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

[Ramp] in IBIS 4.1

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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