Application Report
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DDR3 Register Input Bus Termination Measurement

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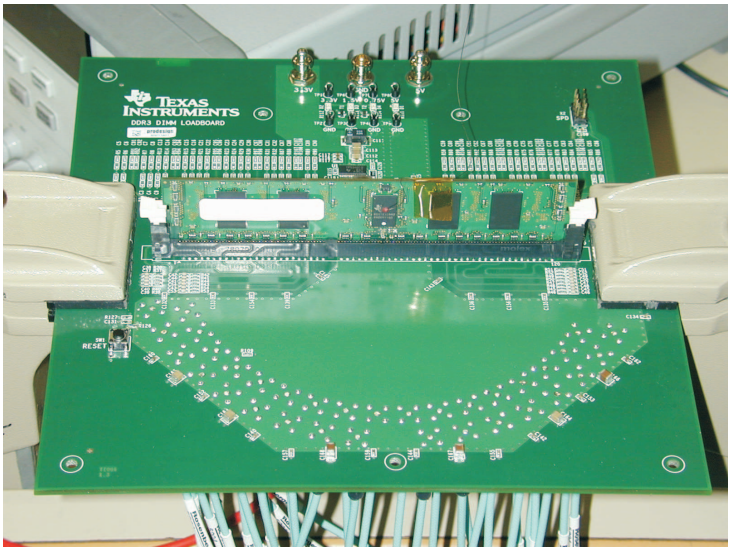
ABSTRACT

This application report demonstrates how to measure input bus termination (IBT) resistors accurately in a simple way using the Texas Instruments Register Validation Board (RVB) Lite. The IBT is the term used in context of the DDR3 register. Similar functionality or the termination on the DRAM (DDR2 and DDR3) is called on die termination (ODT).

As the memory channel has many stubs (DIMM slots), to reduce the reflections from each stub, a termination is usually used at the end of the stub. This termination is usually very close to the input stage and is integrated on the chip. For the DDR3 register, all command address and control inputs have IBT resistors. The accuracy of this resistor has to be within the specified range, and the system or the memory channel is optimized or designed to work (with good signal Integrity) within the specified range for each specified termination value.

Required Instruments

1. Texas Instruments (TI) recommends using a DDR3 register memory module with the TI RVB Lite as a component fixture for the DDR3 register (DUT).



2. Laboratory power supply is required to power the RVB Lite.
3. A clock generator (sufficient to measure the default IBT values) is needed to measure the nondefault IBT values. A pattern generator is required to program the CMR registers (also known as control words) of the DDR3 register.
4. An accurate digital multimeter is also necessary.

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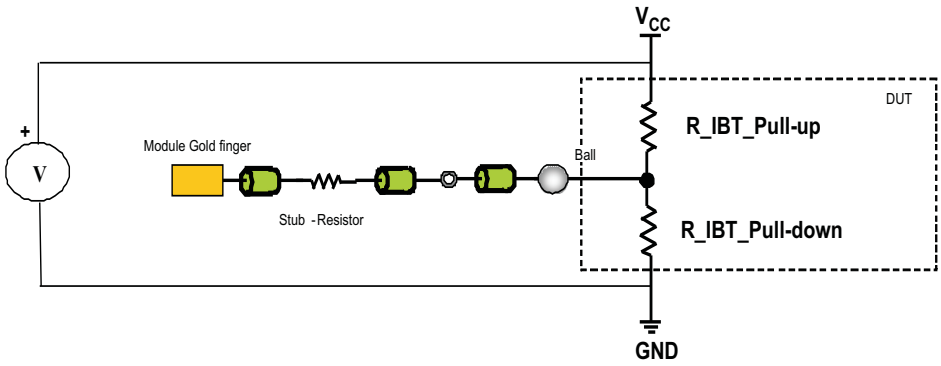
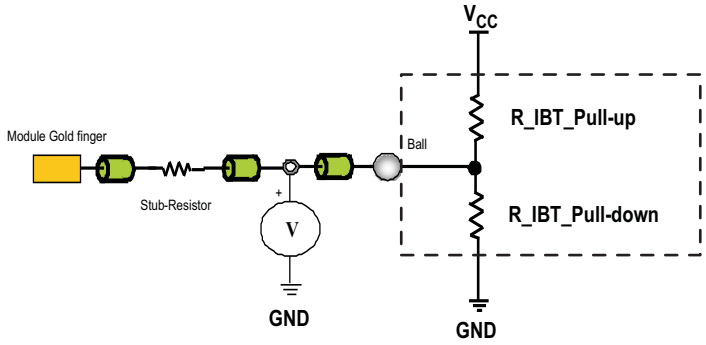
Procedure

Plug in the DDR3 RDIMM memory module into the DDR3 TI RVB Lite. Connect the required power supply for RVB Lite, and power it up. Do not connect anything to the SMA input of the input pin if measuring for IBT resistance. A running clock is necessary to measure the default IBT value of the register. The clock does not have to be at full operation speed because it works even at 100 MHz. Otherwise, the register enters into clock stop, power-down mode. Valid reset levels must be provided; on the RVB Lite, Reset is not floating, so this can be left open. Likewise, valid CKE and CS inputs must be provided; one CKE, CS inputs high and other CKE, CS inputs low – static input is sufficient to measure default IBT.

