Point Reduction Method for IBIS Curves

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Outline

- Point Reduction Introduction
- “Greatest Change” method
- Issue with “Greatest Change” method for IBIS curve representation
- The “Weighted Best Point” (WBP) method
- Conclusions

Point Reduction Introduction

- What is Point Reduction method for?
  - In some situations, a set of data (e.g. waveform) can not satisfy a specification (e.g. IBIS) data limit without sacrifice of its accuracy. For an example, 10,000 extracted I-V curve data points for only 100 point limit in IBIS specification.
  - Point Reduction method intends to use algorithms for proper point number reduction with minimum sacrifices on its accuracy. It is about accurate representation of whole data set with limited data points
- IBIS Cookbook introduces two methods:
  - Points selected using a regular interval
  - Points selected using “greatest change” algorithm

Point Reduction Introduction

5.3 Data Limiting

The IBIS version 2.1 through 3.2 specifications limit V-T tables to 100 points or rows of data total, for each corner, for the [Rising Waveform] and [Falling Waveform] keywords. This limit was extended to 1000 points in IBIS version 4.0. Similarly, I-V table tables are also limited to 100 points total, for each corner, for the [Pullup], [Pulldown], [POWER Clamp], and [GND Clamp] keywords.

These limitations mean that some sort of algorithm must be used to select which points from the raw data file are used in the final IBIS model, should the data file cor
now in use:

- Points selected using a regular interval
- Points selected using "greatest change" algo

The first of these simply selects data points at regula
table data set containing 200 points, from 0 ns to 19
points plus zero; the sequence would then be 0 ns, 2

While this method is simple to implement, it does n
data points. If a V-T table has settled by the 50th us
and added to the IBIS file, though the voltage inform

This is remedied by use of a "greatest change" algorithm, where each data point is added to the final IBIS table based on the degree of difference between it and surrounding points. In this way, more points in the final IBIS file will be expended on areas of the tables where large changes take place, such as inflections. Few points will be used on areas where the output does not change, such as the settled voltages before and after a V-T transition.

An example is shown in Figure 5.13 below. Note that "flat" or unchanging areas of the graph use few points, while curves and other rapidly changing features are represented with more points.

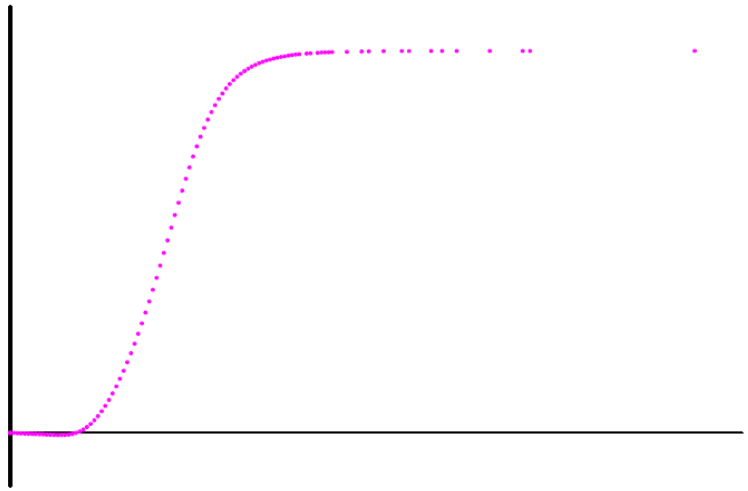
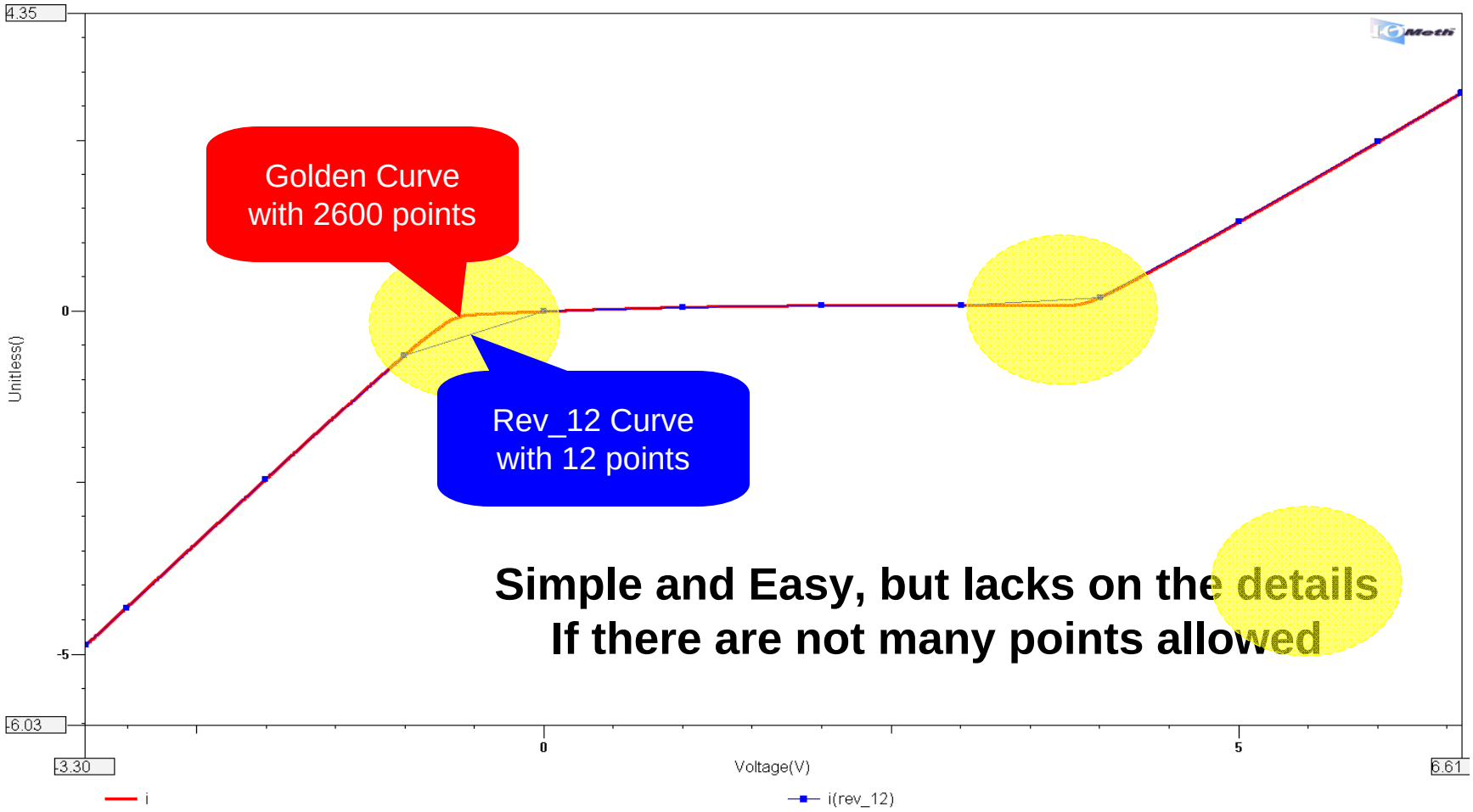


