Use of [Ramp] in IBIS 4.1

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Topics

- History of [Ramp]
- [Ramp] use in EDA tools
- [Ramp] with differential models
- [Ramp] with external models
- [Ramp] in IBIS 4.1
History of [Ramp]

- [Ramp] dates back to IBIS 1.0
- [Ramp] use and derivation
  - Linear V-t
  - Rload to Vcc or Gnd
  - ECL: Rload is 50 Ohms to -2V
- IBIS added V-t tables later
  - Real transitions are not linear (or even monotonic)
  - Still a required keyword (back compatibility)
[Ramp] use in EDA tools

• [Ramp] used in simulation only if no V-t tables
• [Ramp] is still used by EDA tools
  – Used in pre-simulation algorithms
  – Initial simulation time step (dt)
  – Estimating crosstalk (dt, Vcc or dV)
• Valid dV and dt are needed in models!
  – Rload is not a critical parameter
  – As long as Rload is a typical load
[Ramp] use in EDA tools

- EDA tools do not require full-swing I/O
- Any “normal” loading is OK for most EDA tools
  - Use 20% to 80% voltage swing into “normal” load
  - Load under the actual expected operating conditions
  - Example: standard for LVDS gives normal loading
- EDA tools have robust code for [Ramp]
  - Ideal solution uses existing code
[Ramp] with differential models

- “Normal” load is differential
  - Rload to Vcc or Gnd might not make sense
- Signals usually not rail-to-rail
  - Still use 20% to 80% voltage swing
  - Works for both current- and voltage-mode drivers
- Helpful to add comments in model about the actual load
  | Rload of 100ohms between the LVDS output pins.
[Ramp] with external models

• More complex driver circuit designs
  – Programmable or time-varying slew rate
  – Pre-emphasis, multi-level logic, etc.
• More complex terminations
  – Programmable termination
  – Termination not purely resistive (RC network)
• SPICE and AMS models in external files
  – No information in the external files on dt
[Ramp] with external models

• EDA tools use dt to estimate time step
  – [Ramp] is already (mis-)applied as needed today
  – Sometimes with a comment on the actual load
• Logistics: Where to put the information in IBIS 4.1?
  × SI tool simulates to get dV and dt
    – What load and time-step?
    – Where to store dV and dt?
  × New keyword or subparameter
    – [Ramp] already contains all of the needed information
  √ [Ramp] with broader definition of load
[Ramp] in IBIS 4.1

• Why keep it as a required keyword?
  – EDA tools need dt, could use dV
  – Could make Rload optional
• Is this data readily available?
  – On the datasheet for the I/O buffer
  – From the transistor-level simulation results
  – From measured test-bench data
BIRD 85: Slew Time Estimate Clarifications

*  Note that when using [External Model], the [Ramp] keyword is intended to provide EDA tools with a quick first-order estimate of driver slew characteristics. Therefore, data for [Ramp] may be measured using a load that conforms to the driver's intended operation, rather than the load recommended in Section 9: Notes on Data Derivation Method.
[Model] ExBufferSPICE
Model_type I/O
Vinh = 2.0
Vinl = 0.8

[Voltage Range]  3.3  3.0  3.6

[Ramp]
dV/dt_r  1.57/0.36n  1.44/0.57n  1.73/0.28n
dV/dt_f  1.57/0.35n  1.46/0.44n  1.68/0.28n

[External Model]
Language SPICE
Corner Typ buffer_typ.spi buffer_io_typ
...

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