Step 1: Measure the supply voltage with a multimeter (VDD); use the VDD and GND points on the memory module.



Step 2: Measure the voltage with a multimeter (V-Center) at the input pin of the register to be measured for IBT value. Measure after the R-stub on the module, and close the register if possible with respect to the ground on the memory module.



Result 1: The measured voltage V-Center must be equal to VDD/2 within the valid tolerance of the specification. Any deviation of this voltage from VDD/2 gives the mismatch between the R_IBT_Pull-up and the R_IBT_Pull-down resistance of the IBT.

Step 3: Change the multimeter settings to measure current (mA range), and short the input to be measured to the GND. This connects the R_IBT_Pull-up IBT resistor between VDD and GND. Make a note of the current that is now flowing through the R_IBT_Pull-up IBT resistance.

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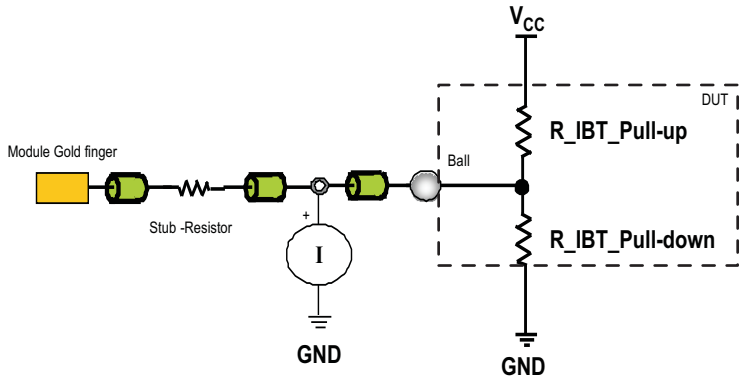
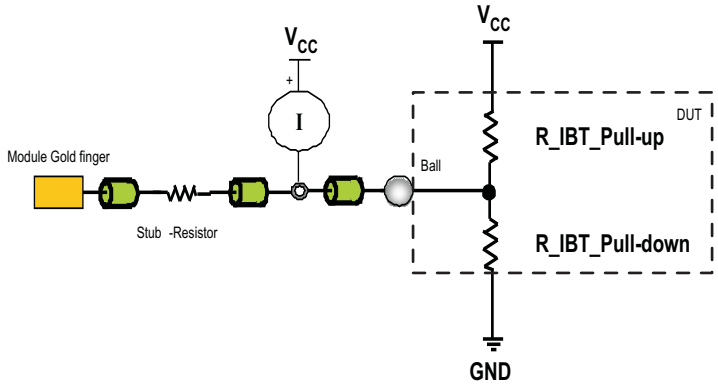


Result 2: The R_IBT_Pull-up value can be calculated from Ohm's Law as the VDD value is known from Step 1. Also, the current flowing through R_IBT_Pull-up IBT resistance is known, having been measured from Step 3.

Step 4: Keep the multimeter settings on measuring current (mA range), and short the input to be measured to the VDD. This connects the R_IBT_Pull-down IBT resistor between VDD and GND. Note the current flowing through the R_IBT_Pull-down IBT resistance.



Result 3: R_IBT_Pull-down value can be calculated using Ohm's Law as the VDD value is known from Step 1. Also, the current flowing through R_IBT_Pull-down IBT resistance is known, having been measured from Step 4.

This gives the values of both R_IBT_Pull-up and R_IBT_Pull-down resistance values and their mismatch of the default IBT setting. If other nondefault IBT settings values of IBT have to be measured, connect all or the required SMA inputs of the RVB Lite to the pattern generator and program the control words (or CMR commands) to change to a different IBT or nondefault IBT values. Then remove the SMA connector of the input IBT to be measured (if connected) and start again with Step 4.

Summary

This method is a simple and easy method to measure the IBT values of DDR3 register accurately. This method also can be used to measure the ODT values of the DRAM using RVB Lite (requires initializing the DRAM with the pattern generator and programming of necessary DRAM Mode registers).

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