instances.	Simulation Output	-
.OPTION SIM_POSTTOP	Limits data written to your waveform file to data from only the top n level nodes.	Simulation Output	-
.OPTION SIM_POWER_ANALYSIS	Prints a list of signals matching the tolerance setting at a specified point in time.	Power Analysis	.POWER
.OPTION SIM_POWER_TOP	Controls the number of hierarchy levels on which power analysis is performed.	Power Analysis	.POWER
.OPTION SIM_POWERDC_ACCURACY	Increases the accuracy of operating point calculations for POWERDC analysis.	Power Analysis	.POWERDC
.OPTION SIM_POWERDC_HSPICE	Increases the accuracy of operating point calculations for POWERDC analysis.	Power Analysis	.POWERDC
.OPTION SIM_POWERPOST	Controls power analysis waveform dumping.	Power Analysis	.POWER
.OPTION SIM_POWERSTART	Specifies a default start time for measuring signals during simulation.	Power Analysis	-
.OPTION SIM_POWERSTOP	Specifies a default stop time for measuring signals during simulation.	Power Analysis	.POWERDC
.OPTION SIM_SPEF	Runs simulation with SPEF expansion of all nets from one or more SPEF files.	SPEF Options	-
.OPTION SIM_SPEF_ACTIVE	Runs simulation with selective SPEF expansion of active nets from one or more DSPF files.	SPEF Options	-
.OPTION SIM_SPEF_INSERROR	Skips unmatched instances.	SPEF Options	-

Control Option	Description	Category	Associated Command
.OPTION SIM_SPEF_LUMPCAPS	Connects a lumped capacitor with a value equal to the net capacitance for instances missing in the hierarchical netlist.	SPEF Options	-
.OPTION SIM_SPEF_MAX_ITER	Specifies the maximum number of simulation runs for the second selective SPEF expansion pass.	SPEF Options	-
.OPTION SIM_SPEF_PARVALUE	Interprets triplet format float:float:float values in SPEF files as best: average: worst.	SPEF Options	-
.OPTION SIM_SPEF_RAIL	Controls whether power-net parasitics are back-annotated.	SPEF Options	-
.OPTION SIM_SPEF_SCALEC	Scales the capacitance values in a SPEF file for a standard SPEF expansion flow.	SPEF Options	-
.OPTION SIM_SPEF_SCALER	Scales the resistance values in a SPEF file for a standard SPEF expansion flow.	SPEF Options	-
.OPTION SIM_SPEF_VTOL	Specifies multiple SPEF active thresholds.	SPEF Options	-
.OPTION SIM_TG_THETA	Controls the amount of second-order Gear method to mix with Trapezoidal integration for the hybrid TRAPGEAR method.	Transient Accuracy Options	-
.OPTION SIM_TRAP	Changes the default SIM_TG_THETA=0 so that METHOD=TRAPGEAR acts like METHOD=TRAP.	Transient Accuracy Options	-
.OPTION SKIP_XINST	Specifies subcircuit instances to be ignored from simulation.	Model Control	-
.OPTION SLOPETOL	Specifies the minimum value for breakpoint table entries in a piecewise linear (PWL) analysis.	Speed and Accuracy	-
.OPTION SNACCURACY	Sets and modifies the size of time steps.	Shooting Newton	-

Control Option	Description	Category	Associated Command
.OPTION SNCONTINUE	Specifies whether to use the sweep solution from the previous simulation as the initial guess for the present simulation.	Shooting Newton	.SN
.OPTION SNINITOUT	Turn-on or turn-off generation of SN initialization output.	Shooting Newton	.SN
.OPTION SNMAXITER	Sets the maximum number of iterations for a Shooting Newton analysis.	Shooting Newton	.SN
.OPTION SNTMPFILE	Specifies whether Shooting Newton analysis stores intermediate solution data to disk or memory.	Shooting Newton	.SN
.OPTION SOIQ0	Invokes the body charge initialization (BQI) algorithm.	Model Analysis	.DC .OP .TRAN
.OPTION SPLIT_DP	Enables the writing of multiple operating points in separate files.	Model Analysis	.OP
.OPTION SPLITMA	Enables the writing of multiple AC measure files, when using AC analysis with transient and OP analyses.	Output Listing	-
.OPTION SPMODEL	Disables the previous .OPTION VAMODEL.	Verilog-A	-
.OPTION STATFL	Controls whether HSPICE creates a `.st0` file.	Output Listing	-
.OPTION STRICT_CHECK	Turns a subset of HSPICE netlist syntax warnings into terminal (abortive) syntax errors.	Model Analysis	-
.OPTION SX_FACTOR	External shrink factor, only used for Ivthx calculation with the .IVTH command.	3D-IC	.IVTH
.OPTION SYMB	Uses a symbolic operating point algorithm to get initial guesses before calculating operating points.	Speed and Accuracy	-

Control Option	Description	Category	Associated Command
.OPTION TIMERES	Sets the minimum separation between breakpoint values for the breakpoint table.	Speed and Accuracy	-
.OPTION TMEVTHMD	Foundry defined constant-current threshold voltage probing and characterization function for BSIM-CMG models.	3D-IC	-
.OPTION TMIAGE	Turn on and turn off TMI reliability analysis (TMI aging) simulation flow.	Custom Models	-
.OPTION TMIFLAG	Invokes the TMI flow and specifies TMI version.	Custom Models	-
.OPTION TMIINPUT	Point to the location of TMI configuration file or previously `.tmiage` file.	Custom Models	-
.OPTION TMIPATH	Points to a TMI *.so (compiled library) file location.	Custom Models	-
.OPTION TMISAVE	A flag to control if TMI model shall save the intermediate TMI aging analysis data to `.tmiage` file.	Custom Models	-
.OPTION TMPLT_POL	Enables HSPICE to print PMOS template output voltage polarity as real bias.	Custom Models	-
.OPTION TNOM	Sets the reference temperature for the simulation.	Temperature	.TEMP / TEMPERATURE
.OPTION TRANFORHB	Forces HB analysis to recognize or ignore specific V/I sources.	HB Options	.HB
.OPTION TRCON	Controls the automatic convergence process of transient simulation.	Speed and Accuracy	-
.OPTION UNWRAP	Displays phase results for AC analysis in unwrapped form.	Output Listing	-
.OPTION USE_TEMP	Checks the values of the temperature when a netlist contains multiple defined .TEMPERATURE statements.	Netlist Parser	.TEMPERATURE

Control Option	Description	Category	Associated Command
.OPTION VAMODEL	Specifies that name is the cell name that uses a Verilog-A definition rather than the subcircuit definition when both exist (for use in HSPICE with Verilog-A).	Verilog-A	-
.OPTION VECBUS	Enables backward compatibility in a vector file for bus mode.		-
.OPTION VER_CONTROL	Determines whether to continue the simulation when encountering non-supported model versions.		-
.OPTION VERIFY	Duplicates the LIST option.		-
.OPTION VFLOOR	Sets the minimum voltage to print in the output listing for DC and transient analysis.	Output Listing	-
.OPTION WACC	Activates the dynamic step control algorithm for a W-element transient analysis.	Transmission Lines	-
.OPTION WARN	Enables or turns off SOA voltage warning message.	Output Listing	-
.OPTION WARN_SEP	Separates out warnings to a file, while suppressing them in the *.lis file.	Output Listing	-
.OPTION WARNLIMIT	Limits how many times certain warnings appear in the output listing.	Output Listing	-
.OPTION WAVE_POP	Enables setting of buffer flush interval for `.tr0` and `.wdf` files.	Output Listing	-
.OPTION WDELAYOPT	Globally applies the DELAYOPT keyword to a W-element transient analysis.	Output Listing	-
.OPTION WDF	Enables HSPICE to produce waveform files in WDF format.	Output Listing	.PRINT .PROBE
.OPTION WINCLUDEGDIMAG	Globally activates the complex dielectric loss model in W-element analysis.	Output Listing	-

Control Option	Description	Category	Associated Command
.OPTION WL	Reverses the order of the VSIZE MOS element.	Model Analysis	-
.OPTION WNFLAG	Controls whether bin is selected based on w or w/nf.	Model Analysis	-
.OPTION XDTEMP	Defines how HSPICE interprets the DTEMP parameter.	Temperature	-
.OPTION XMULT_IN_EXP / M_IN_EXP	Allows X multiplier in right side of expression within a subcircuit.	Model Analysis	-
.VARIATION Block Control Options	Several options can be applied when doing a `.VARIATION` analysis. Note that no leading period is allowed with Variation Block control options.	Variation Analysis	-

.DESIGN_EXPLORATION

The following options can be applied when doing `.DESIGN_EXPLORATION` analysis. Note that no leading period is allowed with variation control options:

Syntax

```
Option Explore_only Subckts= SubcktList
Option Do_not_explore Subckts= SubcktList
Option Export=yes|no
Option Exploration_method=external Block_name=Block_name
Option Ignore_exploration= yes|no
Option Secondary_param= yes|no
```

Description

The Design Exploration control options are described below:

- `Option Explore_only Subckts= SubcktList` This command is executed hierarchically — the specified subcircuits and all instantiated subcircuits and elements underneath are affected. Thus, if an inverter with name `INV1` is placed in a digital control block called `DIGITAL` and in an

analog block `ANALOG`, and `OptionExplore_only Subckts = ANALOG`, then the perturbations only affect the `INV1` in the analog block. You must create a new inverter, `INV1analog`, with the new device sizes.

- `Option Do_not_explore Subckts= SubcktList` Excludes listed subcircuits.
- `Option Export=yes|no` If yes, exports extraction data and runs a simulation with the original netlist. If no (default), runs a simulation with Exploration data.
- `Option MexFileOnly=yes|no` If yes, generates a `*.mex` file without running a simulation. If no (default), generates a `*.mex` file only after a simulation is run. `Option Export=yes` must precede this option.
- `Option Exploration_method=external Block_name=Block_name` The `Block_name` is the same as the name specified in the `.DATA` block; HSPICE will sweep the row content with the *`EXCommand`*`explore`.
- `Option Ignore_exploration= yes|no` (Default=no) HSPICE ignores the content in the design_exploration block, when `Ignore_exploration=yes`.
- `Option Secondary_param= yes|no` (Default=no) If `Secondary_param=yes`, HSPICE exports the MOSFET secondary instance parameters to a `*.mex` file (created when `option export=yes`), and also permits the secondary parameters to be imported as a column header in the `.DATA` block (`option export=no`).

See Also

.DESIGN_EXPLORATION
Exploration Block

.OPTION (X0R,X0I)

The first of three complex starting-trial points in the Muller algorithm used in Pole/Zero analysis.

Syntax

```
.OPTION (X0R,X0I)= x,x
```

Default `X0R=-1.23456e6` `X0I=0.0`

Description

Use this option in Pole/Zero analysis if you need to change scale factors and modify the initial Muller points, (X0R, X0I), (X1R, X1I) and (X2R, X2I). HSPICE multiplies these initial points, and FMAX, by FSCAL.

Scale factors must satisfy the following relations: $GSCAL = CSCAL \cdot FSCAL$

$$GSCAL = \frac{1}{LSCAL \cdot FSCAL}$$

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION FSCAL
.OPTION GSCAL
.OPTION ITLPZ
.OPTION LSCAL
.OPTION PZABS
.OPTION PZTOL
.PZ

.OPTION (X1R,X1I)

The second of three complex starting-trial points in the Muller algorithm used in Pole/Zero analysis.

Syntax

```
.OPTION (X1R,X1I)= x,x
```

Default `X1R=1.23456e5 X1I=0.0`

Description

Use this option in Pole/Zero analysis if you need to change scale factors and modify the initial Muller points, (X0R, X0I), (X1R, X1I) and (X2R, X2I). HSPICE multiplies these initial points, and FMAX, by FSCAL.

Scale factors must satisfy the following relations:

$GSCAL = CSCAL \cdot FSCAL$

$$GSCAL = \frac{1}{LSCAL \cdot FSCAL}$$

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION FSCAL
.OPTION GSCAL
.OPTION ITLPZ
.OPTION LSCAL
.OPTION PZABS
.OPTION PZTOL
.PZ

.OPTION (X2R,X21)

The third of three complex starting-trial points in the Muller algorithm used in Pole/Zero analysis.

Syntax

```
.OPTION (X2R,X2I)= x,x
```

Default X2R=+1.23456e6 X2I=0.0

Description

Use this option in Pole/Zero analysis if you need to change scale factors and modify the initial Muller points, (X0R, X0I), (X1R, X1I) and (X2R, X2I). HSPICE multiplies these initial points, and FMAX, by FSCAL.

Scale factors must satisfy the following relations: $GSCAL = CSCAL \cdot FSCAL$

$$GSCAL = \frac{1}{LSCAL \cdot FSCAL}$$

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION FSCAL
.OPTION GSCAL
.OPTION ITLPZ
.OPTION LSCAL
.OPTION PZABS
.OPTION PZTOL
.PZ

.OPTION ABSI

Sets the absolute error tolerance for branch currents in diodes, BJTs, and JFETs during DC and transient analysis.

Syntax

```
.OPTION ABSI=x
```

Default `1e-9` when `KCLTEST=0` or `1e-6` when `KCLTEST=1`.

Description

Use this option to set the absolute error tolerance for branch currents in diodes, BJTs, and JFETs during DC and transient analysis. Decrease `ABSI` if accuracy is more important than convergence time.

To analyze currents less than 1 nanoamp, change `ABSI` to a value at least two orders of magnitude smaller than the minimum expected current. Min value: 1e-25; Max value: 10.

See Also

.DC
.OPTION ABSMOS
.OPTION KCLTEST
.TRAN

.OPTION ABSIN

Convergence criteria for bisection/pass/fail optimization.

Syntax

```
.OPTION ABSIN=val
```

Default None

Description

This option invokes the absolute input parameter value and takes effect only for bisection methods `bisection` or `passfail`. When set as `.OPTION ABSIN`, it overrides all optimization model card accuracy settings and ignores the `relout` and `itropt` parameters; when set in the model card, `absin` takes effect only for the specified model. In cases where both `absin` and `relin` are set, `absin` takes higher priority and dominates the simulation.

Examples

```
.OPTION ABSIN=5.0e-11
```

For use in a model card:

```
.MODEL optmod opt absin=5.0e-11
```

See Also

.MODEL

.OPTION ABSMOS

Specifies the current error tolerance for MOSFET devices in DC or transient analysis.

Syntax

```
.OPTION ABSMOS=x
```

Default 1uA

Description

Use this option to specify the current error tolerance for MOSFET devices in DC or transient analysis. The `ABSMOS` setting determines whether the drain-to-source current solution has converged. The drain-to-source current converged if:

- The difference between the drain-to-source current in the last iteration and the current iteration is less than `ABSMOS`.

  or:

- This difference is greater than `ABSMOS`, but the percent change is less than `RELMOS`.

Min value: 1e-15; Max value 10.

If other accuracy tolerances also indicate convergence, HSPICE solves the circuit at that timepoint and calculates the next timepoint solution.
For single transistor and small circuits sensitive to leakage current, set `ABSMOS=1e-12`.

See Also

.DC
.OPTION RELMOS
.TRAN

.OPTION ABSTOL

Sets the absolute error tolerance for branch currents in DC and transient analysis.

Syntax

```
.OPTION ABSTOL=x
```

Default 1e-9

Description

Use this option to set the absolute error tolerance for branch currents in DC and transient analysis. Decrease ABSTOL if accuracy is more important than convergence time. ABSTOL is the same as ABSI. Min value: 1e-25; Max value: 10.

See Also

.DC
.OPTION ABSI
.OPTION ABSMOS
.TRAN

.OPTION ABSVDC

Sets the minimum voltage for DC and transient analysis.

Syntax

```
.OPTION ABSVDC=volts
```

Default 50uV.

Description

Use this option to set the minimum voltage for DC and transient analysis. If accuracy is more critical than convergence, decrease ABSVDC. If you need voltages less than 50 uV, reduce ABSVDC to two orders of magnitude less than the smallest voltage. This ensures at least two digits of significance. Typically, you do not need to change ABSVDC unless you simulate a high-voltage circuit. For 1000-volt circuits, a reasonable value is 5 to 50 uV.

See Also

.DC
.TRAN

.OPTION ACCURATE

Selects a time algorithm for circuits such as high-gain comparators.

Syntax

```
.OPTION ACCURATE=[0|1]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to increase the setting of the `RUNLVL` accuracy setting.

The `ACCURATE` option will increase the value of RUNLVL to 5 if RUNLVL is set to `1`, `2`, `3` (default), or `4`. If the `ACCURATE` option is set and RUNLVL is set to `5` or `6`, the value of RUNLVL will be limited to 5 or 6

When used with HSPICE advanced analog functions, this option turns on `.OPTION FFT_ACCURATE` and is subordinate to `.OPTION SIM_ACCURACY`.

To see how use of the `.OPTION ACCURATE` impacts the value settings when used with .`METHOD=GEAR`, and other options, see Appendix A, HSPICE Control Options Notes.

See Also

.OPTION FFT_ACCURATE
.OPTION METHOD
.OPTION RELMOS
.OPTION SIM_ACCURACY

.OPTION ALTCC

Sets onetime reading of the input netlist for multiple `.ALTER` commands.

Syntax

```
.OPTION ALTCC=[-1|0|1]
```

Default 0

Description

Use this option to enable HSPICE to read the input netlist only once for multiple .ALTER commands.

- ALTCC=1 reads input netlist only once for multiple .ALTER commands.
- ALTCC=0 or -1 disables this option. HSPICE does not output a warning message during transient analysis. Results are output following analysis.

.OPTION ALTCC or .OPTION ALTCC=1 ignores parsing of an input netlist before an .ALTER command during standard cell library characterization only when an .ALTER command changes parameters, source stimulus, analysis, or passive elements. Otherwise, this option is ignored.

See Also

.ALTER
.LIB

.OPTION ALTCHK

Disables (or re-enables) topology checking in redefined elements (in altered netlists).

Syntax

```
.OPTION ALTCHK=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

By default, HSPICE automatically reports topology errors in the latest elements in your top-level netlist. It does not report errors in elements that you redefine by using the .ALTER command (altered netlist).

To enable topology checking redefined elements in the .ALTER block, set: .OPTION ALTCHK=1 or .OPTION ALTCHK.

To disable topology checking in redefined elements (that is, to check topology only in the top-level netlist, not in the altered netlist), set:

```
.OPTION ALTCHK=0
```

See Also

.ALTER

.OPTION ALTER_SELECT

Enables selection of one or more alters from a list of alters.

Syntax

```
.OPTION ALTER_SELECT="list_command"
```

Description

Use this option to run specific selected alters from a list of alters where *list_command* can be either:

- "list *num*": Specifies one or more .alters to execute

  or

- "list(num1:num2 num3 num4:num5)": Executes samples from num1 to num2, sample num3, and samples from num4 to num5 (parentheses are optional).

Note: Either single or double quotation marks are required around the "list_command".

Examples

Example 1 This example simulates .ALTER # 5 and #18.

```
.OPTION ALTER_SELECT="list 5 18"
```

Example 2 This example simulates .ALTERs 1, 2, 3, 6, 10, and 11.

```
.OPTION ALTER_SELECT='list(1:3 6 10:11)' $ Parentheses optional
```

.OPTION APPENDALL

Allows the top hierarchical level to use the .APPENDMODEL command even if the MOSFET model is embedded in a subcircuit.

Syntax

```
.OPTION APPENDALL
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option when, for example, MOSFET model cards from fabs might be embedded in subcircuit definitions. The option ends the need to edit fab model files to include .APPENDMODEL commands in subcircuit definitions.When this option is declared above the .APPENDMODEL command, then the main (uppermost) circuit level hierarchy can be used, even if the MOSFET model is embedded in a subcircuit. With this option, if the .APPENDMODEL command appears both in the main circuit and in a subcircuit, the .APPENDMODEL in the subcircuit takes priority.Without this option, the rules of .APPENDMODEL remain unchanged.

Examples

In this example, the .APPENDMODEL in the main circuit is used.

```
.option appendall
.appendmodel n_ra mosra nch nmos
.SUBCKT mosra_test 1 2 3 4
M1 1 2 3 4 nch L=PL W=PW
.model nch nmos level= ...
.ENDS
```

In this example, the .APPENDMODEL in the subcircuit is used.

```
.option appendall
.appendmodel n_ra mosra nch nmos
.SUBCKT mosra_test 1 2 3 4
M1 1 2 3 4 nch L=PL W=PW
.model nch nmos level= ...
.appendmodel n_ra1 mosra nch nmos
.ENDS
```

See Also

.APPENDMODEL
.MODEL
.MOSRA

.OPTION ARTIST

Enables the Cadence Virtuoso Analog Design Environment interface.

Syntax

```
.OPTION ARTIST=[0|1|2]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 2

Description

Enables the Virtuoso® Analog Design Environment if `ARTIST=2`. This option requires a specific license.

This option is generally used together with `.OPTION PSF`. If you use `.OPTION PSF=1` or `2` with `ARTIST=1` or `2` then the output format is always binary (Parameter Storage Format) and you need to use the Cadence ADE converter utility to change the binary format to ASCII format. When `ARTIST=2 PSF=2`, no `*.dp#` files are generated, nor is OP information output in the `*.lis` file. If `.OPTION OPFILE=1` is in a netlist when `ARTIST=2`/`PSF=2`, the OPFILE=1 is ignored.

The combinations shown in the below table produce the following output file format:

PSF Value	ARTIST Value	Output File Format
1	0	Binary
1	1	Binary
1	2	Binary
2	0	ASCII
2	1	Binary
2	2	Binary

Note: The PSF format is only supported on Sun/SPARC, Red Hat/ SUSE Linux and IBM AIX platforms, as well as the 64-bit versions.

The syntax is:
ADE_install_dir/platform/tools/dfII/bin/psf -i *input_file* -o *output_file*

See Also

.OPTION PSF
.OPTION OPFILE

.OPTION ASPEC

Sets HSPICE to ASPEC-compatibility mode.

Syntax

```
.OPTION ASPEC=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to set the application to ASPEC-compatibility mode. When you set this option to `1`, the simulator reads ASPEC models and netlists, and the results are compatible.

If you set *ASPEC*, the following model parameters default to *ASPEC* values:

- ACM=1: Changes the default values for CJ, IS, NSUB, TOX, U0, and UTRA.
- Diode Model: TLEV=1 affects temperature compensation for PB.
- MOSFET Model: TLEV=1 affects PB, PHB, VTO, and PHI.
- SCALM, SCALE: Sets the model scale factor to microns for length dimensions.
- WL: Reverses implicit order for stating width and length in a MOSFET command. The default (WL=0) assigns the length first, then the width.

See Also

.OPTION SCALE
.OPTION SCALM
.OPTION WL

.OPTION AUTO_INC_OFF

Suppresses automatic search for *`model/subckt`*`.inc` files when they are not explicitly included.

Syntax

```
.OPTION AUTO_INC_OFF=0|1
```

Default 0

Description

Set .OPTION AUTO_INC_OFF=1 to disable the HSPICE automatic search for *model/subckt*.inc files when your netlist does not explicitly include them. The default value, 0, allows HSPICE automatically to search by default for *model/subckt*.inc files even when they are not explicitly included.

.OPTION AUTOSTOP / AUTOST

Stops a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions.

Syntax

```
.OPTION AUTOSTOP [FROM_TO=0|1]
```

or:

```
.OPTION AUTOSTOP='expression'
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to terminate a transient analysis in HSPICE after calculating all TRIG-TARG, FIND-WHEN, and FROM-TO measure functions. This option can substantially reduce CPU time. You can use the AUTOSTOP option with any measure type. You can also use the result of the preceding measurement as the next measured parameter.

When using .OPTION AUTOSTOP='expression', the 'expression' can only involve measure results, a logical AND (&&) or a logical OR(||). Using these types of expressions ends the simulation if any one of a set of .MEASURE commands succeeds, even if the others are not completed.

Also terminates the simulation after completing all .MEASURE commands. This is of special interest when testing corners.

If *FROM_TO* is not specified, then the value is 0. If FROM_TO is specified without a corresponding value, the value is 1. FROM_TO is used to terminate a

transient analysis in HSPICE when FROM_TO measure functions are used, but a value for TO is not given.

By default, if a value for TO is not given in a measure function, the transient end point, `tstop`, in the `.TRAN` statement will be assigned to `TO`. In this case, the AUTOSTOP option will have no effect.

If FROM_TO is set and a value for TO is not given in a measure function, HSPICE will terminate once any other measure functions are complete.

Examples

```
.option autostop='m1&&m2||m4'
.meas tran m1  trig v(bd_a0)  val='ddv/2'  fall=1  targ v(re_bd)
+ val='ddv/2'  rise=1
.meas tran m2  trig v(bd_a0)  val='ddv/2'  fall=2  targ v(re_bd)
+ val='ddv/2'  rise=2
.meas tran m3  trig v(bd_a0)  val='ddv/2'  rise=2  targ v(re_bd)
+ val='ddv/2'  rise=3
.meas tran m4  trig v(bd_a0)  val='ddv/2'  fall=3  targ v(re_bd)
+ val='ddv/2'  rise=4
.meas tran m5  trig v(bd_a0)  val='ddv/2' rise=3  targ v(re_bd)
+ val='ddv/2'  rise=5
```

In this example, when either m1 and m2 are obtained or just m4 is obtained, the transient analysis ends.

See Also

.MEASURE (Rise, Fall, Delay, and Power Measurements)
.MEASURE (FIND and WHEN)
.MEASURE (Continuous Results)
.MEASURE (AVG, EM_AVG, INTEG, MIN, MAX, PP, and RMS)
.MEASURE (Integral Function)
.MEASURE (Derivative Function)
.MEASURE (Error Function)
.MEASURE PHASENOISE

.OPTION BA_ACTIVE

Specifies the active net file name(s) selective net back-annotation.

Syntax

```
.OPTION BA_ACTIVE = "FILENAME [;FILENAME2; FILENAME3...]"
```

Description

Conducts selective back-annotation. The active net file name contains the selected nets in the format defined by Star-RC or Star-RCXT. If no file is supplied, all nets (nodes) are selected for annotation. Multiple active net files can be specified, with each other being delimited by semicolon.

You must use this option with `BA_FILE`, or it has no effect. To view examples of active net files used in a format for Star-RC/Star-RCXT, see Selective Net Back-Annotation in the *HSPICE User Guide: Basic Simulation and Analysis*.

Examples

```
.option ba_active = "./hspice/NETLIST/DSPF/active.rcxt"
```

See Also

.OPTION BA_ACTIVEHIER
.OPTION BA_FILE
Back-Annotation Demo Cases

.OPTION BA_ACTIVEHIER

Annotate full hierarchical net names that are specified for BA_ACTIVE files.

Syntax

```
.OPTION BA_ACTIVEHIER = 0|1
```

Default 0

Description

Setting this option to `1` annotates the full hierarchical net names that are specified in BA_ACTIVE files, instead of the name starting from last period (.). For example, in an active net file, if the net name is `xi1.xi2.net_name`, by default, HSPICE truncates this name from the last period and identifies the net name as '`net_name`'. If you set `ba_activehier=1`, HSPICE use the full net name.

See Also

.OPTION BA_ACTIVE
Post-Layout Back-Annotation
Back-Annotation Demo Cases

.OPTION BA_ADDPARAM

Specifies extra parameters to be scaled by .OPTIONS BA_SCALE/ BA_GEOSHRINK.

Syntax

```
.OPTION BA_ADDPARAM = "LINEAR: PARAM [PARAM2 …];
+ QUAD: PARAM [PARAM2 …]"
```

Argument	Description
LINEAR/QUAD	Keywords to indicate how the following parameters to be scaled for instances in the DPF file, i.e., to be scaled linearly/ quadratically.
PARAM	Parameter to be scaled by .OPTIONS BA_SCALE/ BA_GEOSHRINK. Multiple parameters can be specified, with each other being delimited by blank space. The parameter groups (LINEAR/QUAD) are delimited by semicolon.

Description

.OPTION BA_SCALE/BA_GEOSHRINK is usually applied only to common elements (M/D/R/C/J) and common parameters needed for scaling (L/W/AD/ AS/PD/PS/AREA …). At times, extra, unusual parameters need to be scaled by BA_SCALE/BA_GEOSHRINK as well, such as the variation of common parameters from a subckt wrapping a type of element. For example, see a subckt wrapping a MOSFET with parameters wr/lr, which stands for width/ length of the wrapped MOSFET in the following example.

Examples

```
.OPTION BA_ADDPARAM  = "LINEAR: WR LR; QUAD: ASR AREAR"
```

See Also

.OPTION BA_SCALE
.OPTION BA_GEOSHRINK

.OPTION BA_COUPLING

Controls how to treat cutoff coupling capacitors when invoking selective net back-annotation.

Syntax

```
.OPTION BA_COUPLING = 0|1|2
```

Default 0

Description

Coupling capacitors across two nets are very common in parasitic netlists. For example, assume one coupling capacitor CC with terminals connected to two nodes belonging to nets A and B, respectively. When selective net back-annotation is launched and net A is active while net B is inactive, then CC is cut off from the node under net B and the terminal becomes a dangling node.

`.OPTION BA COUPLING` allows three methods to deal with the cutoff coupling capacitor, with `BA_COUPLING` assigned a value listed below:

- `0`: Just discards this coupling capacitor (a warning is issued).
- `1`: Let the cutoff terminal connect to the node defined by *|GROUND_NET.
- `2`: Let the cutoff terminal connect to the unexpanded inactive node (node B in the example above).

Examples

```
.OPTION BA_COUPLING = 2
```

See Also

Post-Layout Back-Annotation
Back-Annotation Demo Cases

.OPTION BA_DPFPFX

Remove the prefix of the instance names in the post-layout file (DSPF) when running back annotation.

Syntax

```
.OPTION BA_DPFPFX="prefix_string"
```

Default the first character

Description

HSPICE removes the prefix (the string defined by BA_DPFPFX) of the instance names in the post-layout file (DSPF) in order to match the instance names in the pre-layout netlist during back annotation. If BA_DPFPFX is not specified,

the first character of the instance names in the post-layout file (DSPF) will be removed.

If BA_DPFPFX alone cannot help HSPICE to match pre-layout netlist instances with post-layout instances, please see .OPTION BA_IDEALPFX for more information.

Examples

In the pre-layout netlist, instance names have prefix, such as `M1`; In the post-layout file (DSPF), instance names have different prefix, such as `M_mM1`.

```
.option ba_dpfpfx="M_m"
```

See Also

.OPTION BA_IDEALPFX
Back-Annotation Demo Cases

.OPTION BA_DPF_ELEM_ENABLE

This command enables or disables back-annotation of instance section in all ba_files.

Syntax

```
.OPTION BA_DPF_ELEM_ENABLE=0|1
```

Default BA_DPF_ELEM_ENABLE=1

Description

BA_DPF_ELEM_ENABLE=0 disables back-annotation of instance section in all ba_files while BA_DPF_ELEM_ENABLE=1 enables the back-annotation.

Examples

Use the following command for HSPICE to ignore the back-annotation of instance section in both `buf.spf` and `buf.dpf`:

```
.option ba_file="./buf.spf ./buf.dpf"  BA_DPF_ELEM_ENABLE=0
```

See Also

.OPTION BA_FILE
.OPTION BA_DPF_ELEM_TYPE
Back-Annotation Demo Cases

.OPTION BA_DPF_ELEM_TYPE

This command lets you control the element types you want to annotate during back-annotation.

Syntax

```
.OPTION BA_DPF_ELEM_TYPE="string"
```

Default BA_DPF_ELEM_ENABLE="M R D X Q"

Description

You can set the value of BA_DPF_ELEM_TYPE as a combination of M, R, D, X, and Q, where M stands for MOSFET, R for Resistor, D for Diode, X for Instance, and Q for BJT. The delimiter between two symbols (M, R, D, X, and Q) should be a space or a comma, or a semicolon.

Examples

Use any one the following command for HSPICE to back annotate only MOSFET and Resistor in instance section, in both `buf.spf` and `buf.dpf`, and ignore elements of other types in the two files:

```
.option ba_file="./buf.spf ./buf.dpf"  BA_DPF_ELEM_TYPE = "M R"
.option ba_file="./buf.spf ./buf.dpf"  BA_DPF_ELEM_TYPE = "M,R"
.option ba_file="./buf.spf ./buf.dpf"  BA_DPF_ELEM_TYPE = "M;R"
```

See Also

.OPTION BA_FILE
.OPTION BA_DPF_ELEM_ENABLE
Back-Annotation Demo Cases

.OPTION BA_ERROR

Mode for handling error on nets.

Syntax

```
.OPTION BA_Error=0|1|2
```

Default `1` (LUMPCAP)

Description

Specifies means to handle an error on nets, where:

- 0: EXIT — Terminates the simulation with an error message
- 1: LUMPCAP — Adds only the total lumped net capacitance
- 2: YES — Expands whatever can be expanded

Examples

```
.OPTION BA_ERROR = 2
```

See Also

Post-Layout Back-Annotation

.OPTION BA_FILE

Launches DPF parasitic back-annotation.

Syntax

```
.OPTION BA_FILE = "FILENAME [;FILENAME2; FILENAME3 …]"
```

Description

This option enables you to specify the DPF file and invoke DPF back-annotation. This option expands usage so that a DSP file does not have to be embedded in a DSPF file as the "Instance Section". "FILENAME" is the name of the file that contains parasitic information in SPEF or DSPF format. Multiple parasitic netlists can be specified, with each other being delimited by semicolon. These parasitic netlists must be independent but cannot cross-reference each other. The advantage of DPF back-annotation is that the prelayout hierarchy is maintained for simulation.

For MOSFET devices, the supported DPF parameters are: L, W, AD, AS, PD, PS, NRD, NRS, SA, SB, SD, NF, DELVTO, MULU0, RGEOMOD, RDC, RSC, SCA, SCB, SCC, SA1, SA2, SA3, SA4, SA5, SA6, SA7, SA8, SA9, SA10, SB1, SB2, SB3, SB4, SB5, SB6, SB7, SB8, SB9, SB10, SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8, SW9, and SW10.

Use .OPTION BA_ACTIVE with .OPTION BA_FILE to launch selective parasitic expansion. To view examples of the SPEF and DSPF file structures, see DSPF and SPEF File Structures in the *HSPICE User Guide: Basic Simulation and Analysis*.

Examples

Example 1 Single Parasitic Netlist

```
.OPTION BA_FILE = "./hspice/NETLIST/DSPF/add4.spf"
```

Example 2 Multiple Parasitic Netlists

```
.OPTION BA_FILE = "./ba_file1.spf; ba_file2.spf; ba_file3.spef"
```

See Also

Full Back-Annotation
Back-Annotation Demo Cases

.OPTION BA_FINGERDELIM

Explicitly specifies the delimiter strings used for finger devices and subcircuit instances.

Syntax

```
.OPTION BA_FINGERDELIM="string1,string2,..."
```

Default `.OPTION BA_FINGERDELIM="@"`

Description

Use this option to specify delimiter strings used on fingered devices and subcircuit instances.

Note: You can use a space or a comma, or a semicolon between two delimiter strings. For example, `.OPTION BA_FINGERDELIM="string1:string2"`.

Examples

```
.OPTION BA_FINGERDELIM="@,_NETTRAN_"
```

See Also

Back-Annotation Demo Cases

.OPTION BA_GEOSHRINK

Element scaling factor used with `.OPTION BA_SCALE`.

Syntax

```
.OPTION BA_GEOSHRINK=X
```

Default Same as `.OPTION GEOSHRINK` (or its default value)

Description

In addition to `.OPTION BA_SCALE`, use this option to further scale geometric parameters of element instances in the DPF file separately, whose default units are meters. By default the instances in the DPF file are scaled by `.OPTION GEOSHRINK` (and `SCALE`), no difference with instances in the ideal netlist. When `.OPTION BA_GEOSHRINK` is specified, the `.OPTION GEOSHRINK` is then disabled for instances in the DPF file and `BA_GEOSHRINK` is applied to them separately.

The final instance geometric parameters are then calculated as:
`final_dimension = original_dimension * BA_SCALE * BA_GEOSHRINK`
The effective scaling factor is the product of the two parameters; HSPICE uses `ba_scale*ba_geoshrink` to scale the parameters/dimensions in the DPF file.

See Also

.OPTION BA_SCALE
.OPTION SCALE
.OPTION GEOSHRINK

.OPTION BA_HIERDELIM

Specifies the hierarchical separator in the DPF file.

Syntax

```
.OPTION BA_HIERDELIM=character
```

Description

If the hierarchical separator used in a DPF file is different from `BA_HIERDELIM`, the hierarchical separator must be specified with `BA_HIERDELIM`.

Examples

```
.OPTION BA_HIERDELIM=/
```

See Also

Back-Annotation Demo Cases

.OPTION BA_IDEALPFX

Instructs HSPICE to prefix the instance names in the post-layout file (DSPF) with the specified string while running back annotation.

Syntax

```
.OPTION BA_IDEALPFX = "prefix_string"
```

Default "X", "M", "X_", "M_", "D", "D_", "Q", "Q_", "R", "R_"

Description

BA_IDEALPFX specifies the prefix string, and instructs HSPICE to prefix the instance names (including Q and R prefixes) in the post-layout file (DSPF) when matching pre and post layout instances during back annotation. Note that a different purpose is served here than using .OPTION BA_DPFPFX.

BA_DPFPFX is used to indicate the prefix that needs to be removed in the post-layout file (DSPF). HSPICE executes BA_DPFPFX before BA_IDEALPFX, if both options are given.

Examples

In the pre-layout netlist, instance names have prefix, such as "xmM1"; In the post-layout file (DSPF), instance names have different prefix, such as "mM1".

By default, BA_DPFPFX will remove the first character of "mM1", it becomes "M1". Therefore, specify:

```
.option ba_idealpfx="xm"
```

See Also

.OPTION BA_DPFPFX
Back-Annotation Demo Cases

.OPTION BA_INST

Specifies the scope of a back-annotation file to a particular subckt or instance.

Syntax

```
.OPTION BA_IINST = "filename ckt [; filename2 ck2, ...]"
```

Description

When a subcircuit definition is specified, the SPEF/DSPF file is back-annotated to all the instances of that subcircuit.

When an subcircuit instance is specified, the SPEF/DSPF file is back-annotated to the specified subcircuit instance only.

Examples

Specify rc1.spf to subcircuit definition inv, and specify rc2.spf to subcircuit instance x and:

```
.option ba_inst= 'rc1.spf inv; rc2.spf xnand'
```

.OPTION BA_MERGEPORT

Controls whether to merge net ports into one node.

Syntax

```
.OPTION BA_MERGEPORT = 0|1
```

Default 1

Description

Merging net ports into one node may introduce some small inaccuracy. To separate the net ports, set BA_MERGEPORT = 0.

Examples

```
.OPTION BA_MERGEPORT = 0
```

See Also

Post-Layout Back-Annotation
Back-Annotation Demo Cases

.OPTION BA_NETFMT

Specifies the format of Active Net file.

Syntax

```
.OPTION BA_NETFMT=[0|1]
```

Default 0

Argument	Description
0	Reports active nets in HSIM Back-Annotation (*.hsimba) format for the Selective Net Back-Annotation Flow.
1	Reports active nets in StarRC (*.rcxt) format for the Selective Net Extraction Flow.

Description

Enables HSPICE to output active nodes in HSIMBA format or STAR-RCXT format.

.OPTION BA_PRINT

Controls whether to output nodes and resistors/capacitors introduced by back-annotation.

Syntax

```
.OPTION BA_PRINT = IDEAL|ALL
```

Default IDEAL

Description

Specify this option to control the output of nodes and resistors/capacitors added by back-annotation.

After back-annotation many nodes and resistors/capacitors are introduced in the output files, which can distract from the effective and useful information. By setting BA_PRINT=IDEAL, the newly-added nodes and resistors/capacitors by back-annotation are filtered from the *.lis, *.ic# and *.tr#. To switch on the output of these nodes and RCs, set BA_PRINT=ALL.

Examples

```
.OPTION BA_PRINT=IDEAL
```

See Also

Post-Layout Back-Annotation
Back-Annotation Demo Cases

.OPTION BA_SCALE

Sets the element scaling factor for instances in the DPF file separately.

Syntax

```
.OPTION BA_SCALE=X
```

Default Same as `.OPTION SCALE` (or its default value)

Description

Use this option to scale geometric parameters of element instances in the DPF file separately, whose default unit is meters. By default the instances in the DPF file are scaled by `.OPTION SCALE`, no difference with instances in the ideal netlist. When `.OPTION BA_SCALE` is specified, the `.OPTION SCALE` is then disabled for instances in the DPF file and `BA_SCALE` is applied to them separately.

You can also use this option with `.OPTION BA_GEOSHRINK` to scale an element even more finely. The effective scaling factor is the product of the two parameters; HSPICE uses `ba_scale*ba_geoshrink` to scale the parameters/dimensions in the DPF file.

See Also

.OPTION BA_GEOSHRINK
.OPTION SCALE
.OPTION GEOSHRINK

.OPTION BA_TERMINAL

Specifies mapping characters for back annotation terminal name.

Syntax

```
.OPTION BA_TERMINAL = "TERMINAL= ALIAS [; TERMINAL2= ALIAS2;
+ TERMINAL3=ALIAS3 …]"
```

Argument	Description
TERMINAL	Terminal name used in the parasitic netlist.
ALIAS	Common terminal name recognized by the simulator, or user-defined/ tool-specific terminal name used in the ideal netlist.

Description

Specifies the terminal name mapping between the parasitic netlist and the terminal names recognized by the simulator. You can specify multiple TERMINAL=ALIAS pairs, with each delimited by semicolon. Generally, terminal names used in the parasitic netlist and ideal netlist are same. These terminals are widely accepted by various simulators, as listed in the following table.

Table 2 Default rules for element terminal names

Term. Index	M (MOS)	Q (BJT)	R,C,D (Resistor, Capacitor, Diode)
1	D [R] [A] [I] [N]	C [O] [L] [L] [E] [C] [T] [O] [R]	A [N] [O] [D] [E], P [L] [U] [S], P [O] [S] [I] [T] [I] [V] [E]
2	G [A] [T] [E]	B [A] [S] [E]	C [A] [T] [H] [O] [D [E], M [I] [N] [U] [S], N [E] [G] [A] [T] [I] [V] [E]
3	S [O] [U] [R] [C] [E]	E [M] [I] [T] [T] [E] [R]	S [U] [B] [S] [T] [R] [A] [T] [E]
4	B [U] [L] [K]	S [U] [B] [S] [T] [R] [A] [T] [E]	N/A

HPSICE uses the first character and optional subsequent characters listed above to determine which terminal is referred to.

