Simple ODT Extraction

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ODT = On-Die Termination

- Earlier presentation for combined Thevenin equivalent "pullup" and "pulldown" ODT
  - DEC September, 2005

  http://www.eda.org/ibis/summits/sep05/ross2.pdf
- Simplified process
  - Tuned for calculating Typ/Min/Max clamps at the same time
  - Defaults to proportional allocation of currents
- Example of DDR2 [Submodel] extraction

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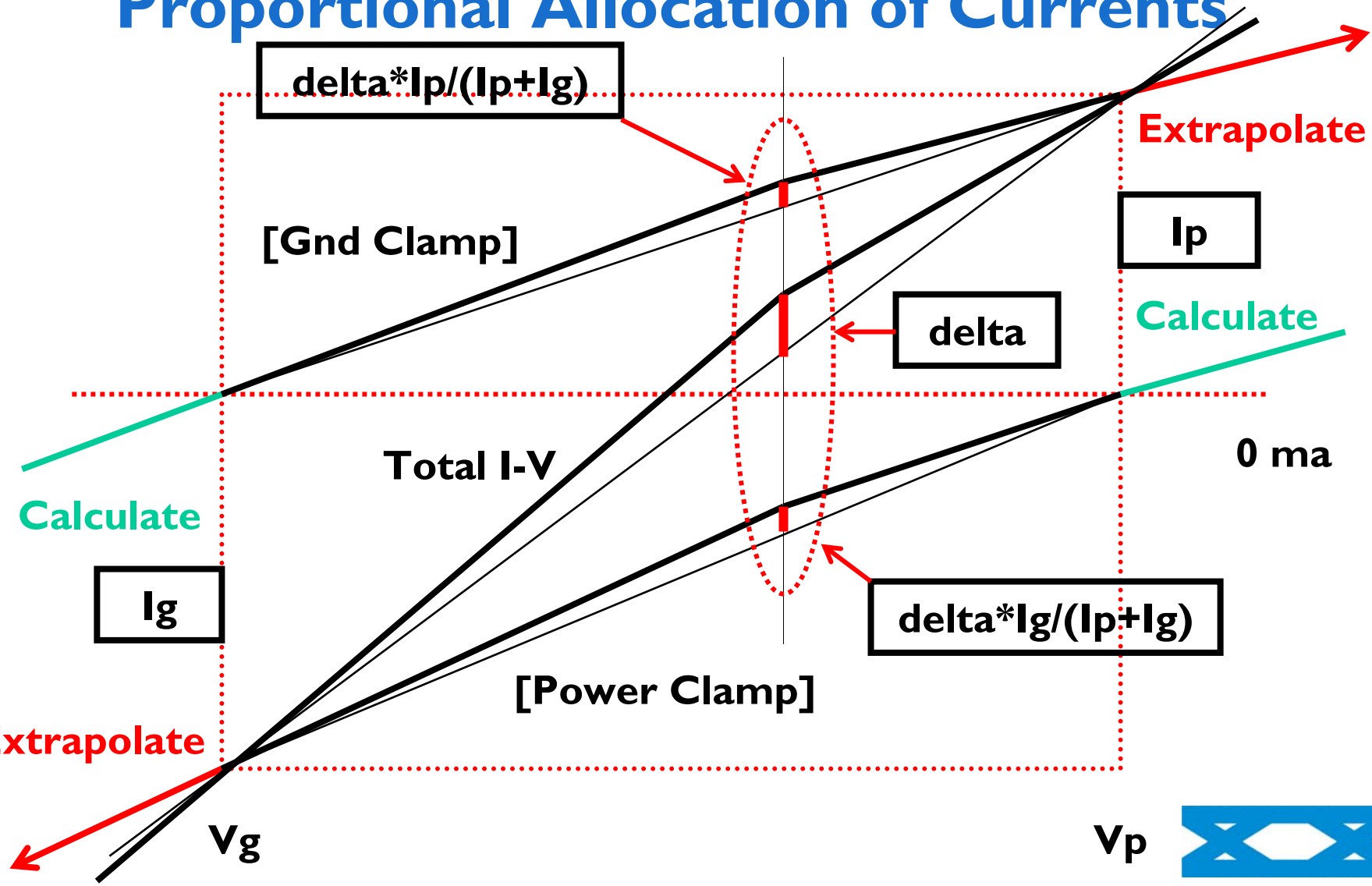
Default DEC Algorithm (2005)
Proportional Allocation of Currents



