ODT, Pre-Emphasis, and Speed

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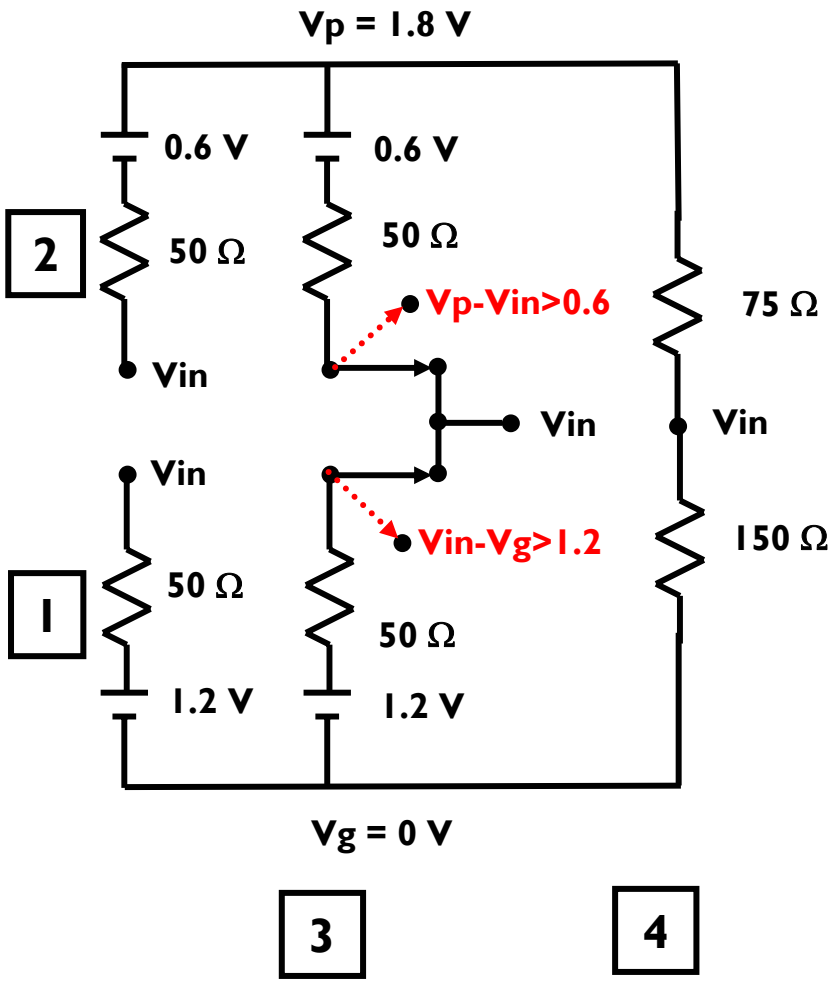
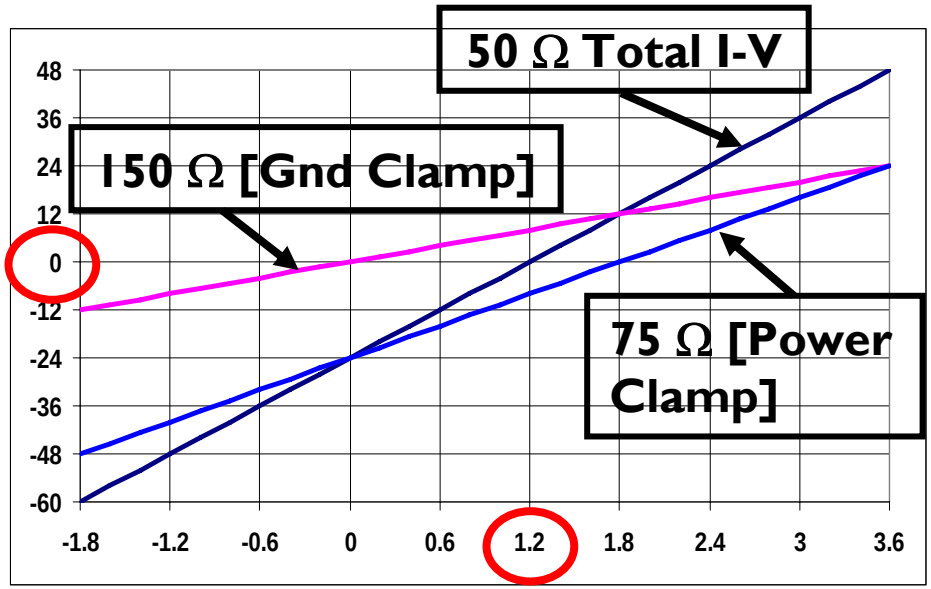
On-Die Terminations (ODT)

