

Using an Internally Terminated LVDS Receiver IBIS File

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Introduction

Internal termination for devices is becoming a popular method for terminating on high-speed point-to-point interconnects. The IBIS specification supports internal termination. However, there are some EDA tools that do not fully support internal termination of receivers in IBIS files currently. This paper describes methods of using internally terminated LVDS Receiver IBIS files in Mentor Graphics XTK and also in Avanti's HSPICE simulators.

Implementation of Internal Termination in IBIS

IBIS supports internal termination by using series pin mapping. IBIS has long supported termination models, such as resistors and capacitors. With series pin mapping, the two device pins where the internal resistor should be placed are linked to the resistor model. The syntax is listed below.

```
[Pin] signal_name  model_name      R_pin L_pin C_pin
|
1   in-      DS90LT012A_DINM   1.000m 0.008n 0.030p
3   in+      DS90LT012A_DINP   1.000m 0.008n 0.030p
|
[Series Pin Mapping] pin_2  model_name  function_table_group
|
3           1      rterm_100
|
[Model]
Model_type Series
|
|           TYP      MIN      MAX
|
C_comp      .1p      .1p      .1p
|
[R Series]      102      90      133
|
[Temperature Range] 25      85      -40
|
[Voltage Range]  3.30      3.00      3.60
|
```

This is an example of an LVDS receiver. The differential inputs, pins 1 and 3, are defined in the Series Pin Mapping section, associated with the resistor model. The resistor model, rterm_100, is defined below as a 100 Ohm resistor. (Note that for the process corners the resistor value will vary.)

Internal Termination in Mentor Graphics XTK

When an IBIS simulator processes an IBIS file, the internal termination model should automatically be applied to the simulation. In the current XTK release (XNS version 6.8.0.1), this is not yet supported. The internal termination can easily be added by modifying the topology file. The following is the XTK syntax for implementing the differential receiver.

```
NODE In1 1
SERIES In1 1&3 TYPE QUAD_FAKE_NODE NO_DISPLAY
NODE In1 3
```

Here the differential input pins are tied together by a fake series element (The default way that XTK handles a differential pair). The following is the XTK syntax for adding the internal termination.

```
NODE In1 1
SERIES In1 1&3 TYPE rterm_100
NODE In1 3
```

The resistor model now replaces the fake series element. The XTK translator should recognize that there is a series element between the differential inputs and apply the resistor model. This is a way to overcome the current tool limitation.

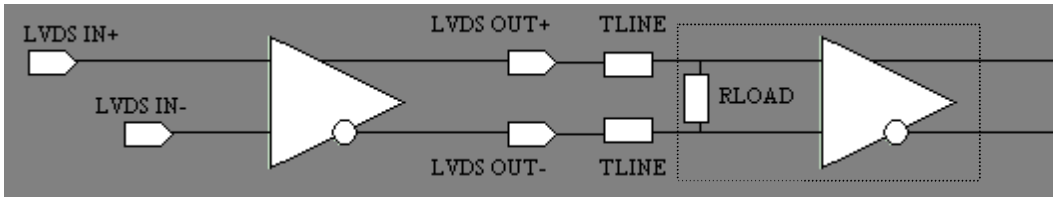


Figure 1. Test Load for Internal Terminated IBIS File

The topology shown in Figure 1 was used to test the internally terminated IBIS file in XTK. A three inch 50 Ohm lossless uncoupled transmission line was used. The resistor, Rload, is internal to the IBIS file. (The resistor was 100 Ohms.) The results are shown below in Figure 2. For the case where the internal resistor was not recognized, the excess ringing can be seen.

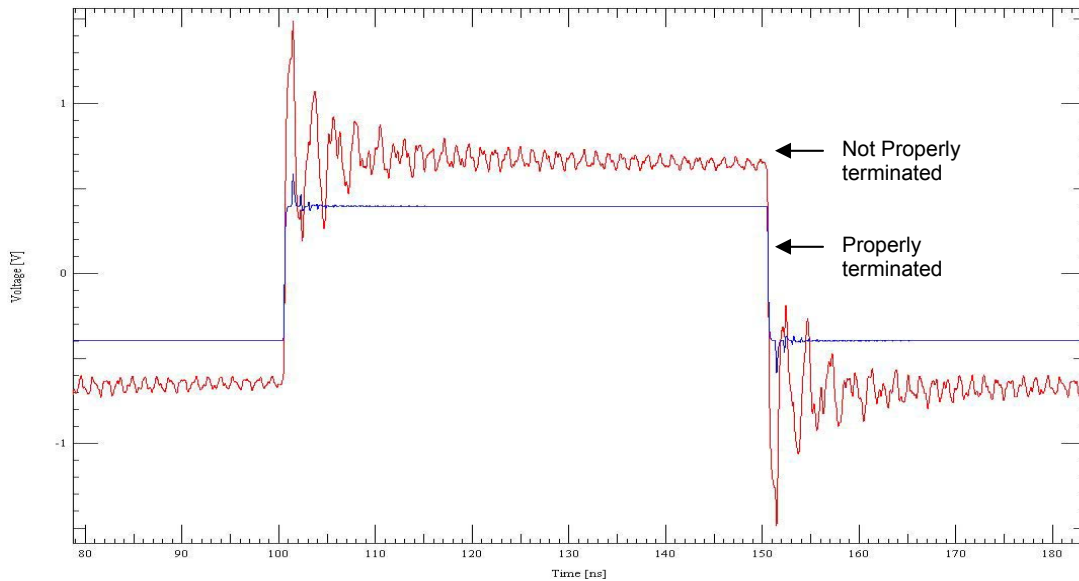


Figure 2. XTK Simulation of LVDS Receiver with Internal Termination

Internal Termination in Avanti HSPICE

When using an internally terminated IBIS file in Avanti HSPICE, the same issue occurs where the resistor model is not applied to the differential input pins. To overcome this, a resistor can simply be implemented in HSPICE and applied directly to the differential input pins. The following is the example HSPICE syntax to use.

```
Rinternal RINP RINM 100
```

In this example, RINP is the non-inverting differential input and RINM is the inverting differential input. Since the resistor is applied directly to the differential input pins, with no transmission lines or other elements attached to it, the resistor will behave as if it was an internal termination. (Note that these are the pins from the die and not from the package)

Summary

Internal termination in IBIS files is not directly supported in all tools, but there are simple solutions to overcome these tool limitations. Future revisions of the tools are expected to enhance the tools capability of supporting internal terminations.