Golden Parser's Non-Monotonic Warning Investigation

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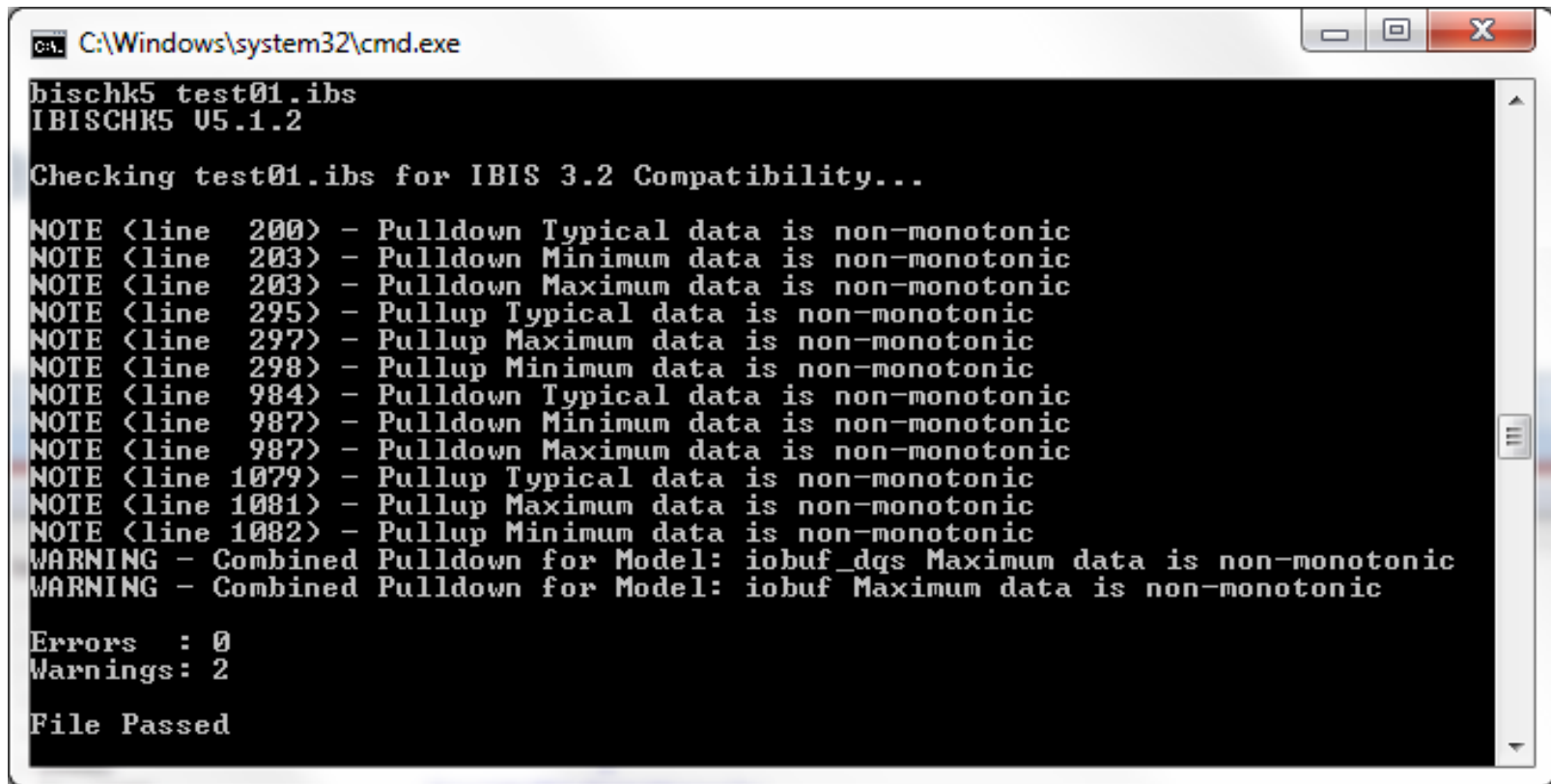
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Summary

- Using Golden Parser, we got false non-monotonic warning messages for a few IBIS models

- Our investigation showed that the false warnings are due to Golden Parser's sampling and PWL interpolation based on IBIS curve's sampling points

