Case Study:
Modeling IBIS for Open_drain True Differential Pair Buffer

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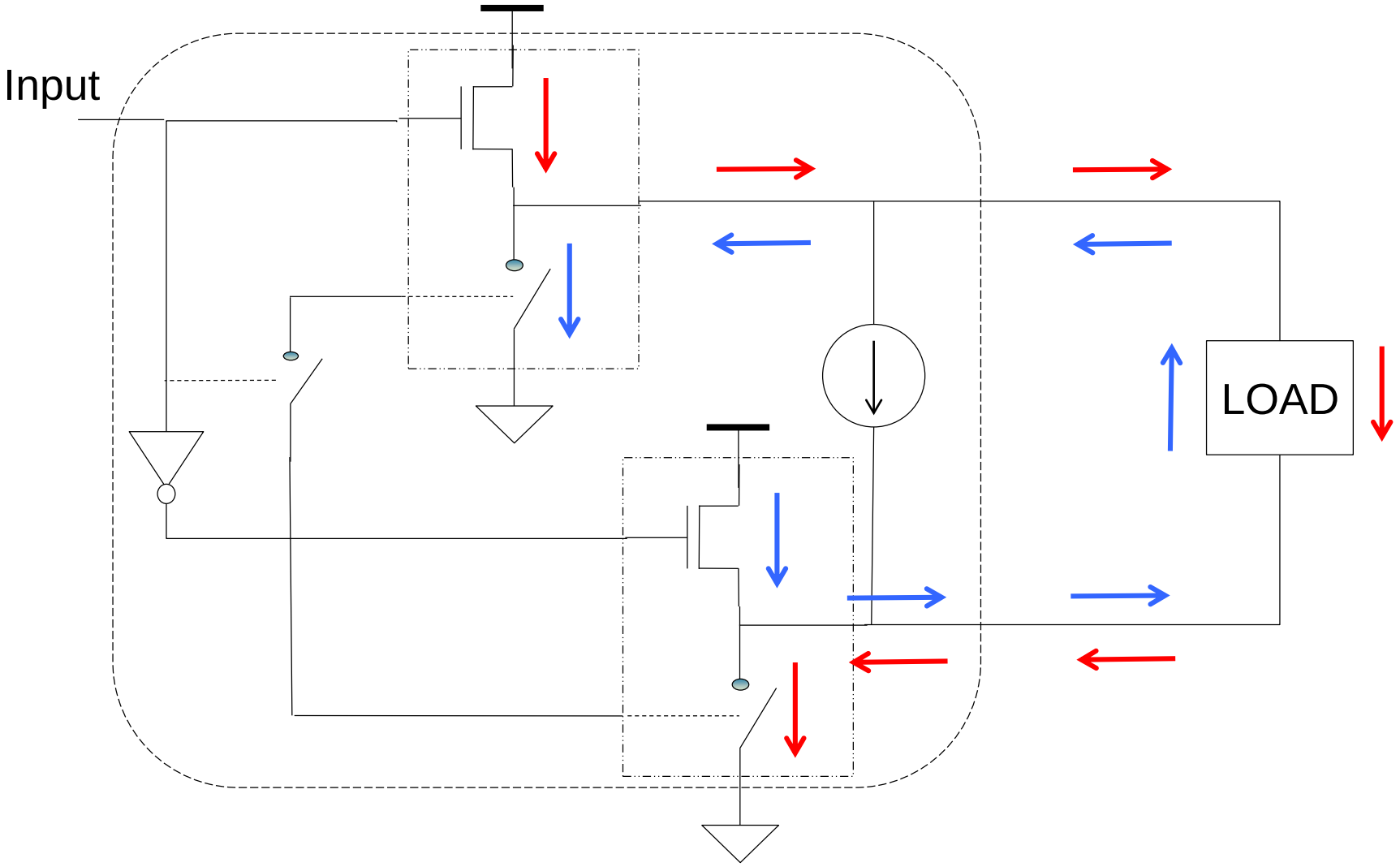
Outline

- Open_drain Differential Pair Buffer Structure
- Review IBIS Modeling Method
  - Differential Pair Modeling Method
  - Output Type Buffer
  - Open_drain Type Buffer
- Practical Method for Open_drain Differential Pair Buffer
- Conclusions

