

# Methods for Correlating an IBIS File

National Semiconductor Corp.  
Interface Products Group

## Introduction

When doing any simulation, the accuracy of the simulation models is pivotal to obtaining accurate results. IBIS (Input/Output Buffer Information Specification) files are widely used to represent devices in high-speed systems. The accuracy of an IBIS file needs to be determined before it can be used in a system level simulation. This paper describes different methods that can be used to correlate an IBIS file to a SPICE device model and to measurement data.

### Correlating IBIS Data to SPICE Data

Generating IBIS data from SPICE simulations is the preferred method for creating IBIS files. This allows process corner data to be included, and more control over the device to obtain the required IBIS data. To ensure the accuracy of the IBIS file, the file should be correlated against the SPICE device model that was used to gain the IBIS data. A set of different test loads can be used to correlate the IBIS file to the SPICE device model. In the defined test loads below, the SPICE file was simulated in Avanti HSPICE version 2001.2, and the IBIS file was simulated in Cadence Signal Explorer version 14.2.

### Standard Load

One test load to use is the manufacturer's specified load from the datasheet. This is important so the device characteristics can be compared against the datasheet to ensure the IBIS file will represent the device for its region of operation. A standard datasheet load for an LVDS-LVDS Buffer is shown below.

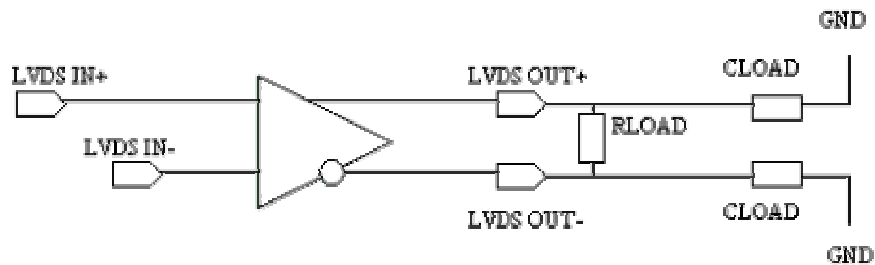


Figure 1. Standard Datasheet Load for an LVDS-LVDS Buffer

An IBIS file is compared to a SPICE device model file for an LVDS-LVDS Buffer for a standard load ( $R_{diff}=100\ \text{Ohms}$ ,  $C_{load}=5\text{pF}$ ) under typical conditions. ( $V_{cc}=2.5\text{V}$ ,  $Temp=25\text{C}$ ) The single-ended and differential results are graphed in the figures below. The small differences between the IBIS and SPICE simulation are due to several factors including data extraction resolution and how an IBIS simulator interprets the IBIS data. It should be noted that different IBIS simulators give different results (usually a small delta difference) when using the same IBIS file, due to that each simulator uses its own algorithm to process the IBIS data.