However, sometimes terminal names referenced in the parasitic netlist are user-defined/tool-specific and different from above default terminal characters. Another case is the terminal names employed in the parasitic netlist follow the default rules, but are different from the ones used in ideal netlist, which are user-defined/tool-specific. This is especially common for elements of subckt type. That's what BA_TERMINAL is intended for.

.OPTION BA_TERMINAL is used to set up the terminal name mapping between the parasitic netlist and ideal netlist. Of the TERMINAL ALIAS pair, the first entry is the terminal name used in the parasitic netlist, and the second entry is the corresponding terminal name used in the ideal netlist.

Note: Consider the following limitation for `BA_TERMINAL`. All terminal mapping pairs specified are of global scope, not only applied for specific elements/blocks, but applicable for all un-found terminal names. Besides, if multiple mapping pairs have the same first entry (key), for example, `.OPTION BA_TERMINAL = "N1 UDRN; N2 UDRN"`, then the latter pair will hide the previous one and take effect.

Examples

Example 1 *This example maps user-defined terminals (UDRN, UGATE) in the parasitic netlist to default terminal characters (D, G).*

```
.OPTION BA_TERMINAL="D UDRN ;G UGATE"
```

Example 2 *This example maps widely accepted terminal characters (D, G, S) in the parasitic netlist to subckt-defined node list (SUBCKT_N1, SUBCKT_N2, SUBCKT_N3) in the ideal netlist.*

```
.OPTION BA_TERMINAL="D SUBCKT_N1;G SUBCKT_N2; S SUBCKT_N3"
```

See Also

Post-Layout Back-Annotation
Back-Annotation Demo Cases

.OPTION BADCHR

Generates a warning on finding a non-printable character in an input file.

Syntax

```
.OPTION BADCHR=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to generate a warning on finding a non-printable character in an input file by setting to `1`.

.OPTION BDFATOL

Sets the absolute tolerance for the global accuracy control of the Backward Differentiation Formulae integration method.

Syntax

```
.OPTION BDFATOL=val
```

Default 1e-3

Description

Use this option to set the absolute tolerance of the circuit convergence integration method BDF (a higher order integration algorithm than Backward-Euler, Gear, or Trapezoidal).

The option operates independent of .OPTIONS RUNLVL and ACCURATE settings with the following exception:

If either .OPTION RUNLVL or ACCURATE follows an .OPTION BDFATOL or BDFRTOL value, the RUNLVL or ACCURATE setting overrides the tolerance of the BDF algorithm. If ACCURATE is set with or without RUNLVL, the default for BDFATOL will always set to 1e-5.

RUNLVL	BDFATOL
0	1e-4
1	1e-2
2	1e-2
3	1e-3
4	1e-4
5	1e-4
6	1e-5

The option appears in the .lis file.

Examples

```
.OPTION METHOD=BDF
+.OPTIONS BDFATOL=1e-4 BDFRTOL=1e-4
```

See Also

.OPTION METHOD
.OPTION BDFRTOL

.OPTION BDFRTOL

Sets the relative tolerance for the global accuracy control of the Backward Differentiation Formulae integration method.

Syntax

```
.OPTION BDFRTOL=val
```

Default 1e-3

Description

Use this option to set the relative tolerance of the circuit convergence integration method BDF (a higher order integration algorithm than Backward-Euler, Gear, or Trapezoidal).

The option operates independent of .OPTIONS RUNLVL and ACCURATE settings with the following exception:

If .OPTION RUNLVL or ACCURATE follows an .OPTION BDFATOL or BDFRTOL value, the RUNLVL or ACCURATE setting overrides the tolerance of the BDF algorithm. If ACCURATE is set with or without RUNLVL, the default for BDFRTOL will always reset to 1e-5.

RUNLVL	BDFRTOL
0	1e-4
1	1e-2
2	1e-2
3	1e-3
4	1e-4
5	1e-4
6	1e-5

The value of the option appears in the .lis file.

Examples

```
.OPTION METHOD=BDF
+.OPTIONS BDFRTOL=1e-4 BDFATOL=1e-4
```

See Also

.OPTION METHOD
.OPTION BDFATOL

.OPTION BEEP

Enables or disables audible alert tone when simulation returns a message.

Syntax

```
.OPTION BEEP=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to enable or disable the audible alert tone when simulation returns a message.

- `BEEP=1` Turns on an audible tone when simulation returns a message (such as `HSPICE job completed`).
- `BEEP=0` Turns off the audible tone.

.OPTION BIASFILE

Sends `.BIASCHK` command results to a specified file.

Syntax

```
.OPTION BIASFILE='file_name'
```

Default `*.lis`

Description

Use this option to output the results of all `.BIASCHK` commands to a file that you specify. If you do not set this option, HSPICE outputs the `.BIASCHK` results to the `*.lis` file. If you do not enter a file name between the quotation

marks, HSPICE generates a file named `output_filename.bias` and the file follows `hspice -o` behavior.

Examples

```
.OPTION BIASFILE='biaschk/mos.bias'
```

See Also

.BIASCHK

.OPTION BIASFMT

Controls the format of `.BIASCHK` command results.

Syntax

```
.OPTION BIASFMT=1|0
```

Default `0`

Description

Use this option with a value 1 to output the results of `.BIASCHK` command in SOA format.

Note:

- Summary information is ignored in the `.BIASCHK` command output in SOA format.
- If the `interval` keyword is used in the `.BIASCHK` statement and the option `biasinterval` is set, the interval information is also output in SOA format with `biasfmt=1`.

Examples

Consider the following example:

```
 .option BIASINTERVAL=3 biasfmt=1
.BIASCHK NMOS TERMINAL1=NG TERMINAL2=NS LIMIT=1.5 MNAME=N
simulation=all interval=15e-09^M biasnam='syy' condition='1>0'
.BIASCHK PMOS TERMINAL1=NG TERMINAL2=NS LIMIT=-1.5 MNAME=p
simulation=all interval=15e-09^M biasnam='syy' condition='1>0'
```

The commands produce the following output in SOA format:

```
Biaschk summary of all violation regions larger than interval:
label condition instance expression X window               error
syy   1>0       mn1      v(ng-ns)   [  20.4545n,  39.5455n] Peak
Value   3.3000 superior to    1.5000
label condition instance expression X window               error
syy   1>0       mp1      v(ng-ns)   [  20.0000n,  40.0000n] Peak
Value   1.8000 superior to   -1.5000
total number of violation region suppressed:  2
Biaschk output during transient analysis:
label        condition instance     expression X window   error
syy          1>0       mn1          v(ng-ns)     21.0000n Value
3.3000 superior to    1.5000
syy          1>0       mp1          v(ng-ns)     21.0000n Value
1.8000 superior to   -1.5000
***   Biaschk end for transient simulation***
```

See Also

.BIASCHK

.OPTION BIASINTERVAL

Controls the level of information output during transient analysis.

Syntax

```
.OPTION BIASINTERVAL=[0|1|2|3]
```

Default

3

Description

Use this option with the `.BIASCHKinterval` argument to control the level of information output during transient analysis.

- `BIASINTERVAL=0`: Ignores the `interval` argument on `.biaschk` statement.
- `BIASINTERVAL=1`: Only output the total number of suppressed violations for those elements being monitored.
- `BIASINTERVAL=2`: Output detailed information of suppressed violations (less than `INTERVAL`). This includes element information, start time, stop time, and peak values.
- `BIASINTERVAL=3`: Output detailed information of actual violations (larger than `INTERVAL`).

Examples

```
.OPTION BIASINTERVAL=1
```

See Also

.BIASCHK

.OPTION BIASNODE

Specifies whether to use node names or port names in element commands.

Syntax

```
.OPTION BIASNODE=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to specify whether to use node names or port names in element commands in `.BIASCHK` warning messages.

- `BIASNODE=1`: use node names instead of port names
- `BIASNODE=0`: use port names (for example, ng of MOS element)

Examples

```
.OPTION BIASNODE=1
```

See Also

.BIASCHK

.OPTION BIASPARALLEL

Controls whether `.BIASCHK` sweeps the parallel elements being monitored.

Syntax

```
.OPTION BIASPARALLEL=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option with the .BIASCHKmname argument to control whether .BIASCHK sweeps the parallel elements being monitored.

- BIASPARALLEL=1: sweep parallel elements. If node voltage is also being monitored, only the first element is used to generate warning messages.
- BIASPARALLEL=0: do not sweep parallel elements.

Examples

```
.OPTION BIASPARALLEL=1
```

See Also

.BIASCHK

.OPTION BIAWARN

Controls whether HSPICE outputs warning messages when local max bias voltage exceeds limit during transient analysis.

Syntax

```
.OPTION BIAWARN=[0|1]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to control whether HSPICE outputs warning messages when a local max bias voltage exceeds the limit during transient analysis.

- BIAWARN=1: Output warning messages. When transient analysis is completed, the results are output as filtered by noise.
- BIAWARN=0: Do not output a warning message. When the transient analysis is completed, output the results.

Examples

```
.OPTION BIAWARN=1
```

See Also

.TRAN

.OPTION BINPRNT

Outputs the binning parameters of the CMI MOSFET model.

Syntax

```
.OPTION BINPRNT=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to output the binning parameters of the CMI MOSFET model. Currently available only for Level 57.

.OPTION BPNMATCHTOL

Determines the minimum required match between the NLP and PAC phase noise algorithms in HSPICE.

Syntax

```
.OPTION BPNMATCHTOL=val
```

Default `0.5`dB

Description

Use this option to determines the minimum required match between the NLP and PAC phase noise algorithms. An acceptable range is 0.05dB to 5dB.

See Also

.OPTION PHASENOISEKRYLOVDIM / PHASENOISE_KRYLOV_DIM
.OPTION PHASENOISEKRYLOVITR / PHASENOISE_KRYLOV_ITR
.OPTION PHASENOISETOL
.OPTION PHNOISELORENTZ / PHNOISE_LORENTZ

.OPTION BSIM4PDS

Flag to control the BSIM4 Ps_{eff} (effective source perimeter) and Pd_{eff} (effective drain perimeter) model equation calculation.

Syntax

```
.OPTION BSIM4PDS=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Setting `BSIM4PDS=1` enhances the ps_{eff} and pd_{eff} calculation, so that when the calculated ps_{eff} and pd_{eff} is negative, HSPICE uses the PA_{eff}Geo function to recalculate it. (This option solves the issue of negative ps_{eff} and pd_{eff} causing potential nonconvergence issues.) When `BSIM4PDS=0`, HSPICE strictly follows the UCB code, and results in no recalculation if negative ps_{eff} or pd_{eff} occurs.

Note: This option is only available for BSIM4 (Level 54).

.OPTION BYPASS

Bypasses model evaluations if the terminal voltages stay constant.

Syntax

```
.OPTION BYPASS=[0|1|2]
```

Default `1` for MESFETs, JFETs, or BJTs; `2` for MOSFETs and diodes

Description

Use this option to bypass model evaluations if the terminal voltages do not change or are within tolerance. Values can be `0` (off), `1` (old algorithm), or `2` (advanced algorithm).

To speed up simulation, `BYPASS=1` does not update the status of latent devices. `BYPASS=2` uses linear prediction to update the devices and balance speed and accuracy.

See Also

.OPTION ACCURATE
.OPTION RUNLVL

.OPTION BYTOL

Sets a voltage tolerance at which a MOSFET, MESFET, JFET, BJT, or diode becomes latent.

Syntax

```
.OPTION BYTOL=x
```

Default `100.00u`

Description

Use this option to specify a voltage tolerance at which a MOSFET, MESFET, JFET, BJT, or diode becomes latent. HSPICE does not update status of latent devices. The default is computed automatically.

.OPTION CAPTAB

Adds up all the capacitances attached to a node and prints a table of single-plate node capacitances.

Syntax

```
.OPTION CAPTAB=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to print a compiled table of single-plate node capacitances for diodes, BJTs, MOSFETs, JFETs, and passive capacitors at each operating point.

Note: When `.OPTION CAPTAB` is used to estimate the equivalent capacitance of the circuit nodes, HSPICE can give a zero capacitance values for some nodes when a resistance is connected to that node. The reason for getting `0` is that the capacitance is a dynamic, frequency-dependent capacitance and not a static capacitance. You need to run an AC analysis to see a non-zero node capacitance.

.OPTION CFLFLAG

Activates the Compiled Function Library (CFL) feature in HSPICE.

Syntax

```
.OPTION CFLFLAG=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to turn on the CFL capability and pass arguments (mathematical or user-defined functions written in C that can be dynamically linked to HSPICE during runtime). See the Features section of the *HSPICE User Guide: Basic Simulation and Analysis* for more information.

Examples

In the following example, `mysqrt(x)` and `func(arg1, arg2)` are a coded as a CFL function. The functions `mysqrt` and `func` are called in the netlist as follows:

```
.option CFLflag
.param area = 4u*u
.param p1 = mysqrt(area)
.param p2 = mysqrt(area/2)
.param p3 = func(p1, p2)
```

See Also

.CFL_PROTOTYPE
.PARAM / PARAMETER / PARAMETERS

.OPTION CMIFLAG

Loads and links the dynamically linked Common Model Interface (CMI) library.

Syntax

```
.OPTION CMIFLAG=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to load and link the compiled CMI object `.so` file to HSPICE during simulation runs. If this option parameter is set with no value or to 1, then the CMI `.so` file is loaded as a dynamically-linked object file. If this option parameter does not exist (deemed as default) in the netlist, or is explicitly set to 0, no loading or linking takes place.

If `CMIFLAG` is set, model parameter `CMIMODEL` can be used to enable “hybrid” model usage, i.e., you can determine if a built-in model or model from custom CMI library is to be used in the simulation.

```
CMIMODEL=0|1|undefined
```

Model parameter `CMIMODEL` values are as follows:

- `0`: HSPICE searches for the model from built-in models. If not found, an error message is issued and HSPICE aborts.
- `1`: HSPICE searches for the model from the Custom CMI. If not found, a warning message is issued and HSPICE then searches for the model from built-in models.
- `undefined`: HSPICE proceeds as if `CMIMODEL=1`.

If `.OPTION CMIFLAG` is not set, model parameter `CMIMODEL` is ignored.

See Also

.OPTION CUSTCMI

.OPTION CMIMCFLAG

Restricted: for specified users only. Enables model memory allocation for each element.

Syntax

```
.OPTION CMIMCFLAG=0|1
```

Default 0

Description

For restricted use: Setting this option to 1, changes the method for storing instance-specific local variation information. With use of this flag, during the instance reset process model memory is allocated for each element. Each instance will have its own model structure to store the local variation information.

Note: Users employing conventional public domain models where many model parameters exist should not use this option to avoid memory issues.

.OPTION CMIPATH

Enables automatic selection of correct Custom CMI `.so` library platform. For information on the HSPICE CMI, contact your Synopsys technical support team.

Syntax

```
.OPTION CMIPATH='LIB_DIRECTORY'
```

Description

This option allows you to automatically select the correct custom CMI `.so` library platform, even though you might not have the right information about the platform HSPICE is running on. This functionality eliminates the need to manually search for the correct platform and allows for efficient CMI `.so` library distribution and customer applications. The solution to this issue keeps the environment variable `hspice_lib_models` backward compatible in its usage model, but users can add the control option `.OPTION CMIPATH='LIB_DIRECTORY'` to the model file.

.OPTION CMIPATH takes precedence over environment variable `hspice_lib_models`.

Their usages are as follows on `<LIB_DIRECTORY>/<PLATFORM>/libCMImodel.so`:

- `.OPTION CMIPATH='LIB_DIRECTORY'$ <PLATFORM>` is not needed.
- `setenv hspice_lib_models '<LIB_DIRECTORY>/<PLATFORM>'`

For the UNIX OS, HSPICE provides two scripts, `hspice` and `hspice64` to invoke the right HSPICE executable for the platform on which HSPICE is being invoked to run. These scripts are enhanced to recognize the correct machine and platform for automatic CMI `.so` library selection. For the Windows OS, no HSPICE script is required, since all Windows platforms share the same single CMI .so library:*LIB_DIRECTORY*/WIN for all Windows platforms.

.OPTION CMIUSRFLAG

Flag to control .OPTION SCALE parsing into the External Common Model Interface (CMI).

Syntax

```
.OPTION CMIUSRFLAG=0|1|2|3
```

Default 0

Description

Controls the CMI element instance parameter value (unit) scaling. This option is only available for custom CMI MOS Level 101. It permits users and/or foundry model development teams to choose desired scaling for the instance parameters of the MOSFET devices that call a foundry's CMI model libraries.

The CMIUSRFLAG values are as follows:

- 0: Turns off other functions of the CMIUSRFLAG option.
- 1: Passes scale*geoshrink value to custom CMI through artificial instance parameter "scale". If set with no value or to 1, the products of option parameters SCALE and GEOSHRINK are passed and made available to scale the CMI model instance parameter values.
- 2: Turns on dynamic model bin selection for custom CMI and turns off other functions.
- 3 HSPICE will pass options SHRINK, SCALE and M into Custom CMI (both MOSFET model with BSIM4-like topology and DIODE model), using string names "optshrink", "optscale", and "mult", respectively. In addition, final constant capacitance value (for capacitors) will be scaled by .OPTION SHRINK.

If the CMIUSRFLAG option parameter does not exist in the netlist (default), or is explicitly set to 0, then the option parameters SCALE and GEOSHRINK are not accessible in the CMI; and the element instance parameter scaling is not activated for the foundry CMI models and libraries.

Examples

In this example, the value `scale*geoshrink=0.9e-6` is parsed to the external CMI.

```
.option cmiflag=1
.option scale=1e-6 geoshrink=0.9 cmiusrflag=1
...
.model nch nmos level=101 ...
```

See Also

.OPTION SCALE
.OPTION GEOSHRINK
.OPTION SHRINK

.OPTION CMIVTH

For Custom CMI MOSFET model only, invokes one additional CMI model function call when convergence criteria is met.

Syntax

```
.OPTION CMIVTH=0|1
```

Default Value if option is not specified in the netlist: 0

Value if option name is specified without a corresponding value: 1

Description

Use this option to enable the following operation: when `CMIVTH` is set, the simulator calls the CMI model function one more time and passes an internal flag, `initf=100`, into CMI to indicate that this is the last iteration. This option supports `DC`/`OP`/`TRAN` analysis.

.OPTION CONVERGE

Invokes various methods for solving nonconvergence problems.

Syntax

```
.OPTION CONVERGE=[-1|0|1|2|3|4|5|100]
```

Description

Use this option to run different methods for solving nonconvergence issues. This option is part of the auto-converge flow.

Note: When HSPICE advanced analog functions are used, this option is ignored because it is replaced by automated algorithms

- `CONVERGE=-1`: Use with `DCON=-1` to disable autoconvergence.
- `CONVERGE=0`: Autoconvergence.
- `CONVERGE=1`: Use the Damped Pseudo Transient algorithm. If simulation does not converge within the set CPU time (in the `CPTIME` control option), then simulation halts.
- `CONVERGE=2`: Use a combination of `DCSTEP` and `GMINDC` ramping. Not used in the autoconvergence flow.
- `CONVERGE=3`: Invoke the source-stepping method. Not used in the autoconvergence flow.
- `CONVERGE=4`: Use the gmath ramping method.
- `CONVERGE=5`: Use the gshunt ramping method. Even you did not set it in an `.OPTION` command, the `CONVERGE` option activates if a matrix floating-point overflows or if HSPICE reports a “time step too small” error. The default is `0`. If a matrix floating-point overflows, then `CONVERGE=1`.
- `CONVERGE=100` Adaptive option control for autoconvergence; this value requires less dependence on convergence option settings, such as `DV`, `ITL1`, `GRAMP`, `SYMB`, and `DCON`.

See Also

.OPTION DCON
.OPTION GMINDC
.OPTION DV
.OPTION GRAMP
.OPTION ITL1
.OPTION SYMB

.OPTION CPTIME

Sets the maximum CPU time allotted for a simulation.

Syntax

```
.OPTION CPTIME=x
```

Default `10.00x`

Description

Use this option to set the maximum CPU time, in seconds, allotted for this simulation job. When the time allowed for the job exceeds `CPTIME`, HSPICE prints or plots the results up to that point and concludes the job. Use this option if you are uncertain how long the simulation takes, especially when you debug new data files. The default is `1e7` (400 days).

.OPTION CSCAL

Sets the capacitance scale for Pole/Zero analysis.

Syntax

```
.OPTION CSCAL=x
```

Default `1.0e+12`

Description

Use this option to set the capacitance scale for Pole/Zero analysis. HSPICE multiplies capacitances by `CSCAL`.

See Also

.OPTION FMAX
.OPTION GSCAL
.OPTION ITLPZ
.OPTION LSCAL
.OPTION PZABS

.OPTION CSDF

Selects the Common Simulation Data Format (Viewlogic-compatible graph data file format).

Syntax

```
.OPTION CSDF=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to specify whether HSPICE outputs CSDF data when you run a HSPICE simulation.

- If `CSDF=0`, CSDF output is disabled.If `CSDF=1`, HSPICE produces CSDF output.

See Also

.OPTION POST

.OPTION CSHDC

Adds capacitance from each node to ground; used only with the `CONVERGE` option.

Syntax

```
.OPTION CSHDC=x
```

Description

Use this option to add capacitance from each node to ground. This is the same option as `CSHUNT`; use CSHDC only with the `CONVERGE` option. When defined, `.OPTION CSHDC` is the same as `.OPTION CSHUNT`, except that CSHDC becomes invalid after DC OP analysis, while CSHUNT stays in both DC OP and transient analysis.

See Also

.OPTION CONVERGE
.OPTION CSHUNT

.OPTION CSHUNT

Adds capacitance from each node to ground.

Syntax

```
.OPTION CSHUNT=x
```

Default `0`

Description

Use this option to add capacitance from each node to ground. Add a small CSHUNT to each node to solve internal “time step too small” time step problems caused by high frequency oscillations or numerical noise. When defined, .OPTION CSHUNT is the same as .OPTION CSHDC, except that CSHDC becomes invalid after DC OP analysis, while CSHUNT stays in both DC OP and transient analysis.

Examples

```
.option gshunt=1e-13 cshunt=1e-17
.option gshunt=1e-12 cshunt=1e-16
.option gshunt=1e-11 cshunt=5e-15
.option gshunt=1e-10 cshunt=1e-15
.option gshunt=1e-9  cshunt=1e-14
```

See Also

.OPTION CSHDC
.OPTION GSHUNT

.OPTION CUSTCMI

Turns on gate direct tunneling current modeling and additional instance parameter support.

Syntax

```
.OPTION CUSTCMI= 0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to turn on gate direct tunneling current modeling and instance parameter support. Set .OPTION CUSTCMI=1 jointly with .OPTION CMIFLAG to turn on gate direct tunneling current modeling and instance parameters. .OPTION CUSTCMI=0 to turns off the feature.

The existing HSPICE BSIM4-like instance parameters include: geomod, acnqsmod, delk1, delnfct, deltox, min, mulu0, nf, rbdb, rbodymod, rbpb, rbpd, rbps, rbsb, rgatemod, sa, sa1, sa10, sa2, sa3, sa4, sa5, sa6, sa7, sa8, sa9, sb, sb1, sb10, sb2, sb3, sb4, sb5, sb6, sb7, sb8, sb9, sd, stimod, sw1, sw10, sw2, sw3, sw4, sw5, sw6, sw7, sw8, sw9, and trnqsmod.

.OPTION CUSTCMI=1 also supports the six integer instance model flags: insflg1, insflg2, insflg3, insflg4, insflg5, and insflg6 and the ten double precision instance parameters supported for customer CMI: insprm1, insprm2, insprm3, insprm4,...,insprm10.

See Also

.OPTION CMIFLAG

.OPTION CVTOL

Changes the number of numerical integration steps when calculating the gate capacitor charge for a MOSFET.

Syntax

```
.OPTION CVTOL=x
```

Description

Use this option to change the number of numerical integration steps when calculating the gate capacitor charge for a MOSFET by using CAPOP=3. See the discussion of CAPOP=3 in Overview of MOSFET Models, in the *HSPICE Reference Manual: MOSFET Models* for explicit equations and discussion.

.OPTION D_IBIS

Specifies the directory containing the IBIS files.

Syntax

```
.OPTION D_IBIS='ibis_files_directory'
```

Description

Use this option to specify the directory containing the IBIS files. If you specify several directories, the simulation looks for IBIS files in the local directory (the directory from which you run the simulation). It then checks the directories specified through .OPTIOND_IBIS in the order that .OPTION cards appear in the netlist. You can use the D_IBIS option to specify up to 40 directories.

Examples

```
.OPTION d_ibis='/home/user/ibis/models'
```

.OPTION DCAP

Specifies equations used to calculate depletion capacitance for Level 1 and 3 diodes and BJTs.

Syntax

```
.OPTION DCAP
```

Description

Use this option to specify equations for HSPICE to use when calculating depletion capacitance for Level 1 and 3 diodes and BJTs. The *HSPICE Reference Manual: Elements and Device Models* describes these equations in the section Using Diode Capacitance Equations.

.OPTION DCCAP

Generates C-V plots.

Syntax

```
.OPTION DCCAP=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to generate C-V plots. Prints capacitance values of a circuit (both model and element) during a DC analysis. You can use a DC sweep of the capacitor to generate C-V plots. If not set, MOS device or voltage-variable capacitance values are not evaluated and the printed value is zero. When doing C-V curves for devices, make sure you set `.OPTION DCCAP` so that the capacitance values can be output. Depending on the MOS model level you are using, ensure that you use the appropriate model templates for the models.

Examples

In the following example, which uses an output template that reports results for a transient analysis, the DCCAP=1 option enforces the printing of the capacitance calculation in a DC analysis.

```
m1 vdd g 0 0 nch l=2u w=10u
vdd vdd 0 3
vg g 0 3
.model nch nmos level=49
.print tran lx23(m1)
.print dc lx23(m1)
.op
.tran 1n 10n
.dc vg 0 3 0.5
.option dccap=1
.end
```

See Also

.DC
MOSFET Device Examples, for paths to demo files gatecap.sp and mosivcv.sp.

.OPTION DCFOR

Sets the number of iterations to calculate after a circuit converges in the steady state.

Syntax

```
.OPTION DCFOR=x
```

Default 0

Description

Use this option to set the number of iterations to calculate after a circuit converges in the steady state. The number of iterations after convergence is usually zero, so DCFOR adds iterations (and computation time) to the DC circuit solution. DCFOR ensures that a circuit actually, not falsely, converges.

Use this option with .OPTION DCHOLD and the .NODESET command to enhance DC convergence.

See Also

.DC

.NODESET
.OPTION DCHOLD

.OPTION DCHOLD

Specifies how many iterations to hold a node at the .NODESET voltage values.

Syntax

.OPTION DCHOLD=*n*

Default 1

Description

Use this option to specify how many iterations to hold a node at the .NODESET voltage values.

Note: When HSPICE advanced analog functions are used, this option is ignored because it is replaced by automated algorithms

Use DCFOR and DCHOLD together to initialize DC analysis.DCFOR and DCHOLD enhance the convergence properties of a DC simulation. DCFOR and DCHOLD work with the .NODESET command. The effects of DCHOLD on convergence differ, according to the DCHOLD value and the number of iterations before DC convergence.

If a circuit converges in the steady state in fewer than DCHOLD iterations, the DC solution includes the values set in .NODESET.

If a circuit requires more than DCHOLD iterations to converge, HSPICE ignores the values set in the .NODESET command, and calculates the DC solution by setting the .NODESET fixed-source voltages as open circuited.

See Also

.DC
.NODESET
.OPTION DCFOR

.OPTION DCIC

Specifies whether to use or ignore .IC commands in the netlist.

Syntax

```
.OPTION DCIC=0|1
```

Description

Use this option to specify whether to use or ignore `.IC` commands in the netlist.

- `DCIC=1` (default): Each point in a DC sweep analysis acts like an operating point and all `.IC` commands in the netlist are used.
- `DCIC=0`: `.IC` commands in the netlist are ignored for DC sweep analysis.

See Also

.IC
.DC

.OPTION DCON

Aids in the autoconvergence routines; can also disable autoconverge routines when set to =-1.

Syntax

```
.OPTION DCON=x
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

This option aids in the autoconvergence routines.

When `DCON` equals

- `-1`: Disables convergence routines, Steps 2 and 3 of the HSPICE auto-converge process (when `DCON=-1` and `.OPTION CONVERGE=-1`).
- `0`: Enables autoconvergence routines as designed
- `1`: If a circuit cannot converge using Newton-Raphson, HSPICE automatically sets `DCON=1` and calculates the following:

$$DV = max\left(0.1, \frac{V_{max}}{50}\right)$$, if DV =1000

$$GRAMP = max\left(6, \log_{10}\left(\frac{I_{max}}{GMINDC}\right)\right) \qquad ITL1 = ITL1 + 20 \cdot GRAMP$$

- `2`: If the circuit still cannot converge, HSPICE sets `DCON=2`, which sets `DV=1e6`.

See Also

.OPTION CONVERGE
.OPTION DV
Autoconverge Process

.OPTION DCTRAN

Invokes different methods to solve nonconvergence problems.

Syntax

```
.OPTION DCTRAN=x
```

Description

Use this option to run different methods to solve nonconvergence problems. `DCTRAN` is an alias for `CONVERGE`.

See Also

.OPTION CONVERGE

.OPTION DEF_GROUND

Connects nodes to ground.

Syntax

```
.OPTION DEF_GROUND=global_ground_node_name
```

Default Value if option is not specified in the netlist: 0

Description

Use this option to connect nodes to ground.

Nodes of all elements (except `Vsrc`) named `0`, `gnd`, `gnd!`, and `ground` will be connected to node defined in `.OPTION DEF_GROUND`. The `global_ground_node_name` should be one node of some V element.

Examples

For example:

```
Vss n1 0 0
.option def_ground=n1
R1 1 0 1
C1 2 0 1
V2 2 0 1
...end
```

will be change to:

```
Vss n1 0 0
R1 1 n1 1
C1 2 n1 1
V2 2 0 1
..
.end
```

.OPTION DEFAD

Sets the default MOSFET drain diode area.

Syntax

```
.OPTION DEFAD=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to set the default MOSFET drain diode area.

.OPTION DEFAS

Sets the default MOSFET source diode area.

Syntax

```
.OPTION DEFAS=x
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to set the default MOSFET source diode area.

.OPTION DEFL

Sets the default MOSFET channel length.

Syntax

```
.OPTION DEFL=x
```

Default `100.00u`

Description

Use this option to set the default MOSFET channel length.

.OPTION DEFNRD

Sets the default number of squares for the drain resistor on a MOSFET.

Syntax

```
.OPTION DEFNRD=n
```

Default `0`

Description

Use this option to set the default number of squares for the drain resistor on a MOSFET.

.OPTION DEFNRS

Sets the default number of squares for the source resistor on a MOSFET.

Syntax

```
.OPTION DEFNRS= n
```

Default `0`

Description

Use this option to set the default number of squares for the source resistor on a MOSFET.

.OPTION DEFPD

Sets the default MOSFET drain diode perimeter.

Syntax

```
.OPTION DEFPD=n
```

Default 0

Description

Use this option to set the default MOSFET drain diode perimeter.

.OPTION DEFPS

Sets the default MOSFET source diode perimeter.

Syntax

```
.OPTION DEFPS=x
```

Default 0

Description

Use this option to set the default MOSFET source diode perimeter.

.OPTION DEFSA

Sets the default BSIM4 MOSFET SA parameter in HSPICE.

Syntax

```
.OPTION DEFSA=x
```

Default 0.0

Description

Use this option to set the default distance between the S/D diffusion edge to the poly gate edge from one side in the BSIM STI/LOD model.

.OPTION DEFSB

Sets the default BSIM4 MOSFET SB parameter.

Syntax

```
.OPTION DEFSB=x
```

Default `0.0`

Description

Use this option to set the default distance between the S/D diffusion edge to the poly gate edge from side opposite the SA side in the BSIM STI/LOD model.

.OPTION DEFSD

Sets default for BSIM4 MOSFET SD parameter.

Syntax

```
.OPTION DEFSD=x
```

Default `0.0`

Description

Use this option to set the default for the distance between neighboring fingers (SD parameter) in a BSIM STI/LOD model.

.OPTION DEFW

Sets the default MOSFET channel width.

Syntax

```
.OPTION DEFW=x
```

Default `100.00u`

Description

Use this option to set the default MOSFET channel width. The default is `1e-4m`.

.OPTION DEGF

Sets the device's failure criteria for lifetime computation when using the MOSRA API if no values are set for `.OPTIONS DEGFN` or `DEGFP`.

Syntax

`.OPTION DEGF=`*`val`*

Description

This option is used in conjunction with `.OPTION MOSRALIFE`. For NMOS, `DEGFN` is used. If `DEGFN` is not defined, `DEGF` is used instead.

For PMOS, `DEGFP` is used. If `DEGFP` is not defined, `DEGF` is used instead. This option sets the device's degradation value at lifetime. The options apply to all MOSFETs. The lifetime values are printed in the RADEG file.

See Also

.OPTION DEGFN
.OPTION DEGFP
.OPTION MOSRALIFE

.OPTION DEGFN

Sets the NMOS's failure criteria for lifetime computation when using the MOSRA API.

Syntax

`.option DEGFN=`*`val`*

Description

This option is used in conjunction with `.OPTION MOSRALIFE`. This option sets the PMOS's degradation value at lifetime. If the option is not specified or the keyword can not be identified by the MRAlifetimeDeg function, HSPICE substitutes `.OPTION DEGF` for lifetime computation. The options apply to all MOSFETs. The lifetime values are printed in the RADEG file.

See Also

.OPTION DEGF
.OPTION DEGFP
.OPTION MOSRALIFE

.OPTION DEGFP

Sets the PMOS's failure criteria for lifetime computation when using the MOSRA API.

Syntax

```
.option DEGFP= val
```

Description

This option is used in conjunction with `.OPTION MOSRALIFE`. This option sets the PMOS's degradation value at lifetime. If the option is not specified or the keyword can not be identified by the MRAlifetimeDeg function, HSPICE substitutes `.OPTION DEGF` for lifetime computation. The options apply to all MOSFETs. The lifetime values are printed in the RADEG file.

See Also

.OPTION DEGF
.OPTION DEGFN
.OPTION MOSRALIFE

.OPTION DELMAX

Sets the maximum allowable step size of the time steps taken during transient analysis in HSPICE.

Syntax

```
.OPTION DELMAX=x
```

Default (Computed automatically)

Description

Use this option to set the maximum allowable step size of the internal time step. The maximum internal time step taken by HSPICE during transient analysis is referred to as Δt_{max}. Its value is normally computed automatically based on

several time step control settings. If you wish to override the automatically computed value, and force the maximum step size to be a specific value, you can do so with .OPTION DELMAX, or by specifying a *delmax* value with the .TRAN command. If not specified, HSPICE automatically computes a DELMAX "auto" value.

The initial calculated DELMAX “auto” value, shown in the output listing, is generally not the value used for simulation. The calculated DELMAX value is automatically adjusted by the time step control method RUNLVL.

If DELMAX is defined in an .OPTION command, its priority is higher than the value given with a .TRAN command and it overrides the DELMAX “auto” value calculations. Min value: -1e10; Max value 1e10.

See Also

.TRAN
.OPTION RUNLVL

.OPTION DIAGNOSTIC / DIAGNO

Logs the occurrence of negative model conductances.

Syntax

```
.OPTION DIAGNOSTIC
```

Description

Use this option to log the occurrence of negative model conductances.

.OPTION DLENCSDF

Specifies how many digits to include in scientific notation (exponents) or to the right of the decimal point when using Common Simulation Data Format.

Syntax

```
.OPTION DLENCSDF=x
```

Default 5

Description

If you use the Common Simulation Data Format (Viewlogic graph data file format) as the output format, this digit length option specifies how many digits

to include in scientific notation (exponents) or to the right of the decimal point. Valid values are any integer from 1 to 10.

If you assign a floating decimal point or if you specify less than 1 or more than 10 digits, HSPICE uses the default. For example, it places 5 digits to the right of a decimal point.

.OPTION DP_FAST

When turned on (=Yes) sets MC_Fast=Yes and uses several other options to reduce the number and size of the output files.

Syntax

```
.OPTION DP_FAST=No|Yes
```

Default No

Description

Minimizes the size and number of output files generated by the worker machines in a distributed processing array, including the listing file.

Note: The sub-options listed below are subject to change.

HSPICE automatically sets the following option values:

- .OPTION MC_FAST=Yes
- .OPTION BADCHR=0
- .OPTION INGOLD=2
- .OPTION LISLVL=1
- .OPTION LIST=0
- .OPTION NOMOD=1
- .OPTION OPFILE=0
- .OPTION PATHNUM=0
- .OPTION WARN_SEP=1
- .OPTION WARNLIMIT=2

See Also

.OPTION MC_FAST

.OPTION DUMPCFL

Prints all the internal variables for HSPICE-CFL simulations.

Syntax

```
.OPTION DUMPCFL=0|1
```

Default 0. Do not print variable values passed to CFL functions

Description

Use this option to print all internal variables for HSPICE-CFL simulations. The default is 0.

- 0: Does not print variable values passed to CFL functions.
- 1: Prints variable values passed to CFL functions. The variable values are output in a separate file named as *.cflprt# which is similar to HSIM output.

Examples

Here is an example of the contents of a *.cflprt# file:

```
xx033.xcm1.cgnd1 =
calculatecgnd(array1,lr1,wr1,sp1,layer1,density1,fgnd1,fcpl1)+1
  ==> calculatecgnd(  0.,  25.0600,  0.1720,  0.2480,  3.0000,
3.0000,  -0.2164,  -0.2095)
    ==>   2.982e-16
xx033.xcx1.ccpl1 =
calculateccpl(array1,lr1,wr1,sp1,layer1,density1,fgnd1,fcpl1)
  ==> calculateccpl(  0.,  25.0600,  0.1720,  0.2480,  3.0000,
3.0000,  -0.2164,  -0.2095)
    ==>   8.703e-16
xx032.xcm1.cgnd1 =
calculatecgnd(array1,lr1,wr1,sp1,layer1,density1,fgnd1,fcpl1)+1
  ==> calculatecgnd(  0.,  25.0600,  0.1720,  0.2480,  3.0000,
2.0000,  -0.2164,  -0.2095)
    ==>   2.860e-16
......
```

See Also

.DC
.OPTION DCON
.TRAN

.OPTION DV

Specifies maximum iteration to iteration voltage change for all circuit nodes in both DC and transient analyses.

Syntax

```
.OPTION DV=x
```

Default 1.00k

Description

Use this option to specify maximum iteration to iteration voltage change for all circuit nodes in both DC and transient analysis. High-gain bipolar amplifiers can require values of 0.5 to 5.0 to achieve a stable DC operating point. Large CMOS digital circuits frequently require about 1 V. The default is 1000 (or 1e6 if DCON=2).

See Also

.DC
.OPTION DCON
.TRAN

.OPTION DYNACC

(Optimization) Dynamic accuracy tolerance setting to accelerate bisection simulation.

