**BUFFER ISSUE RESOLUTION DOCUMENT (BIRD)**

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

**ISSUE TITLE:** [Pin Reference]

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

**DATE SUBMITTED:** (Draft 2, May 3, 2016)

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

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

**DEFINITION OF THE ISSUE:**

All measurements (“IBIS Data”) that are used to generate voltage values for IBIS subparameters within the [Model], [Model Spec], [Submodel Spec], and [Receiver Thresholds] keywords and 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 these voltages. This is not an issue when the simulator supplies rail voltages (“\*\*\*\_ref”) to a model relative to the simulator reference node that are same as the reference voltages (“[\*\*\* Reference]”) supplied to the buffer when generating the IBIS Data. Some simulators use the terminal of the IBIS model that has a [\*\*\* Reference]=0.0V as the reference node for measurements. As a result, when a model is simulated with voltages applied to the models' rail terminals (relative to a simulator reference node) other than the prescribed values, it is not defined in the specification how to compare the voltages at the buffer I/O (pin) terminal with the thresholds that were generated relative to the test fixture reference.

**SOLUTION REQUIREMENTS:**

The IBIS specification must meet these requirements:

Table 1: Solution Requirements

|  |  |
| --- | --- |
| Requirement | Notes |
| 1. Allow an EDA tool to use IBIS model threshold 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. |  |
|  |  |

(Enumerate each requirement in the table above, adding rows as needed.)

**SUMMARY OF PROPOSED CHANGES:**

This BIRD address this confusion by specifying supply pin(s) whose voltage the EDA tool can use to adjust the voltage measurement at the model I/O terminal that can be compared with the model thresholds.

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 recommended, but 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 each pin in the [Pin] keyword for he same [Component] the bus\_label that has been used as the reference node for voltage measurements at the pin.

*Sub-Params:* pin\_name, bus\_label

*Usage Rules:* For each pin listed, the simulation node at the bus\_label shall be used as the reference node of measurements at the pin\_name node when comparing simulation results with model thresholds.

[Pin Reference] The [Component] must have a [Pin Mapping] section if [Pin Reference] is present.

Pin\_name must exist in the [Component] [Pin] section.

Bus\_label must exist in the [Component] [Pin Mapping] section on at least one pin\_name that has a model\_name POWER or GND in the [Pin] section.

*Other Notes:* If there is no [Pin Reference] section, or 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 must choose a reference node for simulation results at the pin\_name and rail terminals of the model. Some EDA tools use simulator Node 0 for this reference. Other EDA tools use the rail terminal that has its Reference voltage [\*\*\* Reference] ([Pullup Reference], [Pulldown Reference], [POWER Clamp Reference], [GND Clamp Reference], [Pullup Reference], and [External Reference]) defined as 0.0V in the model.

When analyzing the waveforms at the buffer to compare them to such things as Vinl, Vinh, Vmeas and Receiver Thresholds, the voltage at the I/O Pin relative to the simulator reference node, must be adjusted by the difference of the voltage at the [Pin Reference] terminal relative to the simulator reference node and the value of the [\*\*\* Reference] at the [Pin Reference] terminal. Note that the “Reference\_supply” in the [Receiver Thresholds] section may not be the same rail bus\_label as the bus\_label in the [Pin Reference] for that buffer. The equation for the adjusted Vth must also supply this correction to the voltage at the Reference\_supply terminal relative to the simulator reference node.

*Example:*

[Component] SAME\_RAILS

[Pin] signal\_name model\_name R\_pin L\_pin C\_pin

1 IO\_1 ECL\_0V

2 IO\_2 PECL\_5V

3 VCC POWER | 5V

4 VEE GND | 0V

5 VSS POWER | -5.0V

[Pin Mapping] pulldown\_ref pullup\_ref gnd\_clamp\_ref power\_clamp\_ref

1 VEE VEE VSS VEE | ECL\_0V

2 VCC VCC VEE VCC | PECL\_5V

3 NC VCC

4 VEE NC

5 NC VSS

[Pin Reference] bus\_label

1 VEE

2 VEE

3 VEE

5 VEE

[Model] ECL\_0V

Model\_type I/O\_ECL

Vinh = -1.13V | 3.87V

Vinl = -1.48V | 3.52V

Vmeas = -1.29 | 3.71

Rref = 50.0

Cref = 0.0

Vref = -2.0 | 3.0

[Voltage Range] 0.0V 0.0V 0.0V

| [Pullup Reference] 0.0V 0.0V 0.0V

| [Pulldown Reference] 0.0V 0.0V 0.0V

| [POWER Clamp Reference] 0.0V 0.0V 0.0V

| [GND Clamp Reference] 0.0V 0.0V 0.0V

[GND Clamp Reference] -5.0V -5.0V -5.0V

|

[Model] PECL\_5V

Model\_type I/O\_ECL

Vinh = 3.87V

Vinl = 3.52V

Vmeas = 3.71

Rref = 50.0

Cref = 0.0

Vref = 3.0

[Voltage Range] 5.0V 4.5V 5.5V

[Pullup Reference] 5.0V 4.5V 5.5V

[Pulldown Reference] 5.0V 4.5V 5.5V

[POWER Clamp Reference] 5.0V 4.5V 5.5V

| [GND Clamp Reference] 5.0V 4.5V 5.5V

**BACKGROUND INFORMATION/HISTORY:**

Walter Katz gave a presentation “Receiver\_Thresholds Assume GND=0.0V=Node 0” in the April 19, 2016 IBIS-ATM meeting, describing this issue.