Open_drain Differential Pair Buffer Structure

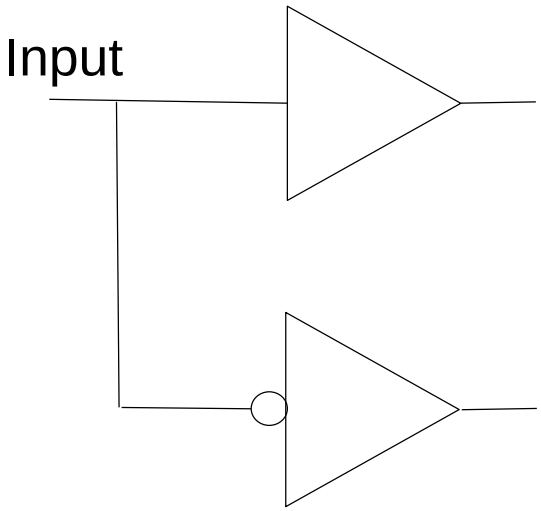


Review IBIS Modeling Method

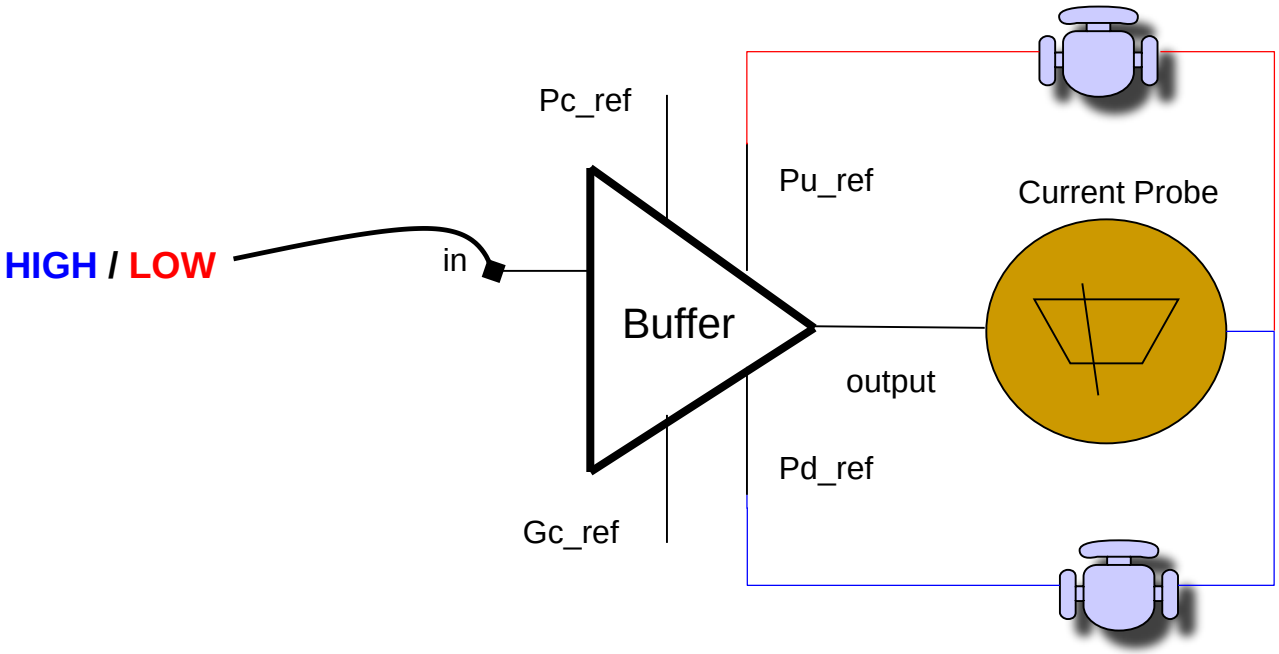
- Differential Pair Modeling Method
- Output Type Buffer
- Open_drain Type Buffer

Differential Pair Modeling Method

- IBIS uses two single-end models to be a differential pair
- IBIS uses [Diff Pin] to define two pins to be a differential pair pins
- Uses two opposite inputs as required