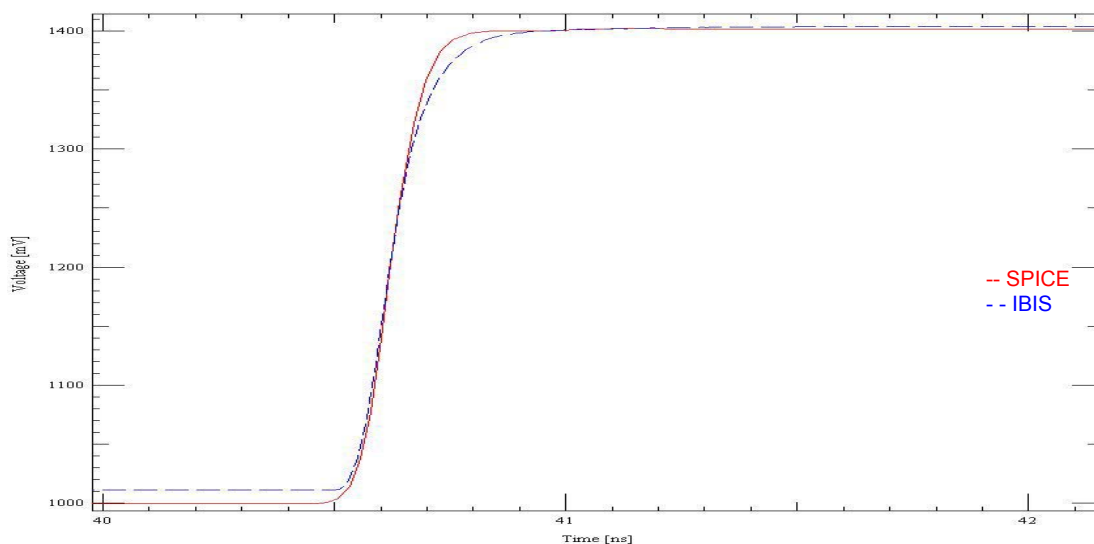


Figure 2. IBIS vs. SPICE (Single-Ended) for Standard Datasheet Load

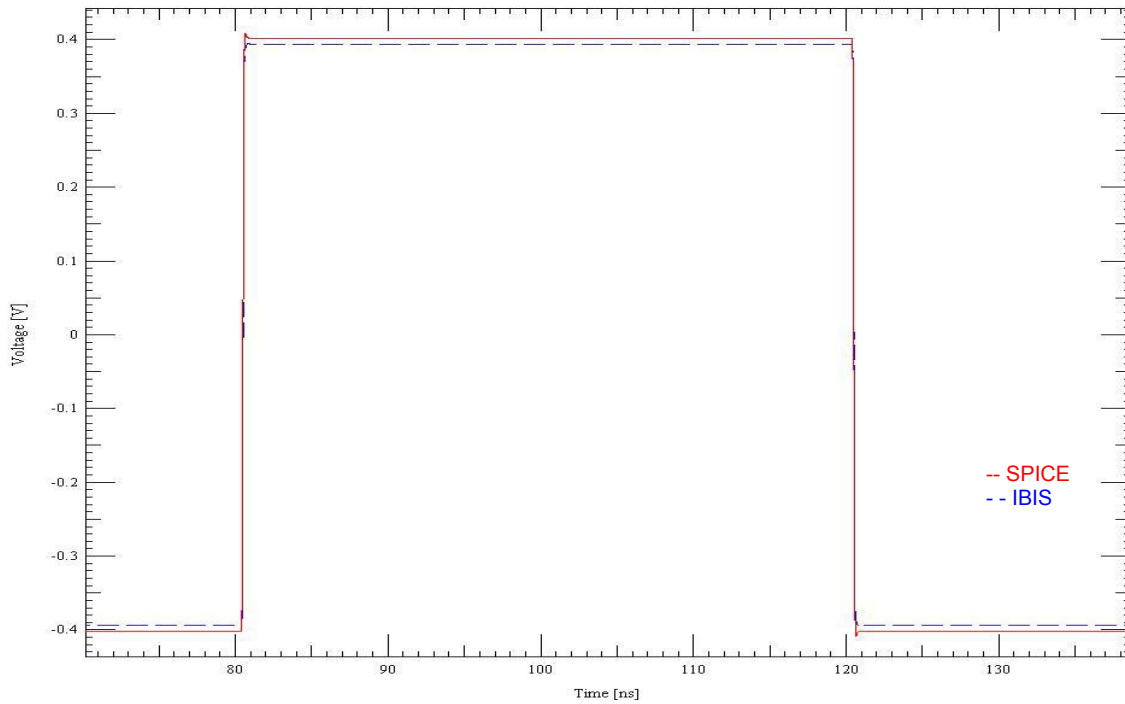


Figure 3. IBIS vs. SPICE (Differential) for Standard Datasheet Load

### Transmission Line

Another test load to use is a transmission line load. A transmission line load will represent real-world conditions that the device would see. The transmission line load will test the reflection coefficients of both the driver and receiver. A transmission line load for an LVDS-LVDS Buffer is shown below. A coupled lossy microstrip transmission line is used in this example.