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Simple Transformation Process (One Clamp at a Time)

- [Gnd Clamp] extraction
  - Extract total I-V curves just beyond 0 to Vdd(max) range
    - E.g., -0.2 to Vdd(max)+0.1
  - Transform curves to the range I(V(0) and I(Vdd(typ/min/max))
  - Extrapolate at both ends
- [Power Clamp] extraction
  - Same process, but use the Vdd referenced data from about -0.2 to Vdd(max)+0.1

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Real Example for 75 Ω ODT DDR2 [Submodel]

- Vdd Typ/Min/Max = 1.8/1.7/1.9 V
- Modified gc* and pc* ranges:
  - -0.2 V to 2.0 V from s2ibis2/3 setup
- Spread sheet processing (but direct equation implementation possible)
- (Here, ESD clamps at Gnd and Power extracted separately by turning off ODT and modeled at top-level)

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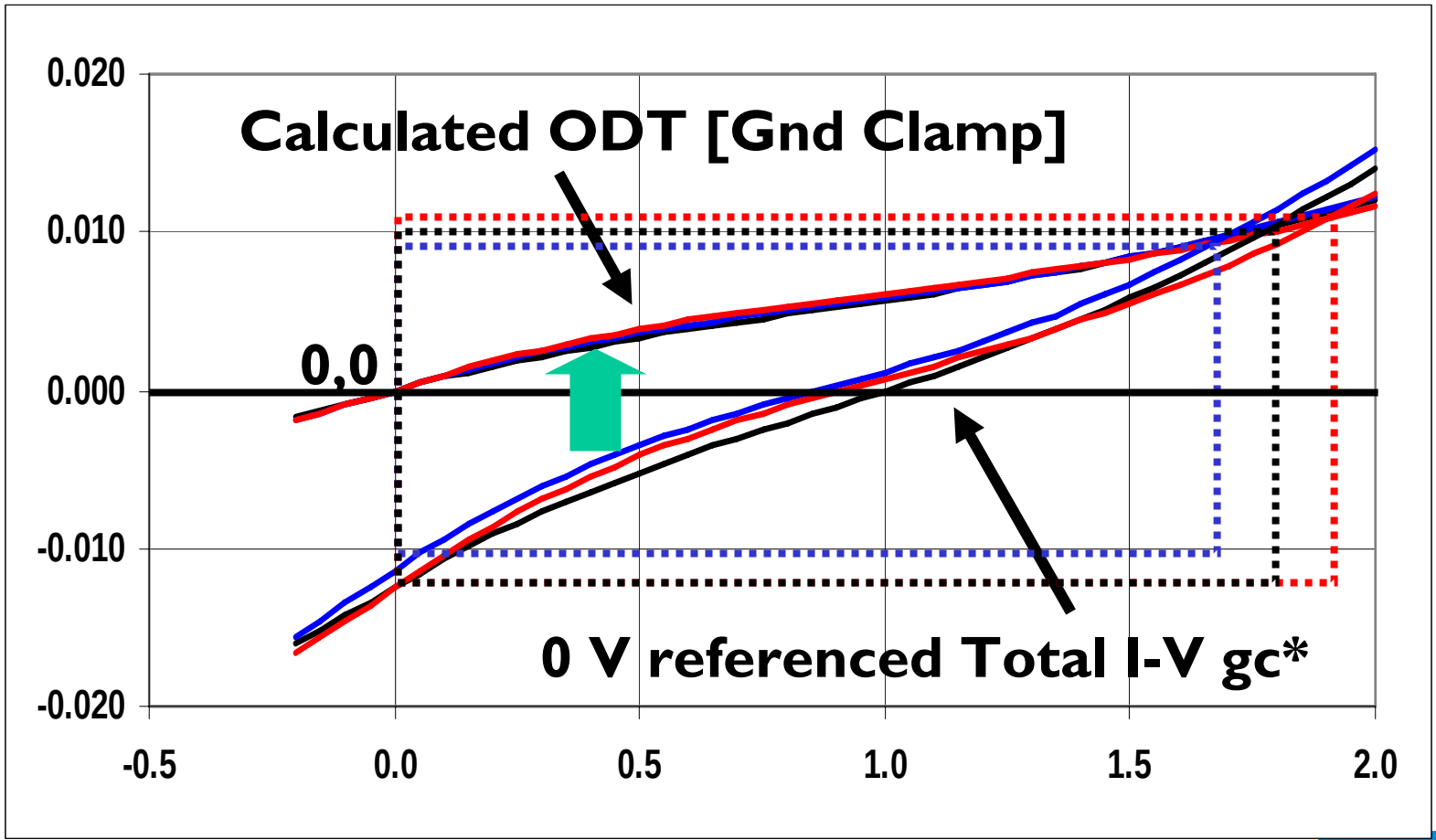
Total I-V and [Gnd Clamp] Typ/Min/Max by Mapping