Syntax

```
.OPTION DYNACC = 0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

When DYNACC=1, if HSPICE is in accuracy mode, it uses reduced accuracy simulations to narrow the bisection window, then switches to the original accuracy algorithm to refine the solution. This method reduces simulation time by doing the majority of simulations at lower accuracy, which run faster by taking fewer time steps.If DYNACC is set using the .OPTION command, the setting of DYNACC in .model card is overridden.

See Also

.MODEL

.OPTION EM_RECOVERY

Provides a coefficient value for measuring “recovered” average current such as electromigration for bipolar currents.

Syntax

```
.OPTION EM_RECOVERY=value
```

Default

`1`

Description

This option is used in a transient analysis with the `.MEAS` keyword `em_avg` (electromigration average) using the From-To function. `.OPTION EM_RECOVERY` assists in measuring “recovered” average current from an electromigration perspective. The option can have a coefficient value between 0.0 and 1.0. Recovered average current is especially meaningful for bipolar currents (for example output of the inverter), as the mathematical average for such a waveform is zero.

Examples

```
.option em_recovery=0.9
```

See Also

.MEASURE (AVG, EM_AVG, INTEG, MIN, MAX, PP, and RMS)

.OPTION EPSMIN

Specifies the smallest number a computer can add or subtract.

Syntax

```
.OPTION EPSMIN=x
```

Default

`1e-28`

Description

Use this option to specify the smallest number that a computer can add or subtract, a constant value. This options helps avoid zero denominator issues.

.OPTION EQN_ANALYTICAL_DERIV

Enables analytical derivative computation for expression-based element evaluations in HPP analysis and advanced analog analyses.

Syntax

```
.OPTION EQN_ANALYTICAL_DERIV=1|0
```

Default Value if option is not specified in the netlist: `0`
Value if option name is specified without a corresponding value: `1`

Description

By default, HSPICE Precision Parallel (HPP) and advanced analog analyses use numerical derivative computations for elements with mathematical expressions. This option enables analytical derivative computation for expression-based element evaluations (for these analyses only).

When `EQN_ANALYTICAL_DERIV` is set to `1`, HSPICE computes analytical derivatives in element evaluations for extensive accuracy with slight additional computational cost.

.OPTION ETMIAGECHK

Controls TMI aging forbidden behaviors.

Syntax

```
.option ETMIAGECHK=0|1|2
```

Default Value if option is not specified in the netlist: 1; Value if option name is specified without a corresponding value: 1

Description

Use this option to control TMI aging forbidden behaviors.

Use this option with the following values:

- 0: Simulation does not abort for any sweep when TMI aging
- 1: Simulation aborts for `.TRAN` analysis with any sweep when TMI aging
- 2: Simulation supports TMI aging with Monte Carlo, but aborts for `.TRAN` analysis with other sweep when TMI aging

.OPTION ETMIUSRINPUT

Points to the location of `TMI *.so` (compiled library). Multiple etmiUsrInput options can be specified in a netlist. Simulator records all the path and files specified and sends them to the TMI model.

Syntax

```
.option etmiUsrInput='$relative_path/$filename'
.option etmiUsrInput='$absolute_path/$filename'
.option etmiUsrInput='$relative_path/$folder/'
.option etmiUsrInput='$absolute_path/$folder/'
.option etmiUsrInput='$filename'
.option etmiUsrInput='$folder/'
```

Default NULL

Description

Option value may be path+filename, path+folder, filename, or folder. This option can be set in model files or netlists.

If this option is set in the model file, `relative_path` means the path is relative to the model file directory.

If this option is set in the netlist, `relative_path` means the path is relative to the netlist directory.

If option value is a file name or folder name, this file or folder must be in the same directory of the model file or netlist.

Simulators need to convert the relative path to absolute path for TMI via new data structure and interface function.

.OPTION EXPLI

Enables the current-explosion model parameter.

Syntax

```
.OPTION EXPLI=x
```

Default `0` (amp/area effective)

Description

Use this option to enable the current-explosion model parameter. PN junction characteristics, above the explosion current are linear. HSPICE determines the slope at the explosion point. This improves simulation speed and convergence.

See Also

BJT and Diode Examples for the path to the demo file `bjtgm.sp`, which uses `.OPTION EXPLI=10`.

.OPTION EXPMAX

Specifies the largest exponent that you can use for an exponential before overflow occurs.

Syntax

```
.OPTION EXPMAX=x
```

Default `80.00`

Description

Use this option to specify the largest exponent for build-in `EXP()` function before overflow occurs. It also limits the exponent of Diode, BJT exponential equation.

.OPTION EXTEND_BISECTION_WINDOW

Specifies the times of extending bisection window.

Syntax

```
.OPTION EXTEND_BISECTION_WINDOW=n
```

Default Value if option is not specified in the netlist: 0. Value if option name is specified without a corresponding value: 3.

Description

This command specifies the times of extending bisection window. In this command `n = 0` means that HSPICE will not extend the user-specified window.

`n > 0` means that when HSPICE finds that the objective function sign is the same at the two ends of the user-specified window, the window size is successively doubled till it reaches 2^n, the initial window size. HSPICE errors out if the function sign remains the same, even with the extended window.

.OPTION EXTERNAL_FILE

Avoids read-in of entire external block at front end.

Syntax

```
.OPTION EXTERNAL_FILE=filename
```

Description

Use this command to enable read-in of external block line-by line-during the simulation stage. This command distributes memory consumption and avoids overtaxing front-end with block containing large samples. This option is also available for DP with Monte Carlo.

Examples

```
.OPTION SAMPLING_METHOD=External Block_Name=extern_data
+ EXTERNAL_FILE=extern.mc0
.DATA extern_data
...
.ENDDATA
```

See Also

.VARIATION Block Control Options

.OPTION EXT_OP

Enable additional OP information output in HSPICE.

Syntax

```
.OPTION EXT_OP=0|1
```

Default Default Value if option is not specified in the netlist: `0`

Description

Set this option to `1` to enable HSPICE to output additional OP information for BSIM3, BSIM4, PSP, and BSIMCMG.

Note: Extended DC operating point output can also be enabled by setting the environment variable `ext_op` to 1 (default 0).

.OPTION FFT_ACCURATE

Produces a computed time point at each FFT sampling time location. The FFT measurement is calculated based on the computed time points. Any post-processing utility such as WaveView can also use these time points for FFT measurement.

Syntax

```
.OPTION FFT_ACCURATE=[0|1|2]
```

Default Value if option is not specified in the netlist: 0. Value if option name is specified without a corresponding value: 1

Argument	Description
`FFT_ACCURATE=0`	No forced time points for FFT in transient analysis.
`FFT_ACCURATE=1` (default)	Forces time points evaluated at FFT required points.
`FFT_ACCURATE=2`	Additional time points are added to not only the FFT time period, but also several periods ahead of the FFT time period.

Description

Use this option to dynamically adjust the time step so that each FFT point is a real simulation point. This eliminates interpolation error and provides the highest FFT accuracy with minimal overhead in simulation time.

Note: This option is active by default only when `.FFT` is used.

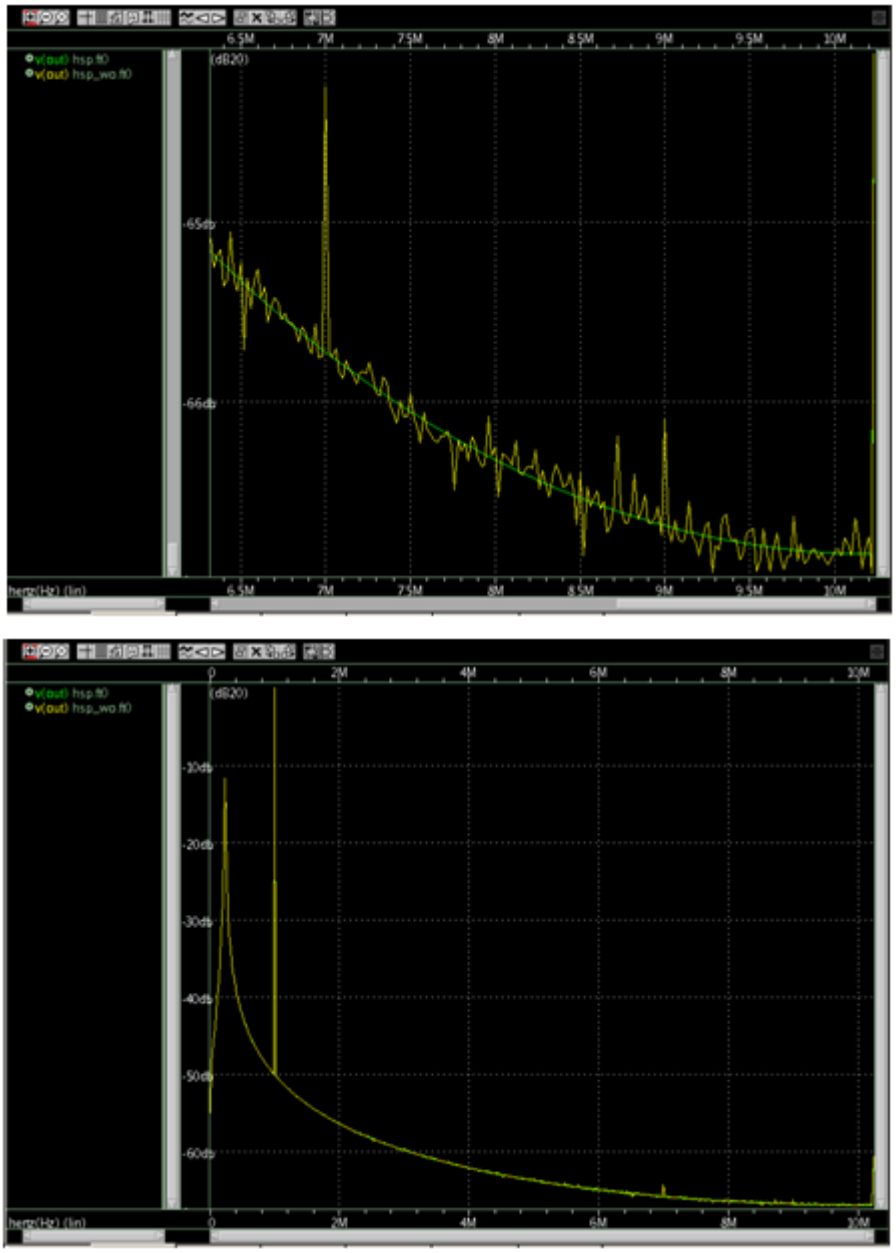
Important: Time point location is stored as single precision numerical data and round-off errors may be introduced when resolving pico-second resolution in a millisecond transient simulation. In this case, it is recommended to store the data as double precision numerical data by setting `.OPTION POST_VERSION=2001`.

FFT Measurement Based on Different Methods

The following table shows the FFT measurement based on different methods:

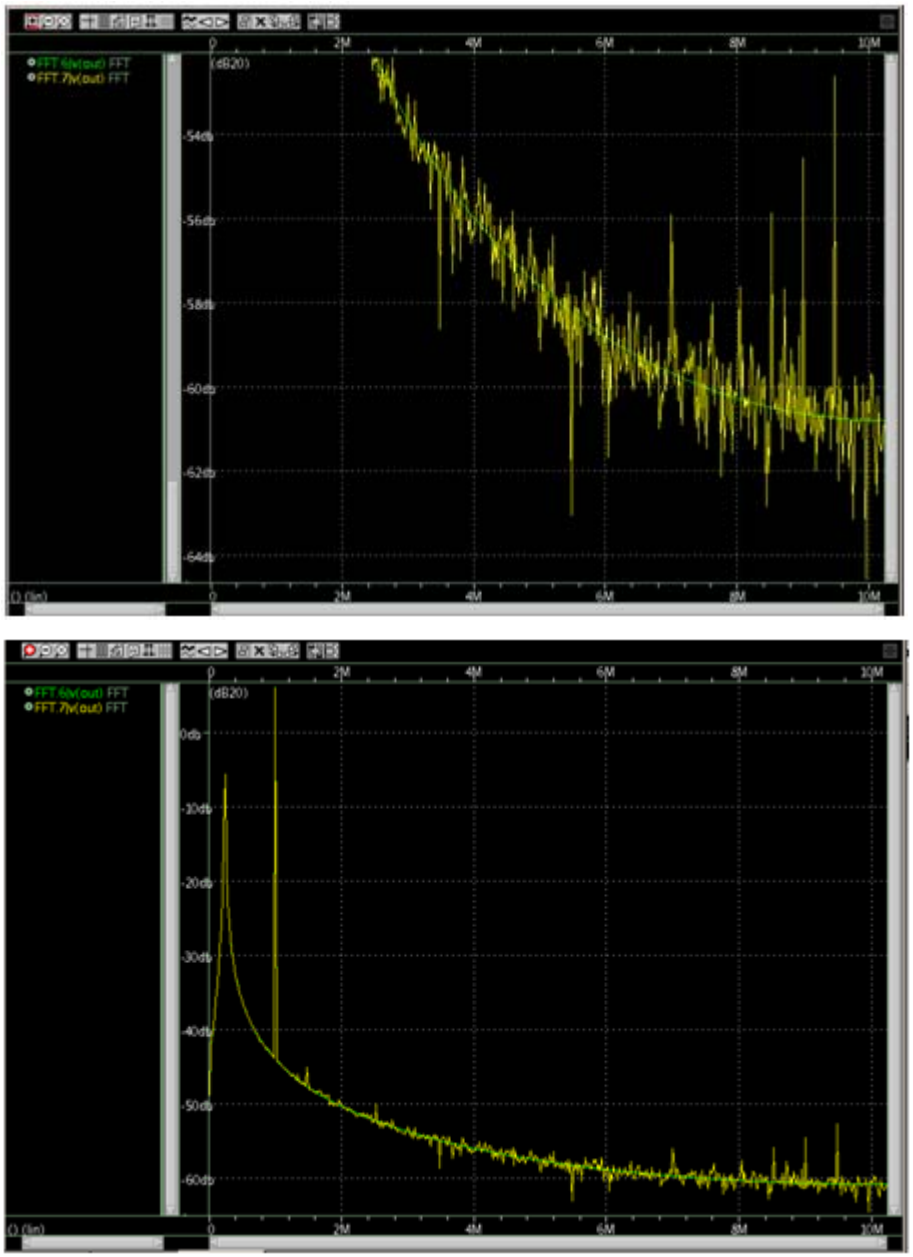
Method	THD (dB)
HSPICE `.FFT` Measurement	`-28.0396`
HSPICE `.FFT` Measurement with `FFT_ACCURATE`	`-28.0346`
WaveView FFT Tool Post-Processing `*.tr0`	`-28.0238`
WaveView FFT Tool Post-Processing `*.tr0` (with `FFT_ACCURATE`)	`-28.0346`

FFT results from HSPICE .FFT output file (*.ft0)



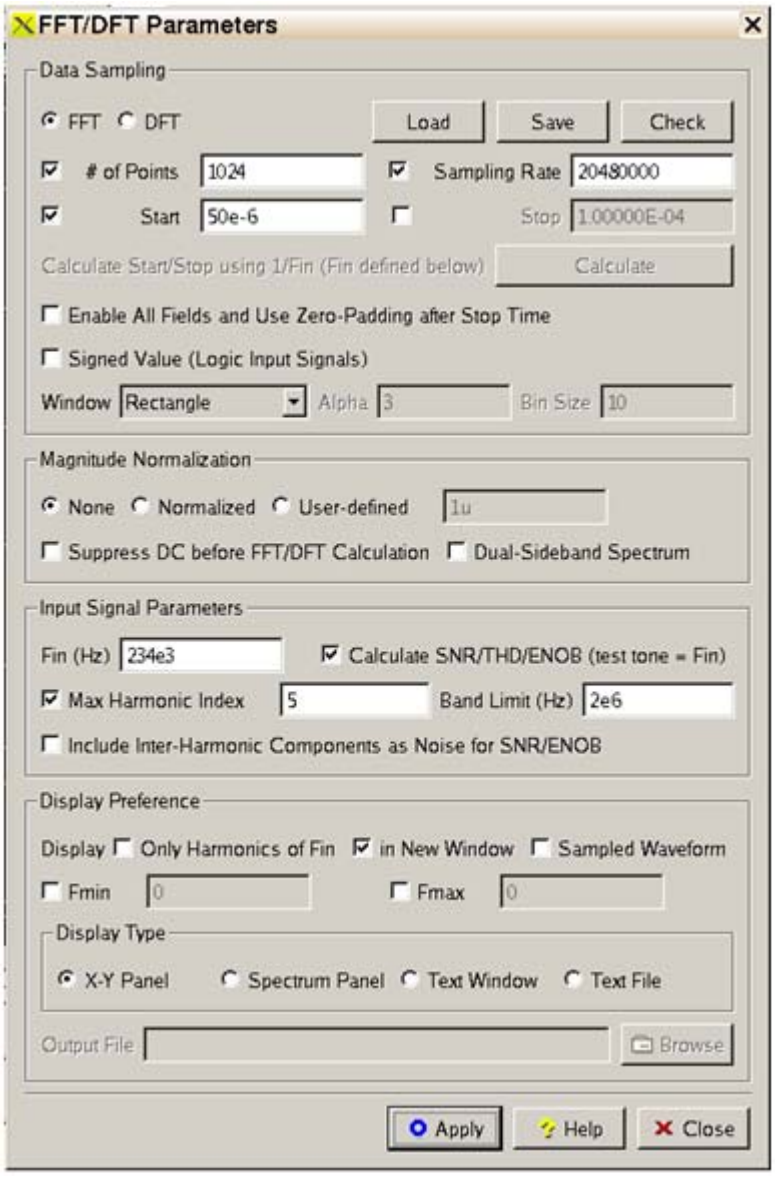
Green curve indicates HSPICE `.FFT` with `FFT_ACCURATE`; Yellow curve indicates HSPICE `.FFT` without `FFT_ACCURATE` showing noises due to interpolation error.

FFT results using WaveView to post-process HSPICE output file (*.tr0)



Green curve indicates HSPICE `.FFT` with `FFT_ACCURATE`; Yellow curve indicates HSPICE `.FFT` without `FFT_ACCURATE` showing noises due to interpolation error.

FFT parameters used for post-processing HSPICE output file (*.tr0)



Examples

The following example illustrates the usage of `.FFT` with the `FFT_ACCURATE` option:

```
*Netlist
vin in 0 sin 0 1 1e6
vind ind_ 0 sin 0 0.3 234e3
Emulti inm 0 vcvs in ind_ 2
rin inm out 0 1k
cout out 0 1p
.tran 1p 100u
.fft v(out) start=50e-6 stop=100e-6 np=1024 freq=234e3
.option fft_accurate
.MEASURE FFT sin_thd THD v(out) NBHARM=5 maxfreq=2e6
.option post
.end
```

See Also

.OPTION ACCURATE
.OPTION SIM_ACCURACY

.OPTION FFTOUT

Prints 30 harmonic fundamentals.

Syntax

```
.OPTION FFTOUT=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to print 30 harmonic fundamentals sorted by size, THD, SNR, and SFDR, but only if you specify a `FFTOUT` option and a `.FFT freq=`*`xxx`* command.

See Also

.FFT

.OPTION FMAX

Sets the maximum frequency value of angular velocity, for poles and zeros.

Syntax

```
.OPTION FMAX=x
```

Default `1.0e+12`

Description

Use this option to set the maximum frequency value of angular velocity for Pole/Zero analysis. The units of value are in rad/sec.

See Also

.OPTION CSCAL
.OPTION FSCAL
.OPTION GSCAL
.OPTION ITLPZ
.OPTION LSCAL
.OPTION PZABS
.OPTION PZTOL
.OPTION RITOL
.PZ

.OPTION FROM_TO

Stops a transient analysis in HSPICE or HSPICE RF for FROM–TO measure functions when `.option AUTOSTOP` is set, but the value of `TO` is not given.

Syntax

```
.OPTION FROM_TO=[0|1]
```

Default if the value of `TO` is not given in measure functions, the transient end point in `.tran` statement will be assigned to `TO`. So the `.option AUTOSTOP` has no any effect for such case. If you want to terminate the transient analysis when `.option AUTOSTOP` is set, but the value of `TO` is not given, you can set `.option FROM_TO` to terminate it once other measure functions are finished.

Description

Use this option to terminate a transient analysis in HSPICE for FROM-TO measure functions when option AUTOSTOP is set, but the value of TO is not given. It only works under option AUTOSTOP and cannot work independently.

See Also

.TRAN

.OPTION FSCAL

Sets the frequency scale for Pole/Zero analysis.

Syntax

```
.OPTION FSCAL=x
```

Default `1e-9`

Description

Use this option to set the frequency scale for Pole/Zero analysis. HSPICE multiplies capacitances by `FSCAL`.

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION GSCAL
.OPTION ITLPZ
.OPTION LSCAL
.OPTION PZABS
.OPTION PZTOL
.OPTION RITOL
.PZ

.OPTION FSDB

Enables HSPICE to output a transient waveform file (`*.tr#`) in FSDB format.

Syntax

```
.OPTION FSDB= [0|1]
```

Default The value if the option is not specified in the netlist is 0. If the option name is specified without a corresponding value, the default is 1.

Description

This option generates a transient waveform file in Fast Signal Database (FSDB) format.

Important: The latest FSDB version supported by HSPICE is 5.0.

The options are as follows:

- `FSDB=0` – Disables the option.
- `FSDB=1` – Causes HSPICE to output the transient waveform file in FSDB format with the suffix: `*.tr#.fsdb`.

Note: Following are some important notes:

- If you specify both the `FSDB` and `POST` options in the same netlist, the last one declared is effective. Make sure the `FSDB` option appears after a `POST` option in the netlist file if you prefer the `FSDB` output format.
- FSDB does not support AC analysis. You will have to reset the FSDB option to POST for AC output.

.OPTION GDCPATH

Adds conductance to nodes having no DC path to ground.

Syntax

```
.OPTION GDCPATH[=x]
```

Default `1e-12`

Description

Use this option to add conductance to nodes having no DC path to ground.

.OPTION GEN_CUR_POL

Enables specifying that the generic current polarity maintain backward compatibility with HSPICE simulation files.

Syntax

```
.OPTION GEN_CUR_POL=ON|OFF
```

Default `OFF`

Description

When `.OPTION GEN_CUR_POL=ON`, the `i2()` and `i3()` direction is changed to use a generic direction rule, that is: the current *in* is positive, and the current *out* is negative. The HSPICE current direction rule is more device-aware. However, for primitive devices and devices with macro models (subcircuit definitions), support of a more generic current direction rule enables ease of use with the Synopsys Galaxy Custom Designer®.

HSPICE current `.PRINT/.PROBE` statements as in (`Wwww`), `Iall(Wwww)` and `Izn(Wwww)` work with this option.

This option can be used with the following elements:

- MOSFETs (N and P)
- BJTs (NPN and PNP)
- JFETs (N and P)
- Diodes (D)
- Sources (V and I)
- Passive elements (L, R and C)
- Behavioral elements (E, F, G and H)

The following elements are *not* affected by this option and are a limitation of the F-2011.09 release: W-, U-, T-, P-, and S-elements and IBIS models.

Examples

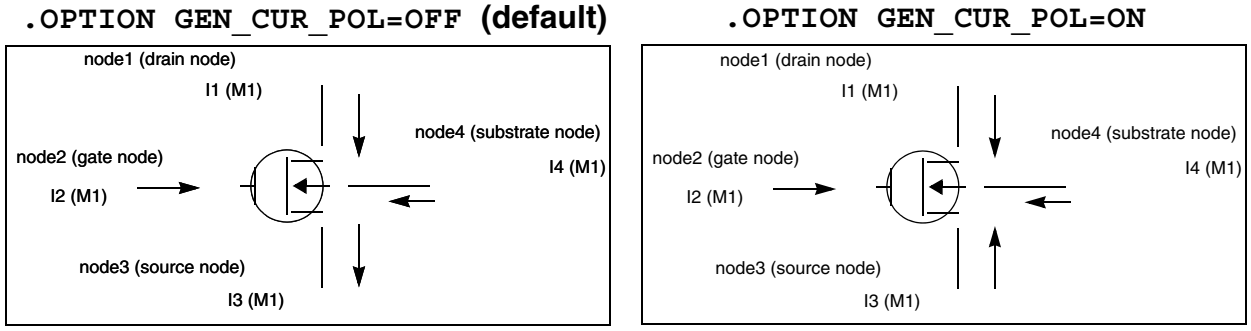


Figure 15 Direction of current: default HSPICE behavior (left), generic rule (right)

.OPTION GENK

Automatically computes second-order mutual inductance for several coupled inductors.

Syntax

```
.OPTION GENK= 0|1
```

Default Value if option is not specified in the netlist: 1
Value if option name is specified without a corresponding value: 0

Description

Use this option to automatically calculate second-order mutual inductance for several coupled inductors. The default (`1`) enables the calculation.

Examples

```
***GENK=1***
   l1  1  0  1
   l2  2  0  1
   l3  3  0  1
   k12  l1 l2 1
   k23  l2 l3 1
```

In the above example, there is an explicit mutual connection between l1 and l2, as well as between l2 and l3. However there is an implicit connection between l1 and l3 that is not given. GENK=1 will generate this implicit mutual K13 automatically.

.OPTION GEOCHECK

Checks MOSFET geometry range in global models.

Syntax

```
.OPTION GEOCHECK=[0|1|2]
```

Default `0`

Description

Use `.OPTION GEOCHECK` to validate the geometry range in a global model. The option checks `wmin/lmin/wmax/lmax` parameters in the model card.

- `0`: Suppresses check of MOSFET geometry range in a global model card.
- `1`: Checks MOSFET geometry range in the global model card that contains `wmin/lmin/wmax/lmax` parameters and issues a warning if the device falls out of range.
- `2`: Checks MOSFET geometry range in the global model card that contains `wmin/lmin/wmax/lmax` parameters and issues an error message if the device falls out of range.

`** warning **` or `** error **` `(filename: linenumber) Mosfet xxx: Instance length or width does not fit the lmin/lmax, wmin/wmax range for the model xxx. The instance Length=xxx' Width=xxx. The model range is Lmin=xxx, Lmax=xxx, Wmin=xxx, Wmax=xxx.`

If you declare `.OPTION GEOCHECK` with no value it is equivalent to `.OPTION GEOCHECK=1`.

.OPTION GEOSHRINK

Element scaling factor used with `.OPTION SCALE`.

Syntax

```
.OPTION GEOSHRINK=x
```

Description

Use this option as a global model to apply to all elements. In addition to `.OPTION SCALE`, use this option (usually through a technology file) on top of the existing `scale` option to further scale geometric element instance parameters whose default units are meters. The final instance geometric parameters are then calculated as:

```
final_dimension = original_dimension * SCALE * GEOSHRINK
```

The effective scaling factor is the product of the two parameters.

The default value for both `SCALE` and `GEOSHRINK` is 1.

If a model library contains devices other that MOSFET, such as R, L, C, diode, bjt..., and so forth, and/or the netlist is a post-layout design with RCs, the shrink factor is applied to all elements.

Examples

Example 1: If there is more than one `geoshrink` option set, only the last `geoshrink` is used.

```
.option geoshrink=0.8
.option geoshrink=0.9
```

Then the `final_dimension = original_dimension * SCALE * 0.9`

Example 2: If there is more than one `geoshrink` and `scale` in the model card, only the last `scale` and the last `geoshrink` are used.

```
.option scale=2u
.option scale=1u
.option geoshrink=0.8
.option geoshrink=0.9
```

Then the `final_dimension = original_dimension * 1u * 0.9`.

See Also

.OPTION SCALE
.OPTION CMIUSRFLAG

.OPTION GMAX

Specifies the maximum conductance in parallel with a current source for `.IC` and `.NODESET` initialization circuitry.

Syntax

`.OPTION GMAX=`*x*

Default `100.00` (mho)

Description

Use this option to specify the maximum conductance in parallel with a current source for `.IC` and `.NODESET` initialization circuitry. Some large bipolar circuits require you to set `GMAX=1` for convergence.

See Also

.IC
.NODESET
.OPTION IC_ACCURATE

.OPTION GMB_CLAMP

Disables negative conductance clamping.

Syntax

```
.OPTION GMB_CLAMP=0|1
```

Default `1`

Description

This option allows you to disable gmbs clamping to 0 (for some MOSFET models, such as Level 54 - BSIM4, when gmbs turns negative, it is automatically set to 0).

- If `.OPTION GMB_CLAMP=0`: HSPICE prevents gmbs output from clamping at zero.
- If `GMB_CLAMP=1`: conductance is clamped at zero (disallows negative values).

.OPTION GMIN

Specifies the minimum conductance added to all PN junctions for a time sweep in transient analysis for HSPICE.

Syntax

```
.OPTION GMIN=x
```

Default `1e-12`

Description

Use this option to specify the minimum conductance added to all PN junctions for a time sweep in transient analysis. Min value: 1e-30; Max value: 100.

For BSIM-CMG, `GMIN` default is 1e-15, and HSPICE scale down user specified option `GMIN` by 1e-3.

See Also

.OPTION GMINDC

.OPTION GMINDC

Specifies conductance in parallel for PN junctions and MOSFET nodes in DC analysis.

Syntax

```
.OPTION GMINDC=x
```

Description

Use this option to specify conductance in parallel for all PN junctions and MOSFET nodes except gates in DC analysis.GMINDC helps overcome DC convergence problems caused by low values of off-conductance for PN

junctions and MOSFETs.

Large values of GMINDC can cause unreasonable circuit response. If your circuit requires large values to converge, suspect a bad model or circuit.

For BSIM-CMG, GMINDC default is 1e-15, and HSPICE scale down user specified option GMINDC by 1e-3.

See Also

.DC
.OPTION GRAMP
.OPTION PIVTOL

.OPTION GRAMP

Specifies a conductance range over which DC operating point analysis sweeps GMINDC.

Syntax

```
.OPTION GRAMP=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to specify a conductance range over which the DC operating point analysis sweeps GMINDC. HSPICE sets this value during autoconvergence. Use GRAMP with the GMINDC option to find the smallest GMINDC value that results in DC convergence.

GRAMP specifies a conductance range over which the DC operating point analysis sweeps GMINDC. HSPICE replaces GMINDC values over this range, simulates each value, and uses the lowest GMINDC value where the circuit converges in a steady state.

If you sweep GMINDC between 1e-12 mhos (default) and 1e-6 mhos, GRAMP is 6 (value of the exponent difference between the default and the maximum conductance limit). In this example:

- HSPICE first sets GMINDC to 1e-6 mhos and simulates the circuit.
- If circuit simulation converges, HSPICE sets GMINDC to 1e-7 mhos and simulates the circuit.
- The sweep continues until HSPICE simulates all values of the GRAMP ramp.

If the combined GMINDC and GRAMP conductance is greater than 1e-3 mho, false convergence can occur.

Min value: 0; Max value: 1000.

See Also

.DC
.OPTION GMINDC

.OPTION GSCAL

Sets the conductance scale for Pole/Zero analysis.

Syntax

```
.OPTION GSCAL=x
```

Default 1e+3

Description

Use this option to set the conductance scale for Pole/Zero analysis. HSPICE multiplies the conductance and divides the resistance by GSCAL.

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION FMAX
.OPTION FSCAL
.OPTION GSCAL
.OPTION LSCAL

.OPTION PZABS
.OPTION PZTOL
.OPTION RITOL
.PZ

.OPTION GSHDC

Adds conductance from each node to ground when calculating the DC operating point of the circuit.

Syntax

```
.OPTION GSHDC=x
```

Default 0

Description

Use this option to add conductance from each node to ground when calculating the DC operating point of the circuit (`.OP`) to help solve convergence issues.

Examples

```
.option gshdc=1e-13
```

See Also

.OPTION GSHUNT

.OPTION GSHUNT

Adds conductance from each node to ground.

Syntax

```
.OPTION GSHUNT=x
```

Default 0

Description

Use this option to add conductance from each node to ground. Add a small `GSHUNT` to each node to help solve “time step too small” problems caused by either high-frequency oscillations or numerical noise.

Examples

```
.option gshunt=1e-13 cshunt=1e-17
.option gshunt=1e-12 cshunt=1e-16
.option gshunt=1e-11 cshunt=5e-15
.option gshunt=1e-10 cshunt=1e-15
.option gshunt=1e-9  cshunt=1e-14
```

See Also

.OPTION CSHUNT
.OPTION GSHDC

.OPTION HB_GIBBS

Option to minimize Gibbs' phenomena.

Syntax

```
.OPTION HB_GIBBS=n
```

Default 0

Description

Minimize any Gibbs' phenomenon that may occur in transforming a square-wave signal from the frequency domain to the time domain. When n is greater than 0, the result is that the waveforms are filtered by a $(\sin c(x))^N$ function before being transformed to the time domain via FFT. This option applies only to single-tone output.

Examples

```
.option hb_gibbs = 2
...
.print hbtran v(2)
```

See Also

The *HSPICE User Guide: Advanced Analog Simulation and Analysis*, Minimizing Gibbs Phenomenon.

.OPTION HBACKRYLOVDIM

Specifies the dimension of the Krylov subspace used by the Krylov solver.

Syntax

```
.OPTION HBACKRYLOVDIM=value
```

Default 300

Description

Use this option to specify the dimension of the Krylov subspace that the Krylov solver uses.

The *value* parameter must specify an integer greater than zero. The range is 1 to infinity.

This option overrides the corresponding PAC option if specified in the netlist.

When this option is not specified in the netlist if HBACKRYLOVDIM < HBKRYLOVDIM, then HBACKRYLOVDIM = HBKRYLOVDIM.

See Also

.HB

.OPTION HBACKRYLOVITER / HBAC_KRYLOV_ITER

Specifies the number of GMRES solver iterations performed by the HB engine.

Syntax

```
.OPTION HBACKRYLOVITER | HBAC_KRYLOV_ITER = value
```

Description

Use this option to specify the number of Generalized Minimum Residual (GMRES) solver iterations that the HB engine performs.

The *value* parameter must specify an integer greater than zero. The range is 1 to infinity.

This option overrides the corresponding PAC option if specified in the netlist.

See Also

.HBAC
.OPTION HBKRYLOVDIM

.OPTION HBACTOL

Specifies the absolute error tolerance for determining convergence.

Syntax

```
.OPTION HBACTOL=value
```

Default `1.e-8`

Description

Use this option to specify the absolute error tolerance for determining convergence. The *value* parameter must specify a real number greater than zero. The range is 1.e-14 to infinity.

This option overrides the corresponding PAC option if specified in the netlist.

When this option is not specified in the netlist if `HBACTOL` > `HBTOL`, then `HBACTOL` = `HBTOL`.

See Also

.HB

.OPTION HBCONTINUE

Specifies whether to use the sweep solution from the previous simulation as the initial guess for the present simulation.

Syntax

```
.OPTION HBCONTINUE= 0|1
```

Default `1`

Description

Use this option to specify whether to use the sweep solution from the previous simulation as the initial guess for the present simulation.

- `HBCONTINUE=1` Use solution from previous simulation as the initial guess.
- `HBCONTINUE=0`: Start each simulation in a sweep from the DC solution.

See Also

.HB

.OPTION HBFREQABSTOL

Specifies the maximum absolute change in frequency between solver iterations for convergence.

Syntax

```
.OPTION HBFREQABSTOL=value
```

Default 1Hz

Description

Use this option to specify the maximum absolute change in frequency between solver iterations for convergence.

This option is an additional convergence criterion for oscillator analysis.

See Also

.HBOSC

.OPTION HBFREQRELTOL

Specifies the maximum relative change in frequency between solver iterations for convergence.

Syntax

```
.OPTION HBFREQRELTOL=value
```

Description

Use this option to specify the maximum relative change in frequency between solver iterations for convergence.

This option is an additional convergence criterion for oscillator analysis.

See Also

.HBOSC

.OPTION HBJREUSE

Controls when to recalculate the Jacobson matrix.

Syntax

```
.OPTION HBJREUSE=0|1
```

Default Conditional, see below

Description

Use this option to control when to recalculate the Jacobson matrix.

- `HBJREUSE=0`: Recalculates the Jacobian matrix at each iteration. This is the default if `HBSOLVER=1`.
- `HBJREUSE=1`: Reuses the Jacobian matrix for several iterations if the error is sufficiently reduced. This is the default if `HBSOLVER=0`.

See Also

.HB

.OPTION HBJREUSETOL

Determines when to recalculate Jacobian matrix if `HBJREUSE=1.0`.

Syntax

```
.OPTION HBJREUSETOL=value
```

Description

Determines when to recalculate Jacobian matrix (if `HBJREUSE=1.0`).

This is the percentage by which HSPICE must reduce the error from the last iteration so you can use the Jacobian matrix for the next iteration. The *value* parameter must specify a real number between 0 and 1.

See Also

.HB

.OPTION HBKRYLOVDIM

Specifies the dimension of the subspace used by the Krylov solver.

Syntax

```
.OPTION HBKRYLOVDIM=value
```

Description

Use this option to specify the dimension of the Krylov subspace that the Krylov solver uses.

The *value* parameter must specify an integer greater than zero.

See Also

.HB

.OPTION HBKRYLOVTOL

Specifies the error tolerance for the Krylov solver.

Syntax

```
.OPTION HBKRYLOVTOL=value
```

Default 0.01

Description

Use this option to specify the error tolerance for the Krylov solver.

The *value* parameter must specify a real number greater than zero.

See Also

.HB

.OPTION HBKRYLOVMAXITER / HB_KRYLOV_MAXITER

Specifies the maximum number of GMRES solver iterations performed by the HB engine.

Syntax

```
.OPTION HBKRYLOVMAXITER | HB_KRYLOV_MAXITER =value
```

Default 500

Description

Use this option to specify the maximum number of Generalized Minimum Residual (GMRES) solver iterations that the HB engine performs.

Analysis stops when the number of iterations reaches this value.

See Also

.HB

.OPTION HBLINESEARCHFAC

Specifies the line search factor.

Syntax

```
.OPTION HBLINESEARCHFAC=value
```

Default 0.35

Description

Use this option to specify the line search factor.

If Newton iteration produces a new vector of HB unknowns with a higher error than the last iteration, then scale the update step by this value and try again. The *value* parameter must specify a real number between 0 and 1.

See Also

.HB

.OPTION HBMAXITER / HB_MAXITER

Specifies the maximum number of Newton-Raphson iterations performed by the HB engine.

Syntax

```
.OPTION HBMAXITER | HB_MAXITER=value
```

Default 10000

Description

Use this option to specify the maximum number of Newton-Raphson iterations that the HB engine performs.

Analysis stops when the number of iterations reaches this value.

See Also

.HB

.OPTION HBOSCMAXITER / HBOSC_MAXITER

Specifies the maximum number of outer-loop iterations for oscillator analysis.

Syntax

```
.OPTION HBOSCMAXITER | HBOSC_MAXITER=value
```

Default `10000`

Description

Use this option to specify the maximum number of outer-loop iterations for oscillator analysis.

See Also

.HBOSC

.OPTION HBPROBETOL

Searches for a probe voltage at which the probe current is less than the specified value.

Syntax

```
.OPTION HBPROBETOL=value
```

Default `1.e-9`

Description

Use this option to cause oscillator analysis to try to find a probe voltage at which the probe current is less than the specified value.

This option defaults to the value of the `HBTOL` option, which defaults to 1.e-9.

See Also

.HBOSC
.OPTION HBTOL

.OPTION HBSOLVER

Specifies a pre-conditioner for solving nonlinear circuits.

Syntax

```
.OPTION HBSOLVER=0|1|2
```

Default 1

Description

Use this option to specify a preconditioner for solving nonlinear circuits.

- HBSOLVER=0: Invokes the direct solver.
- HBSOLVER=1 Invokes the matrix-free Krylov solver.
- HBSOLVER=2: Invokes the two-level hybrid time-frequency domain solver.

See Also

.HBOSC

.OPTION HBTOL

Specifies the absolute error tolerance for determining convergence.

Syntax

```
.OPTION HBTOL=value
```

Default 1.e-9

Description

Use this option to specify the absolute error tolerance for determining convergence.

The *value* parameter must specify a real number greater than zero.

See Also

.HB

.OPTION HBTRANFREQSEARCH

Specifies the frequency source for the HB analysis of a ring oscillator.

Syntax

```
.OPTION HBTRANFREQSEARCH=[1|0]
```

Default 1

Description

Use this option to specify the frequency source for the HB analysis of a ring oscillator.

- `HBTRANFREQSEARCH=1`: HB analysis calculates the oscillation frequency from the transient analysis
- `HBTRANFREQSEARCH=0`: HB analysis assumes that the period is 1/f, where f is the frequency specified in the tones description.

See Also

.HB
.HBOSC
.OPTION HBTOL

.OPTION HBTRANINIT

Selects transient analysis for initializing all state variables for HB analysis of a ring oscillator.

Syntax

```
.OPTION HBTRANINIT=time
```

Description

Use this option to cause HB to use transient analysis to initialize all state variables for HB analysis of a ring oscillator.

The *time* parameter is defined by when the circuit has reached (or is near) steady-state. The default is 0.

See Also

.HB
.HBOSC

.OPTION HBTRANPTS

Specifies the number of points per period for converting time-domain data results into the frequency domain for HB analysis of a ring oscillator.

Syntax

```
.OPTION HBTRANPTS=npts
```

Default `4*nh`

Description

Use this option to specify the number of points per period for converting the time-domain data results from transient analysis into the frequency domain for HB analysis of a ring oscillator.

The *npts* parameter must be set to an integer greater than 0. The units are in nharms (nh).

This option is relevant only if you set `.OPTION HBTRANINIT`. You can specify either `.OPTION HBTRANPTS` or `.OPTION HBTRANSTEP`, but not both.

See Also

.HB
.HBOSC
.OPTION HBTRANINIT
.OPTION HBTRANSTEP

.OPTION HBTRANSTEP

Specifies transient analysis step size for the HB analysis of a ring oscillator.

Syntax

```
.OPTION HBTRANSTEP=stepsize
```

Description

Use this option to specify transient analysis step size for the HB analysis of a ring oscillator.

The *stepsize* parameter must be set to a real number. The default is 1/(4*nh*f0), where *nh* is the nharms value and *f0* is the oscillation frequency.

This option is relevant only if you set `.OPTION HBTRANINIT`.

Note: You can specify either `.OPTION HBTRANPTS` or `.OPTION HBTRANSTEP`, but not both.

See Also

.HB

.HBOSC
.OPTION HBTRANINIT
.OPTION HBTRANPTS

.OPTION HBTROUT

Turn-on or turn-off generation of HBTRANINIT initialization output.

Syntax

```
.OPTION HBTROUT = 0|1
```

Default 0

Description

Use this option to either turn-on or turn-off generation of HBTRANINIT initialization data output. The result is a file with the extension `*.hbtr0`.

- `HBTROUT=0`: Turns-off the generation of HBTRANINIT initialization output.
- `HBTROUT=1`: Turns-on the generation of HBTRANINIT initialization output and the results are stored in a `*.hbtr0` file.

See Also

.HB
.HBOSC
.OPTION HBTRANINIT
.OPTION HBTRANPTS

.OPTION HIER_DELIM

Changes the netlist hierarchy delimiter used for netlist read-in and signal name output.

Syntax

```
.OPTION HIER_DELIM= 0|1|2
```

Default 0, if option is not specified in the netlist; 1, if option name is specified without a corresponding value.

Description

Use `.OPTION HIER_DELIM` to change the hierarchy delimiter from a caret (^) to a period (.) or a slash (/). This option works with `.OPTION PSF` and `.OPTION ARTIST`.

You can set the value of `HIER_DELIM` to one of the following values:

- `0`: When PSF option is set, HSPICE will use a period (.) as the delimiter for netlist read-in and a carat (^) for signal name output.
- `1`: When PSF option is set, HSPICE will use a period (.) as the delimiter for netlist read-in and a period (.) for signal name output.

  Note: The command `.OPTION HIER_DELIM =0|1` will have no impact for non-PSF netlist simulation. That is, HSPICE will use a period (.) as the delimiter for netlist read-in and signal output.

- `2`: Both PSF and non-PSF will use a slash (/) as the delimiter for netlist read-in and signal name output.

See Also

.OPTION ARTIST
.OPTION PSF

.OPTION HIER_SCALE

Uses the parameter S to scale subcircuits.

Syntax

```
.OPTION HIER_SCALE=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option so you can use the parameter S to scale subcircuits.

- `0` Interprets S as a user-defined parameter.
- `1` Interprets S as a scale parameter.

This option enables you to selectively scale the required instance. See the example below.

Examples

Assume you have an encrypted subcircuit from an IP vendor A which has `.option SCALE=1e-6` defined. You have another encrypted subcircuit (from another IP vendor B), which has the units defined as microns and does not need to be scaled. When you simulate the circuit, HSPICE applies the `SCALE` option globally and the subcircuit from IP vendor B is scaled again. You can selectively apply the `SCALE` option so that this does not happen, as follows:

```
* Top level netlist
.option hier_scale=1
.include "subckt_a.inc" $ subcircuit from IP vendor A
.include "subckt_b.inc" $ subcircuit from IP vendor B
vin in 0 5
x1 in 2 subckt_a $ uses .option scale=1e-6 defined in subckt_a.inc
file
x2 2 0 subckt_b S=1e6 $ scale option is not required
.tran 100p 10n
.end
```

The `subckt_a.inc` file has `.option scale=1u` defined and this is applied globally. When `.option hier_scale=1` is used and the subcircuit instance, X2 contains `S=1e6`, the global scaling is offset.If `W=10u` is used in subcircuit instance X2 and `hier_scale` is used, then:

```
W="10u*SCALE*S"="10u*1u*1e6"=10u
```

If `W=10` is used in subcircuit instance `X1` and “S” is not used, then only the global `.option SCALE=1e-6` is applied and the value of `W` is `10u`.