Figure 5.13 – Data Point Selection Example

From IBIS Cookbook

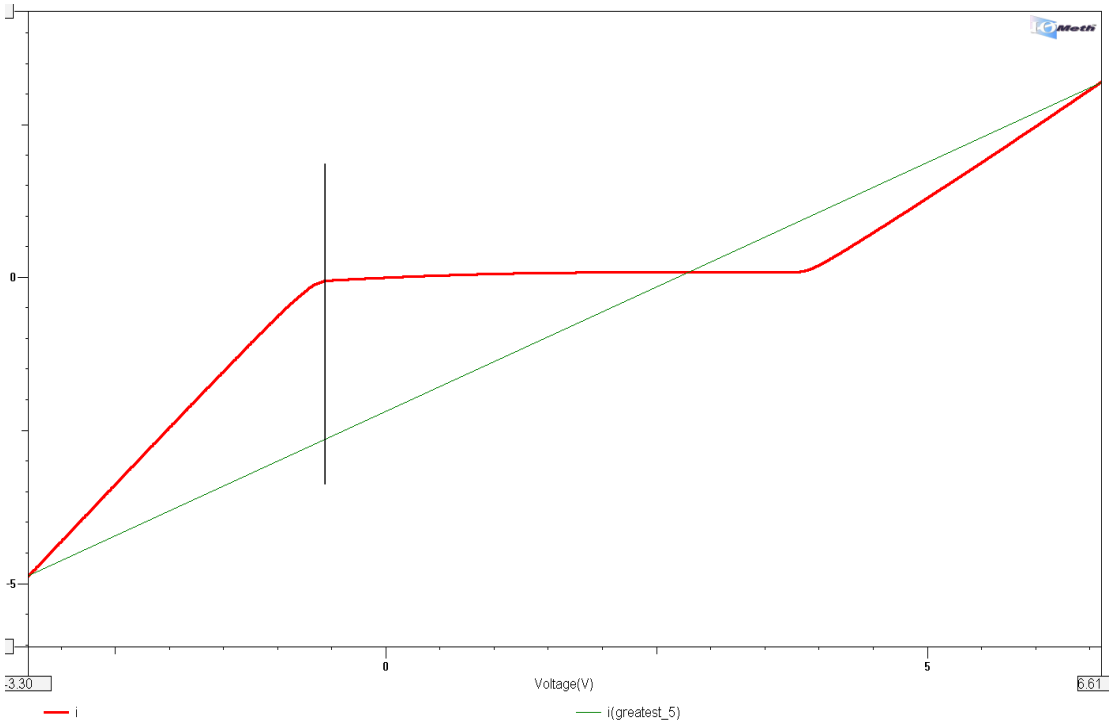
Points selected using “a regular interval” – even spacing



Points selected using “greatest change” algorithm

How it works?

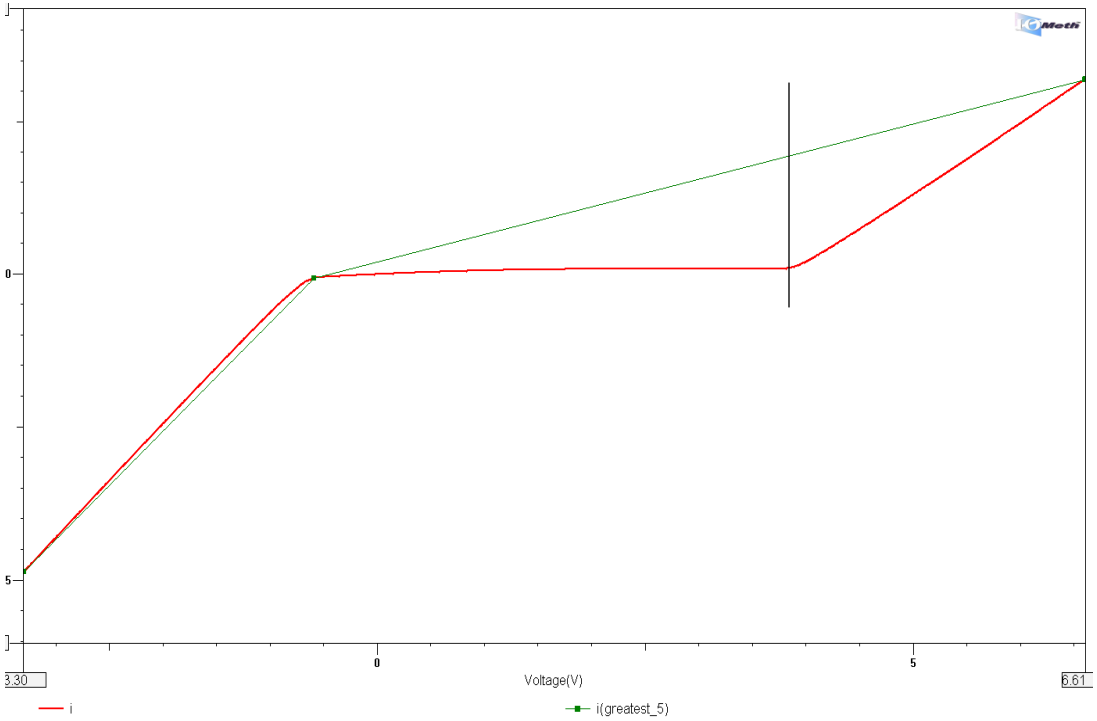
- Draw a line between the first and the last points; find the greatest difference (Y-axle) point between these two curves; add the third point there.



