BUFFER ISSUE RESOLUTION DOCUMENT (BIRD)

BIRD NUMBER: ***Draft 4 December 2, 2014***
ISSUE TITLE: *C_compModel Using IBIS-ISS*
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DATE REVISED: *{date(s) you sent any revisions to the document}*
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STATEMENT OF THE ISSUE:

This BIRD enhances IBIS to allow an alternative C_comp Model using and IBIS-ISS subckt.

ANALYSIS PATH/DATA THAT LED TO SPECIFICATION:

Definitions:

The IBIS-ISS package interconnect BIRD allows for on-die interconnect circuit between the IBIS buffer and the die pad. This BIRD shall assume that VT and IV curves are measured at the terminals of the [Model]. If there is no on-die interconnect model, then this is the "Pad" in legacy IBIS models. If there is on-die interconnect, and an associated on-die interconnect model, then the IV and VT curves are assumed to be measured at the node between the [Model] and on-die interconnect.

- If the VT and IV curves are measured in a test fixture that includes the on-die interconnect, package and test fixture itself, then all of the on-die interconnect, package and test fixture shall be de-embedded to give the VT and IV curves as if generated using the following simulation method.
- If the VT and IV curves are generated by SPICE simulation it shall be assume that the SPICE model shall include the C_Comp Model and that the terminal of the SPICE model shall be connected the Device Under Test (DUT, IBIS 6.0, page 70) directly to the Test Fixture. When using the C_comp Model, the model may not use L_dut, R_dut and C_dut.

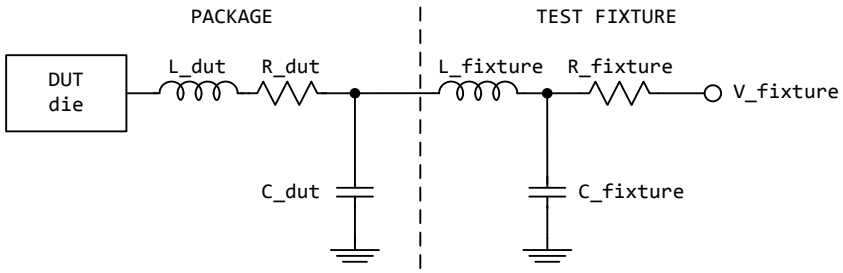
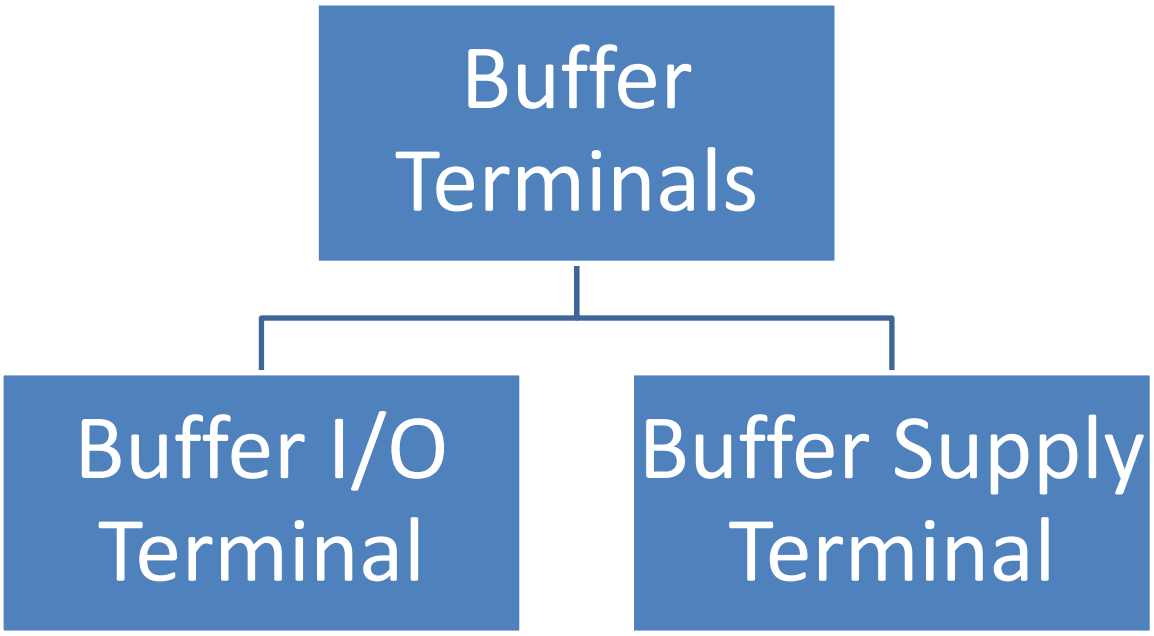


Figure 15 - [Rising Waveform] and [Falling Waveform] Fixtures

NOTE: The use of L_dut, R_dut, and C_dut is strongly discouraged in developing waveform data from simulation models. Some simulators may ignore these parameters because they may introduce numerical time constant artifacts.