.OPTION IC_ACCURATE

Improves the accuracy of the `.IC` command.

Syntax

```
.OPTION IC_ACCURATE=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

When `.OPTION IC_ACCURATE=1` the `.IC` command accuracy is increased for cases requiring tighter precision (for example, when the GMAX value is too large) than is used to set the maximum conductance in parallel with a current

source for .IC and .NODESET initialization circuitry. The option overrides the approximating method used by the .IC command with only slight performance cost. If the option is not set or it equals 0, then the default .IC method is used.

See Also

.IC
.OPTION GMAX

.OPTION ICSWEEP

Saves the current analysis result of a parameter or temperature sweep as the starting point in the next analysis.

Syntax

```
.OPTION ICSWEEP=0|1|2
```

Default 1

Description

Use this option to save the current analysis result of a parameter or temperature sweep as the starting point in the next analysis in the sweep.

- If ICSWEEP=0, the next analysis does not use the results of the current analysis.
- If ICSWEEP=1, the next analysis uses the current results.
- If ICSWEEP=2, the operating point will be re-used between each optimization sweep. (The next analysis skips the OP operation during a transient sweep if the operating point is always same.) Use this setting if the OP has not changed during the transient sweep to speed up the simulation.

.OPTION INGOLD

Controls whether HSPICE prints *.lis file output in exponential form or engineering notation in HSPICE.

Syntax

```
.OPTION INGOLD=[0|1|2]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Argument	Description
INGOLD=0	Engineering Format; defaults 1.234K, 123M
INGOLD=1	G Format (fixed and exponential); defaults 1.234e+03, .123
INGOLD=2	E Format (exponential SPICE); defaults 1.234e+03, .123e-1

Description

Use this option to control if HSPICE prints output in exponential form (scientific notation) or engineering notation. Engineering notation provides two to four extra significant digits and aligns columns to facilitate comparison, as:

```
F=1e-15   M=1e-3
P=1e-12   K=1e3
N=1e-9    X=1e6
U=1e-6    G=1e9
```

When using HSPICE advanced analog functions variable values in engineering notation is printed by default. To use the exponential form, specify `.OPTION INGOLD=1` or `2`. To print variable values in exponential form, specify `.OPTION INGOLD=1` or `2`.

`.OPTION INGOLD` does not control the number format in measure files (`*.mt#`/`*.ms#`/`*.ma#`). If you specify a measure output file using `.OPTION MEASFORM`, HSPICE automatically resets an `INGOLD=0` setting to `INGOLD=1`, which allows the measure file to be imported to Excel when `.OPTION MEASFORM=1`.

For DCMatch and ACMatch results, the significant digits are increased to a default of four. For example:

```
>  Output  1-sigma due to total variations = 317.9979uA
<  Output  1-sigma due to global variations =  224.86uA
---
>  Output  1-sigma due to global variations =  224.8585uA
<  Output  1-sigma due to local variations =   224.86uA
---
>  Output  1-sigma due to local variations =  224.8585uA
```

Examples

```
.OPTION INGOLD=2
```

See Also

.OPTION MEASDGT
.OPTION MEASFORM

.OPTION INTERP

Limits output to only the .TRAN time step intervals for post-analysis tools.

Syntax

```
.OPTION INTERP=0|1
```

Default Value if option is not specified in the netlist: 0 (engineering notation)
Value if option name is specified without a corresponding value: 1

Description

Use to limit output for post-analysis tools to only the .TRAN time step intervals for some post-analysis tools. This option can be used to reduce the size of the post-processing output. By default, HSPICE outputs data at internal time points. In some cases, INTERP produces a much larger design .tr# file, especially for smaller time steps, and it also leads to longer runtime. When using INTERP, ensure you set TSTEP to the intervals you need the simulation data printed at.

Note: Since HSPICE uses the post-processing output to compute the .MEASURE command results, interpolation errors result if you use the INTERP option and your netlist also contains .MEASURE commands. Using the INTERP option with .MEASURE commands is not recommended.

When you run data-driven transient analysis (.TRAN DATA) in an optimization routine, HSPICE forces INTERP=1. All measurement results are at the time points specified in the data-driven sweep.

See Also

.TRAN

.OPTION IPROP

Controls whether to treat all of the circuit information as IP protected.

Syntax

```
.OPTION IPROP 0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use to control whether to treat all of the circuit information as IP protected and not output this information during simulation.

- 0= Output information (IP not protected)
- 1=Do not output information (IP protected)

.OPTION ITL1

Specifies the maximum DC iteration limit.

Syntax

```
.OPTION ITL1=n
```

Description

Use this option to specify the maximum DC iteration limit. Increasing this value rarely improves convergence in small circuits. Values as high as 400 have resulted in convergence for some large circuits with feedback (such as operational amplifiers and sense amplifiers). However, most models do not require more than 100 iterations to converge.

See Also

.DC

.OPTION ITL2

Specifies the iteration limit for the DC transfer curve.

Syntax

```
.OPTION ITL2=n
```

Description

Use this option to specify the iteration limit for the DC transfer curve. Increasing this limit improves convergence only for very large circuits.

See Also

.DC

.OPTION ITL5

Sets an iteration limit for transient analysis.

Syntax

```
.OPTION ITL5=x
```

Default `0` (infinite number of iterations)

Description

Use this option to set an iteration limit for a transient analysis. If a circuit uses more than `ITL5` iterations, the program prints all results up to that point.

.OPTION ITLPTRAN

Controls iteration limit used in the final try of the pseudo-transient method.

Syntax

```
.OPTION ITLPTRAN=x
```

Default `30`

Description

Use this option to control the iteration limit used in the final try of the pseudo-transient method in OP or DC analysis. If a simulation fails in the final try of the pseudo-transient method, provide a higher value.

See Also

.DC
.OP

.OPTION ITLPZ

Sets the iteration limit for pole/zero analysis.

Syntax

```
.OPTION ITLPZ=x
```

Default 100

Description

Use this option to set the iteration limit for pole/zero analysis.

See Also

.OPTION CSCAL
.OPTION GSCAL
.PZ
.OPTION FMAX

.OPTION ITRPRT

Enables printing of output variables at their internal time points.

Syntax

```
.OPTION ITRPRT 0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to enable printing of output variables at their internal time points.

When set to `1`, HSPICE prints output variables at their internal transient simulation time points. In addition, if you use the `-html` option when invoking HSPICE, then HSPICE prints the values to a separate file (`*.printtr0`).

.OPTION IVDMARGIN

Helps characterize Vdmargin using terminal I-V at MOSFET external nodes.

Syntax

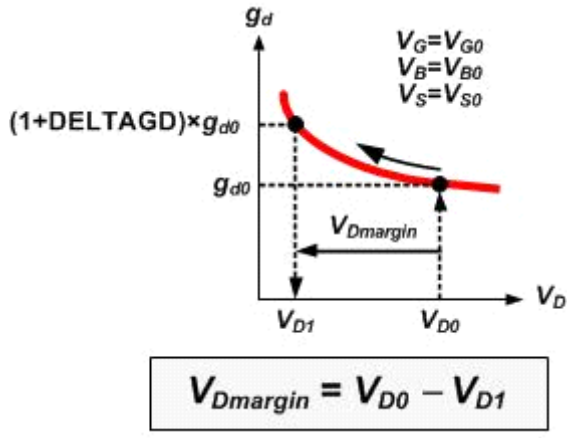
```
.OPTION IVDMARGIN=x
```

Default 0.1

Description

X is a positive variable in double type to define the relative gd change target for vdmargin calculation. X is typically in a range of 0 to 1. An alternative to the command .IVDMARGIN, this option is only available for BSIM4 (Level 54), BSIM-CMG (Level 72), and BSIM6 (Level 77) MOSFETs. Wildcards (*) can be used to specify FETs. If no FET is specified, then the value applies to all FETs in the simulation by default.

Vdmargin, as shown in the following plot, is defined as the MOSFET drain voltage range within which the change in the MOSFET drain conductance $g_d = \frac{\partial I_d}{\partial V_d}$ (with respect to reference (the gd value at operating point) is smaller than a user-specified target. It provides a heuristic measure of how much the drain voltage can be reduced, particularly in the saturation region of MOSFET operation, beyond which the MOSFET drain conductance has degraded beyond a user-specified tolerance.



- If the option is not set, HSPICE does not invoke Vdmargin characterization.
- If the option is given with a nonzero X, Vdmargin simulation is invoked with X as the target of gd change. For example, .OPTION iVdmargin=X
- If the option is given with no argument specified, Vdmargin is invoked and uses X = 0.1
- iVdmargin=0 is equivalent to turning off the Vdmargin simulation.

Note: If both the .IVDMARGIN command and .OPTION IVDMARGIN are both set in a netlist, HSPICE ignores the option.

See Also

.IVDMARGIN
Vdmargin Output

.OPTION IVTH

Invokes a constant-current threshold voltage probing and characterization function.

Syntax

.OPTION IVTH=*val* | IVTHN=*val* | IVTHP=*val*

Description

Specifies the ivth constant drain terminal current density, to be multiplied by the ratio of transistor width (W) and length (L). The value must be greater than zero to enable the function; the IVTH option should always be set to a positive value for both PMOS and NMOS.

.OPTION IVTH supports HSPICE BSIM4 (level 54), BSIMSOI4.x (level 70), and PSP (level 69) and BSIM-CMG (level72). .OPTION IVTHN and IVTHP support NMOS and PMOS, respectively.

Note: The *val* should be a constant.

In OP analysis, a constant current based vth is reported in the OP output. In addition, the element region operation check and Vod output are based on the new vth. During transient or DC analysis, a template output of LX142 accesses the new vth value. You can use LX142(m*) or ivth(m*) for the new vth output. This methodology is based on the monotony Id/Vgs curve.

If Vds is smaller than 0.05 V, HSPICE invokes a special characterization method for small Vds bias to ensure continuation and a meaningful characterization result. Here is the method:

1. Simulate Vth_op(Vdsmin) and Vth_ivth(Vdsmin) where: Vth_op() is the threshold voltage acquired from model formulation, and vth_ivth() is the threshold voltage acquired from iVth method.
2. Calculate DeltaVth = Vth_op(Vdsmin) - Vth_ivth(Vdsmin)

3. Simulate Vth_op(Vds)
4. Calculate Vth_ivth(Vds) = Vth_op(Vds) - DeltaVth

.OPTION IVTH_MODEL

Foundry defined specific constant-current threshold voltage probing and characterization.

Syntax

```
.OPTION IVTH_MODEL=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Foundry defined specific constant-current threshold voltage probing and characterization.

.OPTION KCLTEST

Activates the KCL (Kirchhoff's Current Law) test.

Syntax

```
.OPTION KCLTEST=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to activate the KCL test. This increases simulation time, especially for large circuits, but checks the solution with a high degree of accuracy.

If you set this value to 1, HSPICE sets these options:

- Sets `RELMOS` and `ABSMOS` options to `0` (off).
- Sets `ABSI` to `1e-6 A`.
- Sets `RELI` to `1e-6`.

To satisfy the KCL test, each node must satisfy this condition:

$$\left|\Sigma i_b\right| < RELI \cdot \Sigma\left|i_b\right| + ABSI$$

In this equation, the i_bs are the node currents.

See Also

.OPTION ABSI
.OPTION ABSMOS
.OPTION RELMOS

.OPTION KLIM

Sets the minimum mutual inductance.

Syntax

```
.OPTION KLIM=x
```

Description

Use this option to set the minimum mutual inductance below which automatic second-order mutual inductance calculation no longer proceeds. `KLIM` is unitless (analogous to coupling strength, specified in the K-element). Typical `KLIM` values are between 0.5 and 0.0.

.OPTION LA_FREQ

Specifies the upper frequency for which accuracy must be preserved.

Syntax

```
.OPTION LA_FREQ=value
```

Default 1GHz

Description

Use this option to specify the upper frequency for which accuracy must be preserved.

The *value* parameter specifies the upper frequency for which the `PACT` algorithm must preserve accuracy. If *value* is 0, the algorithm drops all capacitors because only DC is of interest.

The maximum frequency required for accurate reduction depends on both the technology of the circuit and the time scale of interest. In general, the faster the circuit, the higher the maximum frequency.

For additional information, see Linear Acceleration in the *HSPICE User Guide: Basic Simulation and Analysis*.

See Also

.OPTION SIM_LA
.OPTION LA_TIME

.OPTION LA_MAXR

Specifies the maximum resistance for linear matrix reduction.

Syntax

```
.OPTION LA_MAXR=value
```

Default `1e15` ohms

Description

Use this option to specify the maximum resistance for linear matrix reduction.

The *value* parameter specifies the maximum resistance preserved in the reduction. The linear matrix reduction process assumes that any resistor greater than *value* has an infinite resistance and drops the resistor after reduction is completed.

For additional information, see Linear Acceleration in the *HSPICE User Guide: Basic Simulation and Analysis*.

See Also

.OPTION SIM_LA

.OPTION LA_MINC

Specifies the minimum capacitance for linear matrix reduction.

Syntax

```
.OPTION LA_MINC=val
```

Default 1e-16 farads

Description

Removes any capacitor in the original netlist less than the value of `LA_MINC` prior to reduction. For additional information, see Linear Acceleration in the *HSPICE User Guide: Basic Simulation and Analysis*.

See Also

.OPTION SIM_LA
.OPTION LA_FREQ
.OPTION LA_MAXR
.OPTION LA_TIME
.OPTION LA_TOL

.OPTION LA_SPLC

Helps reduce RC post-processing time.

Syntax

```
.OPTION LA_SPLC=0|1
```

Default 0

Description

As an adjunct to `.OPTION SIM_LA`, `.OPTION LA_SPLC=1` turns on capacitor splitting. Cap splitting skips the matrix reservation for coupling entries of the capacitor. This option works only in conjunction with `.OPTION SIM_LA`. For additional information, see Linear Acceleration in the *HSPICE User Guide: Basic Simulation and Analysis*.

See Also

.OPTION SIM_LA

.OPTION LA_TIME

Specifies the minimum time for which accuracy must be preserved.

Syntax

```
.OPTION LA_TIME=value
```

Description

Use this option to specify the minimum time for which accuracy must be preserved. The *value* parameter specifies the minimum switching time for which the PACT algorithm preserves accuracy.

Waveforms that occur more rapidly than the minimum switching time are not accurately represented.

This option is simply an alternative to `.OPTION LA_FREQ`. The default is equivalent to setting `LA_FREQ=1GHz`.

Note: Higher frequencies (smaller times) increase accuracy, but only up to the minimum time step used in HSPICE.

For additional information, see Linear Acceleration in the *HSPICE User Guide: Basic Simulation and Analysis*.

Examples

For a circuit having a typical rise time of 1ns, either set the maximum frequency to 1 GHz, or set the minimum switching time to 1ns:

```
.OPTION LA_FREQ=1GHz
-or-
.OPTION LA_TIME=1ns
```

However, if spikes occur in 0.1ns, HSPICE does not accurately simulate them. To capture the behavior of the spikes, use:

```
.OPTION LA_FREQ=10GHz
-or-
.OPTION LA_TIME=0.1ns
```

See Also

.OPTION SIM_LA
.OPTION LA_FREQ

.OPTION LA_TOL

Specifies the error tolerance for the PACT algorithm.

Syntax

`.OPTION LA_TOL=`*`value`*

Default 0.05

Description

Use this option to specify the error tolerance for the PACT algorithm.

The *value* parameter must specify a real number between 0.0 and 1.0.

For additional information, see Linear Acceleration in the *HSPICE User Guide: Basic Simulation and Analysis*.

See Also

.OPTION SIM_LA

.OPTION LENNAM

Specifies maximum name length for printing operating point analysis results.

Syntax

```
.OPTION LENNAM=x
```

Default 8 (characters)

Description

Use this option to specify the maximum length of names in the printout of operating point analysis results. The maximum value is 1024. .OPTION LENNAME prints the full related name of the transistor in the noise tables and OP tables.

Examples

```
...
.OPTIONS POST=1 LENNAM=40
...
```

.OPTION LIMPTS

Specifies the number of points to print in AC analysis.

Syntax

```
.OPTION LIMPTS=x
```

Default 2001

Description

Use this option to specify the number of points to print or plot in AC analysis. You do not need to set `LIMPTS` for a DC or transient analysis. HSPICE spools the output file to disk.

See Also

.AC
.DC
.TRAN

.OPTION LIMTIM

Specifies the amount of CPU time reserved to generate prints.

Syntax

`.OPTION LIMTIM=`*x*

Default `2` (seconds)

Description

Use this option to specify the amount of CPU time reserved to generate prints and plots if a CPU time limit (`CPTIME=`*x*) terminates simulation. Default is normally sufficient for short printouts.

See Also

.OPTION CPTIME

.OPTION LIS_NEW

Enables streamlining improvements to the `*.lis` file.

Syntax

`.OPTION LIS_NEW=0|1`

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use `.OPTION LIS_NEW` to activate several streamlining improvements to the `*.lis` file as noted below. A value of `0` disables the following functions. A value of `1` enables the following:

- Moves `.PRINT` data and `.NOISE` analysis data to separate files,
- Suppresses operating point node voltage table that exists in the `*.ic#` file.
- Prints loading information for input files.
- Invokes console printing of simulation progress percentage.
- Adds a convergence status update to `*.lis`.
- Increments every 10% of analysis update to `*.lis`.
- Reports analysis output file with analysis-specific format.
- Prints Improved format of circuit statistics information.
- Any `.PRINT` statement in your netlist generates a text file containing the simulation results. For a transient analysis, the file has the extension, `.printtr#`.
- Operating point analysis information is separated to file if `.OP` is used in netlist (`LIS_NEW=1` automatically sets `.OPTION OPFILE=1`).
- Model related information is suppressed (`LIS_NEW=1` automatically sets `.OPTION NOMOD=1`). Circuit hierarchy to number mapping information is not printed to the `*.lis` file because the `LIS_NEW=1` sets `.OPTION LISLVL`.

See Also

.OPTION LIST
.LIB
.NOISE
.OPTION LISLVL
.OPTION NOMOD
.OPTION OPFILE
.OP

.OPTION LISLVL

Controls whether or not HSPICE suppresses the circuit number to circuit hierarchy information in the listing file.

Syntax

```
LISLVL=0|1|-1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

`LISLVL=0` prints the circuit name directory information in the `.lis` file if `.OPTION LIS_NEW=0`. If the value is `1` or `.OPTION LIS_NEW=1`, the circuit number and circuit hierarchy information is not output to the `.lis` file. If .OPTION LIS_NEW=-1 and `.OPTION LIS_NEW=1`, the circuit name directory information will be output to the .lis file.

.OPTION LIST

Prints a list of netlist elements, node connections, and values for components, voltage and current sources, parameters, and more.

Syntax

```
.OPTION LIST=0|1|2|3
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option as follows:

- 0 | NONE: None of below supported
- 1 | ALL: Print circuit element summary table and parameter definitions
- 2 | ELEMENT: Print circuit element summary table only
- 3 | PARAMETER: Print circuit parameter definitions only

The `LIST` option also prints effective sizes of elements as follows, and key values: when `LIST=1` or `List=2`, element information files `*.el0` are generated. The `*.el0` file is generated only when you specify PSF formatted waveform files. HSPICE does not generate a `*.el0` file if you use any other format, and the information generated by the LIST option is recorded in the `*.lis` file.

See Also

.OPTION ARTIST

.OPTION LIS_NEW
.OPTION PSF
.OPTION UNWRAP
.OPTION VFLOOR

.OPTION LOADHB

Loads state variable information from a specified file.

Syntax

```
.OPTION LOADHB='filename'
```

Description

Use this option to load the state variable information contained in the specified file. These values are used to initialize the HB simulation.

See Also

.HB

.OPTION LOADSNINIT

Loads the operating point saved at the end of Shooting Newton analysis initialization.

Syntax

```
.OPTION LOADSNINIT="filename"
```

Description

Use this option to load the operating point file saved at the end of SN initialization, which is used as initial conditions for the Shooting-Newton method.

.OPTION LSCAL

Sets the inductance scale for Pole/Zero analysis.

Syntax

```
.OPTION LSCAL=x
```

Default `1e+6`

Description

Use this option to set the inductance scale for Pole/Zero analysis. HSPICE multiplies inductance by `LSCAL`.

Note: Scale factors must satisfy the following relations: $GSCAL = CSCAL \cdot FSCAL$

$$GSCAL = \frac{1}{LSCAL \cdot FSCAL}$$

If you change scale factors, you might need to modify the initial Muller points, (X0R, X0I), (X1R, X1I) and (X2R, X2I), even though HSPICE internally multiplies the initial values by (1.0e-9/ GSCAL).

The three complex starting-trial points, in the Muller (x1R,X1I) algorithm for pole/zero analysis are listed below with their defaults. HSPICE multiplies these initial points, and FMAX, by FSCAL.

Starting-Trial Points	Defaults	
.OPTION (X0R,X0I)	X0R=-1.23456e6	X0I=0.0
.OPTION (X1R,X1I)	X1R=1.23456e5	X1I=0.0
.OPTION (X2R,X21)	X2R=+1.23456e6	X2I=0.0

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION FSCAL
.OPTION GSCAL
.OPTION ITLPZ
.OPTION PZABS
.OPTION PZTOL
.OPTION RITOL
.OPTION (X0R,X0I)
.OPTION (X1R,X1I)

.OPTION (X2R,X21)
.PZ

.OPTION MACMOD

Enables HSPICE to access the subcircuit definition for MOSFETs, diodes, and BJTs, when there is no matching model reference; also enables an HSPICE X-element to access the model reference when there is no matching subcircuit definition.

Syntax

```
.OPTION MACMOD=[1|2|3|0]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

The following describes `.OPTION MACMOD` characteristics:

- When `macmod=1`, HSPICE seeks a subckt definition for the M/Q/D*** element if no model reference exists. The desired subckt name must match (case insensitive) the `mname` field in the M/Q/D*** instance command. In addition, the number of terminals of the subckt must match the M/Q/D*** element referencing it; otherwise HSPICE exits the simulation based on lack of definition for the M/Q/D*** element. Moreover, the M instance can call Verilog-A models when `macmod=1`.
- When `macmod=2`, HSPICE seeks a model definition when it cannot find a matching subckt or Verilog-A definition for an X-element. The targeted MODEL card could be either an HSPICE built-in model or CMI model. If the model card that matched the X-element reference name is not a type of M/Q/D model, the simulator exits and displays an error message indicating that the reference is “not found.”
- When `macmod=3`, HSPICE enables the same features as when `macmod=1`. HSPICE seeks a `.subckt` definition for an M/Q/D-element if there is no matching model reference; HSPICE seeks a `.model` definition for an X-element if there is no matching `.subckt` or Verilog-A definition. Usage considerations and limitations remain the same for both features, respectively.

If `.OPTION TMIFLAG ≥ 1`, `.OPTION MACMOD` automatically equals `3`.

When macmod=0: if there is no .OPTION MACMOD in the input files or MACMOD=0, then neither of the features is enabled. HSPICE ignores the option MACMOD when any value other than 1 | 2 | 3 | 0 is set.The MACMOD option is a global option; if there are multiple MACMOD options in one simulation, HSPICE uses the value of the last MACMOD option.

For examples and detailed discussion, see MOSFET Element Support Using .OPTION MACMOD in the *HSPICE User Guide: Basic Simulation and Analysis*.

See Also

.OPTION TMIFLAG

.OPTION MAXAMP

Sets the maximum current through voltage-defined branches.

Syntax

```
.OPTION MAXAMP=x
```

Description

Use this option to set the maximum current through voltage-defined branches (voltage sources and inductors). If the current exceeds the MAXAMP value, HSPICE reports an error.

.OPTION MAXORD

Specifies the maximum order of integration for the GEAR method.

Syntax

```
.OPTION MAXORD=[1|2|3]
```

Description

Use this option to specify the maximum order of integration for the GEAR method. When the GEAR method is used, based on the circuit type, HSPICE automatically switches the GEAR order on the fly. If this option is not specifically set, HSPICE automatically selects the BDF or GEAR integration method based on circuit type when METHOD=GEAR.

The value of the parameter can be either 1, 2, or 3:

- `MAXORD=1` selects the first-order GEAR (Backward-Euler) integration (and prohibits GEAR from switching to BDF).
- `MAXORD=2` selects the second-order GEAR (Gear-2), which is more stable and accurate than `MAXORD=1`.
- `MAXORD=3` selects the third-order or high GEAR (Gear-3), which is most accurate, since it uses 3 previous time points to estimate the next time point.

Examples

This example selects the Backward-Euler integration method.

```
.OPTION MAXORD=1 METHOD=GEAR
```

See Also

.OPTION METHOD
.OPTION RUNLVL

.OPTION MAXWARNS

Specifies maximum number of safe operating area (SOA) warning messages.

Syntax

```
.OPTION MAXWARNS=n
```

Default 5

Description

Use this option to specify the maximum number of SOA warning messages when terminal voltages of a device (MOSFET, BJT, Diode, Resistor, Capacitor etc…) exceed a safe operating area. This option is used with `.OPTION WARN`.

See Also

.OPTION WARN
Safe Operating Area (SOA) Warnings

.OPTION MC_FAST

Helps reduce size of output files when distributed processing (`-DP`) includes Monte Carlo simulation.

Syntax

```
.OPTION MC_FAST=No|Yes
```

Default `No`

Description

When set to this option is set to `Yes`, HSPICE takes actions to reduce size of output files.

Note: The sub-options listed below are subject to change.

The following operations and outputs are affected:

- Operating point
  - Uses operating point at sweep index 1 as a nodeset for other sweep points (DC, TR)
  - Sets the store state internally in scalar mode and as a binary file (including internal device nodes) in DP
  - Disables convergence options after sweep point 1 and sets `.OPTION DCON=1`
- Disables probe, print, capacitance tables, and model information
- Sets `.OPTION AUTOSTOP=1` to terminate transient early
- Sets `.OPTION STATFL=1` and `.OPTION MEASFORM=1`

See Also

.OPTION DP_FAST

.OPTION MCBRIEF

Controls how HSPICE outputs Monte Carlo parameters.

Syntax

```
.OPTION MCBRIEF=0|1|2|3|4|5
```

Default `Value in sequential run: 0; Value in DP: 5.`

Description

Use this option to control how HSPICE outputs Monte Carlo parameters:

- MCBRIEF=0: Outputs all Monte Carlo parameters
- MCBRIEF=1: Suppresses Monte Carlo parameters in *.mt# and *.lis files; also suppresses generation of *.mc?#, *.mpp#, and *.annotate files.
- MCBRIEF=2: Outputs the Monte Carlo parameters into a *.lis file only
- MCBRIEF=3: Outputs the Monte Carlo parameters into the measure files only
- MCBRIEF=4: Changes outputs as follows:
  - Eliminates all Monte Carlo information in *.lis file (suppresses measure and parameter information, and statistical analysis results)
  - Eliminates all IRVs in *.mt file
  - Generates an *.mc file
- MCBRIEF=5: (Default) Reduces output by suppressing the following:
  - All information output in *.lis file
  - All IRV information in *.mt file
  - Does not block generation of *.mc0 or *.annotate files
  - Suppresses sensitivity sections in *.mpp0 file

Note that the MCBRIEF option only works for parameters defined in a netlist, and *not* for measurement results.

See Also

.OPTION DP_FAST
.OPTION MC_FAST

.OPTION MEASDGT

Formats the .MEASURE command output of significant digits in both the listing file and the .MEASURE output files.

Syntax

```
.OPTION MEASDGT=x
```

Default 4

Description

Use this option to format the .MEASURE command output's significant digits in both the listing file and the .MEASURE output files (.ma0, .mt0, .ms0, and so on).

The value of *x* is typically between 1 and 7 significant digits, although you can set it as high as 10.

Use MEASDGT with .OPTION INGOLD=*x* to control the output data format.

Examples

For example, if MEASDGT=5, then .MEASURE displays numbers as:

- Five decimal digits for numbers in scientific notation.
- Five digits to the right of the decimal for numbers between 0.1 and 999.

In the listing (.lis) file, all .MEASURE output values are in scientific notation so .OPTION MEASDGT=5 results in five decimal digits.

See Also

.OPTION INGOLD
.MEASURE / MEAS

.OPTION MEASFAIL

Specifies where to print the failed measurement output.

Syntax

```
.OPTION MEASFAIL=0|1
```

Default 1

Description

Use this option to specify where to print the failed measurement output. You can assign this option the following values:

- MEASFAIL=0, outputs "0" into the .mt#, .ms#, or .ma# file, and prints "failed" in the .lis file.
- MEASFAIL=1, prints "failed" in the .mt#, .ms#, or .ma# file, and in the .lis file.

See Also

.MEASURE / MEAS

.OPTION MEASFILE

Controls whether measure information outputs to single or multiple files when an .ALTER command is present in the netlist.

Syntax

```
.OPTION MEASFILE=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to control whether the measure information outputs to a single or multiple files when an .ALTER command is present in the netlist. You can assign this option the following values:

- MEASFILE=0, outputs measure information to several files.
- MEASFILE=1, outputs measure information to a single file.

Note: .OPTION MEASFILE is only supported in combination with .ALTER statements. If no .ALTER statements are in the netlist, the following warning message is displayed:

```
**warning** option measfile is disabled due to no .alter in
the netlist
```

See Also

.ALTER
.MEASURE / MEAS

.OPTION MEASFORM

Enables writing of measurement output files to Excel or HSIM formats, as well as the traditional HSPICE *.mt#, *.ms#, and *.ma# formats.

Syntax

```
.OPTION MEASFORM=0|1|2|3|4
```

Default 0

Description

This option allows specification of file formats other than the traditional HSPICE `*.mt#`, `*.ms#`, and `*.ma#` measure output files to include Excel or HSIM file formats. In addition this option and all of its values can be used with the `.MOSRAPRINT` command for `*.ra` file output.

- 0: Writes measure file in traditional default HSPICE output style. (See Example 1)
- 1: Writes space-separated style which can be imported as data into Excel and Microsoft products (requires manual steps in Excel). (See Example 2)
- 2: Writes the HSIM style in *name=value* format. Easy to read, but difficult to import into standard post-processing tools. (Does not work for `*.mc?#` files [see value 3 below] and defaults to HSPICE default output style). (See Example 3)
- 3: Writes the comma separated style with suffix `*.csv` and this format includes `*.m?#` and `*.mc?#` files. This style and suffix is understood by Windows to be an Excel file and can be opened directly in Excel by double-clicking the file name. (See Example 4)
- 4: Writes the output `trig-targ`, `from-to` information into the `*.mt#`, `*.ms#`, and `*.ma#` files. (See Example 5)

Note: For the `*.mc` file, `.OPTION MEASFORM` is automatically set to `1` if the option had been set to `0` or `2` in a netlist.

Examples

Results Example 1: Default (Traditional) Measure Format (`.option measform=0`)

```
.TITLE '***inverter circuit***'

 delayf      delayr     delay      temper      alter#

9.187e-10   5.487e-10   7.337e-10  -25.0000    1.0000
```

Results Example 2: Excel Format (`.option measform=1`)

```
.TITLE '***inverter circuit***'

 delayf      delayr     delay      temper     alter#

9.187e-10   5.487e-10   7.337e-10  -25.0000    1.0000
```

Results Example 3: HSIM Format (`.option measform=2`)

```
.TITLE '***inverter circuit***'
delayf =  9.187e-10
delayr =  5.487e-10
delay =   7.337e-10
temper =-25.0000
alter# =  1.0000
```

Results Example 4: CSV-Excel Format (`.option measform=3`)

```
*** File name opampmc.ms0_D.csv***
```

$DATA1 SOURCE='HSPICE' VERSION='D-2010.12 32-BIT'							
.TITLE '**							
index	systoffset1	systoffset2	systoffset3	systoffset4	leakpwr	temper	alter#
1	1.40E-03	1.09E-03	9.05E-04	7.71E-04	2.44E-05	25	1
2	1.25E-03	1.01E-03	8.55E-04	7.32E-04	2.53E-05	25	1
3	7.50E-04	7.56E-04	6.72E-04	5.87E-04	2.62E-05	25	1
4	4.48E-03	2.60E-03	1.90E-03	1.52E-03	2.43E-05	25	1
5	2.58E-03	1.68E-03	1.31E-03	1.08E-03	2.56E-05	25	1

Results Example 5: trig-targ and from-to information (`.option measform=4`)

```
$DATA1 SOURCE='HSPICE' VERSION='I-2013.12-BETA 32-BIT'
$OPTION MEASFORM=4
.TITLE '*'
m0 =    failed          trig=   failed          targ=   failed
m1 =    1.0000          from=   2.0000          to=   5.0000
m2 =    1.0000
m3 =    1.0000
temper =   25.0000
alter# = 1
```

See Also

.OPTION INGOLD
.MEASURE / MEAS

.OPTION MEASOUT

Outputs `.MEASURE` command values and sweep parameters into an ASCII file.

Syntax

```
.OPTION MEASOUT=1(default)|0
```

Default Value if option is not specified in the netlist:1; Value if option name is specified without a corresponding value: 1

Description

Use this option to output `.MEASURE` command values and sweep parameters into an ASCII file. Post-analysis processing (WaveView or other analysis tools) uses this *design*`.mt#` file, where # increments for each `.TEMP` or `.ALTER` block.

For example, for a parameter sweep of an output load, which measures the delay, the .mt# file contains data for a delay-versus-fanout plot. You can set this option to `0` (off) in the `hspice.ini` file.

See Also

.ALTER
.MEASURE / MEAS
.TEMP / TEMPERATURE

.OPTION MESSAGE_LIMIT

Limits how many times a certain type warning can appear in the output listing based on the message index.

Syntax

```
.OPTION MESSAGE_LIMIT 'message_index:number'
```

Argument	Description
message_index	Specifies the message index linked below
number	Specifies the limiting number of displays of the message

Description

Use this option to set the number of display times for a certain warning type based on its message index number.

- The message_index parameter specifies the message index listed in the Warning Message Index [00001-11146] or Error Message Index [20001-20084], located in the *HSPICE User Guide: Basic Simulation and Analysis*.
- The number parameter specifies the display times.

.OPTION MESSAGE_LIMIT has a higher priority than OPTION WARNLIMIT and increases the coverage of types messages to be limited.

See Also

.OPTION WARNLIMIT
.OPTION STRICT_CHECK

.OPTION METHOD

Sets the numerical integration method for a transient analysis for HSPICE.

Syntax

```
.OPTION METHOD=GEAR | TRAP [PURETP] | BDF
```

Default TRAP

Description

Use this option to set the numerical integration method for a transient analysis.

- TRAP selects trapezoidal rule integration. This method inserts occasional Backward-Euler time steps to avoid numerical oscillations. You can use the PURETP option to turn this oscillation damping feature off.
- TRAP PURETP selects pure trapezoidal rule integration. This method is recommended for high-Q LC oscillators and crystal oscillators.
- GEAR selects BDF integration or GEAR integration based on circuit type.
- GEAR MAXORD=2|3 selects GEAR integration.
- GEAR MAXORD=1 prohibits GEAR from selecting BDF.
- GEAR MU=0 selects Backward-Euler integration.
- BDF selects the high order integration method based on the backward differentiation formulation.

TRAP (trapezoidal) integration usually reduces program execution time with more accurate results. However, this method can introduce an apparent oscillation on printed or plotted nodes, which might not result from circuit

behavior. To test this, run a transient analysis by using a small time step. If oscillation disappears, the cause is the trapezoidal method.

The GEAR method is a filter, removing oscillations that occur in the trapezoidal method. Highly non-linear circuits (such as operational amplifiers) can require very long execution times when you use the GEAR method. Circuits that do not converge in trapezoidal integration, often converge if you use GEAR.

The BDF method is a high order integration method based on the backward differentiation formulae. Two tolerance options are available to the user for the BDF method: .OPTIONS BDFRTOL (relative) and BDFATOL (absolute); each has a default of 1e-3. BDF can provide a speed enhancement to mixed-signal circuit simulation, especially for circuits with a large number of devices. The BDF method currently provides no advantage for use with small circuits in standard cell characterization. The BDF supported models/devices/elements and limitations are listed. METHOD=BDF supports the following:

- Bulk MOSFET, levels 1-54
- SOI MOSFET, levels 57, 70
- BJT, levels 1, 2, 3
- Diodes, all
- Resistors, all
- Capacitors (excludes DC block)
- Independent sources: V and I
- Dependent sources: E/F/G/H
- L (excludes AC choke)
- K (excludes magnetic core, ideal transformer)
- Signal integrity elements: B (IBIS buffer)/S/ W/ T

Note: BDF issues a warning in the .lis file if it encounters an unsupported model. The message is similar to: `WARNING!!!, netlist contains 'unsupported models', HSP-BDF is disabled.`

Examples

Example 1 sets pure trapezoidal method integration. No Gear-2 or Backward-Euler is mixed in. Use this setting when you simulate harmonic oscillators.

```
.option method=trap puretp
```

Example 2 sets pure Backward-Euler integration.

```
.option method=gear maxord=1
```

Example 3 sets pure Gear-2 integration.

```
.option method=gear
```

Example 4 sets the higher order backward differentiation formulation integration for supported models.

```
.option method=bdf
```

See Also

.OPTION ACCURATE
.OPTION MAXORD
.OPTION MTTHRESH
.OPTION PURETP
.OPTION MU
.OPTION RUNLVL
.OPTION BDFATOL
.OPTION BDFRTOL

.OPTION MINVAL

Provides flexibility in changing values from defaults for specified options in a netlist.

Syntax

`.OPTION MINVAL=`*`val`*

Description

Use this option to control values for the following options: `gmin`, `gmindc`, `gdcpath` (insert the value from NODE to GND if no dc path is found), `ncfilter` (negative: report negative conductance less than the value), and `minval` (`.measure` *`parameter`*). For example, if option `minval` or `.option minval=xxx` is specified in the netlist, then {`gmin`, `gmindc`, `gdcpath`, `ncfilter`, `minval(.meas)`} will be set to 1e-15 or “xxx”.

But if you add a line `.option gmin=sss` (for example, in the netlist after the line `.option minval`, then `gmin` will be set to `sss` separately, and others will keep their default `1e-15`, since the last option statement takes the highest priority in HSPICE.

Examples

To set {`minval(.meas)`} to 1e-15, but set {`gmin`, `gmindc`, `gdcpath`, `ncfilter`} at 1e-13, include the following statements in your netlist

```
.option minval=1e-15
.option gmin=1e-13 gmindc=1e-13 gdcpath=1e-13 ncfilter=-1e-13
```

See Also

.OPTION GMIN
.OPTION GMINDC
.OPTION GSHDC
.OPTION NCFILTER

.OPTION MIN_HSPICE_VER

Specifies the minimum HSPICE version that will be respected by the tool.

Syntax

`.OPTION MIN_HSPICE_VER=`*`hspice_version_number`*

Description

Use this option to specify a minimum HSPICE version that will be respected by the tool.

Examples

The following command sets the minimum HSPICE version to 2013.12-SP1.

```
.option MIN_HSPICE_VER=2013.12-SP1
```

See Also

.OPTION MIN_VER_ABORT

.OPTION MIN_VER_ABORT

Checks the minimum HSPICE version to either print a warning message and continue processing, or to print an error message and abort processing.

Syntax

`.OPTION MIN_VER_ABORT=0|1`

Default 0; the default value is 1 when the option is specified without a corresponding value.

Description

Set the option with one of the following values:

- 0: To report a warning message if the version number of HSPICE that is running is less than the minimum version specified using .OPTION MIN_HSPICE_VER.

  The tool prints a warning message similar to the following message:

  ```
  ** warning ** the version of HSPICE you are using is Ver1, while the minimum version specified in .option min_hspice_ver is Ver2. Please use a newer HSPICE version.
  ```

- 1: To report an error message if the version number of HSPICE that is running is less than the minimum version specified using .OPTION MIN_HSPICE_VER.

  The tool prints an error message similar to the following message:

  ```
  ** error ** the version of HSPICE you are using is Ver1, while the minimum version specified in .option min_hspice_ver is Ver2. Please use a newer HSPICE version.
  ```

Examples

```
.option MIN_HSPICE_VER=2013.12-SP1
.option MIN_VER_ABORT=0
```

In this case, if the version of HSPICE that is running is 2013.12, the tool prints the following warning message in the output log file:

```
** warning ** the version of HSPICE you are using is 2013.12, while the minimum version specified in .option min_hspice_ver is 2013.12-SP1. Please use a newer HSPICE version.
```

See Also

.OPTION MIN_HSPICE_VER

.OPTION MIXED_NUM_FORMAT

Enables use of mixed exponential and engineering key letter number format.

Syntax

```
.OPTION MIXED_NUM_FORMAT=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to support mixed exponential and engineering key letter number formats. Specifying `=1` is optional for the mixed number format to take effect. The mixed sequence enables the exponential number followed by the engineering key letter. This option enables compatibility with HSIM and traditional SPICE. (You can write numbers that use either exponential format or engineering key letter format (1e-12 or 1p) only, when `.OPTION MIXED_NUM_FORMAT=0` or is not included in a netlist. To use both formats, you must specify `.OPTION MIXED_NUM_FORMAT`.)

Examples

```
.OPTION MIXED_NUM_FORMAT=1
.param a=1e-5u
.param b='1p+1e-05u'
```

.OPTION MODMONTE

Controls how random values are assigned to parameters with Monte Carlo definitions.

Syntax

```
.OPTION MODMONTE=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Ordinarily, the assignment of a random value is only done once, then used several times. The exception to this rule is for model parameters. Since a model definition is only done once, the behavior described above would assign the same parameter value to all devices referencing that model. To overcome this, `.OPTION MODMONTE` lets you decide if all instances of a device should get

the same or unique model parameters. Use this option to control how random values are assigned to parameters with Monte Carlo definitions.

- If `MODMONTE=1`, then within a single simulation run, each device that shares the same model card and is in the same Monte Carlo index receives a different random value for parameters that have a Monte Carlo definition.
- If `MODMONTE=0`, then within a single simulation run, each device that shares the same model card and is in the same Monte Carlo index receives the same random value for its parameters that have a Monte Carlo definition.

