NAME

s2ibis - convert SPICE models to IBIS models

SYNOPSIS

s2ibis input_file [output_file]

DESCRIPTION

s2ibis reads in a *s2ibis* input file and produces a Version 1.1 IBIS model file. The *s2ibis* input file consists of a *s2ibis* header, a modified IBIS pin list, and a SPICE input deck describing the topology of the circuit to be modeled. *s2ibis* uses the *s2ibis* header and pin list to generate the IBIS model file header and pin list, and the input deck to generate SPICE input decks for each of the tables in the IBIS model file. *s2ibis* invokes SPICE to run each of the simulations, and collates the results into a syntactically-correct IBIS Version 1.1 model file.

s2ibis generates SPICE simulations for [Pullup], [Pulldown], [POWER_clamp], [GND_clamp], and [Ramp] tables, as is appropriate for each pin in the pin list. The resulting SPICE input and output files are created in the directory in which *s2ibis* is invoked. The files remain in this directory after execution has completed. The general naming scheme for the files is xxxyyyyy.spi or xxxyyyyy.out for the input and output files respectively, where xxx is a three-letter code name for the simulation type and yyyyy is the pin name. The first two characters of the xxx codes are: [Pullup]=pu, [Pulldown]=pd, [POWER_clamp]=pc, [GND_clamp]=gc, and [RAMP]=ru or rd, ru for the rising edge ramp (ramp up) and rd for the falling edge ramp (ramp down). The third character is t for typical, n for min, and x for max.

For all HSPICE and Berkeley SPICE 3 simulations, the standard error output of the simulation run is redirected to a file named xxxyyyyy.msg.

s2ibis reads input from input_file and puts its output on stdout, unless output_file is specified. In all cases s2ibis logs its activities to stderr, which is normally the console.

INPUT FILE

The *s2ibis* input file consists of three parts: 1) the header 2) the modified pin list 3) the SPICE input deck. All of the lines preceding the SPICE input deck must begin with the SPICE comment character, *.

s2ibis HEADER

The header is used to create the IBIS model file header. It consists of all lines before the modified pin list. The first four lines of the header are required. These lines must contain the following information:

LINE 1:*company_name

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        LINE 2:*device_name
        LINE 3:*package_type
        LINE 4:*technology
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Any string or combination of strings is acceptable for LINEs 1-3. LINE 4 must have the string BIPOLAR or the string CMOS somewhere after the asterisk. *s2ibis* uses this information to determine the correct temperature ranges to use for simulations.

OPTIONAL HEADER INFORMATION

Optional information may also be included in the header. Understanding the various options is crucial to efficient use of s2ibis.

s2ibis will automatically suppress the creation and simulation of SPICE decks if the corresponding output files already exist AND the iterate switch is found anywhere in the header. The syntax is:

*[Iterate]

This feature can be very important if any of the simulations initiated by s2ibis fails to complete; for example, due to convergence problems. In many cases a SPICE run can be coaxed to completion by tweaking the SPICE input deck. For example, the .OPTIONS mechanism can be used to change a tolerance parameter or choose a different numerical integration algorithm. Anything that can be done to coax SPICE to finish the table is acceptable, as long as the .PRINT card causes the table to be printed out in the same format that the original s2ibis-added .PRINT card would have, and the correct output file name is used. When the problem is resolved, *s2ibis* is reinvoked with the *[Iterate] line in the header. *s2ibis* checks to see if the associated output file exists before making up any SPICE decks, so the output file for the problem simulation, and the output files from any other completed simulations are read in instead. Any simulations for which output files are not found are invoked as usual. Using this technique it is easy to iteratively create an IBIS model. This technique can also be used to get *s2ibis* to create an IBIS model using SPICE outputs that were created by hand or by other programs, as long as the .PRINT format is the same as that used by *s2ibis*.

s2ibis defaults to Berkeley SPICE version 2, unless a line of the form:

*[Spice] spicetype

is found in the header, where spicetype can be 2,3,P, or H, which correspond to Berkeley SPICE 2, Berkeley SPICE 3, PSPICE, and HSPICE respectively. The selected version is reported on stderr during processing.

The [File Rev] defaults to 0.0 unless a line of the form:

*[File Rev] rev_string

is found in the header. This happens without warning. *s2ibis* will

accept any string for rev_string.

s2ibis inserts a default [Package] section into the output file unless the header contains such a section. This happens without warning. The syntax is identical to the IBIS version 1.1 syntax except that each line must be preceded by an asterisk. Please note that the comment character *must* be the default IBIS comment character: |

The syntax for adding [Source] [Notes] and [Disclaimer] sections is the same as IBIS Version 1.1 except that asterisks are required at the beginning of each line.

s2ibis automatically omits any clamp tables in which the typical clamp current is below 1 microampere. This limit can be changed to any current, using the following syntax:

*[Clamp_Tolerance] amps

where amps is in Amperes. Thus *[Clamp_Tolerance] 1.0e-3 changes the limit to 1.0 milliamps.

s2ibis PIN LIST

Immediately following the header, *s2ibis* expects to find a pin list. The pin list is the same as a standard IBIS pin list except that after each non-NC pin entry a second line, called the pindata line, is inserted to help *s2ibis* to set up the subsequent SPICE simulations.