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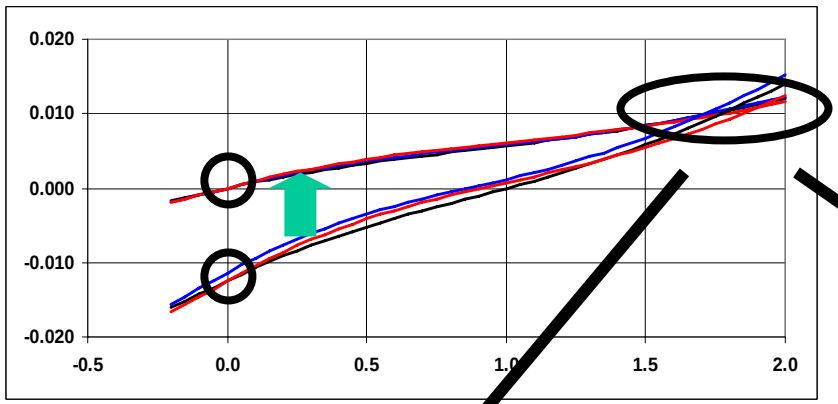
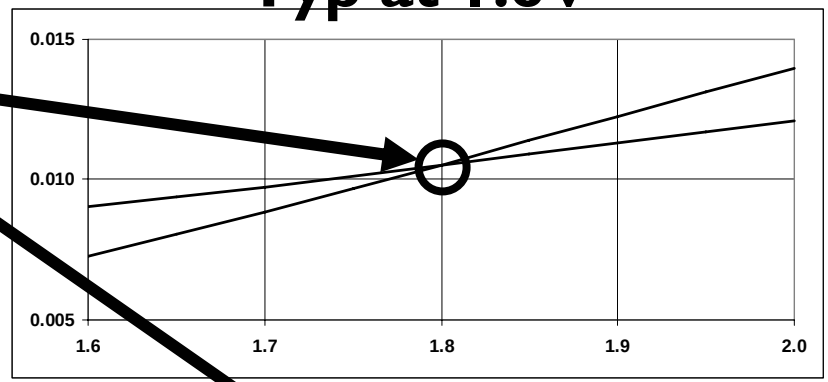
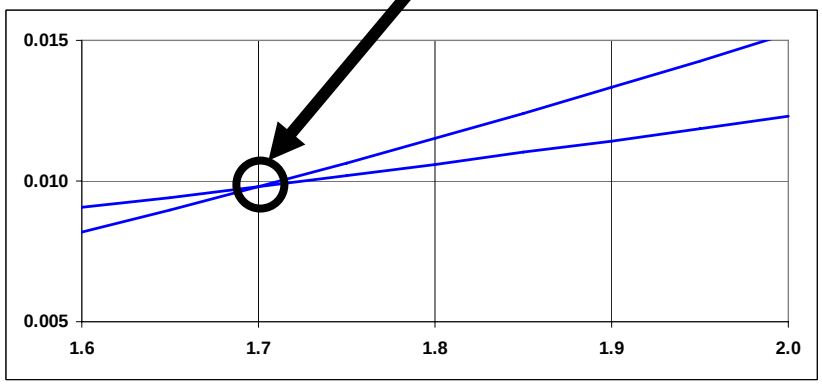
Map Typ/Min/Max
0 V to 1.8/1.7/1.9 V Ranges



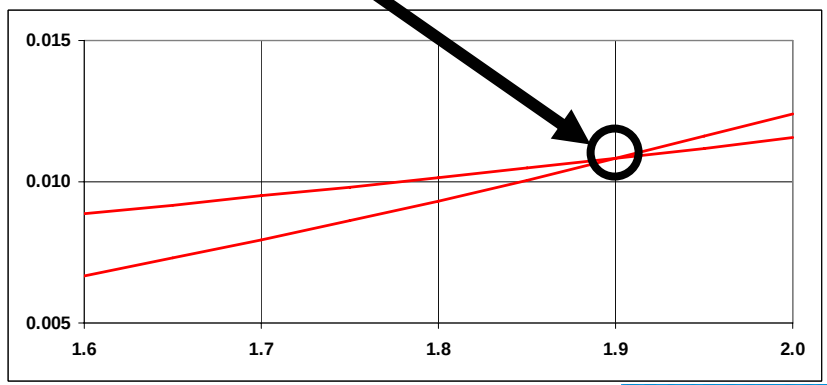
Typ at 1.8V



Min at 1.7 V



Max at 1.9 V



After mapping, extrapolate both tables (not shown)