Examples

In the following example, transistors M1 through M3 have the same random `vto` model parameter for each of the five Monte Carlo runs through the use of the `MODMONTE` option.

```
...
.option MODMONTE=0 $$ MODMONTE defaults to 0;OK to omit this line.
.param vto_par=agauss(0.4, 0.1, 3)
.model mname nmos level=53 vto=vto_par version=3.22
M1 11 21 31 41 mname W=20u L=0.3u
M2 12 22 32 42 mname W=20u L=0.3u
M3 13 23 33 43 mname W=20u L=0.3u
...
.dc v1 0 vdd 0.1 sweep monte=5
.end
```

In Example 2, transistors M1 through M3 have different values of the `vto` model parameter for each of the Monte Carlo runs by the means of setting `.option MODMONTE=1`.

Example 1

```
...
.option MODMONTE=1
.param vto_par=agauss(0.4, 0.1, 3)
.model mname nmos level=54 vto=vto_par
M1 11 21 31 41 mname W=20u L=0.3u
M2 12 22 32 42 mname W=20u L=0.3u
M3 13 23 33 43 mname W=20u L=0.3u
...
.dc v1 0 vdd 0.1 sweep monte=5
.end
```

See Also

.MODEL

.OPTION MODPARCHK

Determines whether HSPICE aborts a simulation if it encounters fatal-errors in model side parameter checking.

Syntax

```
.OPTION MODPARCHK=1|0
```

Default `1`, when option is not specified in the netlist or if option name is specified without a corresponding value.

Description

Use this option to determine whether a simulation aborts when it encounters fatal-errors in model side parameter checking.

- When `MODPARCHK=1` the simulation aborts if it encounters a fatal error during parameter checking and reports the error.
- When `MODPARCHK=0` Checks limited model parameters and resets them to avoid fatal errors (in BSIM-CMG and BSIM6, limited model and instance parameters are checked, but the parameters are not reset, and the errors are reported); simulation runs to conclusion.

Note: This option is only available for BSIM4, BSIM6, and BSIM-CMG.

.OPTION MODPRT

Invokes model preprocessing and parameter flattening.

Syntax

```
.OPTION MODPRT=[0|1]
```

Default `0` (Off)

Description

When `.OPTION MODPRT=1` the following takes place:

- Model information is written to a file called `reduced.models`, readable by standard HSPICE.
- Information for each model occupies a single physical record to facilitate further processing necessary to link the new models to the cell library.
- Comments can appear between the model records (to help tracing).

- Values are printed to 17 digits to simplify validation.
- Fields that are missing on the original model record are not be printed (to avoid warnings and potential errors in HSPICE).
- Fields for which the values equal the default values for the particular level/version are not printed, thus reducing the size of the file; all other fields appearing on the original model card are printed.
- Since each MOSFET has its own model in the `reduced.models` file, the bin designator is replaced by the index of the MOSFET. For example, a model name is `pch_27` because the device belongs to bin 27.
- Since the models are nonbinned, the extra fields: `lmin`, `lmax`, `wmin`, `wmax` (and similar fields, if any), are deleted.
- A `reduced.instances` file is generated in cases where additional information is required for the instance. For example, for the `main n1 …` call inside the subckt, the parameters on the MOSFET need not be the same as what were specified on the subckt invocation. The `reduced.instances` file reports the MOSFET records with the resolved values for the parameters.

  See the examples below for additional information.

Examples

Example 1 *Original Netlist: In the case below, it is assumed that:*
(1) X_1 and X_2 use the same bin model card pch.26, while there are some different parameters values in model cards (because instance parameters will affect the model parameters values);
(2) X_3 and X_4 could share the model card with X_1;
(3) X_5 could not share model card with other instance, and it uses the pch_4 model card;

```
X_1      1 2 0 0      pch_mac          W=… L=…
X_2      1 2 0 0      nch_mac          W=… L=…
X_3      1 2 0 0      pch_mac          W=… L=…
X_4      1 2 0 0      nch_mac          W=… L=…
X_5      1 2 0 0      pch_mac          W=… L=…
```

Example 2 *reduced.models output file for Example 1: This file prints unique model cards and adds instance name information on model card name.*

```
.model      X_1_pch_26      level = 54 ……
.model      X_2_pch_26      level = 54 ……
.model      X_5_pch_4       level = 54 …..
```

Example 3 reduced.instance file: this file connects the model information with instance information as shown below.

```
X_1      X_1_pch_26      W = ..... L = .....
X_2      X_2_pch_26      W = ..... L = .....
X_3      X_1_pch_26      W = ..... L = .....
X_4      X_1_pch_26      W = ..... L = .....
X_5      X_5_pch_4       W = ..... L = .....
```

1. In the `reduced.instance` file, he "." characters by are replaced by "_" in the model names; a model card name `X_1_pch_26` includes two parts:

- Instance name (`X_1`)
- Bin model name (`pch_26`)

the first part is the instance name (X_1) and the second part is the bin

2. The `reduced.instance` file does not print the d/g/s/b connecting information; the format is:

```
instance name       model name              solved parameter values
      X_1           X_1_pch_26                  W = ..... L = .....
```

3. The `reduced.instance` file contains all the fields as they become resolved inside the macro, not just the ones on the original “X” record.

4. For each model, the information is printed to be a single physical record in `reduced.models` (not continued across multiple records with “+” continuation).

.OPTION MONTECON

Continues a Monte Carlo analysis in HSPICE by retrieving the next random value, even if nonconvergence occurs.

Syntax

```
.OPTION MONTECON=0|1
```

Default `1`

Description

Use this option to retrieve the next random value, even if nonconvergence occurs. A random value can be too large or too small to cause convergence to fail. Other types of analyses can use this Monte Carlo random value.

.OPTION MOSRALIFE

Invokes the MOSRA “lifetime” computation.

Syntax

`.OPTION MOSRALIFE=`*`degradation_type_keyword`*

Description

Use this option to compute device lifetime calculation for the degradation type specified.

The option is used in conjunction with `.OPTION DegF=`*`val`*when no values are set for either `.OPTION DegFN=`*`val`* or `.OPTION DegFP=`*`val`*, the designated NMOS's or PMOS’s failure criteria for lifetime computation, respectively. The options apply to all MOSFETs. The lifetime value is printed in the RADEG file. Lifetime calculus is supported with the Synopsys built-in MOSRA Model Level 1 and with the MOSRA API models. (For the implementation of the lifetime function in the API models see the *HSPICE User Guide: Implementing the MOSRA API*, available by contacting the HSPICE technical support team.)

See Also

.OPTION DEGF
.OPTION DEGFN
.OPTION DEGFP
.OPTION RADEGFILE
.OPTION RADEGOUTPUT

.OPTION MOSRASORT

Enables the descending sort for reliability degradation (RADEG) output.

Syntax

`.OPTION MOSRASORT=`*`degradation_type_keyword`*

Default `delvth0`

Description

Use this option `mosrasort` to enable the descending sort for reliability degradation (RADEG) output.

If the `mosrasort` option is not specified, or the degradation type keyword is not recognized, HSPICE does not do the sorting. (Degradation type keywords

are listed in the *HSPICE Application Note: Unified Custom Reliability Modeling API (MOSRA API)*, available by contacting the HSPICE technical support team.)

If you only specify the option `mosrasort`, and do not specify the degradation type keyword, HSPICE sorts RADEG by the `delvth0` keyword.

HSPICE sorts the output in two separate lists, one for NMOS devices, another for PMOS device. HSPICE prints the NMOS device list first, and then the PMOS device list.

Examples

In the following usage, the option does a descending sort for RADEG output on `delvth0`'s value.

```
.option mosrasort=delvth0
```

See Also

.MOSRA
MOSFET Model Reliability Analysis (MOSRA)

.OPTION MRAAPI

Loads and links the dynamically linked MOSRA API library.

Syntax

```
.OPTION MRAAPI=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to load and link the compiled MOSRA API `.so` library file to HSPICE during simulation. If this option parameter is set with no value or to 1, then the MOSRA API `.so` library file is loaded as a dynamically-linked object file.

If this option parameter does not exist in the netlist, or is explicitly set to 0, the MOSRA API `.so` library will not be used.

.OPTION MRADTEMPBA

Back-annotates temperature change calculated by MOSRA.

Syntax

```
.OPTION MRADTEMPBA=0|1
```

Default Value if option is not specified in the netlist: 1 value if option name is specified without a corresponding value: 1

Description

Use this option to specify whether back-annotate temperature change was calculated by MOSRA during the post-simulation. When `MRADTEMPBA=0`, temperature change was not back-annotated during post-simulation. When `MRADTEMPBA=1`, temperature change was back-annotated during post-simulation. Details are in the *HSPICE User Guide: Implementing the MOSRA API.* Contact HSPICE Technical Support for more information.

.OPTION MRAEXT

Enables access to MOSRA API extension functions.

Syntax

```
.OPTION MRAEXT 0|1
```

Default Value if option is not specified in the netlist: 0 value if option name is specified without a corresponding value: 1

Description

Use this option to control the access to the MOSRAAPI extension functions. When `MRAEXT=1`, HSPICE can access the extension functions. Details are in the *HSPICE User Guide: Implementing the MOSRA API.* Contact HSPICE Technical Support for more information.

.OPTION MRAPAGED

Enables the MOSRA API to enable two modes of model parameter degradation.

Syntax

```
.OPTION MRAPAGED=0|1
```

Default 0

Description

If this option parameter does not exist (deemed as default) in the netlist, or is explicitly set to 0, degradation from the MOSRA API model is the parameter value shift with regard to the fresh model, delta_P. If this option parameter is set to 1, then the degradation from the MOSRA API model is the degraded model parameter, `P+delta_P`.

- `0`: delta_P mode
- `1`: Degraded model parameter

.OPTION MRA00PATH, MRA01PATH, MRA02PATH, MRA03PATH

These options support file path access in MOSRA API functions.

Syntax

```
.OPTION MRA00PATH ='file_path1'
.option MRA01PATH ='file_path2'
.option MRA02PATH ='file_path3'
.option MRA03PATH ='file_path4'
```

Default NULL for each path

Description

Use these options to enable global string type variables such as user-defined paths. This option is for API model developers to access the MOSRA API functions.

.OPTION MTTHRESH

Reduces the default active device limit for multithreading.

Syntax

```
.OPTION MTTHRESH=N
```

Default 64

Description

Use .OPTION MTTHRESH only for model evaluation threading. For multithreading to be effective in model evaluation, the number of active devices or elements should meet certain requirements.

The condition for model evaluation to be multithreaded is ONE of the following:

- MOSFET >= 64
- BJT >= 128
- Diode >= 128
- G-element >= 128
- E-element >= 128
- F-element >= 128
- H-element >= 128
- or parameter expressions >= 64

If the circuit lacks the required number of active devices, HSPICE automatically uses a single thread. You can manually enforce multithreading on model evaluation by using .OPTION MTTHRESH. The default MTTHRESH value is 64. You can set it to any positive integer number equal to or greater than 2. This option has no effect on matrix solving. MTTHRESH must = 2 or more. Otherwise, HSPICE MT defaults to 64.

Examples

If MTTHRESH=50, model evaluation of MOSFETs would be threaded if the number of MOSFETs is greater than 50. Similarly, a diode model evaluation would receive benefit from multithreading if the circuit contains more than 100 (50 x 2) diodes.

.OPTION MU

Defines the integration method coefficient.

Syntax

```
.OPTION MU=x
```

Default 0.5

Description

Use this option to define the integration method coefficient. The value range is 0.0 to 0.5. The default integration method is trapezoidal which corresponds to the default coefficient value of 0.5. If the value is set to 0, then the integration method becomes backward-Euler. A value between 0 and 0.5 is a blend of the trapezoidal and backward-Euler integration methods.

See Also

.OPTION METHOD

.OPTION MULT_LESS_1

Controls the HSPICE simulator to either accept M-factor less than 1 in X element or issue a warning.

Syntax

```
.OPTION mult_less_1=0|1
```

Default 0

Description

You can set the value of this option to either 0 or 1. If you do not specify this option in the netlist, its default value will be 0.

If you specify this option with a value 0, the HSPICE simulator issues a warning relating to M-factor less than 1. Also, for X element, M-factor which is less than 1 is reset to 1.

If you specify this option with a value 1, the simulator accepts M-factor less than 1 without any warning message.

.OPTION NCFILTER

Filters negative conductance warning messages according to the setting value.

Syntax

```
.OPTION NCFILTER=val
```

Default -1e-12

Description

When `.option ncwarn` is set, use this option to filter the negative conductance warning messages according to the setting value. If gds, gm, gmbs < *value*, a warning message is reported. When `ncwarn` is set, this filter is automatically enabled. The legal range of *val* is –1e20 to 0.

See Also

.OPTION NCWARN

.OPTION NCWARN

Allows turning on a switch to report a warning message for negative conductance on MOSFETs.

Syntax

```
.OPTION NCWARN=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use the option to turn on (`.option NCWARN=1`), printing out of the first occurrence of MOSFET related “negative conductance” in the listing file; if you want to check the entire negative conductance on MOSFETs, use `.option DIAGNOSTIC` to print all these warning messages.`NCWARN=0` (default) turns off all warning messages on negative conductance.

See Also

.OPTION DIAGNOSTIC / DIAGNO
.OPTION NCFILTER

.OPTION NEWTOL

Calculates one or more iterations past convergence for every calculated DC solution and timepoint circuit solution.

Syntax

```
.OPTION NEWTOL=x
```

Description

Use this option to calculate one or more iterations past convergence for every calculated DC solution and timepoint circuit solution. If you do not set `NEWTOL` after HSPICE determines convergence the convergence routine ends and the next program step begins.

.OPTION NODE

Prints a node cross-reference table.

Syntax

```
.OPTION NODE=x
```

Description

Use this option to print a node cross-reference table. The table lists each node and all elements connected to it. A code indicates the terminal of each element. A colon (:) separates the code from the element name.

The codes are:

+ — Diode anode
- — Diode cathode
B — BJT base
B — MOSFET or JFET bulk
C — BJT collector
D — MOSFET or JFET drain
E — BJT emitter
G — MOSFET or JFET gate
S — BJT substrate
S — MOSFET or JFET source

Examples

This sample indicates that the voltage source `v1`, the gate of the MOSFET `mpfet`, the gate of the MOSFET `mnfet` are all connected to node `in`.

```
******  element node table
...
in   v1   mpfet:g   mnfet:g
...
```

.OPTION NOELCK

Bypasses element checking to reduce preprocessing time for very large files.

Syntax

```
.OPTION NOELCK 0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to bypass element checking to reduce preprocessing time for very large files. HSPICE typically checks for duplicate element definitions. If `.option NOELCK` is set (1), HSPICE skips the element checking and the simulation runs even if there is a duplicate element definition. For the duplicate elements, HSPICE uses the last definition it finds.

When `NOELCHK` is not turned on, if HSPICE finds a duplicate element definition, it issues an error and aborts the simulation.

Note: Subcircuit redefinition is not supported by this option.

Examples

In the following netlist:

```
R1 1 2 1k
R2 2 0 1k
C1 2 end 1p
C1 2 0 1n
```

...unless `.option NOELCHK` is set to 1, HSPICE aborts the simulation and issue an error message.

```
**error** attempts to redefine c1 at line xx and line yy
```

.OPTION NOISEMINFREQ

Specifies the minimum frequency of noise analysis in HSPICE.

Syntax

```
.OPTION NOISEMINFREQ=x
```

Description

Use this option to specify the minimum frequency of noise analysis. If the frequency of noise analysis is smaller than the minimum frequency, then HSPICE automatically sets the frequency for `NOISEMINFREQ`.

.OPTION NOISUM

Control the noise summary table output format.

Syntax

```
.OPTION NOISUM 0|1
```

Default `0`

Description

When `NOISUM=1` HSPICE generates a noise summary showing total noise contribution and total percent for each element at each frequency. The noise summary report is always output to the *`.noise#` file regardless of whether `.OPTION LIS_NEW` is set or not. When `NOISUM=0`, `.OPTION LIS_NEW` settings control noise output.

Examples

Resulting contents of a `*.noise` file

```
 frequency =   1.0000k      hz

 total output noise voltage = 1.6336E-18 sq v/hz  equivalent input noise = 2.1821E-09 rt/hz

Element Name                          Parameter Contribution (V^2/Hz) Total %
r34                                   total     1.61133e-18    98.6385
xi27.xm18sat.main                     total     1.45156e-21    0.0888579
xi27.xm19sat.main                     total     1.45156e-21    0.0888579
xi26.xldopa.xld_out.xr32.r4           total     8.36745e-22    0.0512218
xi26.xldopa.xld_out.xr30.r1           total     8.36745e-22    0.0512218
xi26.xldopa.xld_out.xr32.r1           total     8.36744e-22    0.0512218
xi26.xldopa.xld_out.xr30.r4           total     8.36744e-22    0.0512218
xi26.xldopa.xld_out.xr32.r2           total     8.36744e-22    0.0512218
xi26.xldopa.xld_out.xr30.r3           total     8.36744e-22    0.0512218
xi26.xldopa.xld_out.xr32.r3           total     8.36744e-22    0.0512218
xi26.xldopa.xld_out.xr30.r2           total     8.36744e-22    0.0512218
```

See Also

.OPTION LIS_NEW

.OPTION NOMOD

Suppresses the printout of model parameters.

Syntax

`.OPTION NOMOD=[0|1]`

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to suppress the printout of model parameters.

.OPTION NOPIV

Controls whether HSPICE automatically switches to pivoting matrix factors.

Syntax

```
.OPTION NOPIV=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to prevent HSPICE from automatically switching to pivoting matrix factors if a nodal conductance is less than `PIVTOL`. `NOPIV=1` inhibits pivoting.

See Also

.OPTION PIVTOL

.OPTION NOTOP

Suppresses topology checks to increase preprocessing speed.

Syntax

```
.OPTION NOTOP=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to suppress topology checks to increase the speed for preprocessing very large files. HSPICE normally checks the netlist topology and reports a warning or error message. The different topologies that HSPICE checks includes inductor/voltage loops, dangling nodes, stacked current sources and current sources in a closed capacitor loop. If you set the `NOTOP` option to 1, these checks will not be performed and there will be no warning or error messages issued for these topologies.

Examples

If you run the following netlist:

```
R1 1 2 1k
R2 2 0 1k
C1 2 end 1p
```

...the dangling node check function causes HSPICE to issue a warning in the `.lis` file.

```
only 1 connection at node 0:end ...
```

If `.option NOTOP` is set, the topology check is skipped and you will not get the warning.

.OPTION NOWARN

Suppresses parameter conflict warning messages.

Syntax

```
.OPTION NOWARN=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to suppress all conflicting parameter warning messages, except those generated from commands in `.ALTER` blocks.

`.OPTION WARNLIMIT` can be used to limit the number of a same warning message.

Note: This option only suppresses warnings about conflicting parameters, not model-related or other warnings.

See Also

.ALTER
.OPTION WARNLIMIT

.OPTION NUMDGT

Controls the listing printout accuracy.

Syntax

```
.OPTION NUMDGT=x
```

Description

Use this option to control the listing printout (`.lis`) accuracy. The value of *x* is typically between 1 and 7, although you can set it as high as 10. This option does not affect the accuracy of the simulation.

With the G-2012.06-SP1 release, `.OPTION NUMDGT` can apply to ACMatch and DCMatch results up to four digits.

This option does, however, affect the results files (ASCII and binary) if you use the `.OPTION POST_VERSION=2001` setting. The default setting is 5 digits for results for printout accuracy when using `POST_VERSION=2001`.

Range:

Range is from 1 to 10.

Default:

The default is 5.

See Also

.OPTION POST_VERSION
.OPTION INGOLD

.OPTION NUMERICAL_DERIVATIVES

Diagnostic-only option for checking a problem with the device models.

Syntax

```
.OPTION NUMERICAL_DERIVATIVES=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

This option can be used to help diagnose convergence problems or suspected inaccuracies in small-signal analyses such as HBAC, HBNOISE, or PHASENOISE. If a convergence or accuracy problem stems from an inaccuracy in the current or charge derivatives returned by a transistor or diode model, setting this option to 1 will resolve the problem, although with a performance decrease.

If `NUMERICAL_DERIVATIVES=1` resolves the problem, please contact Synopsys support so that the underlying transistor model issue can be resolved.

If you are confident that the models are providing accurate derivatives, do *not* use this option.

.OPTION NXX

Stops echoing (printback) of the data file to stdout.

Syntax

```
.OPTION NXX=[0|1]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to terminate echoing (printback) of the data file to stdout until HSPICE finds the `.END` command. It also resets the `LIST`, `NODE` and `OPTS` options and sets `NOMOD`.

See Also

.OPTION LIST
.OPTION NODE
.OPTION OPTS

.OPTION OFF

Initializes terminal voltages to zero for active devices not initialized to other values.

Syntax

```
.OPTION OFF=[0|1]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to initialize terminal voltages to zero if you did not initialize them to other values for all active devices. For example, if you did not initialize both drain and source nodes of a transistor (using `.NODESET, .IC` commands, or connecting them to sources), then `OFF` initializes all nodes of the transistor to `0`.

HSPICE checks the `OFF` option before element IC parameters. If you assigned an element `IC` parameter to a node, simulation initializes the node to the element `IC` parameter value, even if the `OFF` option previously set it to `0`.

You can use the OFF element parameter to initialize terminal voltages to 0 for specific active devices. Use the OFF option to help find exact DC operating-point solutions for large circuits.

See Also

.DC
.IC
.NODESET

.OPTION OFF_OUTPUT

Controls whether HSPICE creates *.pa# files.

Syntax

```
.option off_output=0|1|pa
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to control HSPICE to generate and output *.pa# files.

If OFF_OUTPUT=0, HSPICE outputs *.pa# files. If OFF_OUTPUT=1 or OFF_OUTPUT=pa, HSPICE suppresses the *.pa# files.

.OPTION OP_AUTOSTOP

Controls the printing of op at autostop time.

Syntax

```
.OPTION OP_AUTOSTOP=[0|1]
```

Default Value: 0

Description

Use this option to control the printing of op at autostop time. When value =0, HSPICE does not save op at autostop time. When value =1, HSPICE saves op at autostop time.

.OPTION OPFILE

Outputs the operating point information to a file.

Syntax

```
.OPTION OPFILE=[0|1]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to output the operating point information to a file. When back-annotating the operating point information for the Custom Designer, use this option `=1` in conjunction with `.OPTION SPLIT_DP=1`.

For a 1D sweep, the OP analysis is run for each sweep and the operating point information is written to separate files for each sweep.

For 2D Monte Carlo, the OP analysis is run for each Monte Carlo and the number of OP files will be `*.dp#@sweep_number@sample_number`.

For transient Monte Carlo the operating point information is written to a `*_wdf.op0@MC_index` file.

For AC Monte Carlo, the operating point information is written to a `*_wdf.op0@ac@MC_index` file.

For DC Monte Carlo, no matter sweep type is 1D or 2D, only one output file for each Monte Carlo sample is generated (`*_wdf.op0@dc@MC_index`).

If...	then...
`.OPTION OPFILE=0`	the operating point information is written to the stdout.
`.OPTION OPFILE=0` and `.OPTION SPLIT_DP=0`	the `SPLIT_DP` option is ignored and the operating point information is written to a `*.op` file for one operation point.
`.OPTION OPFILE=1` and `.OPTION SPLIT_DP=0`	the operating point information for all Monte Carlo points specified in the `.OP` statement is written to a single `.dp0` file. ■ For a 1D Monte Carlo, the OP points are `MC_sample` ■ For a 2D Monte Carlo, the OP points are `MC_sample*parameter_sweep`

If...	then...
`.OPTION OPFILE=1` and `.OPTION SPLIT_DP=1`	the operating point information in written to a separate file for each sample point specified in the `.OP` statement. For a 2D Monte Carlo, the file name is `*.dp#@sample_number`, each OP file contains number of parameter sweeps OP point information.

Note: `.OPTION OPFILE=1` with `SPLIT_DP=1` supports ASCII waveform format.

`.OPTION OPFILE=1` with `SPLIT_DP=2` supports PSF/WDF waveform format.

See Also

.OP
.OPTION SPLIT_DP
.OPTION ARTIST

.OPTION OPTCON

Continues running a bisection analysis (with multiple .ALTER commands) even if optimization failed.

Syntax

```
.OPTION OPTCON=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to override how HSPICE treats bisection measure failure. With this option turned on, Instead of issuing an error and exiting the simulation, HSPICE treats a bisection search failure like a measurement failure and completes the simulation, or continues if `.ALTER` commands are specified.

Examples

```
.option optcon=1
r1 1 0 2000
v1 1 0 3
.param target=0.5
.param x=opt1(0, 0, 1)
.model opt_model opt method=bisection relout=1e6
relin=0.0005
.meas tran y param = x goal = target
.tran 1.0e-10 1.0e-9 sweep optimize=opt1 results=y
 model=opt_model
.alter target=1.5
.param target=1.5
.alter target=0.75
.param target=0.75
.end
```

If a bisection search fails because of endpoints having the same sign, for example, screen output might appear as follows:

```
>info: ***** hspice job concluded
 the maximum number of iterations ( 14)was
 exceeded. however, results might be accurate.
x = 3.556e-09
y = 1.7103E+00
>info: ***** hspice job concluded
 **Warning** endpoints have same sign in bisection
x = failed
y = failed
>info: ***** hspice job concluded
Output stored in file => test.lis
```

See Also

.ALTER
.OPTION MEASFAIL

.OPTION OPTLST

Outputs additional optimization information.

Syntax

```
.OPTION OPTLST=0|1|2|3
```

Default 0

Description

Use this option to output additional optimization information:

- OPTLST=0: No information (default).
- OPTLST=1: Prints parameter, Broyden update and bisection results information.
- OPTLST=2: Prints gradient, error, Hessian, and iteration information.
- OPTLST=3: Prints all of the above and Jacobian.

Since the results of each iteration during an optimization do not meet the defined electrical specifications, HSPICE does not allow you to probe the results at each optimization iteration. However, you can use .OPTION OPTLST=3 to get the useful information about each iteration.

.OPTION OPTPARHIER

Specifies scoping rules to options.

Syntax

```
.OPTION OPTPARHIER=[GLOBAL|LOCAL]
```

Description

Use this option to specify scoping rules to options to support local GEOSHRINK and SCALE options within .SUBCKT commands. As shown in the example below, when OPTPARHIER=GLOBAL, SCALE=2u GEOSHRINK=0.8 will be valid in subcircuits.

When OPTPARHIER=LOCAL, SCALE=1e-6 GEOSHRINK=0.9 is valid in subcircuits.

Examples

This example explicitly shows the difference between local and global scoping for using options in subcircuits.

```
.OPTION OPTPARHIER=[global | local]
.OPTION SCALE=2u GEOSHRINK=0.8
.PARAM DefPwid=1u
.SUBCKT Inv a y DefPwid=2u DefNwid=1u
.OPTIONS SCALE=1e-6 GEOSHRINK=0.9
Mp1 MosPinList pMosMod L=1.2u W=DefPwid
Mn1 MosPinList nMosMod L=1.2u W=DefNwid
.ENDS
```

See Also

.OPTION GEOSHRINK
.OPTION SCALE
.SUBCKT

.OPTION OPTS

Prints current settings for all control options.

Syntax

```
.OPTION OPTS
```

Description

Use this option to print the current settings for all control options. If you change any of the default values of the options, the OPTS option prints the values that the simulation actually uses.

Note: All SIM_LA* printed settings are shown as LA_*.

.OPTION PARHIER / PARHIE

Specifies scoping rules for netlist parameters.

Syntax

```
.OPTION PARHIER=GLOBAL|LOCAL
```

Default Value if option is not specified in the netlist: GLOBAL

Description

Use this option to specify scoping rules for netlist parameters.

If PARHIER is LOCAL, then all parameters defined in the context of a subcircuit definition remain local to that subcircuit (the lines between .SUBCKT and .ENDS). This applies to any parameters defined in .INCLUDE or .LIB commands referenced within the subcircuit name space.

If PARHIER is GLOBAL, then all parameters not defined on the .SUBCKT line either refer to, or are created in, the global name space. SUBCKT parameters (or instance parameters) are always local to the SUBCKT name space.

Examples

This example defines the models inside of a subcircuit using an `.INCLUDE` command. The parameters defined in included models are global by default. Because you want parameters defined in the included file to be local to the subcircuit, set `.OPTION PARHIER=LOCAL` so that parameter scoping rules are correct for this case.

```
...
.option PARHIER=LOCAL
.subckt INV IN OUT
.include 'weak_ model.inc'
M1 ..
M2 ..
.ends INV
..
X1 IN OUT INV
..
```

See Also

.INCLUDE / INC / INCL
.SUBCKT

.OPTION PATHNUM

Prints subcircuit path numbers instead of path names; overrides 8-character model name limitation.

Syntax

```
.OPTION PATHNUM=[0|1|2]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

When set to `1`, this option prints subcircuit path numbers instead of path names. When set to `2`, the complete model name (no truncation) is printed to the `*.lis` file; without this setting, model names are limited to eight characters. In addition, a full nodal hierarchy table is printed. For example, the following captab nodal hierarchy appears as:

```
<    +xv2i.dac_x[1]= 3.331e-15          xv2i.dac_x[2]= 3.014e-15          xv2i.dac_x[3]= 3.014e-15
<    +xv2i.dset    = 1.260e-13          xv2i.ed[0]    = 3.218e-15         xv2i.ed[1]    = 3.751e-15
<    +xv2i.ed[2]   = 6.964e-15          xv2i.ed[3]    = 1.066e-14         xv2i.ev0      = 3.801e-15
<    +xv2i.ev1     = 5.351e-15          xv2i.ev2      = 5.186e-15         xv2i.k_x[0]   = 4.277e-15
<    +xv2i.k_x[1]  = 5.786e-15          xv2i.kvco[0]  = 3.447e-15         xv2i.kvco[1]  = 2.197e-15
<    +xv2i.n$10444 = 1.858e-15          xv2i.n$10445 = 1.874e-15          xv2i.n2ab     = 9.120e-15
```

.OPTION PCB_SCALE_FORMAT

Extends support for using a scaling factor in place of the decimal point for PCB part number formats during case-sensitive simulation.

Syntax

```
.OPTION PCB_SCALE_FORMAT=[0|1]
```

Default Value if option is not specified in the netlist: 0

Value if option name is specified without a corresponding value: 1

Description

Allows both uppercase and lowercase number formats to be supported when case sensitive simulations are run for parts places on a PCB. This option maintains backward compatibility for those who use a number format that is common for parts placed on a PCB, where the scaling factor is used instead of the decimal point (for example, 3k3 -> 3.3k).
Setting `.OPTION PCB_SCALE_FORMAT= 1` when case-sensitivity is turned on allows the 3k3 number format to be usable in an expression.

This option adds a new scaling factor, “r” or “R,” which is the multiplying factor 1e0 (often used for resistors).

Examples

Example 1 Decimal converted to Expression

```
.option pcb_scale_format=1
.param a='3k3 +2k/2'
```

As seen in the examples below, backward compatibility with the features of HSPICE numbers is maintained (such as optional trailing units and scaling symbols). The examples below show how the values 0 or 1 affect the output.

Example 2 .OPTION PCB_SCALE_FORMAT=0:

```
1) 0u1 / 0U1 / 0u1farads / 0.1u / 0u1farads / 0.1ufarads -> 0.1u
2) 5R6 / 5r6 / 5600m0 / 5600M0 / 5600m -> 5.6
3) 5MEG35 / 5meg35 / 5.35Meg -> 5.35e6
```

Example 3 .OPTION PCB_SCALE_FORMAT=1:

```
a) 0u1 / 0u1farads / 0.1u -> 0.1u
b) 5R6 / 5r6 / 5600m0 / 0M0000056-> 5.6
c) 5MEG35 / 5meg35 -> 5.35e6
```

See Also

.OPTION SI_SCALE_SYMBOLS

.OPTION PHASENOISEKRYLOVDIM / PHASENOISE_KRYLOV_DIM

Specifies the dimension of the Krylov subspace that the Krylov solver uses.

Syntax

```
.OPTION PHASENOISEKRYLOVDIM | PHASENOISE_KRYLOV_DIM
```

Default `500`

Description

Specifies the dimension of the Krylov subspace that the Krylov solver uses. This must be an integer greater than zero.

See Also

.OPTION BPNMATCHTOL
.OPTION PHASENOISEKRYLOVITR / PHASENOISE_KRYLOV_ITR
.OPTION PHASENOISETOL
.OPTION PHNOISELORENTZ / PHNOISE_LORENTZ

.OPTION PHASENOISEKRYLOVITR / PHASENOISE_KRYLOV_ITR

Specifies the maximum number of Krylov iterations that the phase noise Krylov solver takes.

Syntax

```
.OPTION PHASENOISEKRYLOVITR | PHASENOISE_KRYLOV_ITR
```

Default `1000`

Description

Specifies the maximum number of Krylov iterations that the phase noise Krylov solver takes. Analysis stops when the number of iterations reaches this value.

See Also

.OPTION BPNMATCHTOL
.OPTION PHASENOISEKRYLOVDIM / PHASENOISE_KRYLOV_DIM
.OPTION PHASENOISETOL
.OPTION PHNOISELORENTZ / PHNOISE_LORENTZ

.OPTION PHASENOISETOL

Specifies the error tolerance for the phase noise solver.

Syntax

```
.OPTION PHASENOISETOL
```

Default `1e-8`

Description

Specifies the error tolerance for the phase noise solver. This must be a real number greater than zero.

See Also

.OPTION BPNMATCHTOL
.OPTION PHASENOISEKRYLOVDIM / PHASENOISE_KRYLOV_DIM
.OPTION PHASENOISEKRYLOVITR / PHASENOISE_KRYLOV_ITR
.OPTION PHNOISELORENTZ / PHNOISE_LORENTZ

.OPTION PHASETOLI

For HB output, aids in reporting when magnitude of phase current is very small.

Syntax

```
.OPTION PHASETOLI=val
```

Default 1.e-15

Description

Use this option in a harmonic balance analysis to report the output of the magnitude of a current phaser as zero. If the current phaser is less than the PHASETOLI value, then zero phase is reported. (If the magnitude of a current value is very small, the phase does not matter at all.)

See Also

.OPTION PHASETOLV
.HB
.HBAC
.HBLIN
.HBLSP
.HBNOISE
.HBOSC
.HBXF

.OPTION PHASETOLV

For HB output, aids in reporting when magnitude of phase voltage is very small.

Syntax

```
.OPTION PHASETOLV=val
```

Default 1.e-15

Description

Use this option in a harmonic balance analysis to report the output of the magnitude of a voltage phaser as zero. If the voltage phaser is less than the PHASETOLV value, the phase of that phaser is output as zero. (If the magnitude of a voltage value is very small, the phase does not matter at all.)

See Also

.OPTION PHASETOLI
.HB
.HBAC
.HBLIN
.HBLSP
.HBNOISE
.HBOSC
.HBXF

.OPTION PHD

Facilitates fast OP convergence for BSIM4 test cases.

Syntax

```
.OPTION PHD=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

When `PHD` is set to `1` (ON), this option facilitates fast OP convergence for BSIM4 test cases. The PHD flow may show performance improvement in simulations that require large DC OP convergence iterations. When PHD is on but fails to converge, the simulation exits.

.OPTION PHNOISEAMPM

Allows you to separate amplitude modulation and phase modulation components in a phase noise simulation.

Syntax

```
.OPTION PHNOISEAMPM=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to enable HSPICE to calculate separate amplitude (am) and phase modulation (pm) components using the output and measure syntax of a .PHASENOISE simulation. A value of 0 sets the Periodic AC (PAC) phase noise amplitude modulation (AM) component to zero and the results will be identical to earlier releases. A value of 1 calculates separate AM and phase noise components. When `.OPTION PHNOISEAMPM=1`, then

`.MEASURE PHASENOISE` extends output variables to the set:`<am[noise]>` `<pm[noise]>`

Examples

The following explicitly sets the calculation for separate am and pm calculation.

```
.opt phnoiseampm=1
```

See Also

.PHASENOISE
Amplitude Modulation/Phase Modulation Separation

.OPTION PHNOISELORENTZ / PHNOISE_LORENTZ

Turns on a Lorentzian model for the phase noise analysis.

Syntax

```
.OPTION PHNOISELORENTZ | PHNOISE_LORENTZ = 0|1|2|3
```

Default `0`

Description

Allows you to select a Lorentzian model type for the phase noise analysis.

- `0`: (default) Uses a linear approximation to a Lorentzian model and avoids phasenoise values >0dB for low offsets
- `1`: Applies a Lorentzian model to all noise sources
- `2`: Applies a Lorentzian model to all non-frequency dependent noise sources
- `3`: Lorentzian model applied to white noise source, Gaussian model applied to flicker noise sources.

See Also

.OPTION BPNMATCHTOL
.OPTION PHASENOISEKRYLOVDIM / PHASENOISE_KRYLOV_DIM
.OPTION PHASENOISEKRYLOVITR / PHASENOISE_KRYLOV_ITR
.OPTION PHASENOISETOL

.OPTION PIVOT

Selects a pivot algorithm.

Syntax

```
.OPTION PIVOT=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Set this option to 1 to select a pivot algorithm to achieve convergence in circuits that produce hard-to-solve matrix equations. `PIVOT`selects the numerical pivoting algorithm that is used to manipulate the matrices. Pivoting affects both DC and transient analysis. Usually the reason for choosing a pivot method other than the default 0 is that the circuit contains both very large and very small conductances.

If `PIV0T=0`, HSPICE automatically changes from a non-pivoting to pivot strategy if it detects any diagonal-matrix entry less than `PIVTOL`. This strategy provides the time and memory advantages of non-pivoting inversion and avoids unstable simulations and incorrect results. Use `.OPTION NOPIV` to prevent HSPICE from pivoting.

The `SPARSE` option is the same as `PIVOT`.

See Also

.OPTION NOPIV
.OPTION PIVTOL

.OPTION PIVTOL

Sets the absolute minimum value for which HSPICE accepts a matrix entry as a pivot.

Syntax

```
.OPTION PIVTOL=x
```

Description

Use this option to set the absolute minimum value for which HSPICE accepts a matrix entry as a pivot. PIVTOL is used to prevent numeric overflow conditions like divide by 0. If the conductance is less than the value of PIVTOL, HSPICE rebuilds the matrix and chooses the PIVOT algorithm. If the conductance is greater than the value of PIVTOL, the PIVTOL value replaces the conductance in the matrix. When a non-pivot algorithm is selected by setting PIVOT=0, then pivtol is the minimum conductance in the matrix and not a pivot.

The default value of PIVTOL is 1e-15 and the range of PIVTOL is Min:1e-35, Max:1, excluding 0. The value of PIVTOL must be less than GMIN or GMINDC. Values that approach 1 increase the pivot. The example below shows how you can correct a “maximum conductance on node error.”

Note: If PIVTOL is set too small, you run the risk of creating an overflow condition and a convergence problem. If you set the value to 0, an out-of-bounds error is reported.

Examples

If you get an error message such as:

```
**error** maximum conductance on node 1:v75 } =( 9.2414D-23) is
less than pivtol in transient analysis.
Check hookup for this node, set smaller option pivtol and rerun.
```

—the error message informs that the node conductance value is less than the value of PIVTOL. Decrease the PIVTOL value so that it is less than the value in the error message. The valid range of pivtol values is between 1e-35 to 1, excluding 0. For this case a setting PIVTOL to 1e-25 resolves the error.

See Also

.OPTION GMIN
.OPTION GMINDC
.OPTION PIVOT

.OPTION POST

Saves simulation results for viewing by an interactive waveform viewer.

Syntax

HSPICE Syntax

```
.OPTION POST=[0|1|2|3|ASCII|BINARY|CSDF]
```

HSPICE Advanced Analog Syntax

```
.OPTION POST=[0|1|2|3|ASCII|BINARY|CSDF|NW|P|TW|UT|WDBA]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to save simulation results for viewing by an interactive waveform viewer and to provide output without specifying other parameters.

Note: The behavior for `.OPTION POST` when HSPICE advanced analog functions are used is different from the same option used in HSPICE.

The defaults for the `POST` option supply usable data to most parameters:

- `POST=0`: Does not output simulation results.
- `POST=1, BINARY`: (Default if `POST` is declared without a value) Output format is binary.
- `POST=2, ASCII`: Output format is ASCII. When you set `.option POST=2` HSPICE increases the spacing between points after writing out 100k time points. The simulation accuracy is not affected, but the ASCII output waveform file is. To resolve this, either add `.option POST_VERSION=2001` to the netlist to output all time points as double-precision numbers, or use `.option POST=1` in the netlist to create a binary output file.
- `POST=3`: Output format is New Wave binary (which enables you to generate `.tr0` files that are larger than 2 gigabytes on Linux platforms).
- `POST=CSDF`: Output format is Common Simulation Data Format (Viewlogic-compatible graph data file format).

Options available when HSPICE advanced analog functions are used:

- `POST=NW`: Output format is XP/AvanWaves.
- `POST=TW`: Output format is TurboWave.
- `POST=UT`: Output format is Veritools Undertow.

- POST=WDBA: Output format is XP/Custom WaveView.
- POST=XP: Output format is XP/AvanWaves/Custom WaveView.

By default, HSPICE outputs single precision for both time and signal data. If you want to get double precision data, in the netlist set:

```
.OPTION POST POST_VERSION=2001
```

Note: .OPTION POST in HSPICE is *not* a global option to dump output in general and then use other options to specify another format. Other options such as PSF, CSDF, SDA, ZUKEN override POST if they are specified after POST, and vice versa. This is unlike when HSPICE advanced analog functions are used, which allows values beyond [0|1|2|3|ASCII|BINARY|CSDF].

HSPICE uses the last output control option if multiple output control options are specified in the netlist.

In POST format, only the inductor OP information is output into a *.lis file or a *.dp# file (when opfile=1). For inductor and capacitor information see .OPTION PSF and .OPTION WDF formats.

Examples

In this example the option post overrides the options artist/PSF.

```
.option artist=2 psf=2
.option post
```

In this example, the options artist/PSF override the option post.

