**BUFFER ISSUE RESOLUTION DOCUMENT (BIRD)**

**BIRD NUMBER: 197.3**

**ISSUE TITLE:** New AMI Reserved Parameters DC\_Offset and NRZ\_Threshold

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**DATE ACCEPTED:**

**DEFINITION OF THE ISSUE:**

AMI modeling is now being applied to single-ended channels (e.g. DDR5). The current input to AMI\_Init is an Impulse Response. This forces all AMI simulations to be centered around the mid-level of the signal of a single-ended port. A DLL may need to know the single-ended voltage levels (e.g. to handle saturation in a DFE summer). On the other hand, with the inclusion of single-ended signal, it becomes more prominent that the Rx model needs to provide the threshold voltage used by EDA tools to determine the NRZ logic level at the Rx output. This BIRD proposes two new AMI Reserved Parameters. The first one, DC\_Offset, is the mid value of the beginning and end of the step response of the channel. The second one, NRZ\_Threshold, is the threshold for NRZ logic level detection at the Rx latch.

**SOLUTION REQUIREMENTS:**

The IBIS specification must meet these requirements:

Table 1: Solution Requirements

|  |  |
| --- | --- |
| Requirement | Notes |
| 1. Allow the EDA tool to convey to the model the mid-point of the steady state high and low voltages found during analog model characterization of single-ended signals.
2. Allow the receiver model to convey to the EDA tool the threshold to be used when detecting the NRZ logic level at the receiver latch.
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**SUMMARY OF PROPOSED CHANGES:**

Add new AMI Reserved Parameters DC\_Offset and NRZ\_Threshold.

**PROPOSED CHANGES:**

*Parameter:* **DC\_Offset**

*Required:* No, and illegal before AMI\_Version X.x

*Direction:* Rx

*Descriptors:*

Usage:                   In

Type:                     Float

Format:                  Value

Default:                 <numeric\_literal>

Description:<string>

*Definition:* The mean value of the steady state high and low voltages of the channel at the Rx pad.

*Usage Rules:* If the impulse response was generated by differentiating the step response, then the value of DC\_Offset should be the same as the average of the step response initial and final voltages.

It is assumed that the waveform input to the Rx AMI\_GetWave function is the physical Rx input waveform minus this DC\_Offset. The Rx AMI\_GetWave function may choose to reconstruct the physical waveform by adding DC\_Offset to the input waveform.

*Other Notes:*

1. It is the responsibility of the EDA tool to determine the DC\_Offset. The EDA tool may use any method to do this.
2. The Rx AMI\_GetWave output waveform is the physical waveform at the Rx latch. It can have a non-zero DC component, which can be time-varying.

*Example:*

DC\_Offset (Usage In) (Type Float) (Value 0.5)

(Description “The EDA tool is responsible for determining the DC\_Offset value to input to the executable model.”)

*Parameter:* **NRZ\_Threshold**

*Required:* No, and illegal before AMI\_Version X.x

*Direction:* Rx

*Descriptors:*

Usage:                   Out

Type:                     Float

Format:                  Value

Default:                 <numeric\_literal>

Description:<string>

*Definition:* The NRZ threshold voltage at the Rx latch.

*Usage Rules:* The EDA tool uses this voltage in conjunction with Rx clock information to detect the NRZ logic level when the Rx output waveform is sampled.

* Voltages *greater* than **NRZ\_Threshold + Rx\_Receiver\_Sensitivity**
* Voltages *lower* than **NRZ\_Threshold – Rx\_Receiver\_Sensitivity**

Voltages that do *not* fall into one of these regions are considered a symbol error.

The algorithmic model is expected to determine any output values from the AMI\_Init and AMI\_GetWave calls for the EDA tool to use during waveform and eye processing.

*Other Notes:* If this parameter is not in the .ami file, then its default value will be 0.0 Volts.

*Example:*

NRZ\_Threshold (Usage Out) (Type Float) (Value 0.002)

(Description “Threshold voltage to be used to detect the NRZ logic level at the Rx output.”)

**BACKGROUND INFORMATION/HISTORY:**

Typographical updates made in BIRD197.1, based on feedback from Open Forum and ATM review.

BIRD197.2 contains additional editorial changes.

BIRD197.3 contains editorial changes to the verbiage related to the usage of the words “single-ended”.

BIRD197.3 introduces the new reserved parameter NRZ\_Threshold.