- Usage for IBIS models with false non-monotonic warning in simulation are not affected. But we do need Golden Parser improved to eliminate these false warnings
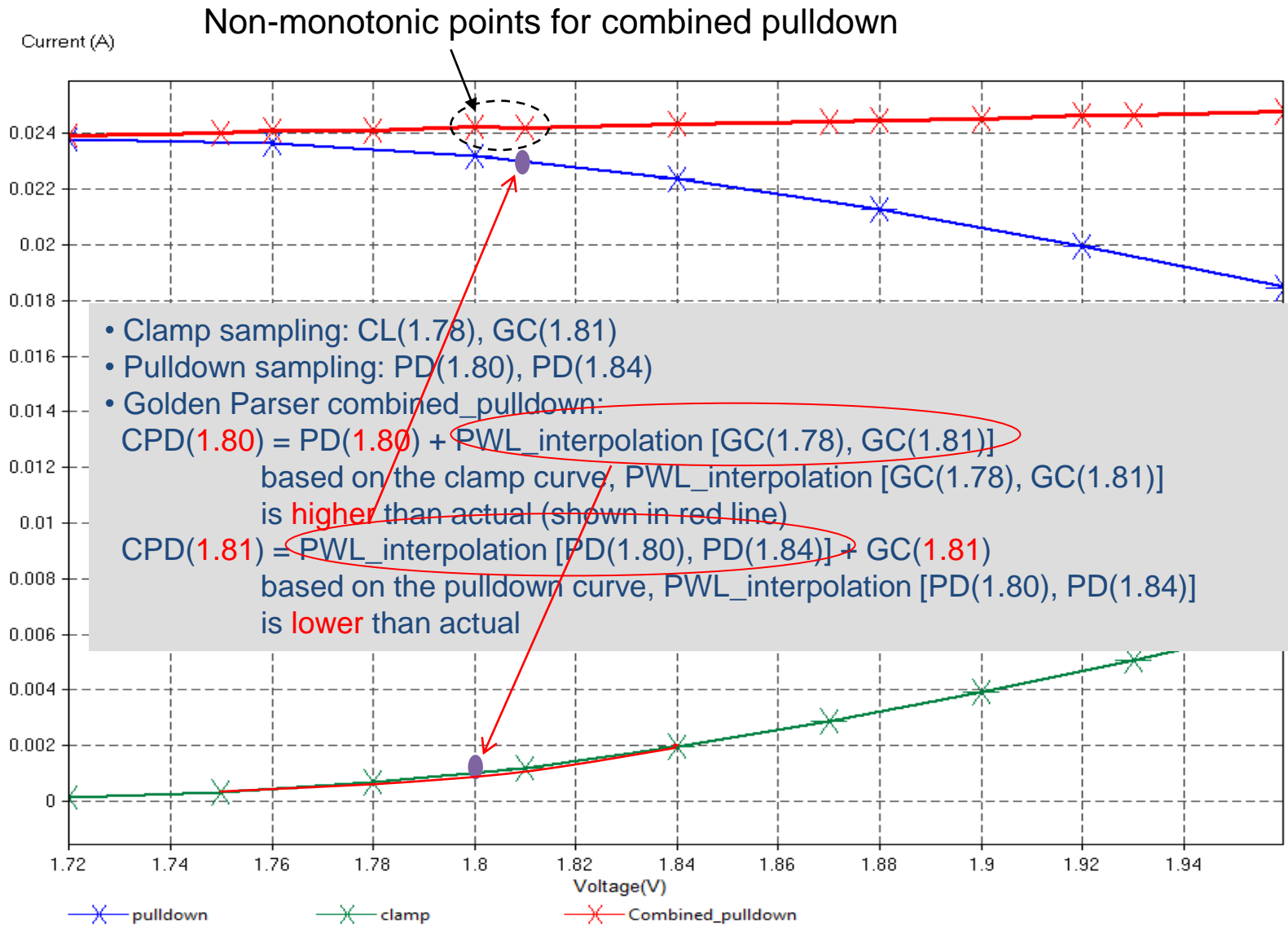
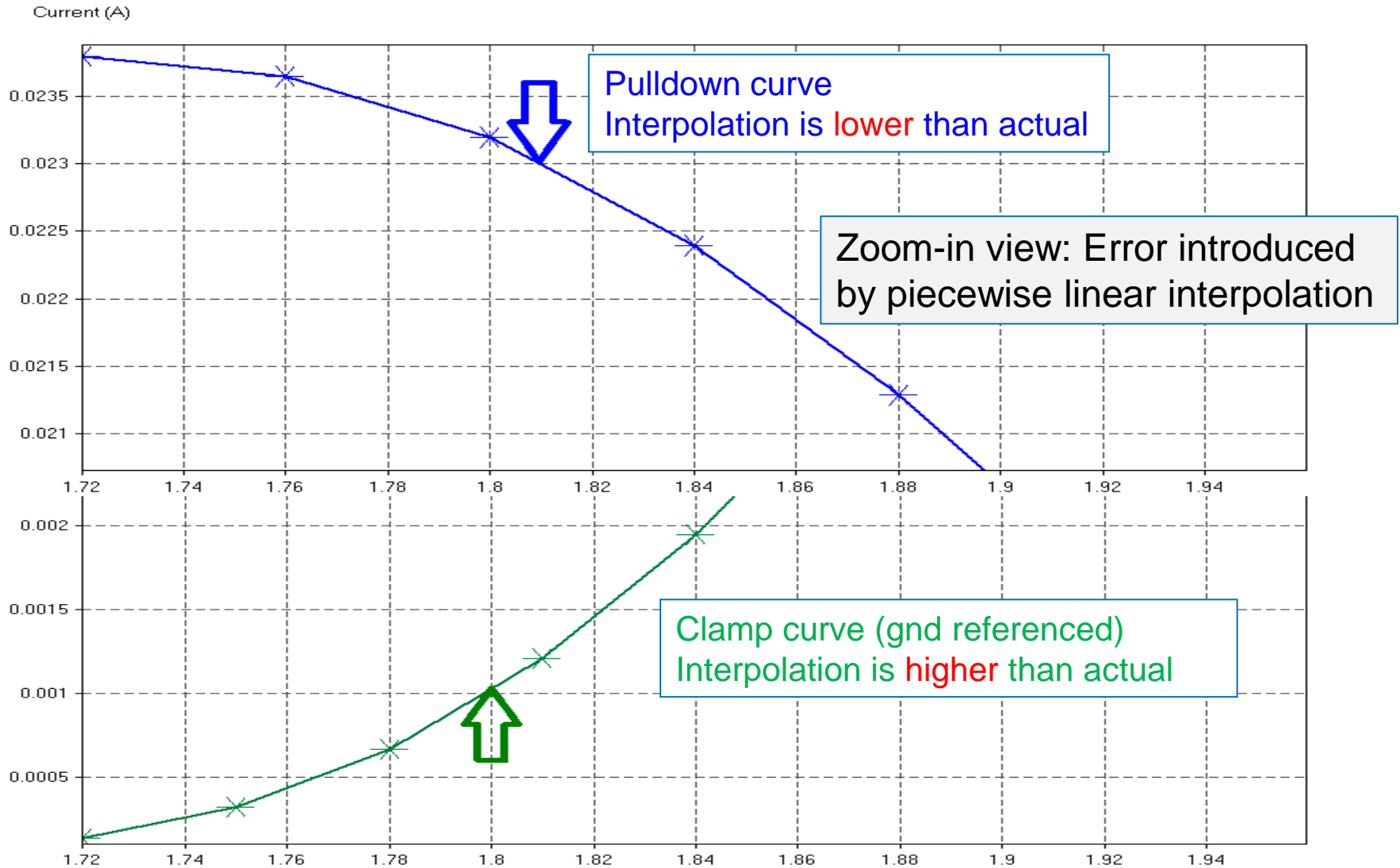**cādence**®