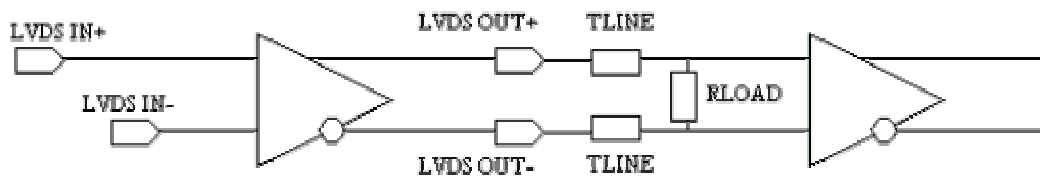


Figure 4. Transmission Line Load for an LVDS-LVDS Buffer

An IBIS file is compared to a SPICE device model file for an LVDS-LVDS Buffer for a transmission line load (T-Line  $Z_0=50$  Ohms, T-Line  $T_D=140$ ps/in.,  $R_{load}=100$  Ohms) under typical conditions. ( $V_{cc}=2.5$ V,  $Temp=25$ C) The single-ended and differential receiver inputs are graphed in the figures below. The small differences in the reflections between the IBIS and SPICE simulation are due to each simulator's own transmission line models.

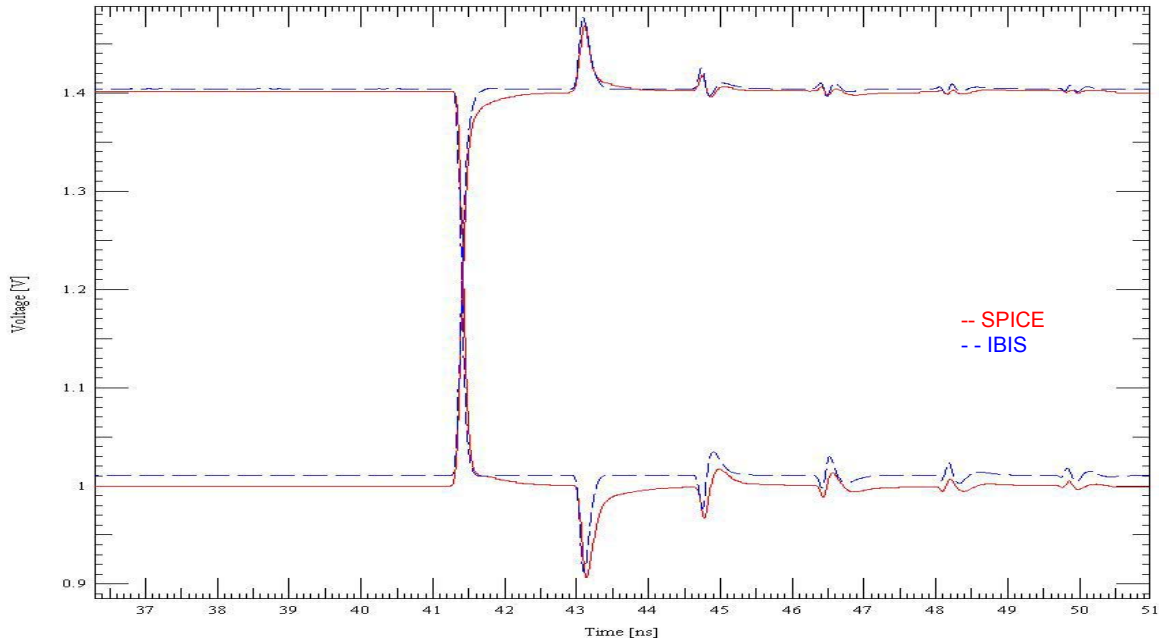


Figure 5. IBIS vs. SPICE (Single-Ended) for Transmission Line Load

