

BUFFER ISSUE RESOLUTION DOCUMENT (BIRD)

BIRD NUMBER: (for administrative use)
ISSUE TITLE: [Pin Reference]
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DATE SUBMITTED: (Draft 5, June 28, 2016)
DATE REVISED: (for administrative use)
DATE ACCEPTED: (for administrative use)

DEFINITION OF THE ISSUE:

All voltage measurements (“IBIS Data”) that are used to generate voltage values for IBIS subparameters within the [Model], [Model Spec], [Submodel Spec], and [Receiver Thresholds] keywords are relative to a test fixture reference node or a simulator reference node.

IBIS defines the derivation of “IBIS Data” consisting of I-V, V-T, ISSO and voltage thresholds for a device under test. For I-V, voltages are defined as measured across the associated [Pullup], [Pulldown], [POWER Clamp], and [GND Clamp] elements. For V-T, ISSO and voltage thresholds, IBIS defines the reference node used to measure these voltages. IBIS contemplates the use of these models with the buffer supplied by specific rail voltages prescribed by the [Voltage Range], [Pullup Reference], [Pulldown Reference], [POWER Clamp Reference], [GND Clamp Reference], and [External Reference] (“[*Reference]”) keywords. These voltages are measured relative to the test fixture reference.

During a simulation that uses IBIS Models, the IBIS specification is not clear what node should be used as the reference node for the voltage at the buffer I/O. This is not an issue when the simulator supplies rail voltages Pullup_ref, Pulldown_ref, Power_clamp_ref, Gnd_clamp_ref and Ext_ref (“*_ref”) to a model relative to the simulator reference node (e.g. Node 0) that are same as the reference voltages (“[*Reference]”) supplied to the buffer when generating the IBIS Data (Device Under Test or DUT).

If the voltages at the rails (*_ref) relative to the simulator reference are not the same as the reference voltages (“[* Reference]”) supplied to the buffer when generating the IBIS Data the Device is In Action (DIA). The specification does not say how to measure the voltages at the DIA buffer I/O terminal and compare them to the thresholds that were generated relative to the test fixture reference. This BIRD clarifies this by stating that the EDA tool should use the same model terminal as the reference terminal during DIA that was used as the reference node during DUT measurement/simulation.

If any one of the [* Reference] values is 0.0V, then the corresponding *_ref terminal is the reference terminal during DUT, and should be used as the reference terminal during DIA.

In some I/O buffers the test fixture reference node is connected to a pin that is not connected to one of the I/O buffer terminals, and specifically, none of the [* Reference] values are 0.0V. This BIRD

enhances the IBIS specification to define the POWER or GND signal name that the EDA tool should use as the reference node for all I/O buffer terminal measurements.

If two [* Reference] have the same value then the two terminals are connected.

Given this clear definition of what a simulator should use as the reference node during DIA simulations, it is now possible to clarify how C_comp should be connected during DIA simulations.

IBIS states on page 72:

The absolute GND is the reference for the V_fixture voltage and the package model equivalent network. It can also serve as a reference for C_comp, unless C_comp is optionally split into ~~component attached to~~ the other reference voltages.

This “absolute GND” is the reference node for all measurements at the buffer when making DUT voltage measurements. During DIA simulations C_comp should be connected between the I/O terminal and the same location in the component that was used as the DUT reference node.

This BIRD relies on three editorial changes that can either be added to this BIRD, or included in the editorial changes currently being considered elsewhere:

- Add to Guideline #2 on page 9:
Note that these reserved name rules do not apply to pin names and signal names in the [Pin] section and node names in figures showing the interconnections between Devices Under Test (DUT) and the Test Fixture.
- Add new Guideline 15 on page 10:
15. There are a number of places in this document where a node in a figure is called “GND” or is an “Earth Ground Symbol”. This is meant to represent the Test Fixture reference node for all Device Under Test voltage measurements. The model terminal (or a pin) on this Test Fixture reference node is to be used by EDA tools as the reference node of all voltage measurements made at the other IBIS model terminals (or pins) in simulations.(Unless otherwise stated)
- Add the following new rule to the [Pin] section on page 21:
 - If two pins have the same signal_name, they must have the same model_name.