Points selected using “greatest change” algorithm

- Find next the greatest difference (Y-axle) and add 4th point

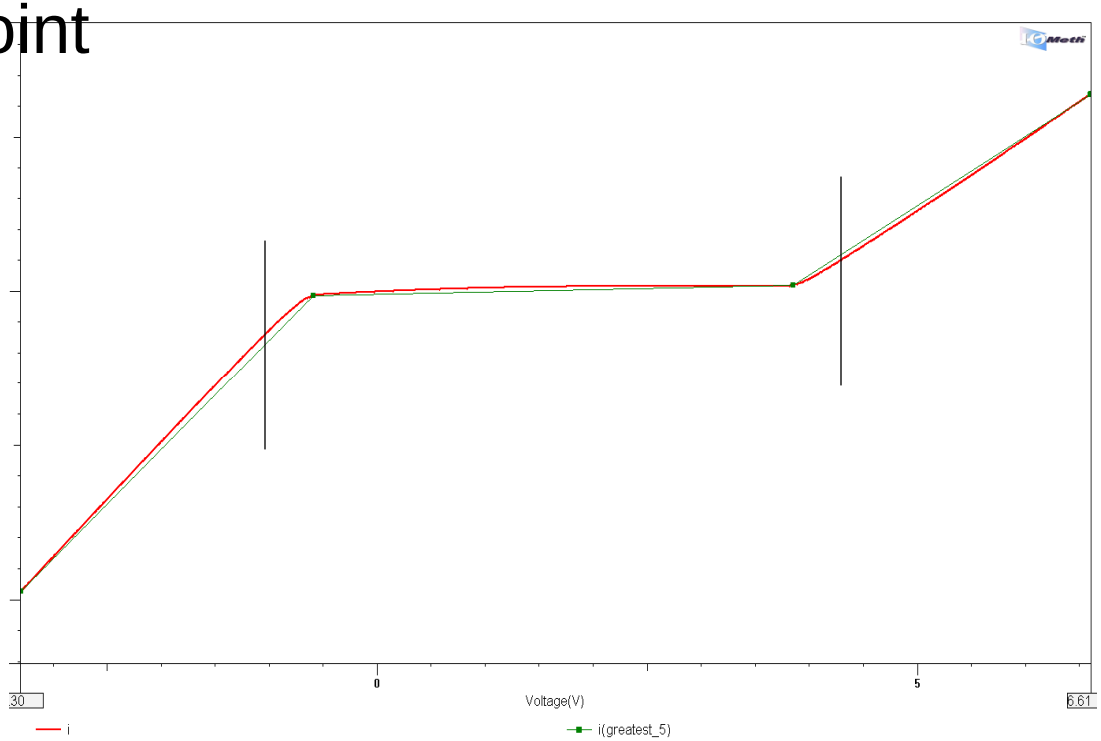
How it works?



Points selected using “greatest change” algorithm

How it works?

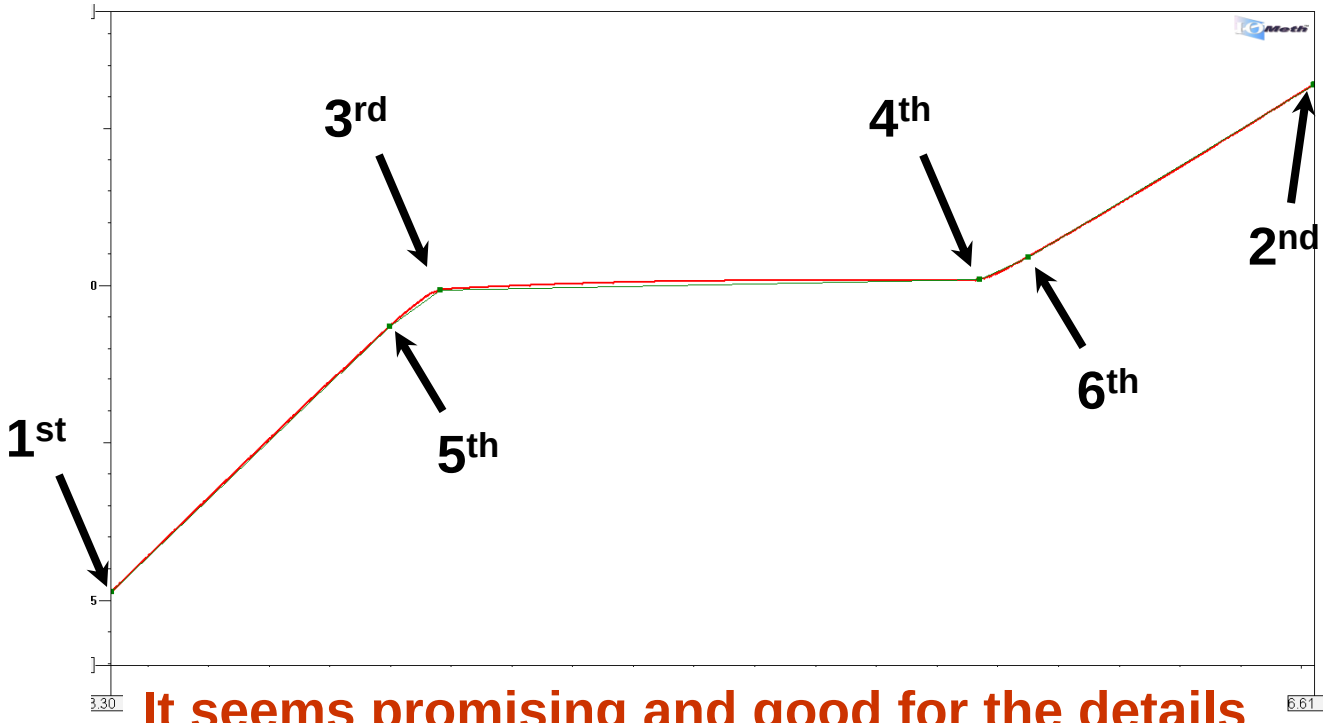
- Find next the greatest differences (Y-axle) and add 5th and 6th point