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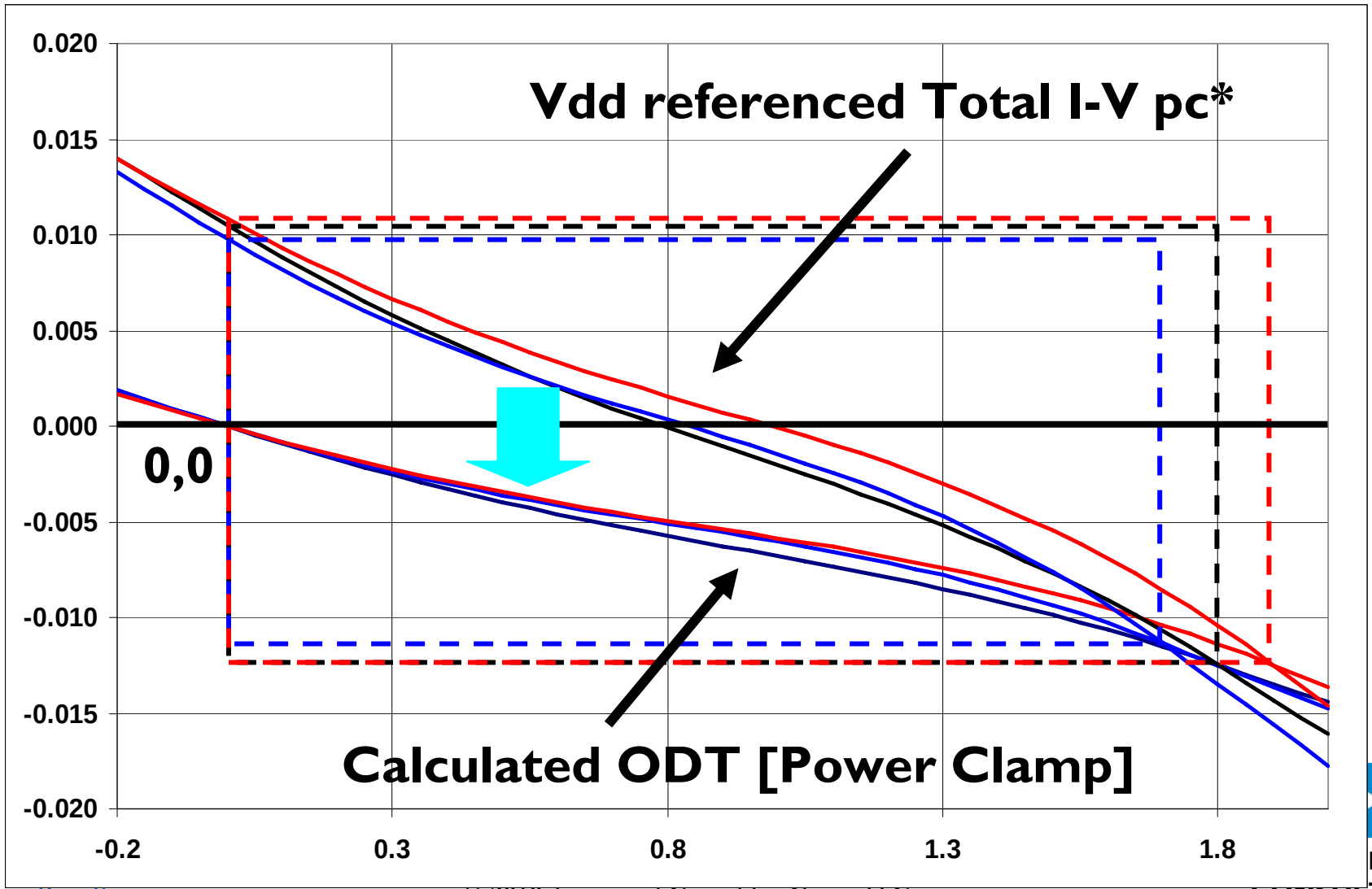
Total I-V to [Power Clamp] Typ/Min/Max Mapping – Same Process