- Model the device structure
- More details on "DEC" (Deviate, Extrapolate, Calculate) process:
  - http://www.eda.org/pub/ibis/summits/sep05/ross2.pdf

Four ODTs With Same Total I-V





1. [Gnd Clamp] (1.2 V, 50 Ω)
2. [Power Clamp] (0.6 V, 50 Ω)
3. "Clip and Extend" (both clamps clipped)
4. "DEC" (75 Ω, 150 Ω)

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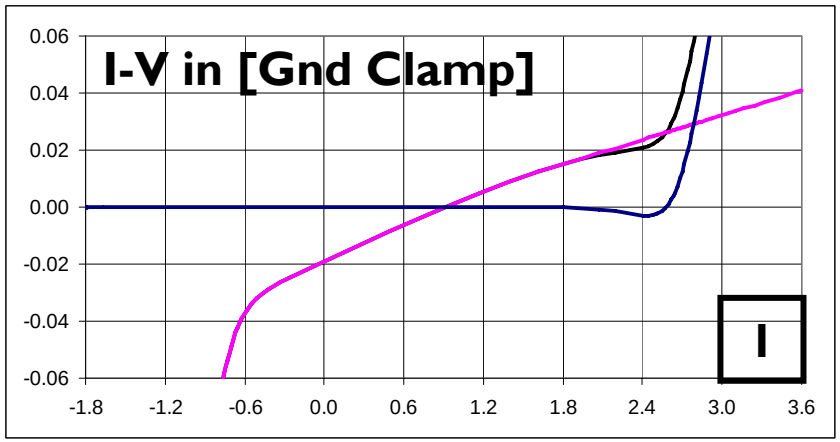
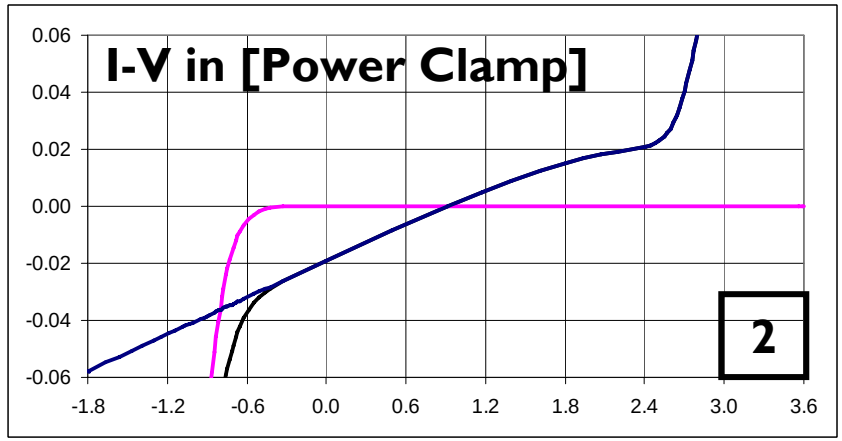
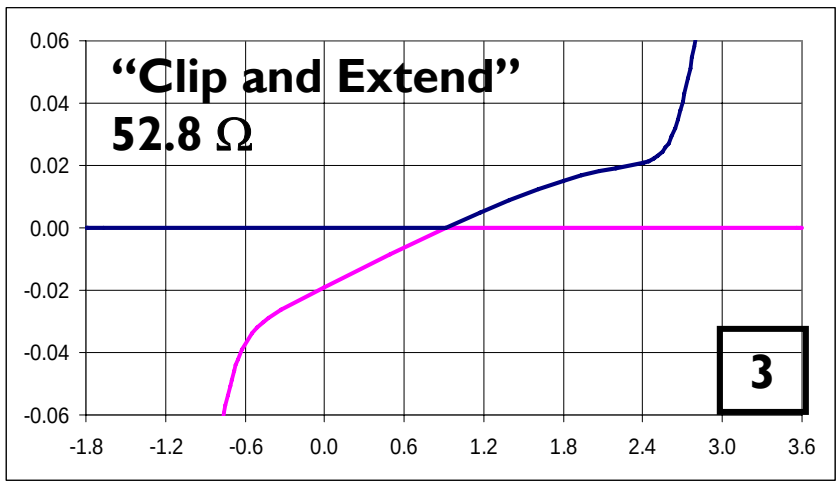
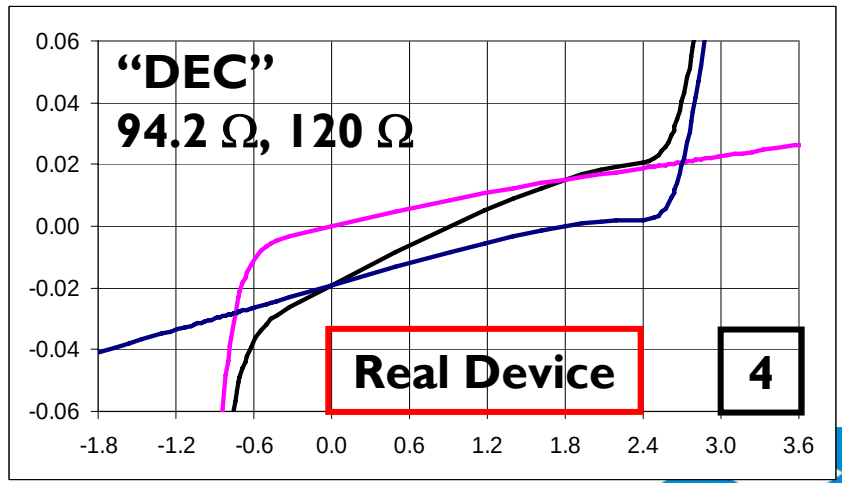
Real "50 Ω" ODT Choices