Points selected using “greatest change” algorithm

- And so on …

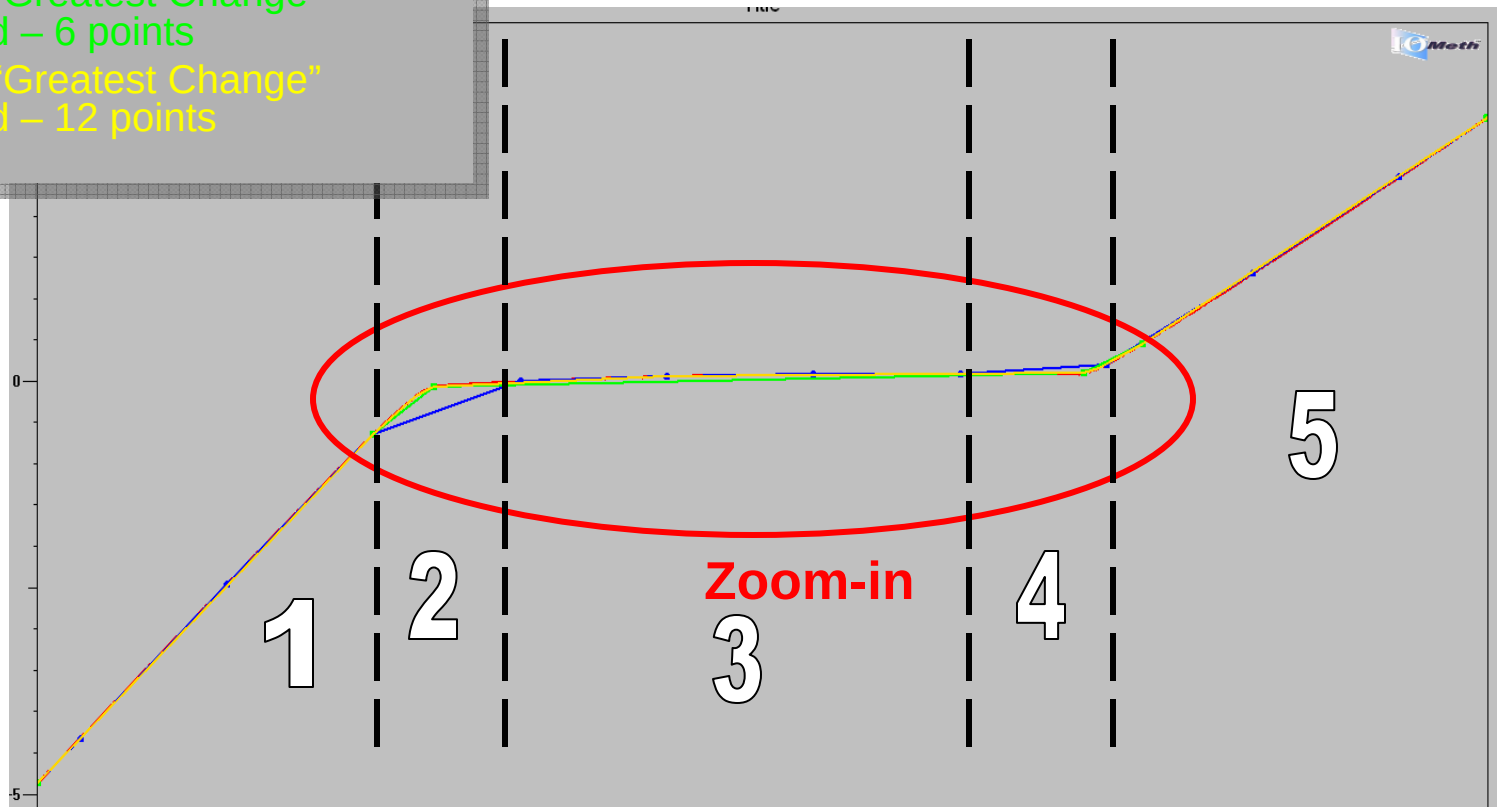
How it works?