70



ANY OTHER BACKGROUND INFORMATION:

{These documents will be archived, so use this section to add any detail that is not part of the section above or the changed text itself , but should not be lost.}

Keyword: **[C_comp Model]**

Required: No

Description: Marks the beginning of a C_comp model description.

Example:

```
[C_comp Model]
```

The following subparameters are defined:

Language
Param
File_TS
File_ISS
Number_of_Terminals
Terminal

Unless noted below, no subparameter requires the presence of any other subparameter. Each subparameter is optional.

Number_of_Terminals rules:

The Number_of_Terminals subparameter is required and defines the number of terminals associated with the C_comp Model. The subparameter name is followed by a single integer argument greater than zero on the same line, separated from the subparameter name by whitespace. Only one Number_of_Terminals subparameter may appear for a given [C_comp Model] keyword.

Param rules:

The subparameter Param is optional and only legal for File_ISS references. Param shall be followed by four arguments: a string argument, param_name, which is the name of the parameter to be passed into the IBIS-ISS; and three numerical values or three string values (surrounded by double quotes) located in the typ, min, and max columns. Several Param lines are permitted as long as each of the param_name entries is unique within that [C_comp Model] keyword. Each Param line shall have a typ entry. Either or both the min and max entries may be NA, in which cases the typ entry is used. The typ, min, and max parameters are, by default, associated with the corner_name Typ, Min, and Max files and their corresponding circuit_names. However, the EDA tool is expected to support passing any of the Param typ, min, or max values, as selected by the User or EDA tool, into any File_ISS corner_name file. The Param values associated with any param_name shall all be numerical or all string values (or NA). If possible, the Param min and max values should represent slow and fast interconnect conditions. Because of parameter interactions, this may not always be possible.

Other Notes: The numerical value rules follow the scaling conventions in Section 3, GENERAL SYNTAX RULES AND GUIDELINES. The EDA tool is responsible for translating IBIS specified parameters into IBIS-ISS parameters. For example, 1 megohm, represented as 1M in Param would be converted to 1meg (1x is not recommended) in IBIS-ISS. The value 1Kohm is 1 ohm in IBIS and would therefore be passed into IBIS-ISS as 1

ohm, even though 1K is 1 kilohm in IBIS-ISS. Quoted string parameters are converted to the string parameter syntax in IBIS-ISS. For example, the Param value "typ.s2p" is converted to str('typ.s2p') in IBIS-ISS.
The base unit of frequency is hertz, and the base unit of length is meter. Values can be passed in terms of other base units of length if scaling conversions are added to the IBIS-ISS .subckt definition. For example, the intended value of 10 mils might be entered as the Param value of 10 if the conversion to 10 mils is done through multiplication within the .subckt.

Examples:

```
| Param      param_name typ       min       max
Param        abc        2m        1m        2m
Param        def        4k        NA        NA
Param        ts_file    "typ.s2p" "min.s2p" "max.s2p" | used in IBIS-ISS
```

File_TS rules:

Either File_TS or File_ISS is required for a [C_comp Model]/[End C_comp Model] group. File_TS is followed by three entries for typ, min, and max file names. The typical entry is required and shall point to a Touchstone file located in the same directory as the .ibs file and representing typical conditions. The minimum and maximum entries may point to the same file or other files representing minimum (slow) and maximum (fast) interconnect conditions or contain NA. If the entry is NA, the typical file entry shall be used.

Example:

```
| file_type  typ      min      max
File_TS      typ.s8p  min.s8p  max.s8p
```

or

```
| file_type  typ      min      max
File_TS      typ.s4p  min.s4p  NA
```

File_ISS rules:

Either File_TS or File_ISS is required for a [C_comp Model]/[End C_comp Model] group. The File_ISS subparameter is followed by three string arguments consisting of corner_name, file_name, and circuit_name (.subckt name) for that file and located in the same directory as the .ibs file. The corner_name shall be Typ, Min, or Max. File_ISS for the Typ corner_name is required, and File_ISS for the Min and Max corner_names are optional. If present, each File_ISS shall have a unique corner_name. If File_ISS for either the Min or Max corner_name is missing, the File_ISS for the Typ corner_name shall be used to describe the missing corner_name file reference. The Min and Max file_names should represent slow and fast interconnect conditions.