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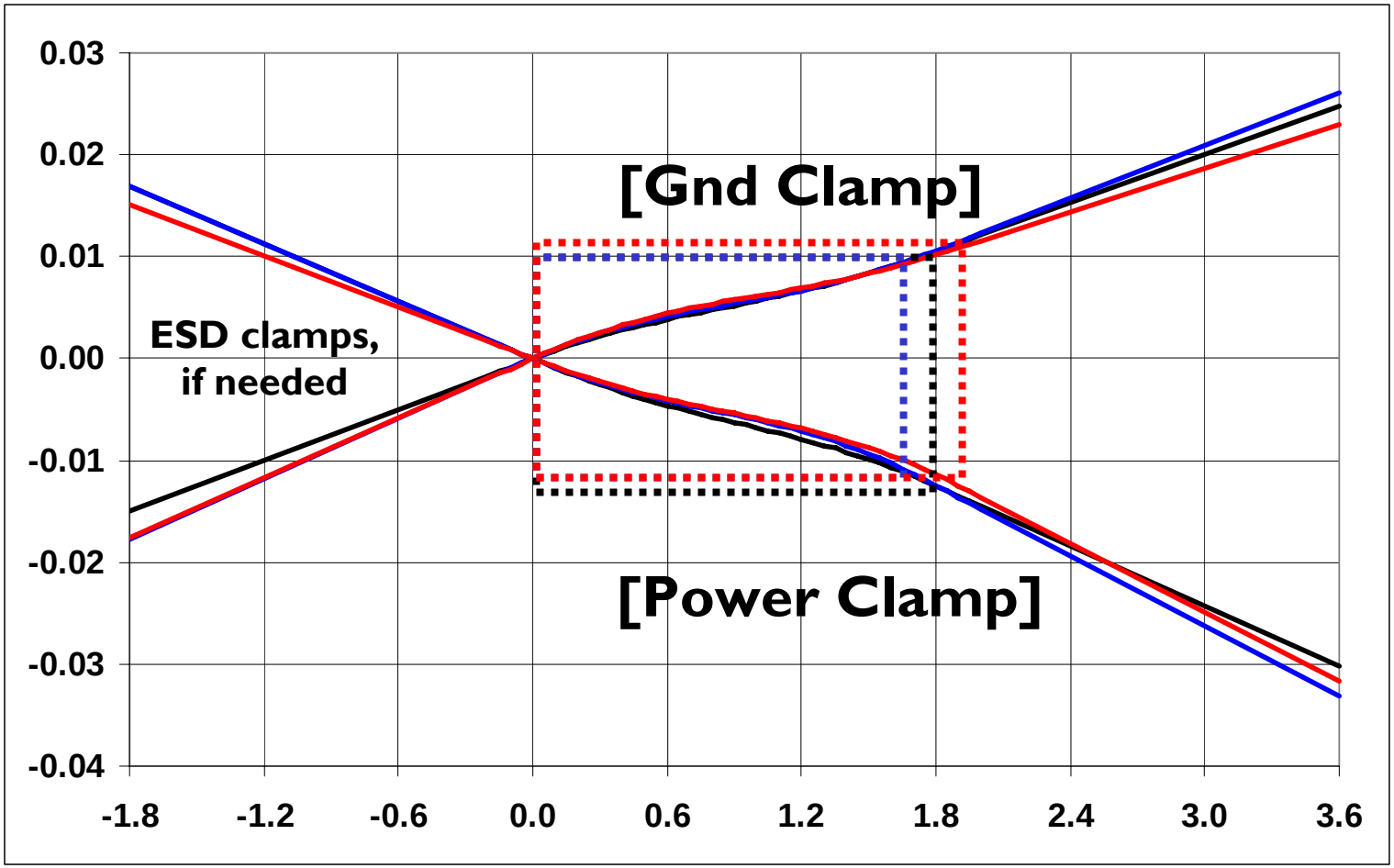
[Gnd Clamp] and [Power Clamp] with Extrapolations for [Submodel]



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Summary of Simplified Process (One Clamp at a Time)

- Use Total I-V just beyond 0 to Vdd(max) range
  - 0 V based for [Gnd Clamp] (gc*)
  - Vdd based for [Power Clamp] (pc*)
- Map Total I-V curves to (0, 0) value and I(Vdd(typ,min,max) values
- Extrapolate to full –Vdd to 2*Vdd range
- (Easy subtractions for including ESD clamps possible, but not covered here)

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