It seems promising and good for the details

Comparing two methods with Golden curve

- Golden curve
- Using “a regular interval” method – 12 points
- Using “Greatest Change” method – 6 points
- Using “Greatest Change” method – 12 points



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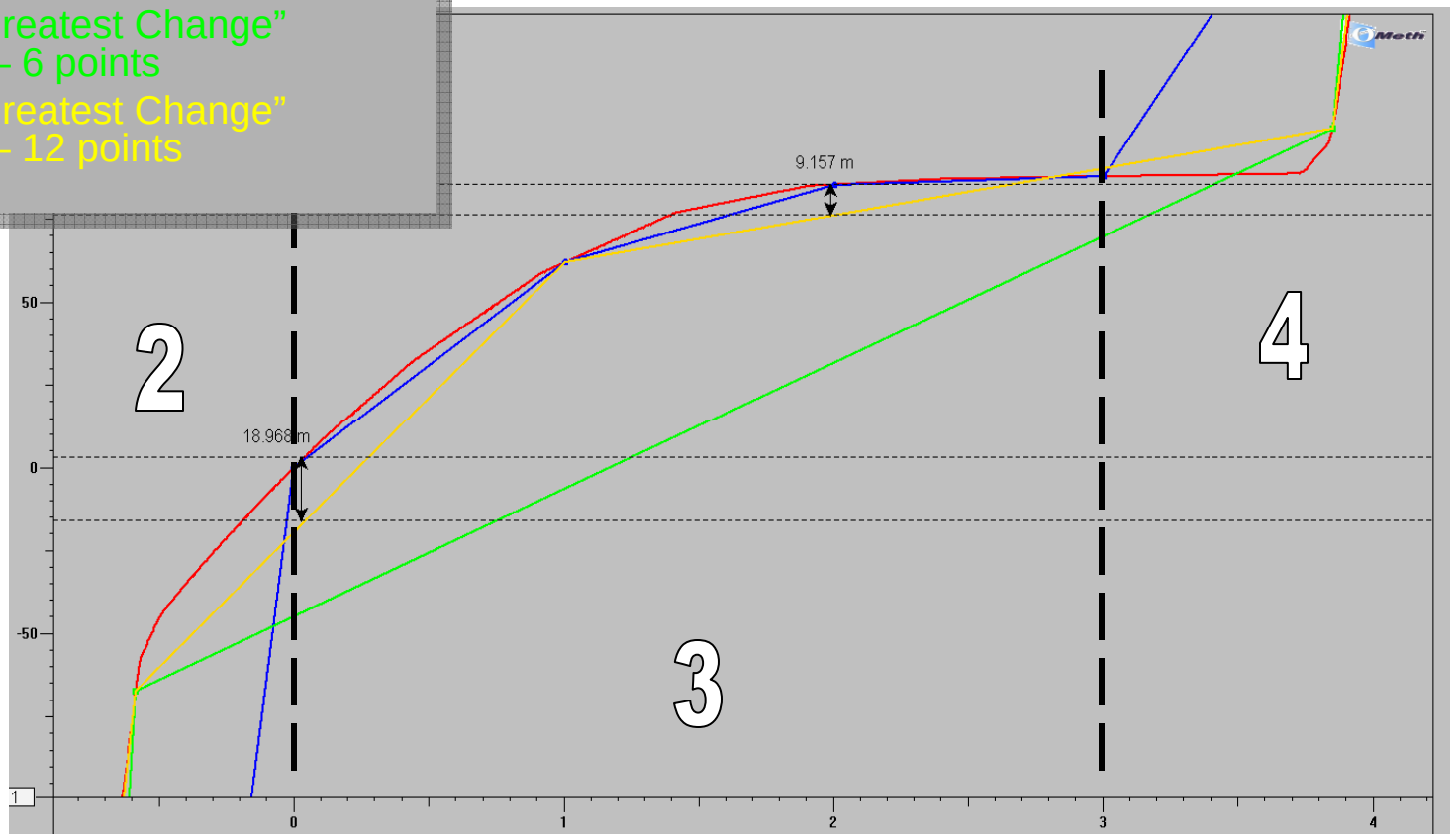