The format for the pindata line depends on the model_type of the associated pin. Eight model_types are currently supported: 1) Input 2) Ouput 3) I/O 4) 3-state 5) Open_drain 6) POWER 7) GND 8) NC.

For pins with model_type Input, the pindata line has the following format:

*model_type SPICE_NODE polarity vil vih

The model_type field must be Input. The SPICE_NODE field is used to specify which node in the attached SPICE deck corresponds to the pin. The polarity field should be 1 for inverting inputs and 0 for non-inverting inputs. The vil field should be a floating point number specifying the voltage that this input should be driven to when a logic low is to be applied. The vih field is similar for the logic high situation.

For pins with model_type Output, I/O, 3-state, and Open_drain, the pindata line has the following format:

*model_type SPICE_NODE ramp_time input_pin [enable_pin] [polarity] [vil] [vih]

The model_type field must be Output, I/O, 3-state, or Open_drain. The SPICE_NODE field is as above. The ramp_time field should be a floating

point number specifying suggested minimum length for the SPICE .TRAN

analysis to be used for generating the [Ramp] tables. All output pins must have an associated input pin. The input_pin field refers to the pin name, *not* the SPICE node name. If the model_type is I/O or 3-state, an enable_pin field is expected, specifying the pin name for the pin that enables the associated output. For I/O pins, the polarity, vil, and vih entries are required, and work just like the analogous entries for an Input pin, described above.

For POWER pins, the pindata line has the following format:

*model_type SPICE_NODE vpwr_typ [vpwr_min] [vpwr_max]

The model_type field must be POWER. The SPICE_NODE field operates as described above. The vpwr_typ field is required. A floating point number is expected, describing the nominal supply voltage to be applied. If multiple POWER pins are specified, *s2ibis* will ignore all except the first.

For GND pins, the pindata line has the following format:

*model_type SPICE_NODE

The SPICE_NODE field operates as described above. Only the first GND pin is acknowledged by *s2ibis*.

Extra lines may optionally be added after a pindata line to specify optional parameters for the [Model] associated with that pin. These lines must begin with a double-asterisk: **. Any line following a pin-data line, and beginning with a double-asterisk will be searched for keywords. The keywords affect the creation of the [Model] for the associated pin. If a keyword is not found, the line will be ignored, thus this technique can be used for inserting comments in the input file. The following keywords are currently recognized:

NoModel (suppresses creation of [Model] entirely)

NoPolarity (suppresses the Polarity parameter)

NoEnable (suppresses the Enable parameter)

Polarity (used to override the Polarity parameter)

Enable (used to override the Enable parameter)

Vinl (the line is copied to the [Model])

Vinh (the line is copied to the [Model])

C_comp (the line is copied to the [Model])

Input_ramp_xxx vil vih tr tf (allows customization of the input

ramp for Ramp tables. xxx can be typ, min, or max, and each must be entered separately or the default will be used. The units are Volts, Volts, seconds, and seconds, respectively.)

Thus, **Vinl = 0.45V can be used to add the following line to the associated [Model]:

Vinl = 0.45V

**Polarity Inverting can be used to force the Polarity parameter in a [Model] to be listed as Inverting, even if the associated pin is Non-Inverting.

The C_comp entry in all models defaults to:

C_comp 5.0pF 5.0pF 5.0pF

if no C_comp is specified in the pin list. This happens without warning.

Finally, the [Pin] section must end with an [Endpin] card:

*[Endpin]

SPICE DECK

The input SPICE deck should contain only circuit elements needed to describe the circuit. The power supply and voltage sources are automatically generated by *s2ibis*. Similarly, control cards probably should not be present in the SPICE deck. *s2ibis* uses default SPICE parameters, so users with convergence problems might want to use the .OPTIONS card to mitigate them.

RESTRICTIONS

SPICE convergence problems may result in missing tables. *s2ibis* tries to continue in the event of problems in the SPICE runs, reporting problems on stderr.

Temporary SPICE input and output file names are not variable and s2ibis will overwrite existing files automatically.

s2ibis does not check to make sure that the output file name meets the requirements of IBIS Version 1.1. (all lower case, .ibs extension, DOS compatible)

A temporary file named s2ibis.tmp is created. *s2ibis* will write to this file without asking for permission.

s2ibis expects all voltages to be expressed in Volts, all times to be expressed in seconds, all currents to be expressed in Amperes. Unit suffixes are not recognized.

s2ibis uses only Berkeley SPICE version 2 or 3, PSPICE, or HSPICE, using the following calls:

```
spice inputfile outputfile
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spice3 -b inputfile &gtoutputfile 2&gtmessagefile

PSPICE inputfile outputfile /D0

hspice inputfile &gtoutputfile 2&gtmessagefile
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The calls for SPICE3 and HSPICE are tailored for UNIX systems which use the Bourne shell (sh) for invoking system calls. The calling sequence may have to be modified for users of SPICE3 and HSPICE that do not use UNIX operating systems. Proprietary versions of SPICE which use different output formats or different calling sequences may not work properly with *s2ibis*.

The pipe character (|), which is the default comment character for IBIS, must be used in any situation where user-specified comments are inserted directly into the output file. For example, if the [Package] keyword is found in the *s2ibis* header, the user-specified [Package] section is copied directly to the output file. If a comment line is included, it must use the pipe character.

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