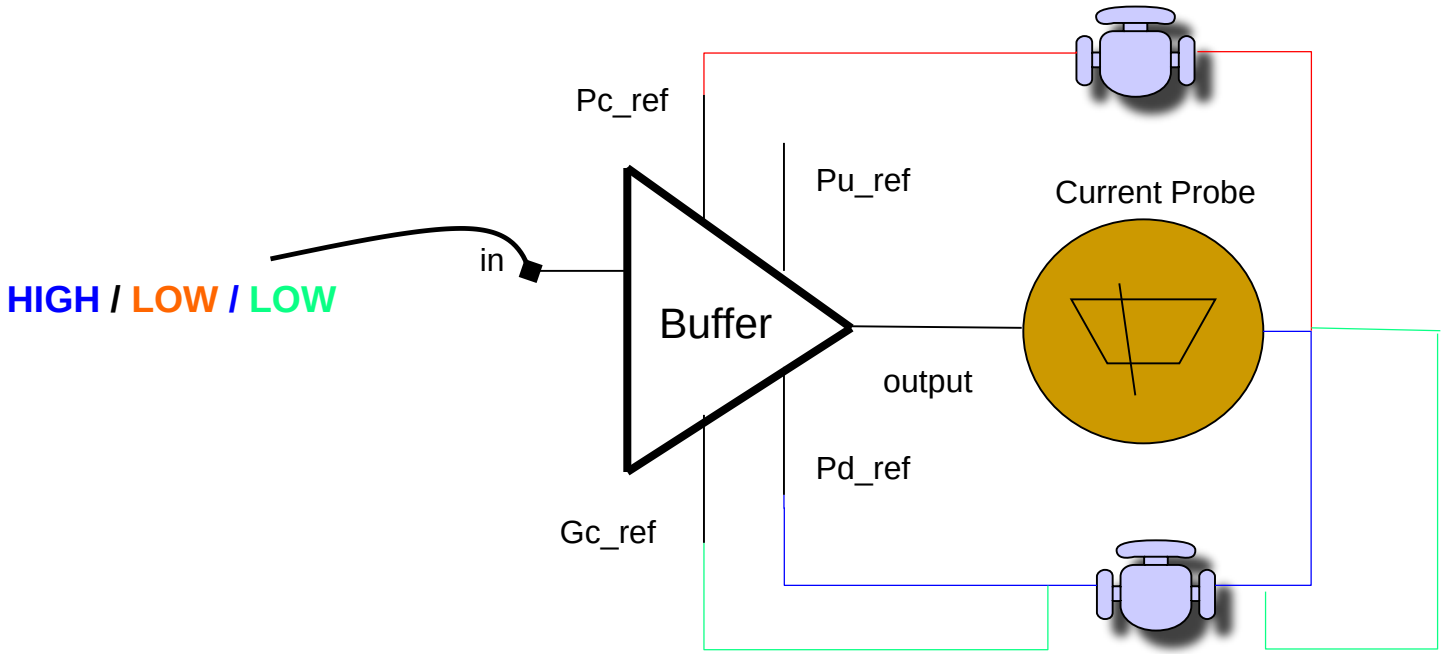
Output Type Buffer (non-inverting)



Set Input LOW to extract Pullup curve

Set Input HIGH to extract Pulldown curve

Open_drain Type Buffer



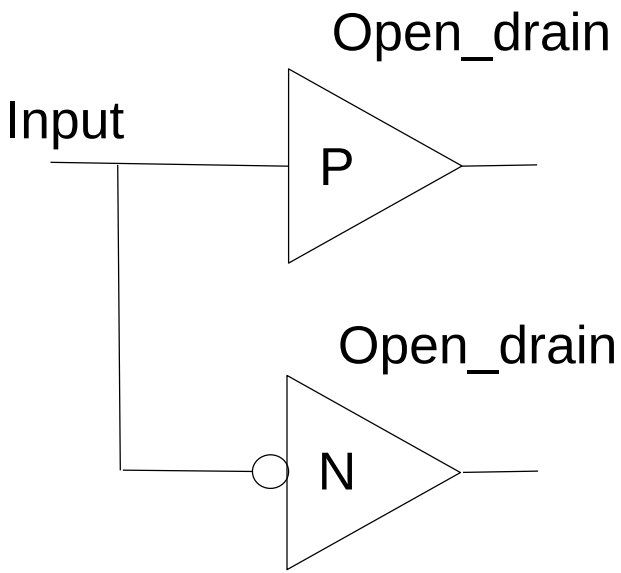
Set Input HIGH to extract Pulldown curve