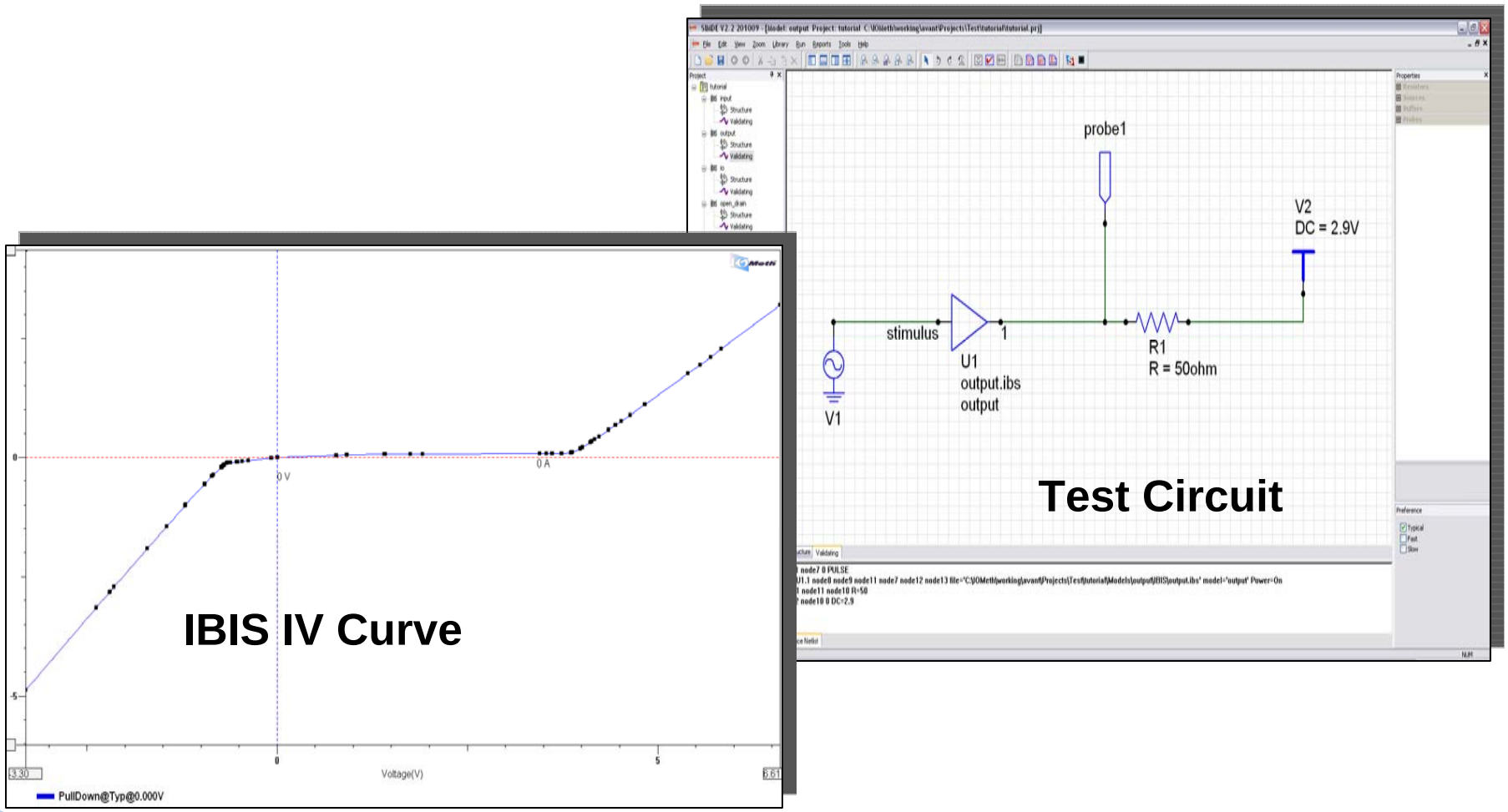
Comparing two methods with Golden curve

- We got:
  - “a regular interval” method – even spacing
    - Simple and easy
    - Lack on the details
    - Accuracy is highly depended on space/point numbers
  - “greatest change algorithm” method
    - Higher accuracy on average
    - Good on the details
    - May have “too few” points in the certain areas and it could compacts the results of simulations

Issue with “Greatest Change” method for IBIS curve representation

- The most of IBIS generation tools are using “Greatest Change” algorithm (so called “Best Point” too) now.