Example 1

- **Golden Parser warning message**

IBIS and Golden Parser sampling points

- From IBIS model pulldown and clamp, Golden Parser combined them to get combined pulldown using

  combined_pulldown = pulldown + clamp

- The sampling point for combined_pulldown comes from both pulldown and clamp

  - If v1 is a sampling point for pulldown

    Combined_pulldown (v1) = pulldown(v1) + clamp_interpolated(v1)

  - If v2 is a sampling point for clamp

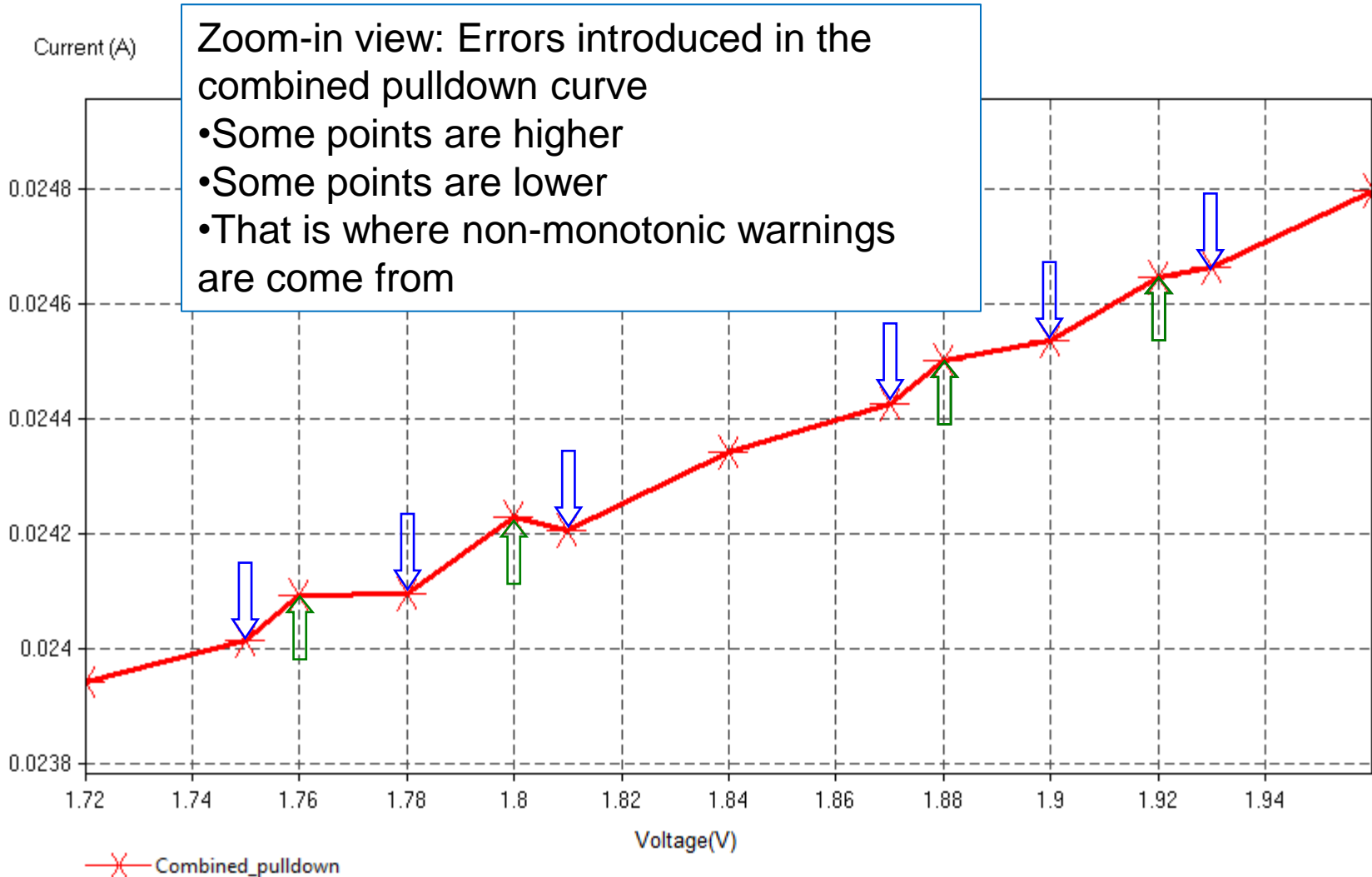   *Combined_pulldown (v2) = pulldown_interpolated(v2) + clamp (v2)*

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Example 1 (Cont.1)

Non-monotonic points for combined pulldown

• Clamp sampling: CL(1.78), GC(1.81)
• Pulldown sampling: PD(1.80), PD(1.84)
• Golden Parser combined_pulldown:
  CPD(1.80) = PD(1.80) + PWL_interpolation [GC(1.78), GC(1.81)]
        based on the clamp curve, PWL_interpolation [GC(1.78), GC(1.81)]
        is higher than actual (shown in red line)
  CPD(1.81) = PWL_interpolation [PD(1.80), PD(1.84)] + GC(1.81)
        based on the pulldown curve, PWL_interpolation [PD(1.80), PD(1.84)]
        is lower than actual

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Example 1 (Cont.2)

Current (A)

Pulldown curve
Interpolation is lower than actual

Zoom-in view: Error introduced
by piecewise linear interpolation

Clamp curve (gnd referenced)
Interpolation is higher than actual

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Example 1 (Cont.3)

Zoom-in view: Errors introduced in the combined pulldown curve
•Some points are higher
•Some points are lower
•That is where non-monotonic warnings are come from