```
.option post
.option artist=2 psf=2
```

See Also

.OPTION POST_VERSION

.OPTION POSTLVL

Limits the data written to your waveform file to a specified level of nodes.

Syntax

```
.OPTION POSTLVL=n
```

Description

Limits the data written to your waveform file to the level of nodes specified by the *n* parameter. This option differs from `POSTTOP` in that it specifies the signals of one given level at any level.

Define the top level as level 1 (level 0 could also be incorrectly guessed for top level, but in this case the option is ignored). Define the behavior, when no numerical value is given, that is `.OPTION POSTTOP` or `.OPTION POSTLVL` are stated, respectively. In both cases only the top level nodes are written into the database.

Note: In a netlist, `.OPTION POSTLVL` overrides `.OPTION PROBE`.

Examples

```
.OPTION POSTLVL=2
```

This example limits the data written to the waveform file to only the second-level nodes (voltage and current).

See Also

.OPTION POSTTOP
.OPTION PROBE

.OPTION POST_VERSION

Specifies the post-processing output version for HSPICE.

Syntax

```
.OPTION POST_VERSION=x
```

Default `9601`

Description

Use this option to set the post-processing output version:

- `x=9007` truncates the node name in the post-processor output file to a maximum of 16 characters.
- `x=9601` sets the node name length for the output file consistent with input restrictions (1024 characters) and limits the number of output variables to 9999.

- `x=2001` uses an output file header that displays the correct number of output variables when the number exceeds 9999. This option also changes the digit-number precision in results files to match the value of `.OPTION NUMDGT` (when < 5).
- `x=2013` outputs the time / frequency / dc variable data with double precision and output the signals data in single precision.

By default, HSPICE outputs single precision for both time and signal data. If you want to get double precision data, in the netlist set:

```
.OPTION POST POST_VERSION=2001
```

If you set `.OPTION POST_VERSION=2001 POST=2` in the netlist, HSPICE returns more accurate ASCII results.

Note: `.OPTION POST_VERSION=2001` and `.OPTION POST_VERSION=2013` does not work for FSDB output (`.OPTION FSDB`).

Examples

If you need to probe more than 9999 signals, set the `POST_VERSION` option to `2001`; for example,

```
.OPTION POST_VERSION=2001
```

HSPICE now outputs all the signals into a waveform file and the correct number of output signals is shown rather than **** when the number of signals exceeds 9999. You can load this waveform file in WaveView to view the signals.

See Also

.OPTION NUMDGT
.OPTION POST

.OPTION POSTTOP

Limits the data written to the waveform file to data from only the top *n* level nodes.

Syntax

```
.OPTION POSTTOP=n
```

Description

Use this option to limit the data written to your waveform file to data from only the top *n* level nodes. This option outputs instances up to `n` levels deep. If you do not specify either the `PROBE` or the `POSTTOP` options, HSPICE outputs all levels. To enable the waveform display interface, you also need to specify the `.OPTION POST` option. This option differs from `.OPTION POSTLVL` in that it specifies the signals of one or multiple levels from the top level down.

Define the top level as level 1 (level 0 could also be incorrectly guessed for top level, but in this case the option is ignored). Define the behavior, when no numerical value is given, that is `.OPTION POSTTOP` or `.OPTION POSTLVL` are stated, respectively. In both cases only the top level nodes are written into the database.

Note: In a netlist, `.OPTION POSTTOP` overrides `.OPTION PROBE`.

Examples

This example limits the data written to the waveform file to only the three top-level nodes (voltage and current).

```
POSTTOP=3
```

See Also

.OPTION POST
.OPTION PROBE
.OPTION POSTLVL

.OPTION PROBE

Limits post-analysis output to only variables specified in `.PROBE` and `.PRINT` commands for HSPICE.

Syntax

```
.OPTION PROBE=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

When turned on (`1`), allows you to set post-analysis output to only variables specified in `.PROBE`, `and PRINT` commands. `0`=off.By default, HSPICE

outputs all voltages and power supply currents in addition to variables listed in .PROBE, and .PRINT commands. Using this option can significantly decrease the sizes of simulation output files.

If .OPTION PROBE is not set:

- All node voltage/source currents output to *.tr#, *.ac#, *.sw# files.
- If measured, the resistor or MOSFET current is also output to *.tr#, *.ac#, or *.sw# files.
- If the resistor or MOSFET current are determined by measurement variables, and .OPTION PUTMEAS is reset (set to 0), these measurement variables are not output to waveform files.

Important: .OPTION PROBE is ignored if any of .OPTIONS POSTTOP, POSTLVL, SIM_POSTTOP, SIM_POSTAT, or SIM_POSTDOWN is also set in the netlist. .OPTION POSTTOP, POSTLVL, SIM_POSTTOP, SIM_POSTAT, or SIM_POSTDOWN each overrides .OPTION PROBE.

See Also

.PRINT
.PROBE
.OPTION PUTMEAS
.OPTION POSTLVL
.OPTION POSTTOP
.OPTION SIM_POSTAT
.OPTION SIM_POSTDOWN
.OPTION SIM_POSTTOP

.OPTION PSF

In a standalone HSPICE simulation, specifies whether the output is binary (Parameter Storage Format) or ASCII. When used with HSPICE, specifies whether binary or ASCII data is output when you run an HSPICE simulation from the Cadence Virtuoso Analog Design Environment.

Syntax

```
.OPTION PSF=0|1|2
```

Default Value if option is not specified in the netlist: 0

Value if option name is specified without a corresponding value: 1

Description

Use this option to specify whether HSPICE outputs binary (Parameter Storage Format—`*.PSF`) or ASCII data when you run an HSPICE simulation through the Cadence Virtuoso Analog Design Environment.

The combinations shown in the below table produce the following output file format:

PSF Value	ARTIST Value	Output File Format
1	0	Binary
1	1	Binary
1	2	Binary
2	0	ASCII
2	1	Binary
2	2	Binary

When `ARTIST=2 PSF=2`, no `*.dp#` files are generated, nor is OP information output in the `*.lis` file. If `.OPTION OPFILE=1` is in a netlist when `PSF=2`, the `OPFILE=1` is ignored.

In `PSF` or `WDF` format, the inductor and capacitor OP information are both output into `*.op#` files.

When the netlist contains `.option psf=2` and a `.tran` analysis statement (with no `.op` statement in the netlist file), HSPICE creates the following output files:

- `.op0` — dc node voltage and dc operating points
- `.op1` — transient voltage and transient operating points for the transient end time.

Ordinarily, PSF output is directed to a directory named `./psf` to accommodate the Analog Design Environment. However, HSPICE and Custom Designer users can redirect PSF output by setting the HSPICE command line option `-o` to a directory other than `./psf` (for example: `-o ../results/input`).

Note: The PSF format is supported on Sun/SPARC, Red Hat/SUSE Linux, x86, and IBM AIX platforms, as well as 64-bit versions.

See Also

.OPTION ARTIST
.OPTION OPFILE

.OPTION PURETP

Specifies the integration method to use for reversal time point in HSPICE.

Syntax

```
.OPTION PURETP=[0|1]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to specify the integration method to use for reversal time point.

If you set `PURETP=1` and HSPICE finds nonconvergence, it uses `TRAP` (instead of `Bbackward-Euler`) for the reversed time point.

Use this option with an `.OPTION METHOD=TRAP` command to help some oscillating circuits to oscillate if the default simulation process cannot satisfy the result.

See Also

.OPTION METHOD

.OPTION PUTMEAS

Controls the output variables listed in the `.MEASURE` command.

Syntax

```
.OPTION PUTMEAS=0|1
```

Default `1`

Description

Use this option to control the output variables listed in the `.MEASURE` command.

- `0`: Does not save variable values listed in the `.MEASURE` command into the corresponding output file (such as `.tr#`, `.ac#` or `.sw#`). This option decreases the size of the output file.
- `1`: Default. Saves variable values listed in the `.MEASURE` command to the corresponding output file (such as `.tr#`, `.ac#` or `.sw#`).

See Also

.MEASURE / MEAS

.OPTION PZ_METHOD

Selects the method for pole and zero analysis.

Syntax

```
.OPTION PZ_METHOD=method_name
```

Default `MULLER`

Description

Use this option to select the method for pole and zero analysis.

- `PZ_METHOD=`*`MULLER`*: Selects the Muller method for pole and zero analysis.
- `PZ_METHOD=`*`SVD`*: Selects the SVD method for pole and zero analysis. This method requires only that G and C are real matrices; however, it requires twice as much memory as HQR and is approximately three times slower.
- `PZ_METHOD=`*`HQR`*: Selects HQR method for pole/zero analysis, and requires that the G matrix is nonsingular.

.OPTION PZ_NUM

Sets the maximum allowable number of poles and zeros that will be output to log file.

Syntax

```
.OPTION PZ_NUM=x
```

Default `10`

Description

Use this option to set maximum number of poles and zeros which will be output to the log file. This option will affect the output of all methods, for example: muller, svd and hqr.

The first x poles (zeros) will be sorted by the absolute value of real part and in an ascending order.

.OPTION PZABS

Sets absolute tolerances for poles and zeros.

Syntax

```
.OPTION PZABS=x
```

Default `1.0e-2`

Description

Use this option to set absolute tolerances for poles and zeros in Pole/Zero analysis. Use this option as follows: If $(X_{\text{real}} + X_{\text{real}} < PZABS)$, then X_{real} and $X_{\text{imag}} = 0$. You can also use this option for convergence tests.

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION FSCAL
.OPTION GSCAL
.OPTION LSCAL
.OPTION PZTOL
.OPTION RITOL

.OPTION PZTOL

Sets the relative tolerance for poles and zeros.

Syntax

```
.OPTION PZTOL=x
```

Default `1.0e-6`

Description

Use this option to set relative tolerances for poles and zeros in Pole/Zero analysis.

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION FSCAL
.OPTION GSCAL
.OPTION LSCAL
.OPTION PZABS
.OPTION RITOL

.OPTION RADEGFILE

Use to specify a MOSRA degradation file name to be used with `SIMMODE=1`.

Syntax

```
.OPTION RADEGFILE=file_name
```

Description

Use this option to specify a MOSRA degradation file name to be used with `SIMMODE=1`. HSPICE will read in the degradation information in the specified file and do a MOSRA post-stress simulation.

Examples

```
.mosra reltotaltime='10*365*24*60*60' lin=11 simmode=1
.option radegfile = '1.radeg0'
```

See Also

.MOSRA
.OPTION RADEGOUTPUT

.OPTION RADEGOUTPUT

Outputs the MOSRA degradation information to the Word Excel CSV format.

Syntax

```
.OPTION RADEGOUTPUT=CSV
```

Description

Use this option to output the MOSRA degradation information to the Microsoft Excel CSV format. If the `CSV` value is not specified no CSV file is generated.

See Also

.OPTION RADEGFILE

.OPTION RANDGEN

Specifies the random number generator used in traditional Monte Carlo analysis.

Syntax

```
.OPTION RANDGEN=[0|1|2|3|4|3lc|moa|uvs|mcg|wh]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to specify the random number generator used in HSPICE traditional Monte Carlo analysis.

RANDGEN Option	Description
3lc | 0	A traditional random number generator is used.
moa | 1	A multiply-with-carry type random number generator with longer cycle is used.
uvs | 2	A 64-bit universal random number generator with longer cycle is used.
mcg | 3	A multiplicative congruential generator with longer cycle is used.
wh | 4	Another longer cycle is used.

For the generators of `mcg` and `wh`, there is almost no time cost to skip random number, no matter how large the number is following the keyword `firstrun`.

Note: The `.OPTION SEED` command is also valid for the new random number generator without usage change.

See Also

.OPTION RUNLVL
.OPTION SEED

.OPTION REDEFMODEL

Allows redefinition of a model in a netlist.

Syntax

```
.OPTION REDEFMODEL=[0|1|2]
```

Default 0

Description

This option enables you to redefine a model in a netlist.

- 0: Issues an error message for multiple definitions
- 1: Uses the last declared definition
- 2: Uses the first definition

`.OPTION REDEFMODEL` without a value equals `.OPTION REDEFMODEL=0`. If you do not specify `REDEFMODEL`, HSPICE errors out on a duplicate model.

.OPTION REDEFSUB

Allows redefinition of a subckt in a netlist.

Syntax

```
.OPTION REDEFSUB =[0|1|2]
```

Default 0

Description

Enables the redefinition of a subcircuit in a netlist.

- 0: Issues an error message for multiple definitions
- 1: Uses the last declared definition
- 2: Uses the first definition

`.OPTION REDEFSUB` without a value equals `.OPTION REDEFSUB=1`.

.OPTION RELIN

(Optimization) Relative input parameter (`delta_par_val / MAX(par_val,1e-6)`) for convergence.

Syntax

```
.OPTION RELIN=value
```

Default `0.001`

Description

(Optimization) Relative input parameter (`delta_par_val / MAX(par_val, 1e-6)`) for convergence. If all optimizing input parameters vary by no more than `RELIN` between iterations, the solution converges. `RELIN` is a relative variance test so a value of 0.001 implies that optimizing parameters vary by less than 0.1% from one iteration to the next. If `RELIN` is set in `.OPTION`, the setting of `RELIN` in the `.model` card will be overridden.

Examples

```
.option RELIN=1e-6 DYNACC
```

See Also

.MODEL

.OPTION RELMOS

Sets the relative error tolerance for drain-to-source current from iteration to iteration.

Syntax

```
.OPTION RELMOS=x
```

Description

Use this option to set the relative error tolerance for drain-to-source current from iteration to iteration.

This option also sets the change in current from the value calculated at the previous timepoint. HSPICE uses the `.OPTION RELMOS` value only if the current is greater than the `.OPTION ABSMOS` floor value.

Min value: 1e-07; Max value 10.

See Also

.OPTION ABSMOS
.OPTION RELMOS

.OPTION RELVDC

Sets the relative error tolerance for voltages from iteration to iteration.

Syntax

```
.OPTION RELVDC=x
```

Description

Use this option to set the relative error tolerance for voltages from iteration to iteration.

If voltages or currents exceed their absolute tolerances, the `RELVDC` test determines convergence. Increasing the *x* parameter value increases the relative error. You should generally maintain `RELVDC` at its default value to conserve simulator charge.

.OPTION REPLICATES

Runs replicates of the Latin Hypercube samples.

Syntax

`.OPTION REPLICATES=`*number*

Description

When the advanced sampling method Latin Hypercube is used with traditional Monte Carlo simulation, you can add this option following `.OPTION SAMPLING _METHOD=LHS`. This option runs replicates of the Latin Hypercube samples. The sample with nominal conditions is simulated once. HSPICE repeats the LHS run the number of times specified by `number`. For example, if, in a regular run, you have 10+1 (including nominal value) iterations, if you set `.OPTION REPLICATES=2`, you generate 21 (or 2* Value +1) Latin Hypercube samples.

Examples

```
.OPTION SAMPLING_METHOD=LHS
.OPTION REPLICATES=2
```

See Also

.OPTION SAMPLING_METHOD

.OPTION RES_BITS

Tightens tolerances when using HSPICE Precision Parallel (HPP) in transient simulations.

Syntax

```
.OPTION RES_BITS=n
```

Default 0

Description

When running a multi-thread operation in a transient simulation using HPP (only) this option can be used to tighten convergence tolerances. Tightening convergence tolerances enable resolving the least significant bit in an n-bit converter.

Note: Setting this option may result in increased number of iterations and, sometimes, slightly increased number of time steps.

Examples

The following example, for a 14-bit A-to-D converter, is set as:

```
.option res_bits=14
```

.OPTION RESMIN

Specifies the minimum resistance for all resistors.

Syntax

```
.OPTION RESMIN=x
```

Default 1E-05

Description

Use this option to specify the minimum resistance for all resistors. Any resistance (including parasitic, inductive resistors, and those in the transistor models) smaller than the specified `RESMIN` is reset to the `RESMIN` value. No resistor reduction is involved. The default is 1E-05. Users can specify a bigger value up to 10 ohms.

See Also

.OPTION RM_RMIN
.OPTION RM_RMAX

.OPTION RISETIME / RISETI

Specifies the smallest signal risetime to be supported in elements and analyses that are sensitive to frequency bandwidth and time scale constraints.

Syntax

```
.OPTION RISETIME=x
```

Default Calculated automatically (see below)

Description

Use this option to specify the smallest signal risetime to be anticipated when analyzing certain elements that have frequency dependencies. Several HSPICE elements require some knowledge regarding either their maximum frequency of operation, or the minimum signal rise time to be expected. This is particularly true of elements that are described in the frequency domain, yet require time-domain simulation. The `RISETIME` option is used to establish time scale and frequency scale information needed for inverse Fourier transform and convolution calculations.

In the W-element (transmission line) model, `RISETIME` is used to determine the maximum signal frequency to be taken into account for frequency dependencies such as skin effect, and dielectric loss (non-zero Rs or Gd).

In the S-element (scattering-parameter) based model, the reciprocal of `RISETIME` sets the maximum signal frequency (`FMAX`) value used for the S-parameter analysis.

In the U-element (lumped transmission line) model, `RISETIME` is used to set the number of lumps according to the equation:

$$\#\text{lumps} = MIN\left[20, 1 + 20 \cdot \left(\frac{TDeff}{RISETIME}\right)\right]$$

where, TD_{eff} is the end-to-end delay in a transmission line.

When needed, HSPICE automatically calculates a default value for `RISETIME` as follows:

- 25% of the `tstep` value specified with the `.TRAN` command.
- The time corresponding to a 90-degree phase shift for the highest frequency specified in `SIN`, `SFFM`, and `AM` sources.
- The smallest delay time, rise time, fall time, or time increment used in `PULSE`, `EXP`, and `PWL` sources.

See Also

.MODEL
.OPTION WACC
.OPTION WDELAYOPT

.OPTION RITOL

Sets the minimum ratio value for the (real/imaginary) or (imaginary/real) parts of the poles or zeros.

Syntax

```
.OPTION RITOL=x
```

Default `1.0e-2`

Description

Use this option to set the minimum ratio value for the (real/imaginary) or (imaginary/real) parts of the poles or zeros. Use the `RITOL` option as follows. if: $|X_{\text{imag}}| \leq RITOL \cdot |X_{\text{real}}|$, then $X_{\text{imag}} = 0$. If $|X_{\text{real}}| \leq RITOL \cdot |X_{\text{imag}}|$, then $X_{\text{real}} = 0$.

See Also

.OPTION CSCAL
.OPTION FMAX
.OPTION FSCAL
.OPTION GSCAL
.OPTION LSCAL

.OPTION PZABS
.OPTION PZTOL
.PZ

.OPTION RM_CMAX

Enables you to set a value above which HSPICE removes capacitors from the circuit.

Syntax

```
.OPTION RM_CMAX=val
```

Default 0 (Disabled)

Description

Use this option to specify a threshold at which linear capacitors are removed. This option is especially useful with extracted netlists containing numerous capacitors. Specifying such a threshold can speed up simulation.

All capacitors that encounter an |R value| > RM_CMAX are immediately removed. If a negative value is set, HSPICE issues a warning message and the simulation ignores the option.

Minimum value: 0, Maximum value: 1e+20.

Examples

In the following example, capacitors greater than 1e12 are removed from the circuit.

```
.opt rm_cmax=1e12
```

See Also

.OPTION RM_CMIN
.OPTION RM_CNEG

.OPTION RM_CMIN

Enables you to set a value below which HSPICE ignores capacitors.

Syntax

```
.OPTION RM_CMIN=val
```

Default 0 (Disabled)

Description

Use this option to specify a threshold at which linear capacitors are ignored. This option is especially useful with extracted netlists containing numerous very small capacitors. Specifying such a threshold helps to speed up simulation.

If a negative value is set, HSPICE issues a warning message and the simulation ignores the option.

Minimum value: 0, Maximum value: 100.

Examples

In the following example, capacitors less than 1e-3 are removed from the circuit.

```
.opt rm_cmin=1e-3
```

See Also

.OPTION RM_CMAX
.OPTION RM_CNEG

.OPTION RM_CNEG

Removes all negative capacitors.

Syntax

```
.OPTION RM_CNEG=0|1
```

Default 0

Description

Use this option to remove all negative capacitors in the netlist.

See Also

.OPTION RM_CMAX
.OPTION RM_CMIN

.OPTION RM_RMAX

Enables you to set a value above which HSPICE removes resistors from the circuit.

Syntax

`.OPTION RM_RMAX=`*`val`*

Default 0 (Disabled)

Description

Use this option to specify a threshold at which resistors are removed. This option is especially useful with extracted netlists containing numerous resistors. Specifying such a threshold can speed up simulation.

All linear resistors that encounter an |R value| > RM_RMAX are immediately removed. The priority of `.OPTION RM_RMAX` is higher than `.OPTION RESMIN` or `.OPTION RM_RMIN`.

If a negative value is set, HSPICE issues a warning message and the simulation ignores the option.

Minimum value: 0, Maximum value: 1e+20.

Examples

In the following example, resistors smaller than 1e-3 are shorted (ignored) and the resistors greater than 1e12 are removed from the circuit.

```
.opt rm_rmin=1e-3 rm_rmax=1e12
```

See Also

.OPTION RM_RMIN
.OPTION RESMIN

.OPTION RM_RMIN

Enables you to set a value below which HSPICE ignores resistors.

Syntax

`.OPTION RM_RMIN=`*`val`*

Default `1e-5`

Description

Use this option to specify a threshold at which resistors are ignored. This option is especially useful with extracted netlists containing numerous very small resistors. Specifying such a threshold helps to speed up simulation.

All linear resistors that encounter an |R value|< RM_RMIN shorts the wire. Its priority is higher than `.OPTION RESMIN`. To disable the option, set the value to `0`.

If a negative value is set, HSPICE issues a warning message and the simulation ignores the option.

Minimum value: 0, Maximum value: 100.

Examples

In the following example, resistors smaller than 1e-3 are shorted (ignored) and the resistors greater than 1e12 are removed from the circuit.

```
.opt rm_rmin=1e-3 rm_rmax=1e12
```

See Also

.OPTION RM_RMAX
.OPTION RESMIN
.OPTION RM_RNEG

.OPTION RM_RNEG

Resets all negative resistors to `.OPTION RESMIN` setting.

Syntax

```
.OPTION RM_RNEG=0|1
```

Default 0

Description

Use this option to reset all negative resistors and all resistors smaller than `RESMIN` in the netlist, as specified by `.OPTION RESMIN`. The priority for this option is lower than `RM_RMIN` and `RM_RMAX`. That is, the priority for `RM_RMAX` > the priority for `RM_RMIN` > the priority for `RM_RNEG`.

See Also

.OPTION RESMIN

.OPTION RM_RMAX
.OPTION RM_RMIN

.OPTION RUNLVL

Controls runtime speed and simulation accuracy.

Syntax

```
.OPTION RUNLVL= 1|2|3|4|5|6
```

Description

Higher values of RUNLVL result in higher accuracy and longer simulation runtimes; lower values result in lower accuracy and faster simulation runtimes.

For HSPICE:

The RUNLVL option setting controls the scaling of all simulator tolerances simultaneously, affecting time step control, transient analysis convergence, and model bypass tolerances all at once. Higher values of RUNLVL result in smaller time step sizes and could result in more Newton-Raphson iterations to meet stricter error tolerances. RUNLVL settings affect transient analysis only.

RUNLVL can be set to 0 (to disable) 1, 2, 3, 4, 5, or 6:

- 1: Lowest simulation runtime
- 2: More accurate than RUNLVL=1 and faster than RUNLVL=3
- 3: Default value, similar to HSPICE's original default mode
- 4: More accurate than RUNLVL=3 and faster than RUNLVL=5
- 5 or 6: Corresponds to HSPICE's standard accurate mode for most circuits:
  - 5 is similar to the standard accurate mode in HSPICE
  - 6 has the highest accuracy

If RUNLVL is specified in the netlist without a value, the value is the default, 3.

If .OPTION ACCURATE is specified in the netlist together with RUNLVL, the value of RUNLVL is limited to 5 or 6; specifying a specifying a RUNLVL value of 1, 2, 3, or 4 defaults to 5.

If .OPTION RUNLVL is not turned off, there is no dependency with GEAR and ACCURATE options, and:

```
.OPTION ACCURATE method=GEAR RUNLVL
```

is equivalent to:

```
.OPTION method=GEAR ACCURATE RUNLVL
```

The RUNLVL option interacts with other options as follows:

- Regardless of its position in the netlist, RUNLVL ignores the following step control-related options (which are replaced by automated algorithms):

  LVLTIM DVDT FT FAST TRTOL ABSVAR RELVAR RELQ CHGTOL DVTR IMIN ITL3

- See the notes to the table below for discussion of .option ACCURATE and .option BYPASS in relation to RUNLVL if it is specified in the netlist.
- The tstep value specified with the .TRAN command affects time step control when a RUNLVL option is used. Time step values larger than tstep*RMAX use a tighter time step control tolerance.

For information on how RUNLVL values affect other options, see the following section, and also see Appendix A, HSPICE Control Options Notes.

For HSPICE Advanced Analog functions:

When using HSPICE advanced analog functions, the SIM_ACCURACY option gives you a more continuous range of settings. You can use .OPTION RUNLVL to control runtime speed and simulation accuracy. As in HSPICE, higher values of RUNLVL result in higher accuracy and longer simulations; lower values result in lower accuracy and faster simulation.

.OPTION RUNLVL maps to .OPTION SIM_ACCURACY as follows:

- RUNLVL=1: SIM_ACCURACY=0.5
- RUNLVL=2: SIM_ACCURACY=0.75
- RUNLVL=3: SIM_ACCURACY=1
- RUNLVL=4: SIM_ACCURACY=5
- RUNLVL=5: SIM_ACCURACY=10
- RUNLVL=6: SIM_ACCURACY=20

Interactions Between .OPTION RUNLVL and Other Options

Since the latest algorithm invoked by RUNLVL sets the time step and error tolerance internally, many transient error tolerance and time step control options are no longer valid. Furthermore, to ensure the most efficiency of the

new RUNLVL algorithm, you should let the new engine manage everything itself. Also, you should not tune the options listed in the following table.

Option	Obsolete options	Default value when RUNLVL=0	Default value with RUNLVL=3	User definition ignored	Recommend not to tune
ABSVAR	Obsolete Options–Transient Time Step and Accuracy on page 705	500m	500m	x	–
ACCURATE [1]		0	0	–	–
BYPASS [a]		2	2 for RUNLVL=1-6	–	–
CHGTOL	Obsolete Options–Transient Time Step and Accuracy on page 705	1.0f	1.0f	x	–
DI	Obsolete Options–Transient Time Step and Accuracy on page 705	100	100	–	x
DVDT	Obsolete Options–Transient Time Step and Accuracy on page 705	4	4	x	–
DVTR	Obsolete Options–Transient Time Step and Accuracy on page 705	1.0k	1.0k	x	–
FAST [2]	Obsolete Options–Transient Time Step and Accuracy on page 705	0	0	x	–
FS	Obsolete Options–Transient Time Step and Accuracy on page 705	250m	250m	–	x
FT	Obsolete Options–Transient Time Step and Accuracy on page 705	250m	250m	x	–
IMIN/ITL3	Obsolete Options–Transient Time Step and Accuracy on page 705	3	3	x	–
LVLTIM	Obsolete Options–Transient Time Step and Accuracy on page 705	1	4	x	–

Option	Obsolete options	Default value when RUNLVL=0	Default value with RUNLVL=3	User definition ignored	Recommend not to tune
METHOD [3]		TRAP	TRAP	–	–
RELQ	Obsolete Options–Transient Time Step and Accuracy on page 705	10m	10m	x	–
RELTOL	Obsolete Options–Transient Time Step and Accuracy on page 705	1.0m	1.0m	–	x
RELV	Obsolete Options–Transient Time Step and Accuracy on page 705	1.0m	1.0m	–	x
RELVAR	Obsolete Options–Transient Time Step and Accuracy on page 705	300.0m	300.0m	x	–
RMAX	Obsolete Options–Transient Time Step and Accuracy on page 705	5	5	x	–
RMIN	Obsolete Options–Transient Time Step and Accuracy on page 705	1.0n	1.0n	–	x
TRTOL	Obsolete Options–Transient Time Step and Accuracy on page 705	7	7	x	–

1. ACCURATE and BYPASS notes:
1. If .option ACCURATE is set, then the RUNLVL value is limited to 5 or 6. Specifying a RUNLVL less than 5 results in a simulation at RUNLVL=5. When both ACCURATE and RUNLVL are set, the RUNLVL algorithm will be used.

2. When RUNLVL is set, BYPASS is set to 2. Users can redefine the BYPASS value by setting .option BYPASS=value; this behavior is independent of the order of RUNLVL and BYPASS;

2. The FAST option is disabled by the RUNLVL option; setting the RUNLVL value to 1 is comparable to setting the FAST option (The FAST option is obsolete).

3. RUNLVL can work with METHOD=GEAR; in cases where GEAR only determines the numeric integration method during transient analysis, the other options that were previously set by GEAR (when there is no RUNLVL) now are determined by the RUNLVL mode. This behavior is independent of the order of RUNLVL and METHOD. See below.

See Also

.OPTION ACCURATE

.OPTION BYPASS
.TRAN
.OPTION SIM_ACCURACY

.OPTION SAMPLING_METHOD

Enables use of advanced sampling methods with traditional Gaussian Monte Carlo trials.

Syntax

```
.OPTION SAMPLING_METHOD=SRS|LHS|Factorial|OFAT|Sobol|
+ Niederreiter
```

Default No default is set with traditional Gaussian Monte Carlo trials. You must set this option explicitly in the netlist to generate data mining reports. The traditional Gaussian flow invokes another SRS implementation which does not support the generation of advanced data mining outputs like `*mc#` and `*mpp#` files.

Argument	Description
`SRS`	Simple random sampling performed in traditional HSPICE Monte Carlo method
`LHS`	Latin Hypercube sampling; efficient for large number of variable parameters (used with `.OPTION REPLICATES`)
`Factorial`	Factorial sampling; ▪ Evaluates the circuit response at the extremes of variable ranges to get an idea of the worst and best case behavior. ▪ Creates polynomial response surface approximations.
`OFAT`	One-Factor-At-a-Time sampling; useful for sensitivity studies and for constructing low order response surface approximations.
`Sobol`	Sobol sampling uses low discrepancy sequences (LDS); LDS sample points are more frequently distributed compared to LHS and the sampling error is lower. Sobol is used with a sampling dimension of 40 or less.
`Niederreiter`	LDS sampling sequence useful as a sampling method for cases of a sampling dimension up to 318. If that number is exceeded, HSPICE switches to the default SRS sampling method.

Description

This option enables use of sampling methods other than Gaussian techniques available in traditional HSPICE Monte Carlo simulation. For a full discussion about advanced sampling methods, see Comparison of Sampling Methods in the *HSPICE User Guide: Basic Simulation and Analysis*. These methods also are available in the HSPICE Variation Block functionality.

See Also

.OPTION REPLICATES

.OPTION SAVEHB

Saves the final-state variable values from an HB simulation.

Syntax

```
.OPTION SAVEHB='filename'
```

Description

Use this option to save the final state (that is, the no-sweep point or the steady state of the first sweep point) variable values from an HB simulation to the specified file.

This file can be loaded as the starting point for another simulation by using a `LOADHB` option.

See Also

.HB
.OPTION LOADHB

.OPTION SAVESNINIT

Saves the operating point at the end of Shooting Newton initialization (sninit).

Syntax

```
.OPTION SAVESNINIT="filename"
```

Description

Use this option to save an operating point file at the end of a SN initialization for use as initial conditions for another Shooting Newton analysis. For more

information, see SN Steady-State Time Domain Analysis in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

See Also

.SN
.OPTION LOADSNINIT
.OPTION SAVESNINIT
.OPTION SNACCURACY
.OPTION SNMAXITER / SN_MAXITER

.OPTION SCALE

Sets the element scaling factor for HSPICE.

Syntax

```
.OPTION SCALE=x
```

Description

Use this option to scale geometric element instance parameters whose default unit is meters. You can also use this option with `.OPTION GEOSHRINK` to scale an element even more finely (usually through a technology file). The effective scaling factor is the product of the two parameters; HSPICE will use `scale*geoshrink` to scale the parameters/dimensions.

In HSPICE, the possible geometrical instance parameters include width, length, or area for both passive and active devices, in addition to the commonly known MOSFET parameters such as AS, AD, PS, PD, and so on.

- For active elements, the geometric parameters scaled by the `SCALE` and `GEOSHRINK` options are:
  - Diode — W, L, Area
  - JFET/MESFET — W, L, Area
  - MOSFET — W, L, AS, AD, PS, PD, SA, SB, SC, SD
- For passive elements having values calculated as a function geometry, the geometric parameters are:
  - Resistor — W, L
  - Capacitor — W, L

In cases where you want to selectively scale a required instance, such as in an encrypted file, you can use .OPTION HIER_SCALE.

See Also

.OPTION GEOSHRINK
.OPTION BA_SCALE
.OPTION CMIUSRFLAG
.OPTION HIER_SCALE

.OPTION SCALM

Sets the model scaling factor.

Syntax

```
.OPTION SCALM=x
```

Description

Use this option to set the scaling factor defined in a .MODEL command for an element. See the HSPICE Elements and Device Models Manual for parameters that this option scales. For MOSFET devices, this option is ignored in Level 49 and higher model levels. See the HSPICE Reference Manual: MOSFET Models for levels available to the SCALM option.

See Also

.MODEL

.OPTION SEARCH

Automatically accesses a library, Verilog-A, or individual vendor files.

Syntax

```
.OPTION SEARCH='directory_path' [path_name]
```

Description

Use this option to automatically search the *directory_path* directories for included files (.INC), library files (.LIB), Verilog-a files (.HDL), loaded files (.LOAD), vec files (.VEC), rlgc files, s-model files, subcircuit, and model files.

For subcircuit and model files, vendors typically supply part files containing a single subcircuit. The name of the file is the same as the subcircuit with the file extension `*.inc`.

Examples

```
.OPTION SEARCH='$installdir/parts/vendor'
```

This example searches for models in the `vendor` subdirectory, under the *`$installdir`*`/parts` installation directory (see Figure 16). The `parts` directory contains the DDL subdirectories.

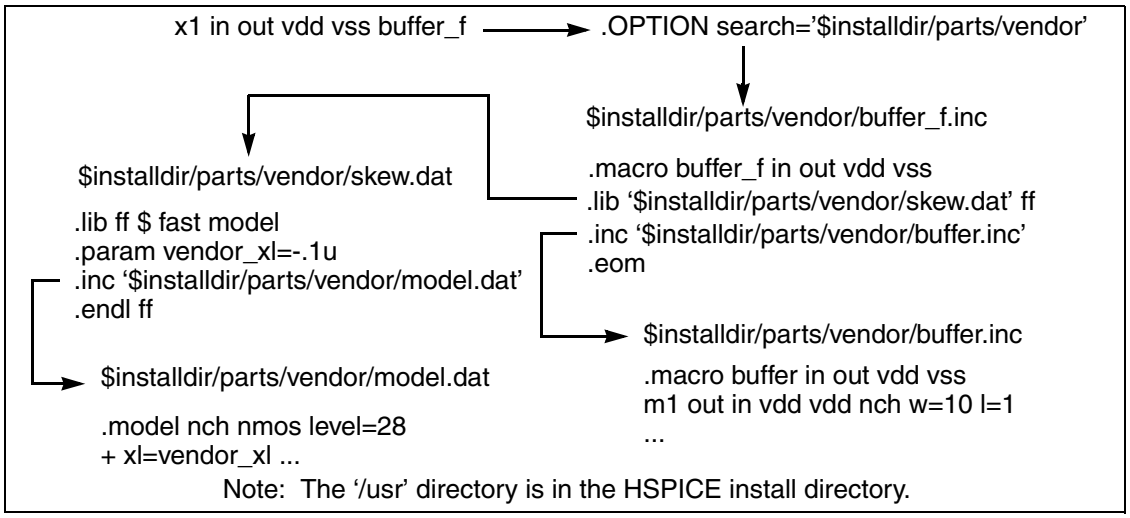


Figure 16 Vendor Library Usage

See Also

Signal Integrity Examples for netlists using `.OPTION SEARCH` including `iotran.sp`, `qa8.sp`, and `qabounce.sp`.

.OPTION SEED

Specifies the starting seed for the random-number generator in Monte Carlo analysis.

Syntax

```
.OPTION SEED=x | 'random'
```

Description

Use this option to specify the starting seed for the random-number generator in HSPICE Monte Carlo analysis. The minimum value is 1; the maximum value is a positive integer of 259200. If `SEED='random'`, HSPICE assigns a random number between 1 and 259200 according to the system clock and prints it in the `.lis` file for you to debug. An equivalent `Option Seed` can be used in the Variation Block flow for AGUASS Monte Carlo usage with advanced sampling methods.

See Also

.OPTION RANDGEN

.OPTION SET_MISSING_VALUES

Sub-option to `SAMPLING_METHOD=External` option, limits reporting of missing independent random variables.

Syntax

```
OPTION SET_MISSING_VALUES = Random|Zero
```

Default `Random`

Description

Use this option to control missing random values in a `.data` block for external sampling:

- `Set_Missing_Values=Random` — HSPICE generates its own random values for the missing random variables in `a .data` block.
- `Set_Missing_Values=Zero` —HSPICE generates zero values for those missing random variables in `.data` block in external sampling table.

Examples

The following is an example of syntax use for this option.

```
.option Sampling_Method = External   Block_Name = XXXX
+ File_Name = YYYY Set_Missing_Values = Random|Zero
```

.OPTION SHRINK

Scales the final constant capacitance value (only works with `.OPTION CMIUSRFLAG=3`).

Syntax

`.OPTION SHRINK=` *val*

Description

Use this option to scale the final constant capacitance value. The default setting overrides `.OPTION SHRINK` before applying `shrink*shrink` scaling to constant capacitance value. The following is the usage of `.OPTION SHRINK` and instance parameter `shrink`:

- `1`: If both `.OPTION SHRINK` and the `shrink` instance are not set in the netlist, do nothing.
- `2`: If only `.OPTION SHRINK` is set in the netlist, use it to scale the final constant capacitance value.
- `3`: If the instance parameter `shrink` is set in the netlist, use the instance `shrink` to scale the final constant capacitance value.

See Also

.OPTION CMIUSRFLAG

.OPTION SI_SCALE_SYMBOLS

Controls whether the scale factors are HSPICE attributes or International System of Units (SI) when case sensitivity is invoked.

Syntax

`SI_SCALE_SYMBOLS=0|1`

Default Value if option is not specified in the netlist: 0

Value if option name is specified without a corresponding value: 1

Description

`SI_SCALE_SYMBOLS=1` changes the scaling factors from the HSPICE standard (default) to the International System of Units (SI) to enable you to use case sensitive scaling symbols. (Using the (`=1`) setting assures consistency with spice scale factors for downstream tools.)

Note: This option is enabled when case-sensitivity is on (`-case 1`).

Multiplying Factors	**Description**	**`.OPTION SCALE_SYMBOLS=S` `%> hspice -case C`**			
		`S=0`, C=0 (default)	`S=0, C=1` (Same as `S=0, C=0`)	`S=1, C=1`	`S=1, C=0` Same as `S=0,C=0`
1e12	Tera	T, t		T, t	
1e9	Giga	G, g		G, g	
1e6	Mega	MEG, meg, X, x		M, MEG, meg, X, X	
1e3	Kilo	K, k		K, k	
1e-3	Milli	M or m		m	
25.4e-6	1,000(s) of an inch	MIL, mil		MIL, mil	
1e-6	Mico	U, u		U, u	
1e-9	Nano	N, n		N, n	
1e-12	Pico	P, p		P, p	
1e-15	Femto	F, f		F, f	
1e-18	Atto	A, a		A, a	

See Also

.OPTION PCB_SCALE_FORMAT

.OPTION SIM_ACCURACY

Sets and modifies the size of time steps.

Syntax

`.OPTION SIM_ACCURACY=`*`value`*

Default Conditional, see below.

Description

Use this option to set and modify the size of time steps. This option applies to all modes and tightens all tolerances, such as Newton-Raphson tolerance, local truncation error, and other errors. The *value* must be a positive number. The default is 1; however, if you specify `.OPTION ACCURATE`, the default value changes to 10. The higher `SIM_ACCURACY` value you set, the finer granularity (resolution) you see. The value does not have to be a multiple of 10. Larger values may result in a more accurate solution, but may require more time points and result in a significant increase in simulation time.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION ACCURATE
.OPTION RUNLVL
.OPTION SNACCURACY

.OPTION SIM_DELTAI

Sets the selection criteria for current waveforms in WDB and NW format.

Syntax

```
.OPTION SIM_DELTAI=value
```

Default `0` amps

Description

Use this option to set the selection criteria for advanced analog current waveforms in WDB and NW format. The *value* parameter specifies the amount of change.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

In this example, at the *n* time step, HSPICE saves only data points that change by more than 0 amps from previous values at the *n-1* time step.

```
.OPTION SIM_DELTAI = 0amps
```

See Also

.OPTION SIM_DELTAV

.OPTION SIM_DELTAV

Sets the selection criteria for current waveforms in WDB and NW format.

Syntax

```
.OPTION SIM_DELTAV=value
```

Default `1mv`

Description

Sets the selection criteria for current waveforms in WDB and NW format.

The *value* parameter specifies the amount of change.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

In this example, at the *n* time step, HSPICE saves only data points that change by more than 1 mV from their previous values at the *n-1* time step.

```
.OPTION SIM_DELTAV = 1mv
```

See Also

.OPTION SIM_DELTAI

.OPTION SIM_DSPF

Runs simulation with standard DSPF expansion of all nets from one or more DSPF files.

Syntax

```
.OPTION SIM_DSPF="[scope] dspf_filename"
```

Description

Use this option to run simulation with standard DSPF expansion of all nets from one or more DSPF files.

`scope` can be a subcircuit definition or an instance. If you do not specify `scope`, it defaults to the top-level definition.

You can repeat this option to include more DSPF files.

This option can accelerate simulation by more than 100%. You can further reduce total CPU time by including the `.OPTION SIM_LA` in the netlist.

For designs of 5K transistors or more, including `.OPTION SIM_DSPF_ACTIVE` in your netlist to expand only active nodes also provides a performance gain.

Note: HSPICE requires both a DSPF file and an ideal extracted netlist. Only flat DSPF files are supported; hierarchy commands, such as `.SUBCKT` and .x1 are ignored.

For additional information, see Post-Layout Back-Annotation in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog features are used.

Examples

In Example 1, the parasitics in the DSPF file are mapped into the hierarchical ideal netlist.