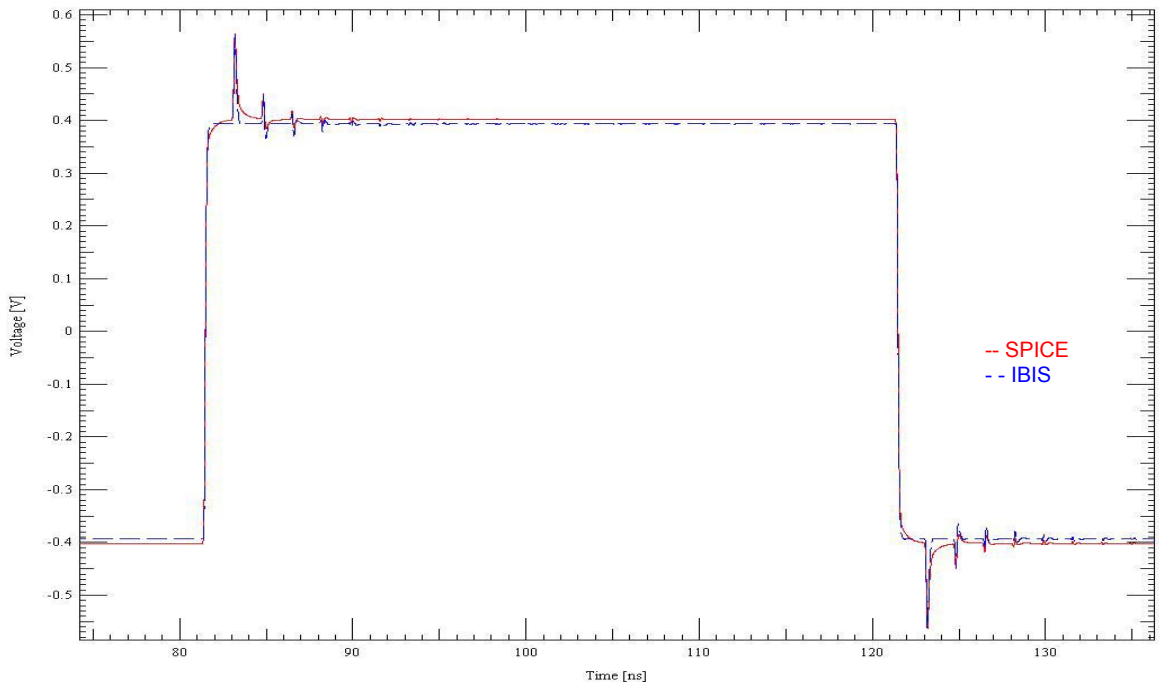


Figure 6. IBIS vs. SPICE (Differential) for Transmission Line Load

### Correlating IBIS Data to Lab Data

IBIS data can be generated from lab measurements. While process corner data is not usually collected from measurement, accurate typical IBIS data can be collected. For an Output model type in an IBIS file, it is important to correlate the I/V and V/T data. For the I/V data, the pullup and pulldown data are of interest. The pullup and pulldown data define the drive strength of the device. The pullup and pulldown IBIS data is compared to the pullup and pulldown lab data in the following figures.