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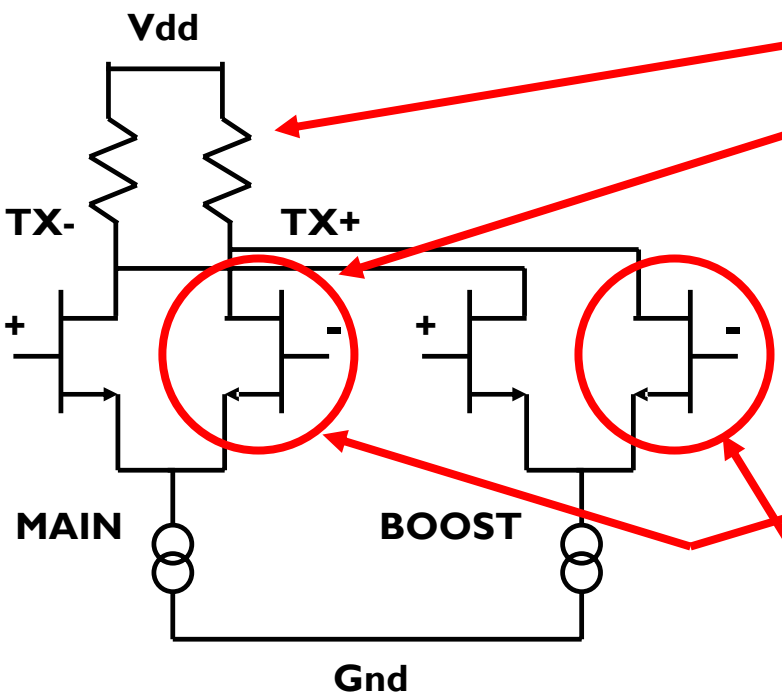
Pre-emphasis