Example 1

```
$  models
.MODEL p pmos
.MODEL n nmos

.INCLUDE add4.dspf
.OPTION SIM_DSPF="add4.dspf"
.VEC "dspf_adder.vec"
.TRAN 1n 5u
vdd vdd 0 3.3
.OPTION POST
.END
```

In Example 2, the SIM_DSPF option accelerates the simulation by more than 100%. By using the SIM_LA option at the same time, you can further reduce the total CPU time:

Example 2

```
$  models
.MODEL p pmos
.MODEL n nmos
.INCLUDE add4.dspf
.OPTION SIM_DSPF="add4.dspf"
.OPTION SIM_LA=PACT
.VEC "dspf_adder.vec"
.TRAN 1n 5u
vdd vdd 0 3.3
.OPTION POST
.END
```

Example 3, the x1.spf DSPF file is back-annotated to the x1 top-level instance. It also back-annotates the inv.spf DSPF file to the inv subcircuit.

Example 3

```
.OPTION SIM_DSPF = "x1 x1.spf"
.OPTION SIM_DSPF = "inv inv.spf"
```

See Also

.OPTION SIM_LA
.OPTION SIM_DSPF_ACTIVE
.OPTION SIM_DSPF_SCALEC
.OPTION SIM_DSPF_SCALER
.OPTION SIM_SPEF

.OPTION SIM_DSPF_ACTIVE

Runs simulation with selective DSPF expansion of active nets from one or more DSPF files.

Syntax

```
.OPTION SIM_DSPF_ACTIVE="active_node"
```

Description

Use this option to run simulation with selective DSPF expansion of active nets from one or more DSPF files. HSPICE performs a preliminary verification run to determine the activity of the nodes and generates two ASCII files:

active_node.rc and *active_node*.rcxt. These files save all active node information in both Star-RC and Star-RCXT formats. If an *active_node* file is not generated from the preliminary run, no nets are expanded. Active nets are added to the file as they are identified in the subsequent transient simulation. A second simulation run using the same file and option causes only the nets listed in the *active_node* file to be expanded. Activity changes may be due to timing changes caused by expansion of the active nets. In this case, additional nets are listed in the *active_node* file and a warning is issued.

HSPICE uses the *active_node* file and the DSPF file with the ideal netlist to expand only the active portions of the circuit. If a net is latent, then HSPICE does not expand it, which saves memory and CPU time.

For additional information, see Selective Post-Layout Flow in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

In the following example, an active net in which the tolerance of the voltage change is greater than 0.5 V is saved to both the active.rc and active.rcxt files. Based on these files, HSPICE back-annotates only the active parasitics from x1.spf and s2.spf to the x1 and x2 top-level instances.

```
.OPTION SIM_DSPF = "x1 x1.spf"
.OPTION SIM_DSPF = "x2 x2.spf"
.OPTION SIM_DSPF_ACTIVE = "active"
.OPTION SIM_DSPF_VTOL = 0.5V
```

See Also

.OPTION SIM_DSPF
.OPTION SIM_DSPF_MAX_ITER
.OPTION SIM_DSPF_VTOL
.OPTION SIM_SPEF_ACTIVE

.OPTION SIM_DSPF_INSERROR

Skips unmatched instances.

Syntax

```
.OPTION SIM_DSPF_INSERROR=ON | OFF
```

Default OFF

Description

Use this option to skip unmatched instances.

- ON: Skips unmatched instances
- OFF: Does not skip unmatched instances.

For additional information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

.OPTION SIM_DSPF_LUMPCAPS

Connects a lumped capacitor with a value equal to the net capacitance for instances missing in the hierarchical netlist.

Syntax

```
.OPTION SIM_DSPF_LUMPCAPS=ON | OFF
```

Default ON

Description

Use this option to connect a lumped capacitor with a value equal to the net capacitance for instances missing in the hierarchical netlist.

- ON (default): Adds lumped capacitance while ignoring other net contents
- OFF: Uses net contents

For additional information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

.OPTION SIM_DSPF_MAX_ITER

Specifies the maximum number of simulation runs for the second selective DSPF expansion pass.

Syntax

```
.OPTION SIM_DSPF_MAX_ITER=value
```

Default 1

Description

Use this option to specify the maximum number of simulation runs for the second selective DSPF expansion pass.

The *value* parameter specifies the number of iterations for the second simulation run.

Some of the latent nets might turn active after the first iteration of the second simulation run. In this case:

- Resimulate the netlist to ensure the accuracy of the post-layout simulation.
- Use this option to set the maximum number of iterations for the second run. If the active_node remains the same after the second simulation run, HSPICE ignores these options.

For details, see Selective Post-Layout Flow in *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_DSPF_ACTIVE
.OPTION SIM_DSPF_VTOL

.OPTION SIM_DSPF_RAIL

Controls whether power-net parasitics are back-annotated

Syntax

```
.OPTION SIM_DSPF_RAIL=ON | OFF
```

Default OFF

Description

Use this option to control whether power-net parasitics are back-annotated.

- `OFF`: Do not back-annotate nets in a power rail
- `ON`: Back-annotate nets in a power rail

For additional information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

.OPTION SIM_DSPF_SCALEC

Scales the capacitance values in a DSPF file for a standard DSPF expansion flow.

Syntax

```
.OPTION SIM_DSPF_SCALEC=scaleC
```

Description

Use this option to scale the capacitance values in a DSPF file for a standard DSPF expansion flow.

The *scaleC* parameter specifies the scale factor.

For additional information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_LA
.OPTION SIM_DSPF_ACTIVE

.OPTION SIM_DSPF_SCALER

Scales the resistance values in a DSPF file for a standard DSPF expansion flow.

Syntax

```
.OPTION SIM_DSPF_SCALER=scaleR
```

Description

Use this option to scale the resistance values in a DSPF file for a standard DSPF expansion flow.

The *scaleR* specifies the scale factor.

For additional information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_LA
.OPTION SIM_DSPF_ACTIVE

.OPTION SIM_DSPF_VTOL

Specifies multiple DSPF active thresholds.

Syntax

```
.OPTION SIM_DSPF_VTOL="value | scope1 scope2 ...
+ scopen"
```

Default `0.1V`

Description

Use this option to specify multiple DSPF active thresholds.

- The *value* parameter specifies the tolerance of voltage change. This value should be relatively small compared to the operating range of the circuit or smaller than the supply voltage.
- *scopen* can be a subcircuit definition that uses a prefix of "@" or a subcircuit instance.

HSPICE performs a second simulation run by using the active_node file, the DSPF, and the hierarchical LVS ideal netlist to back-annotate only active portions of the circuit. If a net is latent, HSPICE does not expand the net. This saves simulation runtime and memory.

By default, HSPICE performs only one iteration of the second simulation run. Use the `SIM_DSPF_MAX_ITER` option to change this setting.

For additional information, see Selective Post-Layout Flow in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

Example 1 *The first line sets the sensitivity voltage to 0.01V. Subcircuit definition* snsamp *and the subcircuit instance xvco have full parasitics if their nodes move more than 0.01V during active nodes generation. In the second line,* xand *and* xff *are less sensitive than the default, indicating that they are not sensitive to parasitics*

```
.OPTION SIM_DSPF_VTOL="0.01 | @snsamp xvco"
.OPTION SIM_DSPF_VTOL="0.25 | xand xff"
```

Example 2 *The sense amp circuit uses full parasitics if their nodes move more than 0.01V during active-node generation. The inv subcircuit definition is less sensitive than the default so the nodes are less sensitive to the parasitics.*

```
.OPTION SIM_DSPF = "inv inv.spf"
.OPTION SIM_DSPF = "senseamp senseamp.spf"
.OPTION SIM_DSPF_ACTIVE = "activenet"
.OPTION SIM_DSPF_VTOL = "0.15 | @inv"
.OPTION SIM_DSPF_VTOL = "0.01 | @senseamp"
```

See Also

.OPTION SIM_DSPF_ACTIVE
.OPTION SIM_DSPF_MAX_ITER

.OPTION SIM_LA

Activates linear matrix (RC) reduction for HSPICE.

Syntax

```
.OPTION SIM_LA=[PACT | PI | LNE [0|1|2|3]]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to activate linear matrix reduction. `SIM_LA` does not reduce a node used by any analysis command, such as `.PROBE`, `.MEASURE`, and so on

This option accelerates the simulation of circuits that include large linear RC networks by reducing all matrixes that represent RC networks.

- `0` turns off `SIM_LA`
- `1` is the equivalent of `PACT`, which selects the Pole Analysis via Congruence Transforms (PACT) algorithm to reduce RC networks in a well-conditioned manner, while preserving network stability.
- `2` invokes the `PI` algorithm to create a PI model analyzing the small signal behavior of bipolar junction and field effect transistors. The model can be quite accurate for low-frequency circuits and can easily be adapted for higher frequency circuits with the addition of appropriate inter-electrode capacitances and other parasitic elements. models of the RC networks.
- `3` invokes the `LNE` (Linear Node Elimination) algorithm to speed up the simulation of circuits with huge numbers of coupling capacitors.
- If `SIM_LA` is not specified in the input file, the `lis` file returns `SIM_LA=0`.
- If `SIM_LA` is specified with no value or `SIM_LA=PACT`, the `lis` file returns `SIM_LA=1`.
- If `SIM_LA=PI`, the `lis` file returns `SIM_LA=2`.
- If `SIM_LA=LNE`, the `lis` file returns `SIM_LA=3`.

For additional information, see Linear Acceleration in the *HSPICE User Guide: Basic Simulation and Analysis* or Linear Acceleration in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

See Also

.OPTION SIM_DSPF
.OPTION LA_FREQ
.OPTION LA_MAXR
.OPTION LA_MINC
.OPTION LA_TIME
.OPTION LA_TOL

.OPTION SIM_LA_FREQ

Specifies the upper frequency for which accuracy must be preserved.

Syntax

```
.OPTION SIM_LA_FREQ=value
```

Default `1GHz`

Description

Use this option to specify the upper frequency for which accuracy must be preserved. The *value* parameter specifies the upper frequency for which the `PACT` algorithm must preserve accuracy. If *value* is 0, the algorithm drops all capacitors because only DC is of interest.

The maximum frequency required for accurate reduction depends on both the technology of the circuit and the time scale of interest. In general, the faster the circuit, the higher the maximum frequency. For additional information, see Linear Acceleration in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

See Also

.OPTION SIM_LA
.OPTION SIM_LA_TIME

.OPTION SIM_LA_MAXR

Specifies the maximum resistance for linear matrix reduction.

Syntax

```
.OPTION SIM_LA_MAXR=value
```

Default `1e15` ohms

Description

Use this option to specify the maximum resistance for linear matrix reduction. The *value* parameter specifies the maximum resistance preserved in the reduction. The linear matrix reduction process assumes that any resistor greater than *value* has an infinite resistance and drops the resistor after reduction completes. For additional information, see Linear Acceleration in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

See Also

.OPTION SIM_LA

.OPTION SIM_LA_MINC

Specifies the minimum capacitance for linear matrix reduction.

Syntax

```
.OPTION SIM_LA_MINC=value
```

Default `1e-16` farads

Description

Use this option to specify the minimum capacitance for linear matrix reduction.

The *value* parameter specifies the minimum capacitance preserved in the reduction.

The linear matrix reduction process lumps any capacitor smaller than *value* to ground after the reduction completes.

For additional information, see Linear Acceleration in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

See Also

.OPTION SIM_LA

.OPTION SIM_LA_TIME

Specifies the minimum time for which accuracy must be preserved.

Syntax

```
.OPTION SIM_LA_TIME=value
```

Default `1` ns.

Description

Use this option to specify the minimum time for which accuracy must be preserved.

The *value* parameter specifies the minimum switching time for which the PACT algorithm preserves accuracy.

Waveforms that occur more rapidly than the minimum switching time are not accurately represented.

This option is simply an alternative to `.OPTION SIM_LA_FREQ`. The default is equivalent to setting `SIM_LA_FREQ=1GHz`.

Note: Higher frequencies (smaller times) increase accuracy, but only up to the minimum time step used in HSPICE.

For additional information, see Linear Acceleration in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Examples

For a circuit having a typical rise time of 1ns, either set the maximum frequency to 1 GHz, or set the minimum switching time to 1ns:

```
.OPTION SIM_LA_FREQ=1GHz
-or-
.OPTION SIM_LA_TIME=1ns
```

However, if spikes occur in 0.1 ns, HSPICE does not accurately simulate them. To capture the behavior of the spikes, use:

```
.OPTION SIM_LA_FREQ=10GHz
-or-
.OPTION SIM_LA_TIME=0.1ns
```

See Also

.OPTION SIM_LA
.OPTION SIM_LA_FREQ

.OPTION SIM_LA_TOL

Specifies the error tolerance for the PACT algorithm.

Syntax

`.OPTION SIM_LA_TOL=`*`value`*

Default `0.05`ns.

Description

Use this option to specify the error tolerance for the PACT algorithm.

The *value* parameter must specify a real number between 0.0 and 1.0.

For additional information, see Linear Acceleration in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

See Also

.OPTION SIM_LA

.OPTION SIM_ORDER

Controls the amount of Backward-Euler (BE) method to mix with the Trapezoidal (TRAP) method for hybrid integration.

Syntax

```
.OPTION SIM_ORDER=x
```

Default `1.9`

Description

Use this option to control the amount of Backward-Euler (BE) method to mix with the Trapezoidal (TRAP) method for hybrid integration.

The *x* parameter must specify a real number between 1.0 and 2.0.

- `SIM_ORDER=1.0` selects BE
- `SIM_ORDER=2.0` selects TRAP.

  Note: `.OPTION SIM_ORDER` has precedence over `.OPTION SIM_TRAP`.

A higher order is more accurate, especially with inductors (such as crystal oscillators), which need `SIM_ORDER=2.0`. A lower order has more damping.

This option affects time stepping when you set `.OPTION METHOD` to `TRAP` or `TRAPGEAR`.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

This example causes a mixture of 10% Gear-2 and 90% BE-trapezoidal hybrid integration. The BE-trapezoidal part is 10% BE.

```
.option sim_order=1.9
```

See Also

.OPTION METHOD
.OPTION SIM_TRAP

.OPTION SIM_OSC_DETECT_TOL

Specifies the tolerance for detecting numerical oscillations.

Syntax

```
.OPTION SIM_OSC_DETECT_TOL=value
```

Default `10^8`

Description

Use this option to specify the tolerance for detecting numerical oscillations. If HSPICE detects numerical oscillations, it inserts Backward-Euler (BE) steps. Smaller values of this tolerance result in fewer BE steps.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION METHOD

.OPTION SIM_POSTAT

Specifies waveform output to nodes in the specified subcircuit instance only.

Syntax

```
.OPTION SIM_POSTAT=instance
```

Description

Use this option to limit waveform output to nodes in the specified subcircuit instance only in HSPICE and HPP. `SIM_POSTAT` is available for both HSPICE. Wildcards are supported. This option is equivalent to `.OPTION POSTAT`.

Each of these options, `SIM_POSTTOP`, `SIM_POSTAT`, `SIM_POSTDOWN`, `SIM_POSTSKIP` works for both default output (`.option probe=0`) and `.probe/.print v(*)`.

Examples

Example 1 The following example outputs X1.X4 node signals only; see Figure 17.

```
.OPTION SIM_POSTAT=X1.X4
```

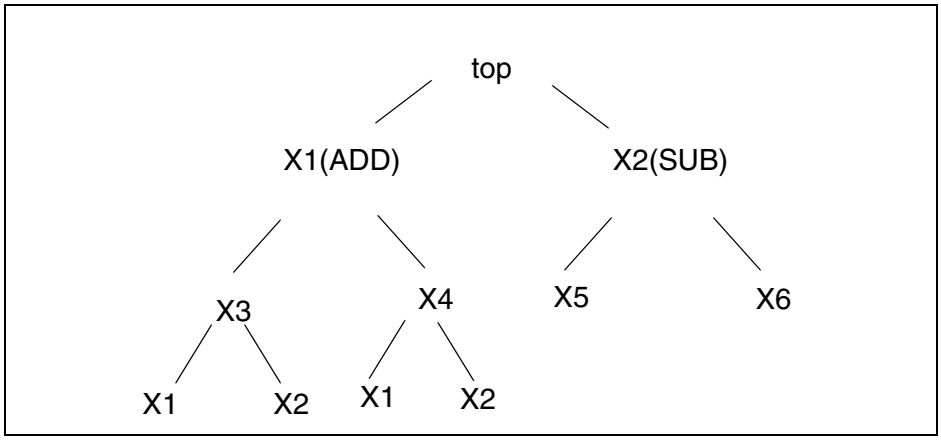


Figure 17 Node Hierarchy

Example 2 Without .OPTION PROBE, HSPICE plots all voltages of subcircuit x1.x1.

```
.option post
.option sim_postat = x1.x1
```

Example 3 With .OPTION PROBE, HSPICE plots all voltages of subcircuit x1.x1.

```
.option post
.option probe
.option sim_postat = x1.x1
```

Example 4 With a .PROBE statement, HSPICE plots all voltages of subcircuit x1.x1.

```
.option post
.option probe
.option sim_postat = x1.x1
.probe v(*)
```

See Also

.OPTION SIM_POSTSKIP
.OPTION SIM_POSTTOP
.OPTION POSTTOP

.OPTION SIM_POSTDOWN

Limits waveform output to nodes in the specified subcircuit instance and their children.

Syntax

```
.OPTION SIM_POSTDOWN=instance
```

Description

Use this option with `.OPTION SIM_POSTTOP` and it takes precedence over `.OPTION SIM_POSTSKIP`.

Wildcards are supported.

Each of these options, `SIM_POSTTOP`, `SIM_POSTAT`, `SIM_POSTDOWN`, `SIM_POSTSKIP` works for both default output (`.option probe=0`) and `.probe/.print v(*)`.

Examples

The following example outputs top, X1, X1.X4, X1.X4.X1, X1.X4.X2, and X2. (See Figure 17 on page 651.)

```
.OPTION SIM_POSTTOP=2
.OPTION SIM_POSTDOWN=X1.X4
```

See Also

.OPTION SIM_POSTAT
.OPTION SIM_POSTSKIP
.OPTION SIM_POSTTOP

.OPTION SIM_POSTSCOPE

Specifies the signal types to probe from within a scope.

Syntax

```
.OPTION SIM_POSTSCOPE= net | port | all
```

Description

Use this option to specify the signal types to probe from within a scope.

- `net`: Outputs only nets in the scope
- `port`: Outputs both nets and ports
- `all`: Outputs nets, ports, and global variables.

See Also

.OPTION POST

.OPTION SIM_POSTSKIP
.OPTION SIM_POSTTOP

.OPTION SIM_POSTSKIP

Causes the SIM_POSTTOP option to skip *subckt_definition* instances.

Syntax

```
.OPTION SIM_POSTSKIP=subckt_definition
```

Description

Use this option to cause the SIM_POSTTOP option to skip any instances and their children that are defined by the *subckt_definition* parameter. To specify more than one subcircuit definition, issue this option once for each definition you want to skip. SIM_POSTSKIP is available for both HSPICE. Wildcards are supported.

Each of these options, SIM_POSTTOP, SIM_POSTAT, SIM_POSTDOWN, SIM_POSTSKIP works for both default output (`.option probe=0`) and `.probe/.print v(*)`.

Examples

The following example outputs top, and skips X2. X1 because they are instances of the ADD subcircuit. (See Figure 17 on page 651.)

```
.OPTION SIM_POSTTOP=2
.OPTION SIM_POSTSKIP=ADD
```

See Also

.OPTION SIM_POSTTOP

.OPTION SIM_POSTTOP

Limits data written to your waveform file to data from only the top *n* level nodes.

Syntax

```
.OPTION SIM_POSTTOP=n
```

Description

Limits the data written to your waveform file to data from only the top *n* level nodes. SIM_POSTAT is available for both HSPICE.

This option outputs instances to *n* levels deep.

- SIM_POSTTOP=3: Outputs instances from 3 levels deep
- SIM_POSTTOP=1: Outputs instances from only the top-level signals.

Specifying the PROBE option without specifying a SIM_POSTTOP option HSPICE sets the SIM_POSTTOP=0. HSPICE outputs all levels if you do not specify the PROBE option or a SIM_POSTTOP option. Wildcards are supported.

Note: Specify the POST option to enable a waveform display interface.

SIM_POSTTOP is equivalent to POSTTOP used in HSPICE.

Each of these options, SIM_POSTTOP, SIM_POSTAT, SIM_POSTDOWN, SIM_POSTSKIP works for both default output (.option probe=0) and .probe/.print v(*).

Examples

Example 1 Outputs top, X1, and X2. (See Figure 17 on page 651.)

```
.OPTION SIM_POSTTOP=2
```

The following example outputs top, X1, X2,and X4, X1and X2. (See Figure 17 on page 651.)

Example 2

```
.OPTION SIM_POSTTOP=2
.OPTION SIM_POSTDOWN=X1.X4
```

See Also

.OPTION POST
.OPTION PROBE
.OPTION SIM_POSTSKIP

.OPTION SIM_POWER_ANALYSIS

Prints a list of signals matching the tolerance setting at a specified point in time.

Syntax

```
.OPTION SIM_POWER_ANALYSIS="time_pointtol"
.OPTION SIM_POWER_ANALYSIS="bottom time_pointtol"
```

Argument	Description
time_point	Time when HSPICE detects signals where the port current is larger than the tolerance value.
tol	Tolerance value for the signal defined in the .POWER command.
bottom	Signal at the lowest hierarchy level, also called a *leaf* subcircuit.

Description

Use this option to print a list of signals matching the tolerance (`tol`) setting at a specified point in time.

The first syntax produces a list of signals that consume more current than `tol` at `time point`, in this format:

The second syntax produces the list of lowest-level signals, known as leaf subcircuits that consume more than `tol` at `time point`. The output is similar to this:

For additional information, see Power Analysis in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

In this example, print the names of leaf subcircuits that use more than 100uA at 100ns into the simulation are printed.

```
.OPTION SIM_POWER_ANALYSIS="bottom 100ns 100ua"
.POWER VDD
```

See Also

.POWER

.OPTION SIM_POWER_TOP

Controls the number of hierarchy levels on which power analysis is performed.

Syntax

```
.OPTION SIM_POWER_TOP=value
```

Description

Use this option to control the number of hierarchy levels on which power analysis is performed.

By default, power analysis is performed on the top levels of hierarchy.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

In the following example, HSPICE produces `.POWER` command results for top-level and first-level subcircuits (the subcircuit children of the top-level subcircuits).

```
.OPTION SIM_POWER_TOP=2
```

See Also

.POWER

.OPTION SIM_POWERDC_ACCURACY

Increases the accuracy of operating point calculations for POWERDC analysis.

Syntax

```
.OPTION SIM_POWERDC_ACCURACY=value
```

Description

Use this option to increase the accuracy of operating point calculations for POWERDC analysis.

A higher *value* results in greater accuracy, but more time to complete the calculation.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.POWERDC
.OPTION SIM_POWERDC_HSPICE

.OPTION SIM_POWERDC_HSPICE

Increases the accuracy of operating point calculations for POWERDC analysis.

Syntax

```
.OPTION SIM_POWERDC_HSPICE
```

Description

Use this option to increase the accuracy of operating point calculations for POWERDC analysis.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.POWERDC
.OPTION SIM_POWERDC_ACCURACY

.OPTION SIM_POWERPOST

Controls power analysis waveform dumping.

Syntax

```
.OPTION SIM_POWERPOST=ON|OFF
```

Description

Use this option to enable or disable power analysis waveform dumping.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.POWER

.OPTION SIM_POWERSTART

Specifies a default start time for measuring signals during simulation.

Syntax

```
.OPTION SIM_POWERSTART=time
```

Description

Use this option with a `.POWER` command to specify a default start time for measuring signals during simulation. This default time applies to all signals that do not have their own `FROM` measurement time. This option together with the `.OPTION SIM_POWERSTOP` control the power measurement scope for an entire simulation.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

In this example, the scope for simulating the x1.in signal is from 10 to 90 ps.

```
.OPTION SIM_POWERSTART=10ps
.OPTION SIM_POWERSTOP=90ps
.power x1.in
```

See Also

.OPTION SIM_POWERSTOP
.OPTION SIM_POWERSTART

.OPTION SIM_POWERSTOP

Specifies a default stop time for measuring signals during simulation.

Syntax

```
.OPTION SIM_POWERSTOP=time
```

Description

Use this option with a `.POWER` command to specify a default stop time for measuring signals during simulation. This default time applies to all signals that do not have their own TO measurement time. This option together with the `.OPTION SIM_POWERSTART` controls the power measurement scope for an entire simulation.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_POWERSTART
.POWER

.OPTION SIM_SPEF

Runs simulation with SPEF expansion of all nets from one or more SPEF files.

Syntax

```
.OPTION SIM_SPEF="spec_filename"
```

Description

Use this option to run simulation with SPEF expansion of all nets from one or more SPEF files.

You can repeat this option to include more SPEF files.

For additional information, see Post-Layout Back-Annotation in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

Examples

In this example, the `senseamp.spf` SPEF file is back-annotated to the sense amp circuit.

```
.OPTION SIM_SPEF = "senseamp.spf"
```

See Also

.OPTION SIM_SPEF_ACTIVE
.OPTION SIM_SPEF_SCALEC
.OPTION SIM_SPEF_SCALER

.OPTION SIM_SPEF_ACTIVE

Runs simulation with selective SPEF expansion of active nets from one or more DSPF files.

Syntax

`.OPTION SIM_SPEF_ACTIVE="`*`active_node`*`"`

Description

Use this option to run simulation with selective SPEF expansion of active nets from one or more DSPF files.

HSPICE performs a preliminary verification run to determine the activity of the nodes and generates two ASCII files: *`active_node`*`.rc` and *`active_node`*`.rcxt`. These files save all active node information in both Star-RC and Star-RCXT formats.

If an *`active_node`* file is not generated from the preliminary run, no nets are expanded. Active nets are added to the file as they are identified in the subsequent transient simulation. A second simulation run using the same file and option causes only the nets listed in the *`active_node`* file to be expanded. It is possible that activity changes are due to timing changes caused by expansion of the active nets. In this case, additional nets are listed in the *`active_node`* file and a warning is issued.

By default, a node is considered active if the voltage varies by more than 0.1 V. You can use the `SIM_SPEF_VTOL` option to change this value.

HSPICE uses the *`active_node`* file and the DSPF file with the ideal netlist to expand only the active portions of the circuit. If a net is latent, then HSPICE does not expand it, which saves memory and CPU time.

For additional information, see Selective Post-Layout Flow in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_SPEF_VTOL

.OPTION SIM_SPEF_INSERROR

Skips unmatched instances.

Syntax

```
.OPTION SIM_SPEF_INSERROR=ON | OFF
```

Description

Use this option to skip unmatched instances.

- ON: Skips unmatched instances.
- OFF: Does not skip unmatched instances.

For more information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

.OPTION SIM_SPEF_LUMPCAPS

Connects a lumped capacitor with a value equal to the net capacitance for instances missing in the hierarchical netlist.

Syntax

```
.OPTION SIM_SPEF_LUMPCAPS=ON | OFF
```

Description

Use this option to connect a lumped capacitor with a value equal to the net capacitance for instances missing in the hierarchical netlist.

- `ON`: Adds lumped capacitance while ignoring other net contents.
- `OFF`: Uses net contents.

For additional information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

.OPTION SIM_SPEF_MAX_ITER

Specifies the maximum number of simulation runs for the second selective SPEF expansion pass.

Syntax

```
.OPTION SIM_SPEF_MAX_ITER=value
```

Description

Use this option to specify the maximum number of simulation runs for the second selective SPEF expansion pass.

The *value* parameter specifies the number of iterations for the second simulation run.

Some of the latent nets might turn active after the first iteration of the second simulation run. In this case:

- Re simulate the netlist to ensure the accuracy of the post-layout simulation.
- Use this option to set the maximum number of iterations for the second run. If the active_node remains the same after the second simulation run, HSPICE ignores these options.

For additional information, see Selective Post-Layout Flow in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_SPEF_ACTIVE
.OPTION SIM_SPEF_VTOL

.OPTION SIM_SPEF_PARVALUE

Interprets triplet format *float*:*float*:*float* values in SPEF files as best: average: worst.

Syntax

```
.OPTION SIM_SPEF_PARVALUE=1|2|3
```

Description

Use this option to interpret triplet format *float*:*float*:*float* values in SPEF files as best: average: worst.

- `SIM_SPEF_PARVALUE = 1`: Use best.
- `SIM_SPEF_PARVALUE = 2`: Use average.
- `SIM_SPEF_PARVALUE = 3`: Use worst.

For further information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

.OPTION SIM_SPEF_RAIL

Controls whether power-net parasitics are back-annotated.

Syntax

```
.OPTION SIM_SPEF_RAIL=ON | OFF
```

Description

Use this option to control whether power-net parasitics are back-annotated.

- `OFF`: Do not back-annotate nets in a power rail.
- `ON`: Back-annotate nets in a power rail.

For further information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

.OPTION SIM_SPEF_SCALEC

Scales the capacitance values in a SPEF file for a standard SPEF expansion flow.

Syntax

```
.OPTION SIM_SPEF_SCALEC=scaleC
```

Description

Use this option to scale the capacitance values in a SPEF file for a standard SPEF expansion flow.

The *scaleC* parameter specifies the scale factor.

See Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_SPEF_ACTIVE

.OPTION SIM_SPEF_SCALER

Scales the resistance values in a SPEF file for a standard SPEF expansion flow.

Syntax

```
.OPTION SIM_SPEF_SCALER=scaleR
```

Description

Use this option to scale the resistance values in a SPEF file for a standard SPEF expansion flow.

The *scaleR* parameter specifies the scale factor.

For more information, see Additional Post-Layout Options in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_SPEF_ACTIVE

.OPTION SIM_SPEF_VTOL

Specifies multiple SPEF active thresholds.

Syntax

```
.OPTION SIM_SPEF_VTOL="value | scope1 scope2...
+ scopen"
```

Description

Use this option to specify multiple SPEF active thresholds.

- The *value* parameter specifies the tolerance of voltage change. This value should be relatively small compared to the operating range of the circuit, or smaller than the supply voltage.
- The *scopen* parameter can be a subcircuit definition that uses a prefix of "@" or a subcircuit instance.

HSPICE performs a second simulation run by using the active_node file, the SPEF, and the hierarchical LVS ideal netlist to back-annotate only active portions of the circuit. If a net is latent, then HSPICE does not expand the net. This saves simulation runtime and memory.

By default, HSPICE performs only one iteration of the second simulation run. Use the `SIM_SPEF_MAX_ITER` option to change it.

For additional information, see Selective Post-Layout Flow in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION SIM_SPEF_ACTIVE
.OPTION SIM_SPEF_MAX_ITER

.OPTION SIM_TG_THETA

Controls the amount of second-order Gear method to mix with Trapezoidal (TRAP) integration for the hybrid TRAPGEAR method.

Syntax

```
.OPTION SIM_TG_THETA=[0|1]
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to control the amount of second-order Gear (Gear-2) method to mix with TRAP integration for the hybrid TRAPGEAR method.

The *value* parameter must specify a value between 0.0 and 1.0. The default is 0.1.

- `SIM_TG_THETA=0` selects TRAP without Gear-2.
- `SIM_TG_THETA=1` selects pure Gear-2.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION METHOD

.OPTION SIM_TRAP

Changes the default `SIM_TG_THETA=0` so that `METHOD=TRAPGEAR` acts like `METHOD=TRAP`.

Syntax

```
.OPTION SIM_TRAP=x
```

Description

Use this option to change the default `SIM_TG_THETA=0` so that `METHOD=TRAPGEAR` acts like `METHOD=TRAP`.

The *x* parameter must specify a value between 0.0 and 1.0.

Note: This option is active only when HSPICE advanced analog functions are used.

See Also

.OPTION METHOD
.OPTION SIM_TG_THETA

.OPTION SKIP_XINST

Specifies subcircuit instances to be ignored from the simulation.

Syntax

```
.option skip_xinst='x_instance1 x_instance2 … x_instancen'
```

Description

Use this option to specify the subcircuit instances to be ignored from the simulation. The subcircuit instance names can contain wildcard characters and full hierarchical path. For specifying multiple subcircuit instances, use the quotation mark with space as the delimiter between two instance names.

Examples

The following command causes HSPICE to ignore the x1 and x2.xinv instances in the netlist.

```
.option skip_xinst='x1 x2.xinv'
```

.OPTION SLOPETOL

Specifies the minimum value for breakpoint table entries in a piecewise linear (PWL) analysis.

Syntax

```
.OPTION SLOPETOL=x
```

Description

Use this option to specify the minimum value for breakpoint table entries in a PWL analysis. If the difference in the slopes of two consecutive PWL segments is less than the SLOPETOL value, HSPICE ignores the breakpoint for the point between the segments. Min value: 0; Max value: 2.

.OPTION SNACCURACY

Sets and modifies the size of time steps.

Syntax

```
.OPTION SNACCURACY=integer
```

Default 10

Description

Use this option to set and modify the size of time steps. Larger values of snaccuracy result in a more accurate solution, but may require more time points. Because Shooting-Newton must store derivative information at every time point, the memory requirements may be significant if the number of time points is large. The maximum integer value is 50.

For additional information, see SN Steady-State Time Domain Analysis in the *HSPICE User Guide: Advanced Analog Simulation and Analysis.*

See Also

.OPTION SIM_ACCURACY
.OPTION SNMAXITER / SN_MAXITER

.OPTION SNCONTINUE

Specifies whether to use the sweep solution from the previous simulation as the initial guess for the present simulation.

Syntax

```
.OPTION SNCONTINUE= 0|1
```

Default 1

Description

Use this option to specify whether to use the sweep solution from the previous simulation as the initial guess for the present simulation.

- SNCONTINUE=1: Use solution from previous simulation as the initial guess.
- SNCONTINUE=0: Start each simulation in a sweep from the DC solution.

See Also

.SN

.OPTION SNINITOUT

Turn-on or turn-off generation of SN initialization output.

Syntax

```
.OPTION SNINITOUT = 0|1
```

Default 0

Description

Use this option to either turn-on or turn-off generation of SN initialization data output. The result is a file with the extension `.sntr0`.

- `SNINITOUT=0`: Turns-off the generation of SN initialization data output.
- `SNINITOUT=1`: Turns-on the generation of SN initialization data output and the results are stored in a `*.sntr0` file.

See Also

.SN

.OPTION SNMAXITER / SN_MAXITER

Sets the maximum number of iterations for a Shooting Newton analysis.

Syntax

```
.OPTION SNMAXITER | SN_MAXITER=integer
```

Description

Use this option to limit the number of SN iterations. For more information, see Steady-State Shooting Newton Analysis in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

See Also

.SN

.OPTION SNTMPFILE

Specifies whether Shooting Newton analysis stores intermediate solution data to disk or memory.

Syntax

```
.OPTION SNTMPFILE=0|1
```

Default 0

Description

Use this option to control how Shooting Newton (`.SN`) analysis stores intermediate solution data. Storing data to disk, using temporary files, can significantly reduce the analysis memory footprint, and allow the analysis of larger circuits. Storing to memory tends to result in faster simulations.

- `SNTMPFILE=0`: Store intermediate results in memory.
- `SNTMPFILE=1`: Store intermediate results to disk, using temporary files.

See Also

.SN
Steady-State Shooting Newton Analysis in the *HSPICE User Guide: Advanced Analog Simulation and Analysis*.

.OPTION SOIQ0

Invokes the body charge initialization (BQI) algorithm.

Syntax

```
.OPTION SOIQ0=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to invoke the BQI algorithm for floating body SOI transistors. This option is to be used in conjunction with instance parameter soiq0.

The BQI algorithm allows users to specify a SOI device initial state for simulation to start with the initial state. The initial body charge can be provided by CFL function calls.

The BQI algorithm is applied to SOI models (Levels: 57, 60, and 70). For additional information, see MOSFET Models (BSIM): Levels 47 through 78 in the *HSPICE Reference Manual: MOSFET Models*.

See Also

.DC
.OP
.TRAN

.OPTION SPLIT_DP

Enables the writing of multiple operating points in separate files.

Syntax

```
.OPTION SPLIT_DP=0|1|2
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option in conjunction with `.OPTION OPFILE` when back annotating the operating point information for the Custom Designer.

If...	then...
`.OPTION OPFILE=0` and `.OPTION SPLIT_DP=0`	the `SPLIT_DP` option is ignored and the operating point information is written to a `*.op` file for one operation point.
`.OPTION OPFILE=1` and `.OPTION SPLIT_DP=0`	the operating point information for all Monte Carlo points specified in the `.OP` statement is written to a single `.dp0` file. ■ For a 1D Monte Carlo, the OP points are `MC_sample` ■ For a 2D Monte Carlo, the OP points are `MC_sample*parameter_sweep`
`.OPTION OPFILE=1` and `.OPTION SPLIT_DP=1`	the operating point information in written to a separate file for each sample point specified in the `.OP` statement. For a 2D Monte Carlo, the file name is `*.dp#@sample_number`, each OP file contains number of parameter sweeps OP point information.

Note: `.OPTION OPFILE=1` with `SPLIT_DP=1` supports ASCII waveform format.

`.OPTION OPFILE=1` with `SPLIT_DP=2` supports PSF/WDF waveform format.

Examples

The following command, these files below are returned:

```
.option  opfile=1 split_dp=2
*.op0
*.dp0
*.op@timepoint@sweep_index
*.dp@timepoint@sweep_index
```

With .op timepoint1 timepoint2... in the netlist,

```
.tran  '1n' '2n' start='0' sweep monte=10 firstrun=1
.option  opfile=1 split_dp=1
```

The resulting files are generated:

```
*.op0
*.dp0
*.dp@timepoint@sweep_index
```

See Also

.OPTION OPFILE
.OPTION WDF
.OP

.OPTION SPLITMA

Enables the writing of multiple AC measure files, when using AC analysis with transient and OP analyses.

Syntax

```
.OPTION SPLITMA=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

When using AC analysis with OP and transient analyses, by default, HSPICE outputs a single AC measure file, with the extension .ma#@tranop, containing measured values at all the time points specified in the .OP statement.

If you use the option SPLITMA set to 1, HSPICE outputs a separate AC measure file for each time point specified in the .OP statement. Each file will have the extension .ma#@op_time#.

.OPTION SPMODEL

Disables the previous .OPTION VAMODEL.

Syntax

```
.OPTION SPMODEL [= name]
```

Description

Use this option to disable a previously issued VAMODEL option. In this option, the name is the cell name that uses a SPICE definition. Each SPMODEL option can take no more than one name. Multiple names need multiple SPMODEL options.

Examples

Example 1 disables the previous .OPTIONVAMODEL but has no effect on the other VAMODEL options if they are specified for the individual cells. For example, if .OPTIONVAMODEL=vco has been set, the vco cell uses the Verilog-A definition whenever it is available until .OPTIONSPMODEL=vco disables it:

```
.OPTION SPMODEL
```

This example disables the previous .OPTIONVAMODEL=chargepump, which causes all instantiations of chargepump to now use the subcircuit definition again:

```
.option spmodel=chargepump
```

See Also

.OPTION VAMODEL

.OPTION STATFL

Controls whether HSPICE creates a .st0 file.

Syntax

```
.OPTION STATFL=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use this option to control whether HSPICE creates a .st0 file.

- STATFL=0 Outputs a .st0 file.
- STATFL=1 Suppresses the .st0 file.

.OPTION STRICT_CHECK

Turns a subset of HSPICE netlist syntax warnings into terminal (abortive) syntax errors.

Syntax

```
.OPTION STRICT_CHECK 0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

When enabled (set to 1), netlist conditions listed below will abort HSPICE with an error message. When disabled (set to 0), HSPICE will make assumptions and continue to run with only a warning message.

This option also enables HSPICE to report duplicate parameter declarations in design netlist files.

For more information, see Warning Message Index [00001-11146] located in the *HSPICE User Guide: Basic Simulation and Analysis*.

Note: `.OPTION STRICT_CHECK=1` also ignores all parameters that start with the keyword “HSIM”.

See Also

.OPTION MESSAGE_LIMIT

.OPTION SX_FACTOR

External shrink factor, only used for Ivthx calculation with the `.IVTH` command.

Syntax

```
.IVTH model_name Ivth0=x DW=x DL=x
.OPTION SX_factor=x
```

Description

This option is only used with the IVTH command as shown in the Syntax section. It is restricted to use for ivthx calculation only.

See Also

.IVTH

.OPTION SYMB

Uses a symbolic operating point algorithm to get initial guesses before calculating operating points.

Syntax

```
.OPTION SYMB=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to calculate the operating point. When `SYMB` is set to `1`, HSPICE operates with a symbolic operating point algorithm to get initial guesses before calculating operating points. `SYMB` assumes the circuit is digital and assigns a low/high state to all nodes that set a reasonable initial voltage guess. This option improves DC convergence for oscillators, logic, and mixed-signal circuits.

`.OPTION SYMB` does not have any effect on the transient analysis if you set UIC in the `.TRAN` command.

.OPTION TIMERES

Sets the minimum separation between breakpoint values for the breakpoint table.

Syntax

```
.OPTION TIMERES=x
```

Description

Use this option to set the minimum separation between breakpoint values for the breakpoint table. If two breakpoints are closer together in time than the `TIMERES` value, HSPICE enters only one of them in the breakpoint table.

.OPTION TMEVTHMD

Foundry defined specific constant-current threshold voltage probing and characterization.

Syntax

```
.OPTION TMEVTHMOD=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Foundry defined specific constant-current threshold voltage probing and characterization.

.OPTION TMIAGE

Turns on and turns off TMI reliability analysis (TMI aging) simulation flow.

Syntax

```
.option TMIAGE=0|1
```

Default Value if option is not specified in the netlist: 0

Value if option name is specified without a corresponding value: 1

Description

Use this option to turn on and turn off TMI aging flow.

- 0: Turn-off TMI aging flow
- 1: Turn-on TMI aging flow

.OPTION TMIFLAG

Invokes the TMI flow and specifies TMI version.

Syntax

```
.OPTION TMIFLAG=0|1.00|2.00|2.01
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: the latest version supported by simulator.

Description

Use this option to invoke the TMI flow. The TMIFLAG option must equal 1 or greater to enable a TMI flow. If the TMIFLAG is set to a value greater than the highest version supported by simulator, the simulator will abort.