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Example 2

Example 2 (Cont.1)

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Example 2 (Cont.2)

Current (A)

Pulldown curve

Error introduced by piecewise linear interpolation

Clamp curve (gnd referenced)

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Example 2 (Cont.3)

Errors introduced in the combined pulldown curve (close look)

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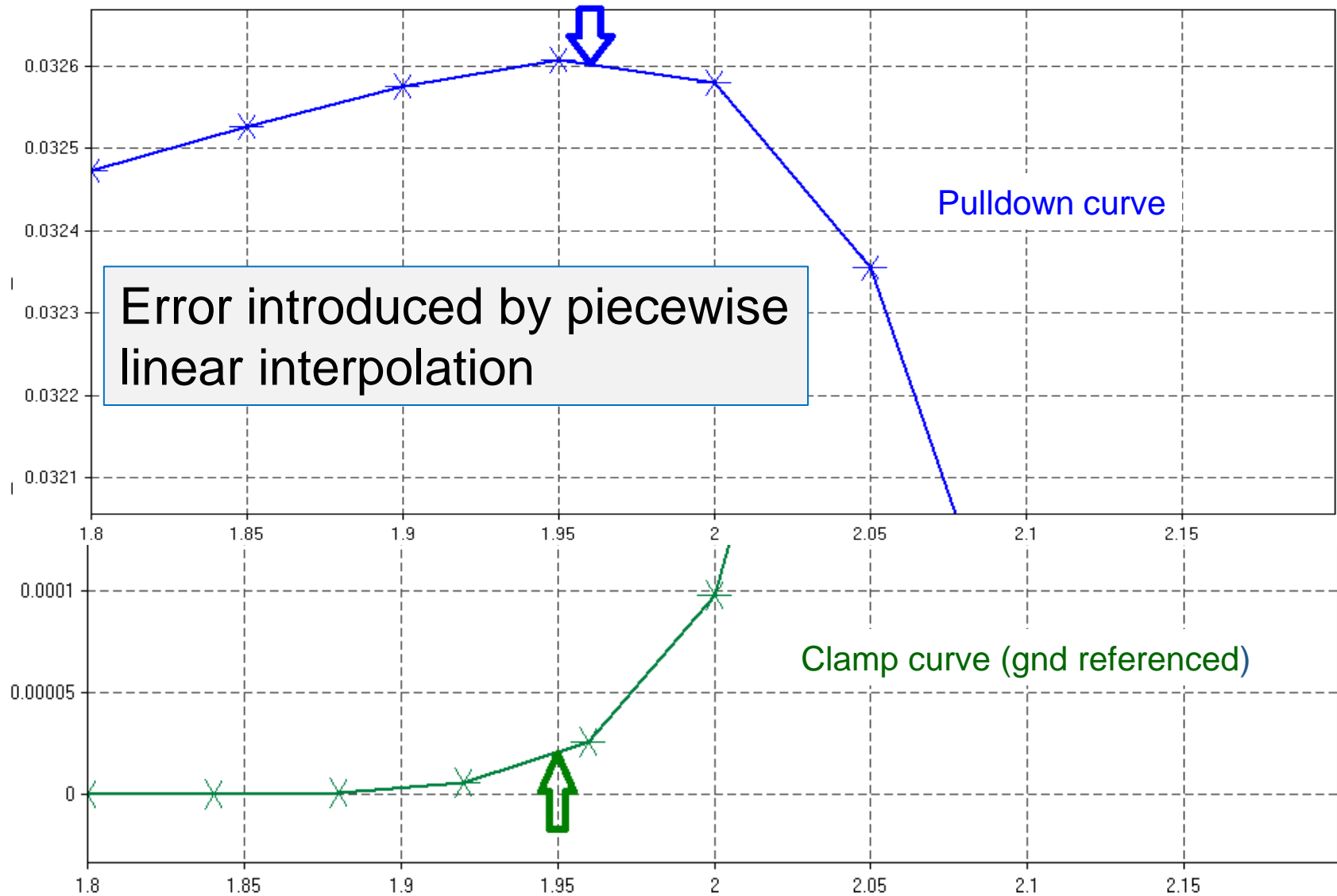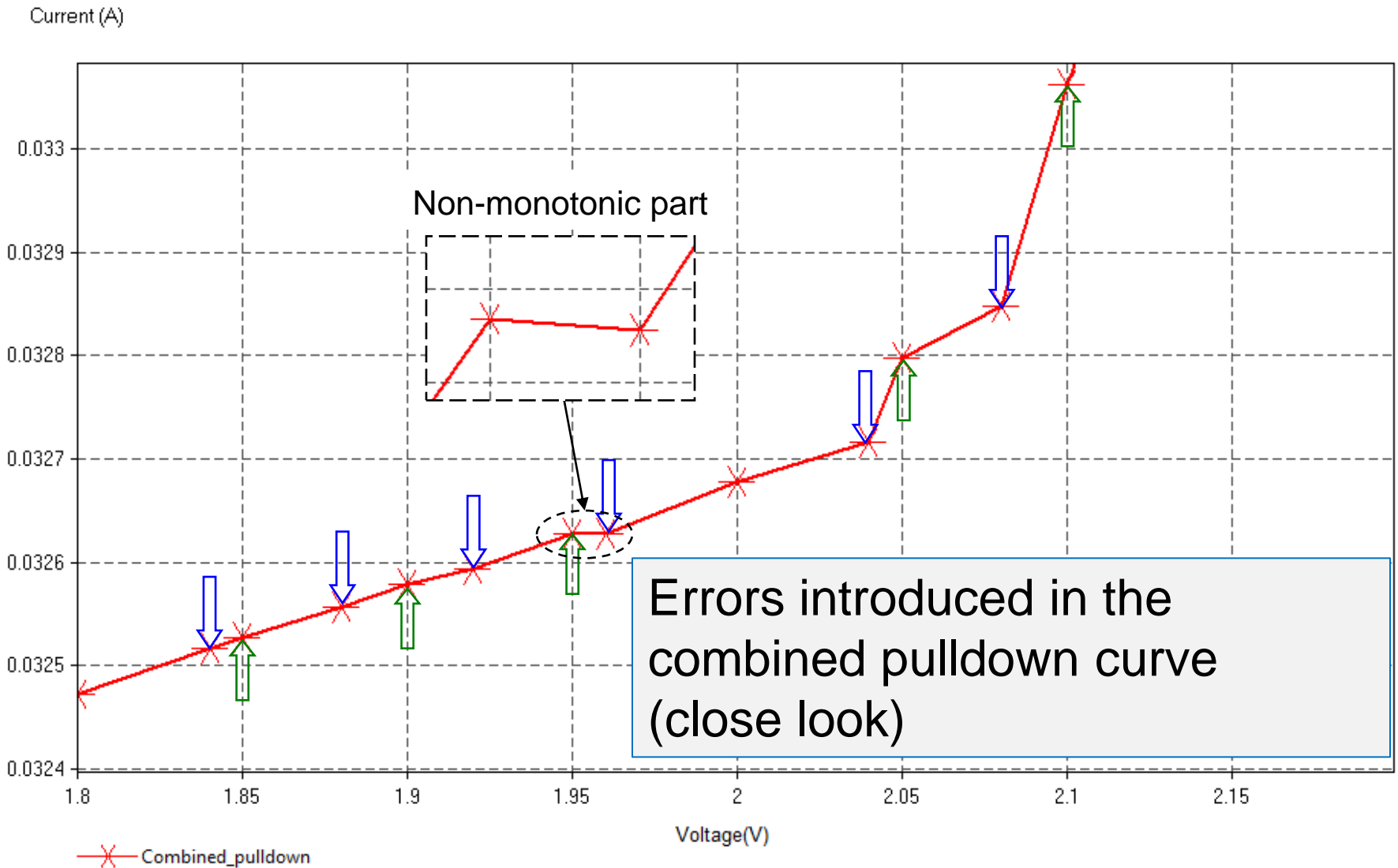
Conclusion

- The I-V data in the ibis file with Golden Parser's non-monotonic warnings are good

- Golden Parser false warnings are due to the piecewise linear interpolation error when generating the combined I-V curves

- There is no major effect for the IBIS models to be used in simulation because the I-V curve smooth is usually done before simulation starts

- Improve IBIS model sampling points is not likely to be a solution because
  - IBIS model generation can not guarantee the alignment of IBIS curve sampling points. Some of I-V curves are Vcc related and the Vcc value is usually different between typ/min/max
  - Making the I-V data sampling points denser may reduce the possibility false warnings but there is no guarantee. Further more, there are only 100 points are allowed in one I-V table.

- We would like to see Golden Parser sampling and interpolation algorithms improved to eliminate false non-monotonic warnings

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