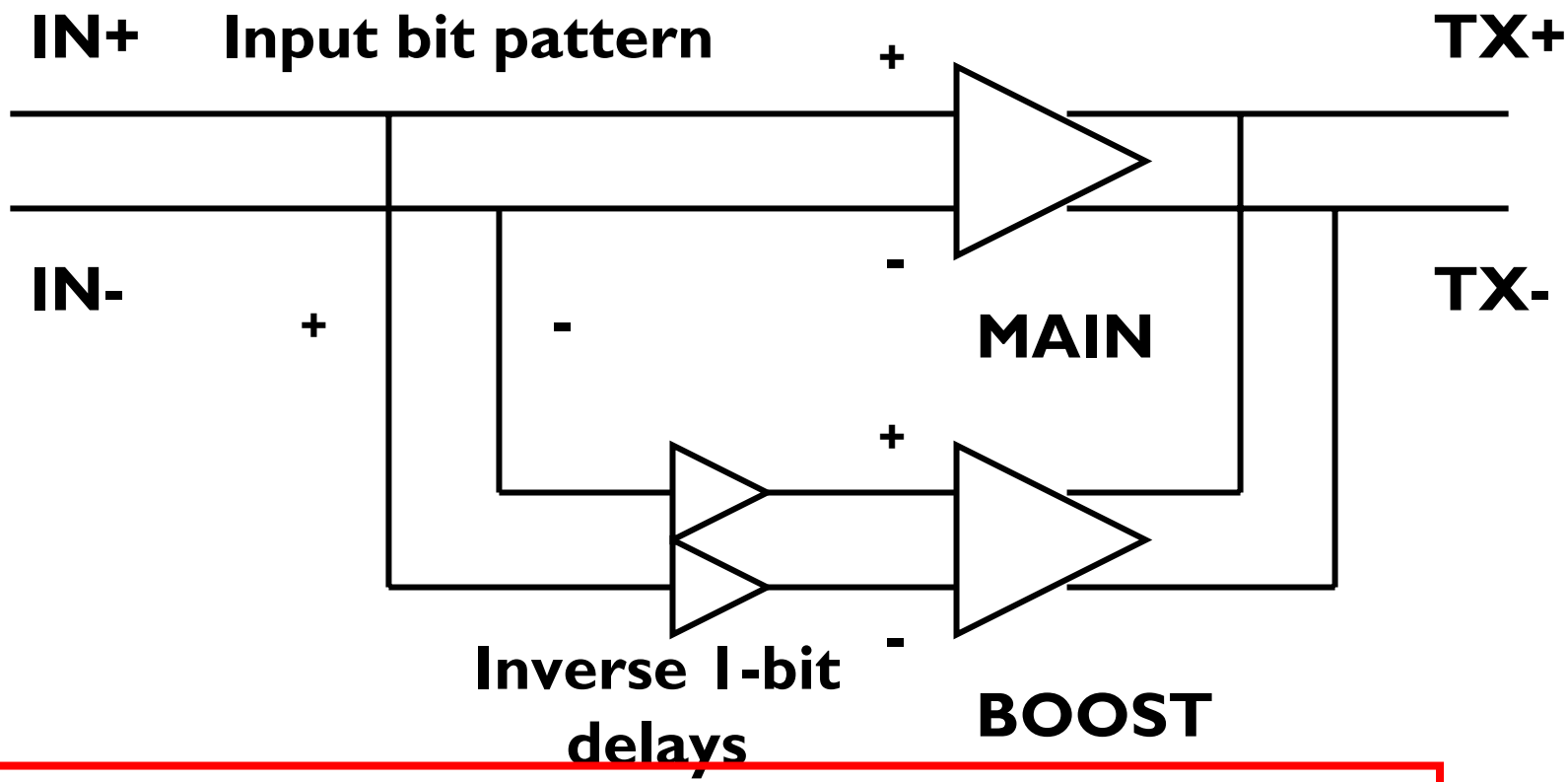
- Add [Driver Schedule] to match the device structure
- Examples:
  - 2-tap current mode logic (CML) 1-bit delay (de-emphasis) structure
  - Kickers for internal logic controlled boosts (and adjusted waveform delays)

CML Structure using IBIS Open_drain Models and Connected by [Diff Pin]



- Top-level
  - ODT [Power Clamp]
  - MAIN [Pulldown]
    - Extracted waveforms with ODT & 50 Ω
    - Pre-emphasis = 0
  - [Driver Schedule]
- MAIN [Pulldown]
  - Scaled waveforms
- BOOST [Pulldown]
  - Scaled waveforms