To distinguish a TMI device from simulator built-in devices, the model parameter TMIMODEL can be used.

- If model parameter TMIMODEL=0 (default), HSPICE uses the built-in model for the simulation.
- If model parameter TMIMODEL=1, HSPICE uses the TMI model for the simulation.

When .OPTION TMIFLAG ≥ 1, .OPTION MACMOD automatically equals 3 to enable the mapping of an instance name starting with “x” to “m.”

(Contact the Compact Model Council for the detailed specification of TMI.)

See Also

.OPTION TMIPATH
.OPTION MACMOD

.OPTION TMIINPUT

Points to the location of TMI configuration file or previously .tmiage file.

Syntax

```
.OPTION TMIINPUT='$your_tmi_cfg_file_name'
```

Description

Use this option to point to the TMI configuration file or to the previously generated .tmiage file.

The file name and path must be enclosed in single quotation marks. This option supports both relative and absolute paths.

Examples

```
.option tmiinput='./tmi.cfg'
.option tmiinput='test.tmiage0'
```

.OPTION TMIPATH

Points to a TMI `*.so` (compiled library) file location.

Syntax

```
.OPTION TMIPATH='tmifilename_dir'
```

Description

Use this option to point to a TSMC Model Interface (TMI) `*.so` file location. The path must be enclosed in single quotation marks. This option supports both relative and absolute paths.

Examples

```
.option tmipath='tmi_v0d03_dir'
```

See Also

.OPTION TMIFLAG

.OPTION TMISAVE

A flag to control if the TMI model saves the intermediate TMI aging analysis data to `.tmiage` file.

Syntax

```
.option TMISAVE=0|1
```

Default Value if option is not specified in the netlist: 0

Value if option name is specified without a corresponding value: 1

Description

Use this option to control if saving intermediate age data to files.

- 0: TMI model does not save intermediate TMI aging data to `.tmiage` file
- 1: TMI model save intermediate age data to `.tmiage` file

.OPTION TMPLT_POL

Enables HSPICE to print PMOS template output voltage polarity as real bias.

Syntax

```
.OPTION TMPLT_POL=0|1
```

Default Value if option is not specified in the netlist: 0
Value if option name is specified without a corresponding value: 1

Description

Use `.OPTION TMPLT_POL=1` to output the real bias of PMOS template voltage. (The default PMOS template voltage output is taken as NMOS.) This option applies to the following output templates:

MOSFET LX0/LX1/LX2/LX3/LV9/LX133/LX134

.OPTION TNOM

Sets the reference temperature for the simulation.

Syntax

```
.OPTION TNOM=x
```

Default 25°C

Description

Use this option to set the reference temperature for the HSPICE simulation. At this temperature, component derating is zero.

Note: The reference temperature defaults to the analysis temperature if you do not explicitly specify a reference temperature.

See Also

.TEMP / TEMPERATURE

.OPTION TRANFORHB

Forces HB analysis to recognize or ignore specific V/I sources.

Syntax

```
.OPTION TRANFORHB=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

This option forces HB analysis to recognize or ignore specific V/I sources.

- `TRANFORHB=1`: Forces HB analysis to recognize V/I sources that include SIN, PULSE, VMRF, and PWL transient descriptions, and to use them in analysis. However, if the source also has an HB description, analysis uses the HB description instead.
- `TRANFORHB=0`: Forces HB to ignore transient descriptions of V/I sources and to use only HB descriptions.

To override this option, specify `TRANFORHB` in the source description.

See Also

.HB

.OPTION TRCON

Controls the automatic convergence process of transient simulation.

Syntax

```
.OPTION TRCON=[0|1|2]
```

Default `1`

Description

Use this option to control autoconvergence of transient simulations. If the circuit fails to converge using the default trapezoidal (`TRAP`) numerical integration method (for example because of trapezoidal oscillation), HSPICE sets the `GEAR` method to run the transient simulation again from `time=0`. This process is autoconvergence. If HSPICE fails to converge, an “internal time step too small” error is issued.

- `TRCON=0`: Disables autoconvergence.
- `TRCON=1`: Enables autoconvergence for transient simulation only when the accumulated CPU time of the current simulation is less than 1 hour.
- `TRCON=2`: Enables autoconvergence with no restriction; in addition, a simulation enters into transient analysis without a converged operating point.

.OPTION UNWRAP

Displays phase results for AC analysis in unwrapped form.

Syntax

```
.OPTION UNWRAP=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to display phase results for AC analysis in unwrapped form (with a continuous phase plot). HSPICE uses these results to accurately calculate group delay. HSPICE also uses unwrapped phase results to compute group delay, even if you do not set `UNWRAP`. By default, HSPICE calculates the unwrapped phase first and then converts it to wrapped phase. The convention is to normalize the phase output from –180 degrees to +180 degrees. A phase of –181 degrees is the same as a phase of +179 degrees. The following example illustrates how HSPICE wraps the phase.

Examples

Default Method (Without)

```
Freq Phase
3.16228k --> -167.7243
3.98107k --> 178.7844
```

If you use .OPTION UNWRAP = 1

```
3.16228k --> -167.7243
3.98107k --> -181.2156
```

If the phase value goes beyond –180, then it wraps to a positive value. At the frequency 3.98107 kHz the actual value is –181.2156, but by default, it is wrapped to +178.7844.

HSPICE does the following calculation to wrap the phase:

```
 -181.2156
 +180.0000
----------
 -1.2156
 +180.0000
 -1.2156
----------
  178.7844
```

.OPTION USE_TEMP

Checks the values of the temperature when a netlist contains multiple defined .TEMP statements.

Syntax

```
.OPTION USE_TEMP = FIRST|LAST|ALL
```

Default ALL

Description

Use this option to check the values of the temperature when more than one .TEMP command is used in a netlist.

Choose from the following options:

- ALL (default) — Run simulation for all defined .TEMP statements. If USE_TEMP is not defined, or defined without an argument, then run simulation for all defined .TEMP statements.
- LAST — Run simulation using the last .TEMP statement found in the netlist.
- FIRST — Run simulation using the first .TEMP statement found in the netlist.

This option can be used for both HSPICE and HPP.

HSPICE checks duplicate temperature values for .TEMP statements and reports a warning in the *.lis file:

```
** warning ** duplicate temperature xxx is defined in .temp. Only
the first one will be used.
```

See Also

.TEMP / TEMPERATURE

.OPTION VAMODEL

Specifies that *name* is the cell name that uses a Verilog-A definition rather than the subcircuit definition when both exist (for use in HSPICE with Verilog-A).

Syntax

```
.OPTION VAMODEL [=name]
```

Description

Use this option to specify that *name* is the cell name that uses a Verilog-A definition rather than the subcircuit definition when both exist. Each VAMODEL option can take no more than one name. Multiple names need multiple VAMODEL options.

If a name is not provided for the VAMODEL option, HSPICE uses the Verilog-A definition whenever it is available. The VAMODEL option works on cell-based instances only. Instance-based overriding is not allowed.

Examples

The following example specifies a Verilog-A definition for all instantiations of the cell vco:

Example 1

```
.option vamodel=vco
```

Example 2 specifies a Verilog-A definition for all instantiations of the vco and chargepump cells:

Example 2

```
.option vamodel=vco vamodel=chargepump
```

The following example instructs HSPICE to always use the Verilog-A definition whenever it is available:

Example 3

```
.option vamodel
```

.OPTION VECBUS

Enables backward compatibility in a vector file for bus mode.

Syntax

```
.OPTION VECBUS=0|1
```

Default 0

Description

This option enables both backward compatibility of VEC file bus notation written as sig[1:2] and new bus name resolution. Using the new convention, this signal searches for nodes sig[1] and sig[2]. The old format (single bit mode) is valid when VECBUS=0 and the bus resolves as sig[1] and sig[2].

- `VECBUS=0`: Backward compatibility, use previous bus name resolution
- `VECBUS=1`: Use new bus name resolution

For example: formerly, a bus with a `vname` of a `[2:0]` would look for nodes named `a2`, `a1`, and `a0` in the netlist to associate the stimulus. Starting in 2010.12-SP2, the same bus notation resolves to `a[2]`, `a[1]`, and `a[0]`. This makes the HSPICE handling of bus name resolution in vector files consistent with the Synopsys CustomSim®simulator.

.OPTION VER_CONTROL

Determines whether to continue the simulation when encountering nonsupported model versions.

Syntax

```
.OPTION VER_CONTROL [0|1]
```

Default Value if option is not specified in the netlist: `0`

Description

Use this option to determine whether HSPICE should continue the simulation when encountering nonsupported model versions.

- `VER_CONTROL=1` The simulation aborts for non-supported versions.
- `VER_CONTROL=0` Turns off version control.

Note: This option is only available for BSIM4 (level54), BSIMSOI (level57), BSIM6(level77), BSIM-CMG (level72), and PSP (level69).

.OPTION VERIFY

Duplicates the `LIST` option.

Syntax

```
.OPTION VERIFY=[0|1]
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option as an alias for the LIST option.

See Also

.OPTION LIST

.OPTION VFLOOR

Sets the minimum voltage to print in the output listing for DC and transient analysis.

Syntax

```
.OPTION VFLOOR=x
```

Default 0.5e-6

Description

Use this option to set the minimum voltage to print in the output listing. All voltages lower than VFLOOR print as 0. Affects only the printed output listing for DC and TRAN analysis.

.OPTION VPD

Enables generation of VPD files with analog and digital information.

Syntax

```
.OPTION 1|2
```

Default 1 (analog data)

Description

For HSPICE-VCS co-simulation:

- Set .OPTION VPD =1 (instead of .OPTION POST=1(or others, such as: .OPTION CSDF) to specify the output format for analog signals to generate a VPD format file.
- Set .OPTION VPD=2 to generate a merged VPD file containing both analog and digital signals. After you set .OPTION VPD[=1], split VPD files are generated.

The merged VPD file takes the name determined by VCS, which can be either of the following:

- The VCS default name
- The file name specified by the `$vcdplusfile()` system task in Verilog

.OPTION WACC

Activates the dynamic step control algorithm for a W-element transient analysis.

Syntax

```
.OPTION WACC=x
```

Default `-1` (variable, see below)

Description

Use this option to activate the dynamic step control algorithm for a W-element transient analysis. `WACC` is a nonnegative real value that can be set between 0.0 and 10.0. The `WACC` value influences a series of tolerances for W-element simulation. The default value of `WACC` is determined by HSPICE according to the transmission line properties, such as loss and delay. Therefore, for different transmission line, the default `WACC` value is different. It is suggested that you not give a `WACC` value in the `.option` line because it will give a constant value to all the transmission lines in the netlist. HSPICE assigns `WACC -1` if you do not set a `WACC` option or if you set `.OPTION WACC`. When a value of 1 is specified, HSPICE assigns `WACC` a positive value. If a nonnegative value is set in the `.option` line (`.OPTION WACC=XXX`), HSPICE uses the specified `WACC` value for all the W-elements. When `WACC=0`, HSPICE uses static breakpoint with the interval between each two as the transmission line system delay. Otherwise, when a positive value is set, the W-element uses dynamic time step control, which may improve the performance, especially for short delay cases. A large `WACC` value results in loose tolerance and bigger time steps, while small values result in tight tolerances and smaller time steps.

The following refers to HSPICE only: For cases containing IBIS, PKG, EBD, or ICM blocks, HSPICE turns `WACC` off automatically. If you want to use the dynamic time step control algorithm for IBIS-related cases, you must set it explicitly in the netlist. For example:

```
.option WACC  $ Make HSPICE use automatically generated
WACC value for each W element
```

or:

```
.option WACC=value   $ Use this value for all the W
elements
```

See Also

Dynamic Time-Step Control using WACC in the *HSPICE User Guide: Signal Integrity Modeling and Analysis*.

.OPTION WARN

Enables or turns off SOA voltage warning message.

Syntax

`.OPTION WARN=1|0`

Default 1 or unspecified

Argument	Description
`1` or unspecified	Turns *on* the warning message
`0`	Turns *off* the warning message

Description

Use this option to enable or disable HSPICE warning messages when terminal voltages of a device (MOSFET, BJT, Diode, Resistor, Capacitor, and so forth…) exceed the safe operating area (SOA).

The warning message is as follows:

`**warning**(`*`filename`*`:`*`line number`*`): `*`node_voltage_name`* `=`*`val`* `has exceeded `*`node_voltage_name`* `max =`*`val`*

Control the number of warnings issued by using `.OPTION MAXWARNS=`*`n`*

See Also

.OPTION MAXWARNS
Safe Operating Area (SOA) Warnings

.OPTION WARN_SEP

Separates out warnings to a file, while suppressing them in the `*.lis` file.

Syntax

```
.OPTION WARN_SEP [0|1]
```

Default Value if option is not specified in the netlist: 0 value if option name is specified without a corresponding value: 1

Description

Setting a value of `1` for this option separates error and warning messages from the `*.lis` file into a separate file (`.warnlog`). This file reports error and warning message subheadings, contents, and summaries. This option also prints message types to the terminal.

See Also

.OPTION WARNLIMIT
.OPTION LIS_NEW

.OPTION WARNLIMIT

Limits how many times certain warnings appear in the output listing.

Syntax

```
.OPTION WARNLIMIT=n
```

Description

Use this option to limit how many times the same warning appears in the output listing. This reduces the output listing file size. The *n* parameter specifies the maximum number of warnings for each warning type.

This limit applies to the following warning messages:

- MOSFET has negative conductance.
- Node conductance is zero.
- Saturation current is too small.
- Inductance or capacitance is too large.
- Model warnings issued by compact models. For example, parameter range checking and unsupported parameters.

See Also

.OPTION NOWARN
.OPTION MESSAGE_LIMIT

.OPTION WAVE_POP

Enables setting of buffer flush interval for `.tr0` and `.wdf` files (Not supported when HSPICE advanced analog functions are used).

Syntax

```
.OPTION WAVE_POP=val
```

Default `0.1` (10%)

Description

Sets waveform buffer flush interval as a percentage of the total simulation time. The value can be set from 0.001 to 1, where 0.001 is 1% and 1 is 100% of the total transient runtime. `.OPTION WAVE_POP` values can also work when `.OPTION PSF` is set. If the option is not set, then the waveform buffer will be flushed at every 10% of the total simulation time.

Examples

In this example, the waveform buffer is flushed at every 5% of the total simulation time.

```
.OPTION WAVE_POP=0.05
```

.OPTION WDELAYOPT

Globally applies the `DELAYOPT` keyword to a W-element transient analysis.

Syntax

```
.OPTION WDELAYOPT=[0|1|2|3]
```

Default `0`

Description

Use this option as a global option which applies to all W-elements in a netlist. `.OPTION WDELAYOPT` can be overridden by the `DELAYOPT` keyword for a specified W-element.

- In cases where WDELAYOPT is set in the .OPTION and the DELAYOPT keyword is not specially set for Wxxx, the WDELAYOPT keyword is autoset for Wxxx.
- In cases where the DELAYOPT keyword is already set for Wxxx, .OPTION WDELAYOPT is overridden for the Wxxx.
- In cases where neither .OPTION WDELAYOPT nor the DELAYOPT keyword is set, the DELAYOPT keyword defaults to 0.

.OPTION WDELAYOPT helps construct a W-element transient (recursive convolution) model with a higher level of accuracy. By specifying this option, you can add the DELAYOPT keyword to the W-element instance line.

You can use DELAYOPT=0|1|2 to deactivate, activate, and automatically determine, respectively.

Use DELAYOPT=3 to achieve a level of accuracy up to a tens of GHz operation and involve harmonics up to THz order. With this option, line length limits are removed, which frees the simulation from segmenting and allows independence in the behavior of the RISETIME option setting. A setting of WDELAYOPT=3 automatically detects whether or not frequency-dependent phenomena need to be recorded, which makes it identical to the DELAYOPT=0 setting if it produces a high enough accuracy.

See Use DELAYOPT Keyword for Higher Frequency Ranges in the *HSPICE User Guide: Signal Integrity Modeling and Analysis*

See Also

.OPTION WINCLUDEGDIMAG
.OPTION RISETIME / RISETI

.OPTION WDF

Enables HSPICE to produce waveform files in WDF format.

Syntax

```
.OPTION WDF=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to enable HSPICE to produce waveform files in WDF (Waveform Data File) format. The WDF format is a proprietary waveform storage format. The WDF format compresses analog and logic waveform data, and facilitates fast waveform access for large data files. Only lossless compression is supported. Use this option with the `.PRINT` or `.PROBE` command.

- `.option WDF=0`—Disables this option
- `.option WDF` or `.option WDF=1`—Enables HSPICE to produce the waveform file in WDF format. When `WDF=1`, no `*.dp#` files are generated, nor is OP information output in the `*.lis` file. If `.OPTION OPFILE=1` is in a netlist when `WDF=1`, the `OPFILE=1` is ignored.

In `PSF` or `WDF` format, the inductor and capacitor OP information are both output into `*.op#` files.

For the WDF waveform file, HSPICE automatically appends `_wdf` into the output file root name to specify that it is in WDF format. The file names appear as: `*_wdf.tr#`, `*_wdf.sw#`, or `*_wdf.ac#`.

For example, the WDF waveform output file will be named: *`design`*`_wdf.tr0`.

The WDF format is available to HSPICE for `.AC`, `.DC`, and `.TRAN` analyses.

When the netlist contains `.option wdf=1` and a `.tran` analysis statement (with no `.op` statement in the netlist file), HSPICE creates the following output files. (See examples below.)

- `.op0` — dc node voltage and dc operating points.
- `.op1` — transient voltage and transient operating points for the transient end time.

Examples

Example 1 *In this example, HSPICE creates these output files:*
input_wdf.op0
input.dp0@timepoint@spweep_index

```
.option WDF=1  opfile=1 split_dp=1
.tran '1n' '2n' start='0' sweep monte=10 firstrun=1
.op All 0.5n 1n 1.5n
```

Example 2 *In this example, HSPICE outputs:*
input_wdf.op0@timepoint@sweep_index
input.dp0@timepoint@spweep_index

```
.option WDF=1 opfile=1 split_dp=2
```

See Also

.PRINT
.PROBE
.OPTION OPFILE
.OPTION SPLIT_DP

.OPTION WINCLUDEGDIMAG

Globally activates the complex dielectric loss model in W-element analysis.

Syntax

```
.OPTION WINCLUDEGIMAG=[YES|NO]
```

Default NO

Description

Use this option as a global option to activate the complex dielectric loss model for all W-elements a netlist by introducing an imaginary term of the skin effect to be considered. If WINCLUDEGDIMAG=YES and there is no wp input, the W-element regards the Gd matrix as the conventional model and then automatically extracts constants for the complex dielectric model.
The .OPTION WINCLUDEGIMAG operates with the .OPTION WDELAYOPT option.

- In cases where WINCLUDEGDIMAG is set in the .OPTION and the INCLUDEGDIMAG keyword is not specially set for Wxxx, the INCLUDEGDIMAG is autoset for Wxxx.
- In cases where the INCLUDEGDIMAG keyword is already set for Wxxx, .OPTION WINCLUDEGDIMAG is overridden for the Wxxx.
- In cases where neither .OPTION WINCLUDEGDIMAG nor the INCLUDEGDIMAG keyword is set, the INCLUDEGDIMAG keyword defaults to NO.

For details about the INCLUDEGDIMAG keyword, see Fitting Procedure Triggered by INCLUDEGDIMAG Keyword in the *HSPICE User Guide: Signal Integrity Modeling and Analysis*.

See Also

.OPTION WDELAYOPT
.OPTION RISETIME / RISETI

.OPTION WL

Reverses the order of the VSIZE MOS element.

Syntax

```
.OPTION WL=0|1
```

Default Value if option is not specified in the netlist: 0 Value if option name is specified without a corresponding value: 1

Description

Use this option to reverse the order of the MOS element VSIZE. The default order is length-width; this option changes the order to width-length.

.OPTION WNFLAG

Controls whether bin is selected based on w or w/nf.

Syntax

```
.OPTION WNFLAG=[0|1]
```

Default 1 (global)

Description

Use this option to control whether HSPICE selects the bin based on the total device width (WNFLAG=0) or based on the width of one finger of a multifingered device (WNFLAG=1).

For devices using a BSIM4 model, an element parameter wnflag=[0|1] can be set with the same effect as the option, and this element parameter overrides the option setting on an element basis.

Examples

For All Levels:

```
.option wnflag
M1 out in vdd vdd pmos w=10u l=1u nf=5
```

For BSIM4 models only:

```
M1 out in vdd vdd pmos w=10u l=1u nf=5 wnflag=1
```

.OPTION XDTEMP

Defines how HSPICE interprets the DTEMP parameter.

Syntax

```
.OPTION XDTEMP=0|1
```

Default Value if option is not specified in the netlist: 0 (user-defined parameter) Value if option name is specified without a corresponding value: 1

Description

Use this option to define how HSPICE interprets the DTEMP parameter, where *value* is either:

- 0: Indicates a user-defined parameter
- 1: Indicates a temperature difference parameter

If you set .OPTION XDTEMP to 1, HSPICE adds the DTEMP value in the subcircuit call command to all elements within the subcircuit that use the DTEMP keyword syntax. The DTEMP parameter is cumulative throughout the design hierarchy.

Examples

```
.OPTION XDTEMP
X1 2 0 SUB1 DTEMP=2
.SUBCKT SUB1 A B
R1 A B 1K DTEMP=3
C1 A B 1P
X2 A B sub2 DTEMP=4
.ENDS
.SUBCKT SUB2 A B
R2 A B 1K
.ENDS
```

In this example:

- X1 sets a temperature difference (2 degrees Celsius) between the elements within the subcircuit SUB1.
- X2 (a subcircuit instance of X1) sets a temperature difference by the DTEMP value of both X1 and X2 (2+4=6 degrees Celsius) between the elements within the SUB2 subcircuit. The DTEMP value of each element in this example is:

```
Elements DTEMP Value (Celsius)
X1 2
X1.R1 2+3 =5
X1.C1 2
X2 2+4=6
X2.R2 6
```

.OPTION XMULT_IN_EXP / M_IN_EXP

Allows X multiplier in right side of expression within a subcircuit.

Syntax

```
.OPTION XMULT_IN_EXP=Yes|No
```

Default No

Description

This option permits the M-factor to appear on the right side of expressions for backward compatibility.

When .OPTION XMULT_IN_EXP=YES, the Multiplier of the x element can be used in the right side of expression within .SUBCKT. The M in X element works as both a multiplier and as a user-defined parameter.

When .OPTION XMULT_IN_EXP=NO, the Multiplier of the x element cannot be used in the right side of expression within .SUBCKT. The M in X element works only as a multiplier.

You can also use this option within a subcircuit definition. When you specify this option inside a .subckt, it is applicable locally only within this subcircuit.

Note: M_IN_EXP is an alias for XMULT_IN_EXP.

Examples

When .OPTION XMULT_IN_EXP=YES, x1.l='M*1e-6'='2*1e-6'=2e-6.

```
X d g s b M=2   // Here, M is a keyword (m-factor)
.subckt sub1 d g s b M=1   //Here, M is a user-defined parameter,
and it cannot be overriden by the M in X element by default
.param l='M*1e-6'  // l=1e-6 by default
M1 d g s b pch l=l w=…
.ends
```

.VARIATION Block Control Options

The following options can be applied when doing .VARIATION analysis. Note that no leading period is allowed with Variation Block control options.

Syntax

```
[Option Normal_Limit=val]
[Option Ignore_Variation_Block=Yes]
[Option Ignore_Local_Variation=Yes]
[Option Ignore_Global_Variation=Yes]
[Option Ignore_Spatial_Variation=Yes]
[Option Ignore_Interconnect_Variation=Yes]
[Option Output_Sigma_Value=Value]
[Option Vary_Only Subckts=SubcktList]
[Option Do_Not_Vary Subckts=SubcktList]
[Option Vary_Only instances=instance1, instance2...]
[Option Do_Not_Vary instances=instance1, instance2...]
[Option MC_File_only=Sample_Number]
[Option External_File=filename]
[OPTION SET_MISSING_VALUES=Random|Zero]
```

Monte Carlo-Specific Options Using the Variation Block

```
[Option Random_Generator=[Default|MSG]]
[Option Stream=[x|Random|Default]]
[Option Use_Agauss_Format=Yes|No]
[Option Normal_Limit=Value]
[Option Output_Sigma_Value=Value]
[Option Vary_Only instances=instance1, instance2...]
[Option Do_Not_Vary instances=instance1, instance2...]
[Option Print_Only Subckts=SubcktList]
[Option Do_Not_Print Subckts=SubcktList]
[Option MC_File_only=Sample_Number]
[Option External_File=filename]
[Option Seed=x|random]
[Option Add_Variation=yes]
[Option Other_Percentile]
[Option Mirror_Components=instanceList]
[Option large_scale_mc=no|yes]
[Option measure_file=no|yes]
[Option tail_samples=100|#]
[Option histogram_bins=800|#]
[Option sensitivity_analysis=[yes|no]]
[Option qqnorm_file=[yes|no]]
```

Description

The following describes the available options:

- `Option Use_Agauss_Format=Yes`

  Allows use of Gaussian sampling methods as well as advanced sampling formats in a Variation Block. Default is *yes*.

- `Option Normal_Limit=[val]`

  Limits the range for the numbers generated by the random number generator for standard normal distributions. The default value is 20 for sampling methods SRS, LHS, SOBOL and NIED. The default value is 4 for the OFAT and FACTORIAL sampling methods. For example, numbers in the range –/+4 are created. The allowed range for the option is 0.1 to 20. Negative values are automatically reset to the default.

- Option Ignore_Variation_Block=Yes

  Ignores the Variation Block and executes earlier style variations (traditional Monte Carlo analysis). By default, the contents of the variation block are executed and other definitions (`AGAUSS`, `GAUSS`, `AUNIF`, `UNIF`, `LOT`, and `DEV`) are ignored. Previous methods of specifying variations on parameters and models are not compatible with the Variation Block. By default, the contents of the Variation Block are used and all other specifications are ignored. Thus, no changes are required in existing netlists other than adding the Variation Block.

- `Option Ignore_Local_Variation=Yes`

  Excludes effects of local variations in simulation. Default is `No`.

- Option Ignore_Global_Variation=Yes

  Excludes effects of global variations in simulation. Default is `No`.

- `Option Ignore_Spatial_Variation=Yes`

  Excludes effects of spatial variations in simulation. Default is `No`.

- `Option Ignore_Interconnect_Variation=Yes`

  Excludes effects of interconnect variations in simulation. Default is `No`. (See Interconnect Variation in Star-RC with the HSPICE Flow.)

- `Option Output_Sigma_Value=Value`

  Specifies the sigma value of the results of Monte Carlo, DCMatch, and ACMatch analyses. Default is 1; range is 1 to 10. Note that this option only changes the output listings and that the input sigma is not affected.

- `Option Vary_Only Subckts=SubcktList`

  Limits variation on the specified subcircuits. Use this option to either limit variation to the specified subcircuits or the one below, but not both. Actual subcircuit names are specified here (hierarchical names are also supported).

- `Option Do_Not_Vary Subckts=SubcktList`

  Excludes variation on the specified subcircuits. Use this option to either limit variation to the specified subcircuits or the one above, *but not both*. Actual subcircuit names are specified here (hierarchical names are also supported).

- Option Vary_Only instances=instance_1, instance_2...

  Limits the variations on the specified elements only.

- `Option Do_Not_Vary_instances=instance_1, instance_2...`

  Excludes the specified elements varying during the Monte Carlo Simulation.

  Both AGAUSS-type variation and variation block local and element variation are supported. All sampling methods, except external data block, are supported. Wildcards are supported in the instance list.

  Limitation: .DCMATCH and .ACMATCH analyses are not supported and global variations would still be applied all the elements.

Example 1 *In this example, all xi10.mn* instances will be varied during the Monte Carlo analysis*

```
.variation
 option vary_only instances=xi10.mn*
.end_variation
```

Example 2 *In this example, Instance xi1.mp1 and xi2.mp2 will not be varied during the Monte Carlo analysis*

```
.variation
 option do_not_vary instances=xi1.mp1,xi2.mp1
.end_variation
```

- `Option MC_File_Only=yes|no`

  Generates a random number sample file (`*.mc0`) without invoking any analysis. This is applicable to AGAUSS style too. The feature is useful for external block sampling simulation where you want to modify the samples

before running the Monte Carlo simulation. If the netlist has a Monte Carlo command, then the sampling number is taken from the MC command; if the netlist has no MC command, then the sampling number is zero.

- Option Screening_Method = Pearson|Spearman

  HSPICE calculates the variables screened by importance using the Pearson or Spearman algorithm. Default: `Pearson`.

- `Option MC_File_Only=yes|no`

  Generates a random number sample file (`*.mc0`) without invoking any analysis (applicable to AGAUSS style also). The feature is useful for an external block sampling simulation when you want to modify the samples before running the Monte Carlo simulation. If the netlist has a Monte Carlo command, then the MC command provides the number of samples; if the netlist has no MC command, then the number of samples is zero.

- `Option Stream =[x | Random | Default]`

  Specifies an integer stream number for random number generator (only for Variation Block). The minimum value of x is 1, the maximum value of x is 20; If `Stream=Random`, HSPICE creates a random stream number between 1 and 20 according to the system clock, and prints it in the `*.lis` file for the user for later use. `Stream=Default` is equivalent to `Stream=1`.

- `Option Seed=`*`x`*`|random`

  Where *x* is a positive integer from 1to 259200. Setting `Random` allows HSPICE to select an integer from the range. This option also works for AGAUSS-style Monte Carlo when you use advanced sampling methods.

  Note: `Option Seed` is only valid for the random number generator of `MOA` and overrides the setting of `Option Stream`. Use `Stream` only when `Seed` is not set.

- `Option Add_Variation=yes`

In this example, the first four lines are variations provided by the foundry. `Option Add_Variation=yes` and `.Option Sampling_Method` are user-supplied required options and `nmos nch_mac.nch toxe= 10%` is the VB global variation where `nch_mac` is the subckt name and `nch` is the binned model name.

```
.lib 'mismatch_totalflag_b.l' stat
.lib 'mismatch_totalflag_b.l' global
.lib 'mismatch_totalflag_b.l' total
.lib 'mismatch_totalflag_b.l' tt
```

```
.Variation
   Option_Add_Variation=yes
 .Global_Variation
     nmos nch_mac.nch= 10%
 .End_Global_Variation
 .Local_Variation
     nmos nch_mac.nch toxe= 10%
 .End_Local_Variation
.End_Variation
```

- `Option Other_Percentile=`*`data_block_name`*

  Or `Option Other_Percentile=list(`*`val1, val2,..,valn`*`)`, where the value range for *`val1`* to *`valn`* is between 0 and 1.

  Or `Option Other_Percentile=list_sigma(`*`val1, val2,..,valn`*`)`, where the value range for *`val1`* to *`valn`* is between -6 and 6.

  Use this option to specify quantiles lower than 1%. This option allows you to help to see how much impact there is from trailing data points, or to count samples near the absolute minimum for a sample set.

  Use the first or the second syntax to specify the information in terms of a cumulative distribution. Or use the third syntax to specify the information in terms of sigma values of a normal distribution.

  For more information, refer to Using the Other_Percentile Option in *HSPICE User Guide: Basic Simulation and Analysis*.

- `Option Mirror_Components = instanceList`

  Use this option to specify the list of instances. The instance list uses the same set of random values in Monte Carlo simulation. This option does not support external sampling, the sampling values in external data block always has higher priority. This option supports SRS, LHS, Factorial, OFAT, Sobel, Niederreiter sampling methods. This option also supports wildcard instance name matching.

  Note: This option is supported in:

  - VB local/element and AGAUSS local type variation only.
  - User needs to set `.OPTION SAMPLING_METHOD=SRS` (or other supported sampling methods) in the netlist with traditional or AGAUSS type variation definitions.

- `Option External_File=`*`filename`*

Where this command enables read-in of external block line-by line-during the simulation stage. This command distributes memory consumption and avoids overtaxing front-end with block containing large samples. This option is also available for DP+ DC Monte Carlo.

- `.OPTION SET_MISSING_VALUES = Random | Zero`

  Suboption of `Option External_File` to limit external file IRV output. See .OPTION SET_MISSING_VALUES

- `Option large_scale_mc=no|yes`

  Default) *no*, if sample size<1m; *yes*, if sample size>=1m. When sample size is larger than 1 M, HSPICE evokes streaming algorithm for Monte Carlo automatically and the following warning message is issued:

  ```
  **warning** The Monte Carlo sample size >=, one million
  and HSPICE is switching to the large sample mode, (option
  Large_Scale_MC = Yes) for efficient computations and
  lower disk space requirements. If you do not want this
  feature, please set Large_Scale_MC = No in variation
  block.
  ```

- `Option measure_file=no|yes`

  Essential for validation of the results and for initial deployment. You can get all the simulations done in one pass with `large_sacle_mc=Yes` and `measure_file=Yes`. Default is *no*.

- `Option tail_samples=100|#`

  Controls the tail samples to be retained. Default is *100*.

- `Option histogram_bins=800|#`

  Controls the resolution of histograms. Default is *800*.

- `Option sensitivity_analysis = yes| no`

  Controls the generation of a sensitivity table in the `.mpp0` file. The default value for this option is `yes`.

- `Option qqnorm_file = yes| no`

  Controls the generation of the Q-Q table file. This file has the extension `.qqt0.csv`. You can plot the data in the file in Excel. The default value for this option is `yes`.

See Also

Variability Analysis Using the Variation Block

Monte Carlo Analysis — Variation Block Flow

A

HSPICE Control Options Notes

Describes the effects of specifying control options on other options in the netlist.

This chapter covers the following topics:

Control Options–Aliases and Defaults

- ABSTOL aliases ABSI
- VNTOL aliases ABSV
- If ABSVDC is not set, VNTOL sets it.
- DCTRAN aliases CONVERGE
- GMIN does not overwrite GMINDC, nor does GMINDC overwrite GMIN
- RELH only takes effect when ABSH is nonzero
- RELTOL aliases RELV
- RELVDC defaults to RELTOL
- If RELTOL < BYTOL then BYTOL = RELTOL
- RELVAR applies to LVLTIM = 1|3 only
- CHGTOL, RELQ, and TRTOL are the only error tolerance options for LVLTIM = 2 (LTE)

- The `DVDT` algorithm works with `LVLTIM = 1 and 3`
- `.OPTION M_IN_EXP` aliases `.OPTION XMULT_IN_EXP`.

Obsolete Options–Transient Time Step and Accuracy

The following options used for original transient time step and accuracy algorithms are obsolete:

Control Option	Description	Category	Associated Command
.OPTION ABSH	Sets the absolute current change through voltage-defined branches.	Error Tolerance	-
.OPTION ABSV	Sets the absolute minimum voltage for DC and transient analysis.	Error Tolerance	.DC .TRAN
.OPTION ABSVAR	Sets the absolute limit for maximum voltage change between time points.	Error Tolerance	-
.OPTION CHGTOL	Sets a charge error tolerance.	Error Tolerance	-
.OPTION DI	Sets the maximum iteration to iteration current change in HSPICE.	Speed and Accuracy	-
.OPTION DVDT	Adjusts the time step based on rates of change for node voltage.	Speed and Accuracy	-
.OPTION DVTR	Limits the voltage in transient analysis.	Speed and Accuracy	-
.OPTION FAST	Disables status updates for latent devices; this speeds up simulation.	Speed and Accuracy	-
.OPTION FS	Decreases FS value to help circuits that have time step convergence difficulties.	Speed and Accuracy	.TRAN
.OPTION FT	Decreases delta by a specified fraction of a time step for iteration set that does not converge.	Speed and Accuracy	.TRAN
.OPTION IMAX	Specifies the maximum time step in time step algorithms for transient analysis.	Speed and Accuracy	-
.OPTION IMIN	Specifies the minimum time step in time step algorithms for transient analysis.	Speed and Accuracy	-
.OPTION ITL3	Specifies minimum time step in time step algorithms for transient analysis.	Speed and Accuracy	.TRAN

Control Option	Description	Category	Associated Command
.OPTION ITL4	Specifies maximum time step in time step algorithms for transient analysis in HSPICE.	Speed and Accuracy	.TRAN
.OPTION LVLTIM	Selects the time step algorithm for transient analysis.	Transient Control Integration	-
.OPTION MBYPASS	Computes the default value of the BYTOL control option.	Bypass	-
.OPTION RELH	Sets the relative current tolerance from iteration to iteration through voltage-defined branches.	Error Tolerance	-
.OPTION RELI	Sets the relative error/tolerance change from iteration to iteration.	Error Tolerance	-
.OPTION RELQ	Sets the time step size from iteration to iteration.	Error Tolerance	-
.OPTION RELTO	Sets the relative error tolerance for voltages from iteration to iteration.		-
.OPTION RELV	Sets the relative error tolerance for voltages from iteration to iteration.	Error Tolerance	-
.OPTION RELVAR	Sets the relative voltage change for LVLTIM=1 or 3 from iteration to iteration.	Error Tolerance	-
.OPTION REMAX	Sets the TSTEP multiplier, which controls the maximum value for the internal time step delta for HSPICE.	Transient Control Limit	-
.OPTION REMIN	Sets the minimum value of delta (internal time step).	Speed and Accuracy	-
.OPTION TRTOL	Estimates the amount of error introduced when the time step algorithm truncates the Taylor series expansion.	Error Tolerance	-
.OPTION VNTOL	Duplicates the ABSV option.	Error Tolerance	-

Influence of an Option on Other Options

Note: This section applies to the original HSPICE tolerance and time step options that are now obsolete since RUNLVL is now the default tolerance and time step control.

The following options either impact or are impacted by the specifying of other .OPTION parameters:

Specifying...	Sets the values of other options as follows...
.OPTION METHOD=*GEAR*	BYPASS = 0 BYTOL = 50u DVDT = 3 LVLTIM = 2 MBYPASS = 1.0 METHOD = 2 RMAX = 2.0 SLOPETOL = 500m
.OPTION ACCURATE=[*0*|*1*]	ABSVAR = 0.2 ACCURATE = 1 BYPASS = 2 DVDT = 2 FFT_ACCU = 1 FT = 0.2 LVLTIM = 3 RELMOS = 0.01 RELVAR = 0.2
.OPTION FAST=[*0*|*1*]	BYTOL = 50u DVDT = 3 BYPASS = 0 DVDT = 2 FAST = 1 MBYPASS = 1.0 RMAX = 2.0 SLOPETOL = 500m

Specifying...	Sets the values of other options as follows...
.OPTION METHOD=*GEAR* first followed by .OPTION ACCURATE=[*0*|*1*]	ABSVAR = 0.2 ACCURATE =1 BYPASS = 2 BYTOL = 50u DVDT = 2 FFT_ACCU = 1 FT = 0.2 LVLTIM = 3 MBYPASS = 1.0 METHOD = 2 RELMOS = 0.01 RELVAR = 0.2 RMAX = 2 SLOPETOL = 500m
.OPTION ACCURATE=[*0*|*1*] first followed by .OPTION METHOD=*GEAR*	ABSVAR = 0.2 ACCURATE =1 BYPASS = 2 BYTOL = 50u DVDT = 3 FFT_ACCU = 1 FT = 0.2 LVLTIM = 2 MBYPASS = 1.0 METHOD = 2 RELMOS = 0.01 RELVAR = 0.2 RMAX = 2 SLOPETOL = 500m

Specifying...	Sets the values of other options as follows...
.OPTION ACCURATE=[*0*|*1*] with .OPTION FAST=[*0*|*1*]	ABSVAR = 0.2 ACCURATE =1 BYPASS = 2 BYTOL = 50u DVDT = 2 FAST = 1 FFT_ACCU = 1 FT = 0.2 LVLTIM = 3 MBYPASS = 1.0 RELMOS = 0.01 RELVAR = 0.2 RMAX = 2 SLOPETOL = 500m **Note:** The .OPTION ACCURATE and .OPTION FAST options are order-independent.
.OPTION METHOD=*GEAR* with .OPTION FAST=[*0*|*1*]	BYTOL = 50u DVDT = 3 FAST = 1 LVLTIM = 2 MBYPASS = 2 METHOD = 0.01 RMAX = 2 SLOPETOL = 500m **Note:** The .OPTION METHOD=GEAR and .OPTION FAST options are order-independent.

Specifying...	Sets the values of other options as follows...
.OPTION METHOD=*GEAR* with .OPTION ACCURATE=[*0*|*1*] and .OPTION FAST=[*0*|*1*]	ABSVAR = 0.2 ACCURATE =1 BYPASS = 2 BYTOL = 50u DVDT = 2 FAST = 1 FFT_ACCU = 1 FT = 0.2 LVLTIM = 3 METHOD = 2 MBYPASS = 1.0 RELMOS = 0.01 RELVAR = 0.2 RMAX = 2 SLOPETOL = 500m **Note:** If .OPTION METHOD=GEAR is specified first followed by .OPTION ACCURATE and .OPTION FAST, then DVDT=2 and LVLTIM=3 else all the options are order-independent.
.OPTION RUNLVL=*1*|*2*|*3*|*4*|*5*|*6*	BYPASS = 2 **Note:** If .OPTION METHOD=GEAR with RUNLVL=0, then BYPASS=0. DVDT = 3 LVLTIM = 4 RUNLVL = N SLOPETOL = 500m
.OPTION RUNLVL=*1*|*2*|*3*|*4*|*5*|*6* with .OPTION ACCURATE=[*0*|*1*], .OPTION FAST=[*0*|*1*], and .OPTION METHOD=*GEAR*	RUNLVL option (LVLTIM = 4) is always on. GEAR method is always selected. RUNLVL = 5 is always selected. FAST has no effect on RUNLVL. **Note:** All the options are order-independent.
.OPTION DVDT=*1*|*2*|*3*	BYPASS = 0 BYTOL = 50u MBYPASS = 1.0 RMAX = 2 SLOPETOL = 500m

Specifying...	Sets the values of other options as follows...
.OPTION LVLTIM=[*1*|*2*|*3*]	BYPASS = 0 BYTOL = 50u MBYPASS = 1.0 RMAX = 2 SLOPETOL = 500m **Note:** The DVDT value is ignored if LVLTIM = 2.
.OPTION KCLTEST=*0*|*1*	ABSTOL = 1u RELI = 1u **Note:** KCLTEST is order-dependent with ABSTOL and RELI.

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