- It works fine with IBIS VT curve point reduction
  - The big part of reason is that VT curves are co-factor in simulation calculations. More details are better.
- Sometimes it causes inaccurate simulation result due to too few points in the working range in the IV curves

A test case for the curves using “the greatest change” algorithm method



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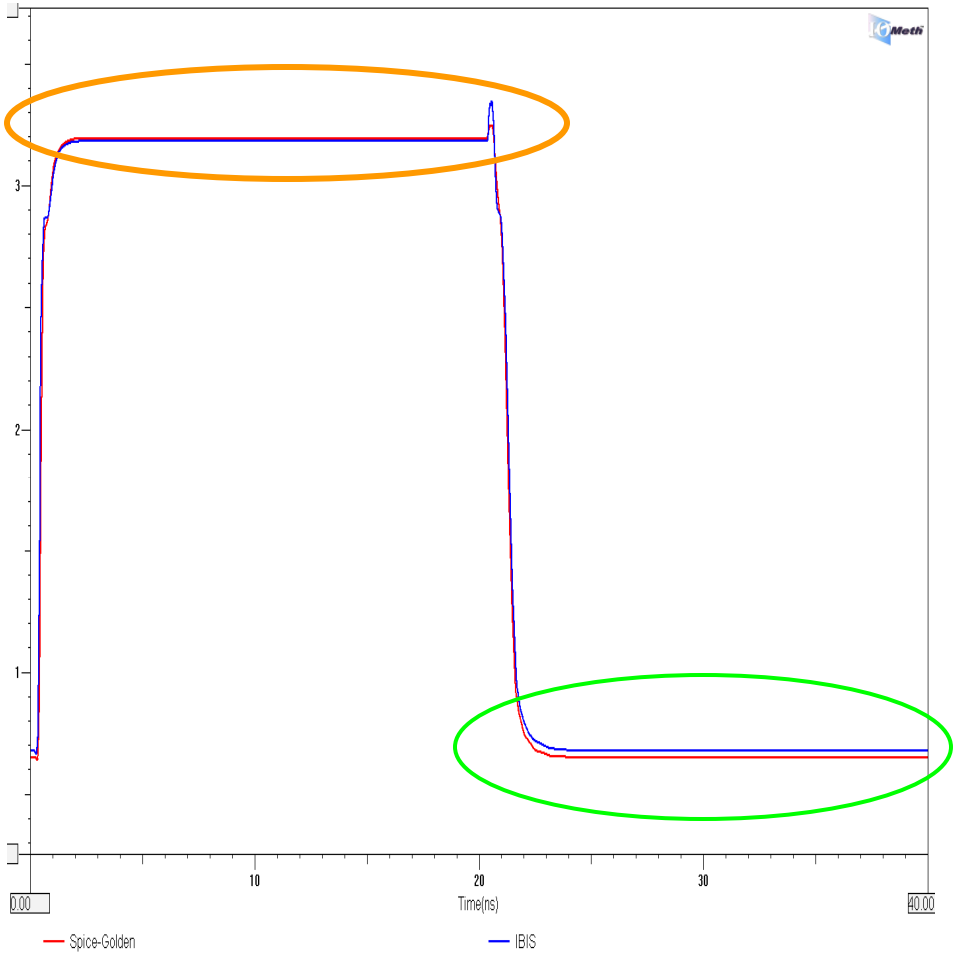
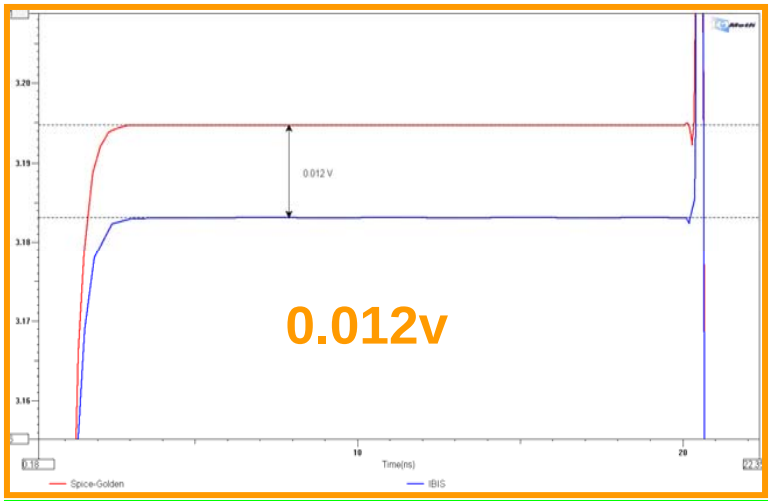
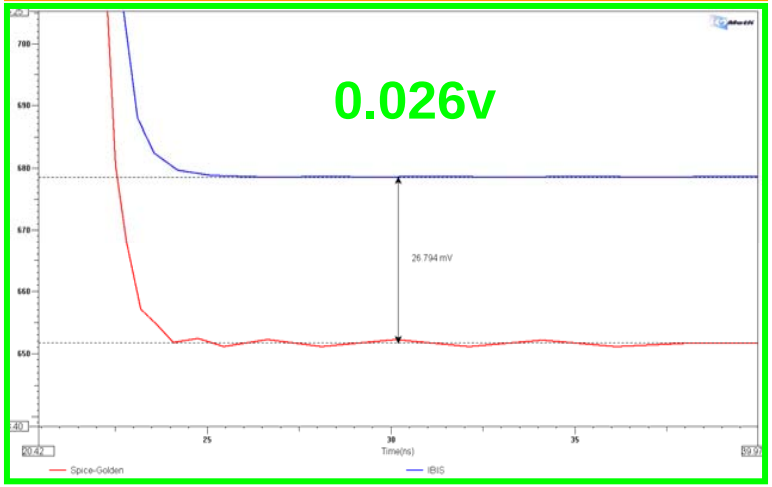
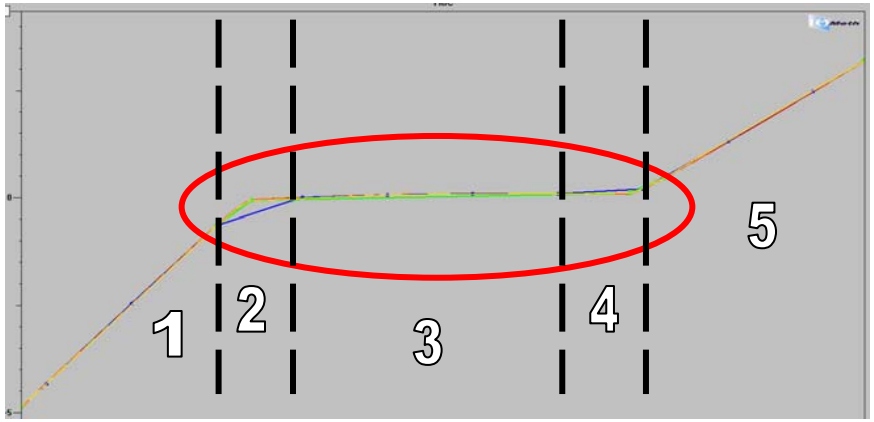