SOLUTION REQUIREMENTS:

The IBIS specification must meet these requirements:

Table 1: Solution Requirements

Requirement	Notes
1. Allow an EDA tool to use IBIS model thresholds in simulations where the voltages applied to a model rail terminals are not the same as the voltages applied to	

the rail terminals of the model when the “IBIS Data” is generated.	
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SUMMARY OF PROPOSED CHANGES:

This BIRD address this confusion by specifying supply node that the EDA tool should use as a reference node for measurements at the I/O pad when DIA.

For review purposes, the proposed changes are summarized as follows:

Table 2: IBIS Keywords, Subparameters, AMI Reserved_Parameters, and AMI functions Affected

Specification Item	New/Modified/Other	Notes
New [Component] section [Pin Reference]	New	It is not required that there is a [Pin Mapping] section in the [Component]

PROPOSED CHANGES:

Add to section 5 after [Pin Mapping]:

Keyword: [Pin Reference]

Required: No

Description: This keyword defines for any pin in the [Pin] section of the [Component] section the signal_name that has been used as the reference node for voltage measurements at the terminals of the model connected to the pin.

Sub-Params: pin_name, signal_name

Usage Rules: For each pin listed, a simulation node of the signal_name connection shall be used as the reference node of measurements at the pin_name node when comparing simulation results with model thresholds.

Pin_name must exist in the [Component] [Pin] section, and its pin must have a Model_name that is not POWER, GND or NC.

Signal_name must exist in the [Component] [Pin] section on at least one pin_name that has a model_name POWER or GND.

Other Notes: If a pin_name in the component section does not have an entry in the [Pin Reference] section, and there is a model_name on that pin that is not NC, POWER or GND, then the EDA tool should use as the reference node the rail terminal that has its DUT reference voltage ([Pullup Reference], [Pulldown Reference], [POWER Clamp Reference], [GND Clamp Reference], [Pullup Reference], and [External Reference]) defined as 0.0V in the model. If more than on [* Reference] values are 0.0 then (are they colapsed together, what to do if Pulldown_ref goes to one signal and Gnd_clamp_ref goes to a different signal_name).

During simulations, unless C_comp is optionally split into the other reference voltages, C_comp shall be connected between the buffer I/O terminal and the reference node.

Example:

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[Component] MECL
[Package]
R_pkg 1.0E-02 1.0E-02 1.0E-02
L_pkg 1.7E-09 1.7E-09 1.7E-09
C_pkg 4.2E-13 4.2E-13 4.2E-13
|
[Pin] signal_name model_name R_pin L_pin C_pin
1 IN in 1.0E-02 1.7E-09 4.2E-13
2 VCC POWER 1.0E-02 1.7E-09 4.2E-13
3 VEE POWER 1.0E-02 1.7E-09 4.2E-13
4 VSS GND 1.0E-02 1.7E-09 4.2E-13
[Pin Mapping] pulldown_ref pullup_ref gnd_clamp_ref power_clamp_ref
1 VEE VEE VCC VEE
[Pin Reference] signal_name
1 VSS
[Model] in
Model_type ECL_Input
Vinl = 0.35V
Vinh = 0.55V
C_comp 1.0pF 1.0pF 1.0pF
[POWER Clamp Reference] 2.0V 2.0V 2.0V
[GND Clamp Reference] -0.5V -0.5V -0.5V
[Temperature Range] 25.0 85.0 -40.0

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BACKGROUND INFORMATION/HISTORY:

Walter Katz gave a presentation “IO_Buffer_Reference_Terminal” in the June 7, 2016 IBIS-ATM meeting, describing this issue.