**BUFFER ISSUE RESOLUTION DOCUMENT (BIRD)**

**BIRD NUMBER:** (for administrative use) Draft 2

**ISSUE TITLE:** Reference\_terminal

**REQUESTOR:**  Walter Katz, Signal Integrity Software, Inc.

**DATE SUBMITTED:** (TBD)

**DATE REVISED:** (for administrative use)

**DATE ACCEPTED:** (for administrative use)

**DEFINITION OF THE ISSUE:**

IBIS defines the derivation of “IBIS Data” consisting of I-V, V-T, ISSO and voltage thresholds for a device under test. IBIS Data assumes that the buffer rail terminals are 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.

IBIS has assumed that the test fixture reference is “Ground”, and that the voltage of “Ground” was 0.0 V relative to the “Simulator Reference Node” (often refered to as “Node 0”). This assumption was made when data rates were 20 Meg. Data rates are now 56,000 Meg (56 Gig), and “Ground” is no longer a valid concept. At these high data rates, voltages at I/O buffer terminals must be measured relative to a local signal reference, and the only possible local signal references in an I/O buffer must be one of the rail terminals of the I/O buffer.

This BIRD introduces a new optional IBIS [Model] sub-parameter Reference\_terminal which will specify the rail reference terminal that shall be used to make all voltage measurements at all the terminals of the I/O buffer (excluding control terminals such as the stimulus and enable terminals which shall be relative the simulator reference node, e.g. Node 0).

This BIRD shall also define which rail terminal shall be the reference terminal when the Reference\_terminal is not specified.

Note that this BIRD only defines the reference terminal to use when making voltage measurements at the terminals of an I/O buffer. This BIRD does not define how the voltage measurements should be compared to measurement thresholds in the IBIS model when the voltages measured at the rail terminals relative to the Reference\_terminal are not the same as the DC Values defined by the keywords [Pulldown Reference], [Pullup Reference], [GND Clamp Reference], [POWER Clamp Reference] or [External Reference].

**SOLUTION REQUIREMENTS:**

The IBIS specification must meet these requirements:

Table 1: Solution Requirements

|  |  |
| --- | --- |
| Requirement | Notes |
| 1. Allow a model maker to specify the I/O buffer rail terminal to be used for all simulation voltage measurements.
2. Define the rail terminal to be used for all simulation voltage measurements when the model make does not specify one.
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**SUMMARY OF PROPOSED CHANGES:**

This BIRD address this confusion by using a new optional [Model] sub-parameter Reference\_terminal that specifies rail terminal that the EDA tool should use as a reference terminal for all measurements at the I/O buffer terminals.

**PROPOSED CHANGES:**

**Add to section 6.1, somewhere before [Model Spec]**

*Sub-Param:* **Reference\_terminal**

*Required:* No

*Description:* This sub\_parameter defines the terminal used as the reference terminal for voltage measurements at all rail and and I/O terminals of the buffer model.

*Usage Rules:* The value of Reference\_terminal shall be one of the following

pulldown\_ref

pullup\_ref

gnd\_clamp\_ref

power\_clamp\_ref

ext\_ref

pulldown\_ref and pullup\_ref are illegal for input models. If there is an [External Model] in the model then the Reference\_terminal must be one of the ports of the [External Model], the following table contains the mapping between the allowed values of the Reference\_terminal and the [External Model] port names:

pulldown\_ref A\_pdref

pullup\_ref A\_puref

gnd\_clamp\_ref A\_gcref

power\_clamp\_ref A\_pcref

ext\_ref A\_extref

The voltage at an I/O or rail terminal shall be:

Voltage at terminal = V(terminal,Reference\_terminal)+[Reference\_terminal Reference]

Where [Reference\_terminal Reference] is defined by the following table

Reference\_terminal [Reference\_terminal Reference]

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pulldown\_ref [Pulldown Reference]

pullup\_ref [Pullup Reference]

gnd\_clamp\_ref [GND Clamp Reference]

power\_clamp\_ref [POWER Clamp Reference]

ext\_ref [External Reference]

*Other Notes:* If a [Model] does not have a Reference\_terminal sub-parameter then

If any one of the keywords [Pulldown Reference], [Pullup Reference],

[GND Clamp Reference], [POWER Clamp Reference] or [External Reference] have a value of 0.0 V, then:

All the terminals that have a value of 0.0 V shall be shorted together and any one of these terminals can be used as the Reference\_terminal.

If none of the keywords [Pulldown Reference], [Pullup Reference],

[GND Clamp Reference], [POWER Clamp Reference] or [External Reference] have a value of 0.0 V, then:

The EDA tool can choose any of these terminals as the Reference\_terminal depending on the I/O buffer Model\_type.

Change 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.

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For a device under test, C\_comp may be treated as connected to the test fixture reference node which in SPICE-to-IBIS simulations may be the simulator reference node “GND” or Node 0. If C\_comp is not split into rail terminals using sub-params C\_comp\_pullup, C\_comp\_pulldown, C\_comp\_power\_clamp and/or C\_comp\_gnd\_clamp the EDA tool should connect C\_comp to the Reference\_terminal or split it among the rail terminals as the EDA tool or User chooses.

**BACKGROUND INFORMATION/HISTORY:**

Walter Katz gave a presentation “IO\_Buffer\_Reference\_Terminal” in the June 7, 2016 IBIS-ATM meeting, describing this issue.