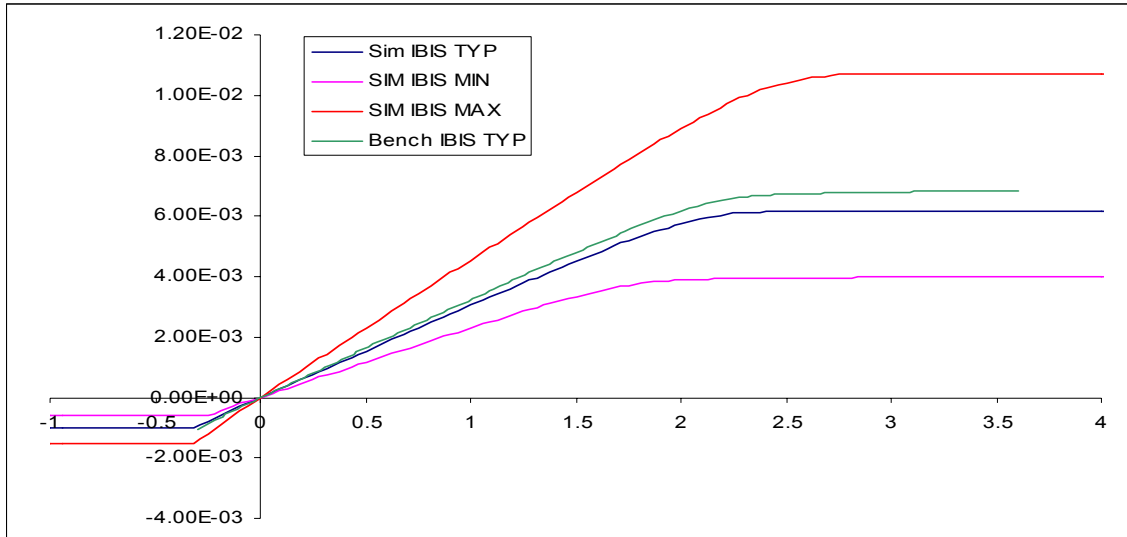


Figure 5. IBIS Pulldown Data vs. Lab Measured Pulldown Data

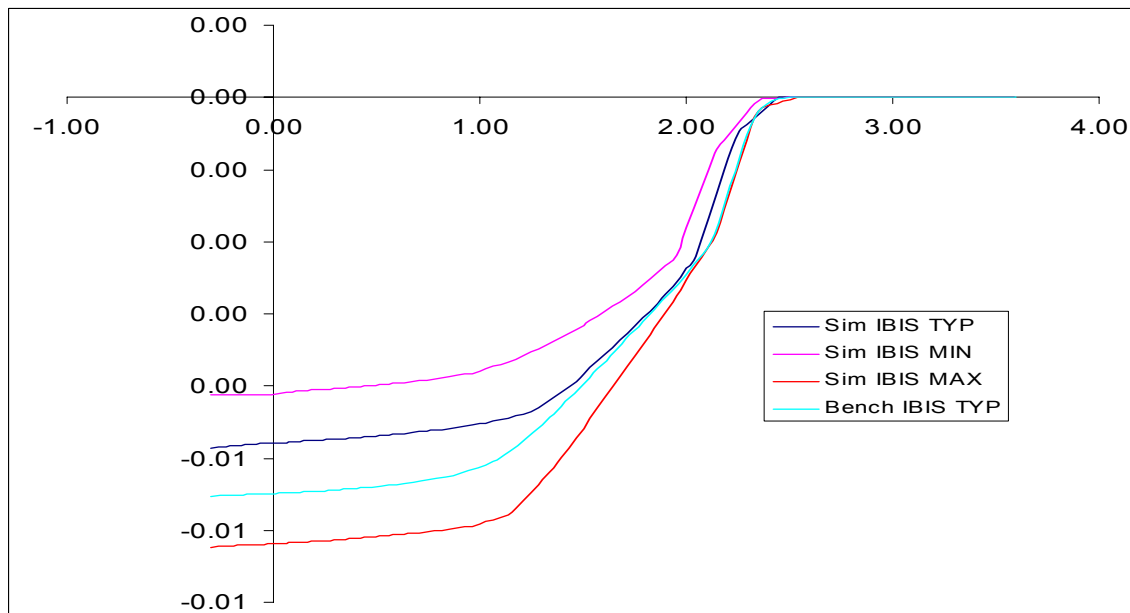


Figure 6. IBIS Pullup Data vs. Lab Measured Pullup Data

IBIS Short Topic Paper  
Methods for Correlating an IBIS File

The IBIS Bench data should fall within the boundaries of the simulated IBIS min and max process corner data. This ensures that the actual device works within the simulation boundaries.

**Summary**

This paper has shown how an IBIS file can be correlated to the original SPICE device model file under certain load conditions and how the simulated IBIS data can be compared to the measured IBIS data. These types of correlation methods are necessary to define the accuracy of an IBIS file.