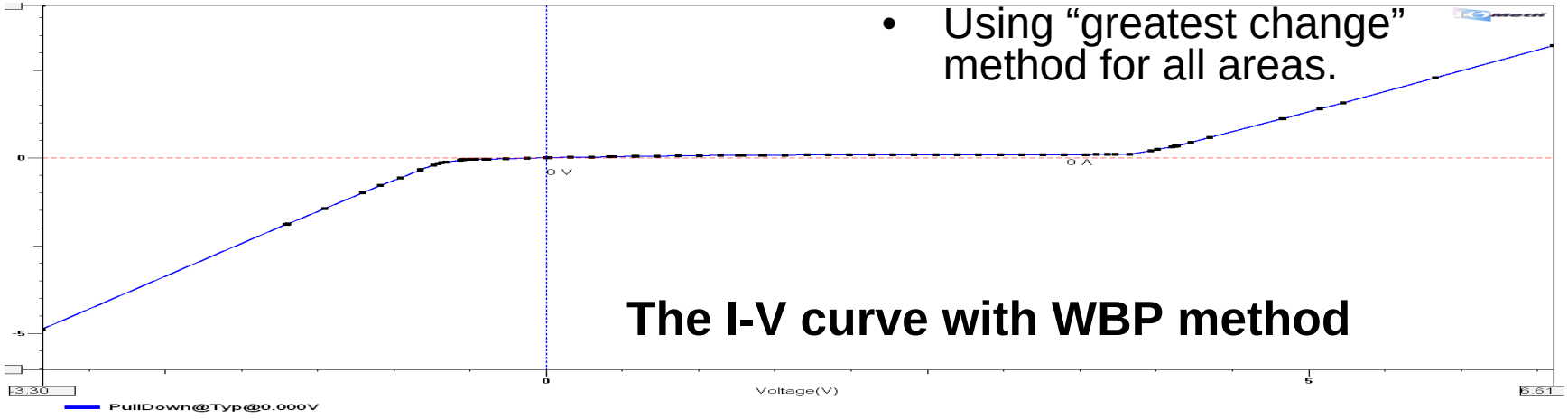




The Weighted Best Point (WBP) method

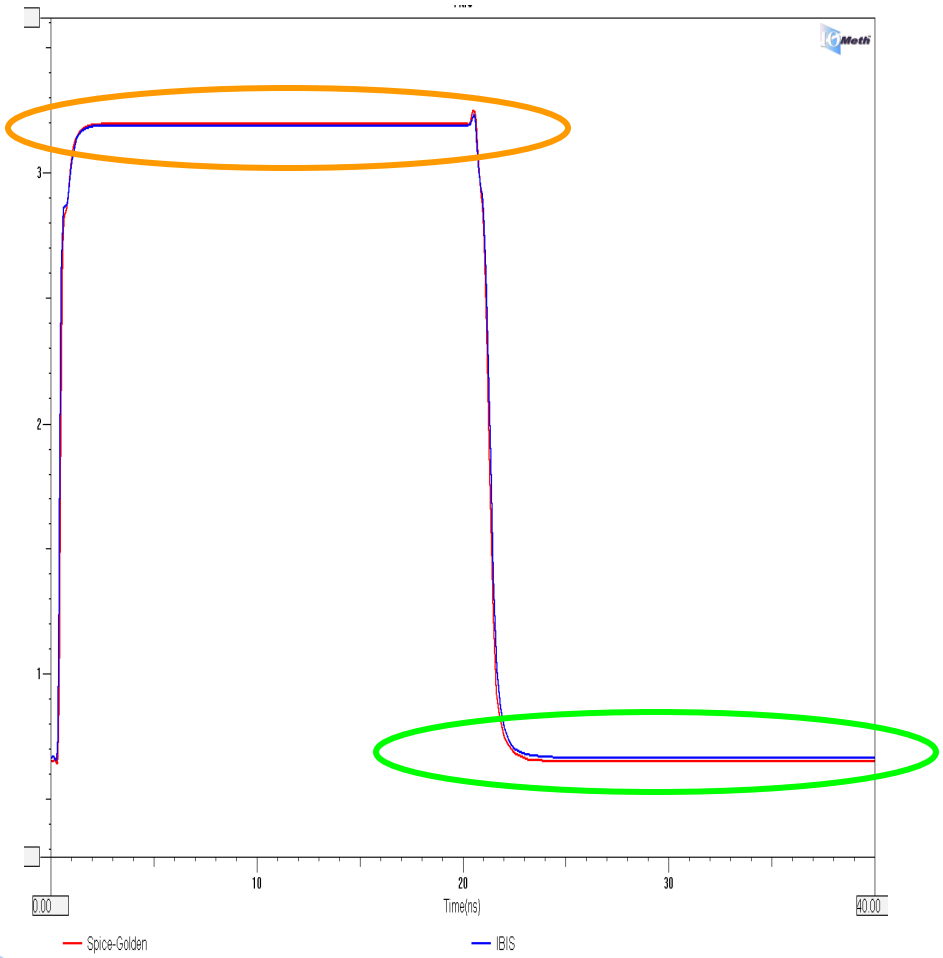


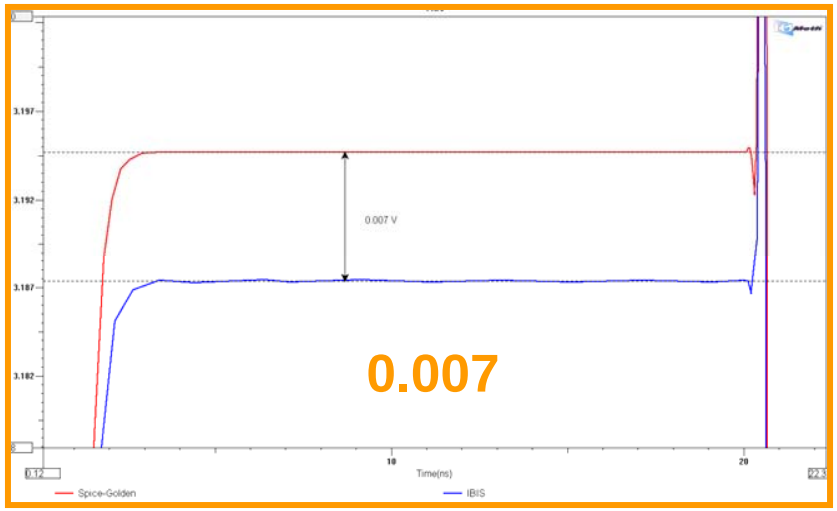
- WBP method is a combination of “regular interval” and “greatest change” methods with more focuses on working range
  - Using “regular interval” for Area 3 (working range)
  - Using dedicated number of points with “greatest change” method for Area 3, 2 and 4 (detailed areas)
  - Using “greatest change” method for all areas.

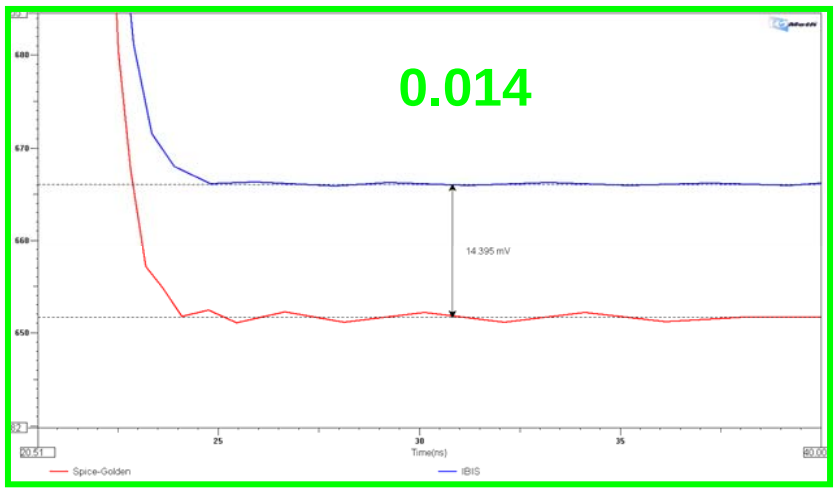


The I-V curve with WBP method

Test result with WBP processed IBIS model







Conclusion

- Point Reduction method is needed for buffer I-V and V-T curve representations in IBIS format
- Both “Regular Interval” and “Greatest Change” algorithm methods have strong and weak areas
- WBP method combined both methods with focused areas. It improves the accuracy in IBIS simulations.
  - It is more effective for low-level signal buffer models

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