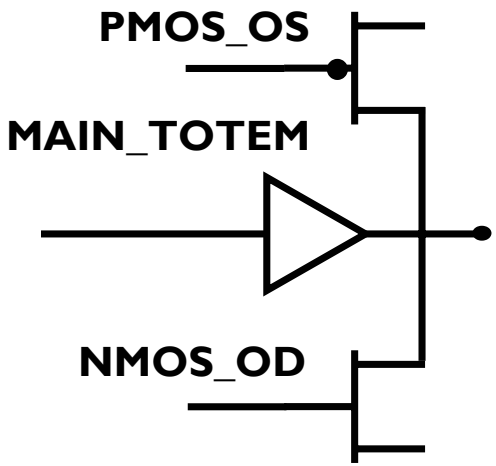
Actual SPICE Configuration with Differential Control

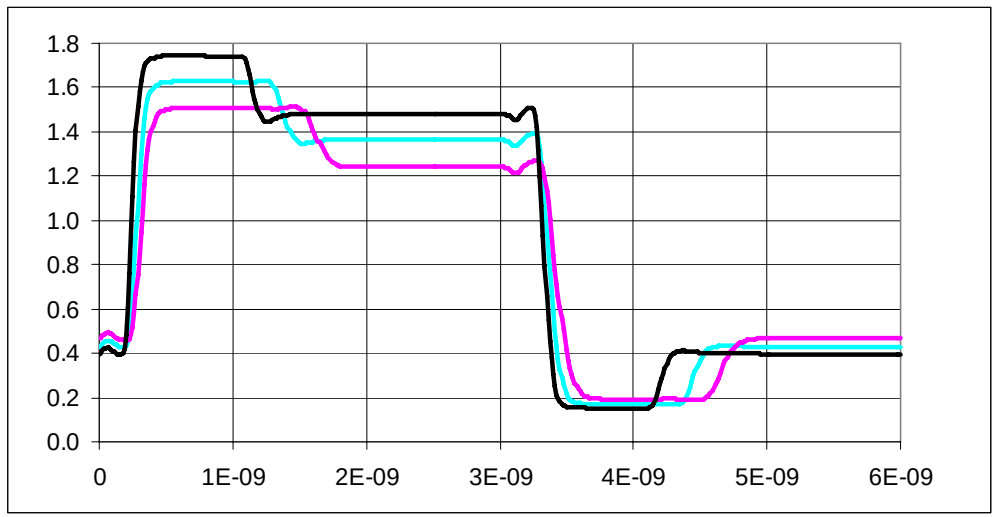



```
[Driver Schedule]
| Model_name Rise_on_dly Rise_off_dly Fall_on_dly Fall_off_dly
MAIN         0           NA           0           NA
BOOST        NA          0.47059ns    NA          0.47059ns
```

Different Typ-Min-Max Kicker Times (Internal Logic Control Kickers)

```
[Driver Schedule]
| Model_name      Rise_on_dly   Rise_off_dly   Fall_on_dly   Fall_off_dly
|
MAIN_TOTEM        0             NA             0             NA
PMOS_OS           0             1.05n          NA            NA
NMOS_OD           NA            NA             0             1.05n
```





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Speed – How Fast Is IBIS?

- World's fastest published IBIS model:

```
[IBIS Ver]      1.1
[File Name]     fastest.ibs
[File Rev]      0
[Date]          October 27, 2006
[Component]     Worlds_Fastest_Model
[Manufacturer]  Teraspeed Consulting Group
[Package]
R_pkg           0                   NA NA
L_pkg           0                   NA NA
C_pkg           0                   NA NA
[Pin]           signal_name         model_name
  1             Open_Drain          FAST_OD
[Model]         FAST_OD
Model_type      Open_drain
C_comp          0                   NA NA
[Voltage Range] 1E-100              NA NA
[Pulldown]
-1e-100         -20E-103            NA NA
2e-100          40E-103             NA NA
[Ramp]
dV/dt_r         0.3e-100/0.6E-109   NA NA
dV/dt_f         0.3e-100/0.6E-109   NA NA
[End]
```

1.0E-100 V, 50 Ω driver

1.0E-109 s ramps

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Conclusion

- How fast is IBIS?
  - "As fast as you are smart"
- How accurate is IBIS?
  - Configure IBIS to match device structure for best accuracy
  - IBIS is as accurate as you are smart