Example:

```
| file_type  corner_name file_name   circuit_name (.subckt name)
File_ISS     Typ         net.iss     netlist_typ
File_ISS     Min         net.iss     netlist_min | in same file as net.sp
File_ISS     Max         net_max.iss netlist_max | in separate file
```

Terminal rules:

One or more Terminal subparameters may appear under a given [C_comp Model] keyword. At least one Terminal subparameter is required. Each Terminal record contains information on a terminal of an IBIS-ISS subckt (or Touchstone file).

The Terminal subparameter is followed by three arguments: Terminal_number and Terminal_Location Terminal_number shall be a positive non-zero integer and less than or equal to the number of terminals in the Number_of_Terminals argument. The same Terminal_number shall not appear more than once for a given Interconnect Model. All Terminals must be present for a given Interconnect C_comp.

A C_comp Model can either replace C_comp by conntecting a single terminal of the C_comp Model at the same location of the Buffer Model that C_comp would be conntect, or can replace C_comp with a series model in which case the C_comp Model will require terminals at the output of the Buffer (Buf) and a terminal at a new Internal Buffer node (Buf_I).

Terminal_Location is a string, and shall have one of the values Buf, Buf_I, BufC, BufC_I, Buf_PURef, Buf_PDRef, Buf_PCRef, Buf_GCRef or Buf_XRef.

- Buf indicates this terminal connected to the buffer model I/O or signal terminal. This is the location that is either at the Die Pad, or there may optionaly be on-die interconnect between this terminal and the Die Pad.
- Buf_I is used when there is a series component to the C_comp Model.
- BufC indicates this terminal connected to the complementary (Inverting side) of a buffer model I/O or signal terminal. This is the location that is either at the Die Pad, or there may optionaly be on-die interconnect between this terminal and the Die Pad.
- BufC_I is used when there is a series component to the differential C_comp Model.
- Buf_PURef indicates this terminal connected to a specific buffer model pullup reference, Terminal_ID shall be a Pin_name, Model_name or Default.
- Buf_PDRef indicates this terminal connected to a specific buffer model pulldown reference, Terminal_ID shall be a Pin_name, Model_name or Default.
- Buf_PCRef indicates this terminal connected to a specific buffer model power clamp reference, Terminal_ID shall be a Pin_name, Model_name or Default.
- Buf_GCRef indicates this terminal connected to a specific buffer model ground clamp reference, Terminal_ID shall be a Pin_name, Model_name or Default.
- Buf_XRef indicates this terminal connected to a specific buffer model external reference, Terminal_ID shall be a Pin_name, Model_name or Default.

Other Notes:

An Interconnect Model with File_TS with N Ports. N is either determined from the N in the .sNp file name extension for a Touchstone I file or from the [Number of Ports] record in a Touchstone II file. The [Number of Terminals] in the Interconnect Model shall be N+1. Terminal Rules are described below:

- The EDA tool shall use the Pin_name or Signal_name specified in the Terminal "N+1" record as the reference node for each of the N ports.
- Terminal/Port Mapping
    - Terminal Port
    - 1 1

  - 2 2
  - …
  - N N
  - N+1 reference
- It shall be an error if Terminal N+1 is not specified to a Buffer that is not on a connection to a Signal_name that is POWER or GND

Examples:

```
[C_comp Model]
Language IBIS-ISS
File_ISS     Typ         A.iss     A
Param        C    1pF    2pF    .5pF
Number_of_Terminals 1
Terminal 1 Buf
[End C_comp Model]

[C_comp Model]
Language Touchstone
File_TS  C_typ.s2p  C_min.s2p  C_max.s2p
Number_of_Terminals 2
Terminal 1 Buf_I
Terminal 2 Buf
[End C_comp Model]

[C_comp Model]
Language IBIS-ISS
File_ISS     Typ         B.iss     B
Number_of_Terminals 3
Terminal 1 Buf_I
Terminal 2 Buf
Terminal 3 Buf_GCRef
[End C_comp Model]

[C_comp Model]
Language Touchstone
File_TS  C_typ.s4p  NA NA
Number_of_Terminals 4
Terminal 1 Buf_I
Terminal 2 BufC_I
Terminal 3 Buf
Terminal 4 BufC
[End C_comp Model]
```

Keyword: [**End C_comp Model**]
Required: Yes, to end the **[C_comp Model**] keyword
Description: Indicates the end of the C_comp model data.
Other Notes:

The following section should be appended to the end of the IBIS document.

RULES OF PRECEDENCE

The EDA tool shall either use C_comp or [C_comp Model], but not both. The user and EDA tool may assume that the [C_comp Model] is more accurate than C_comp.