Set Input LOW to extract PowerClamp curve

Set Input LOW to extract GroundClamp curve

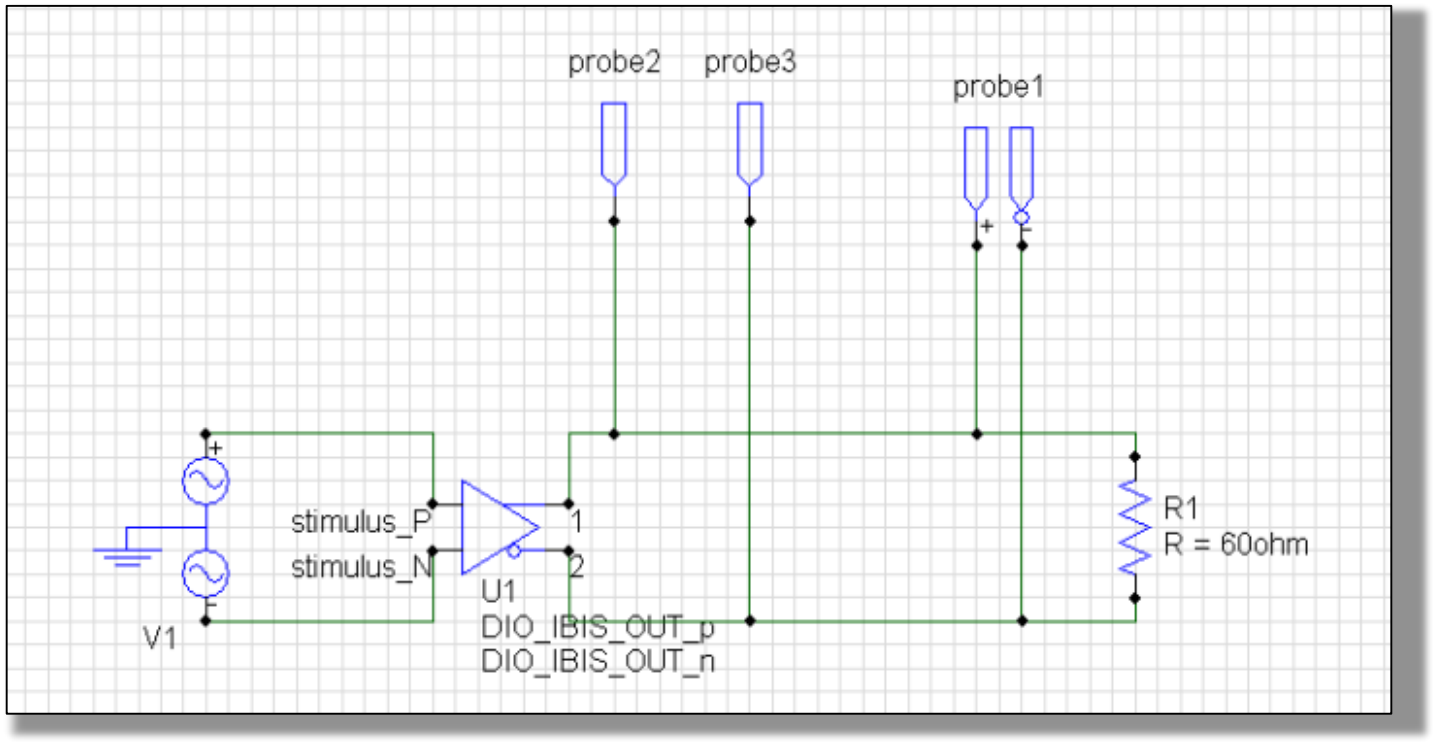
Practical Method for Open_drain Differential Pair Buffer

- As the normal method, we will use two Open_drain type IBIS models for Positive and Negative pins.

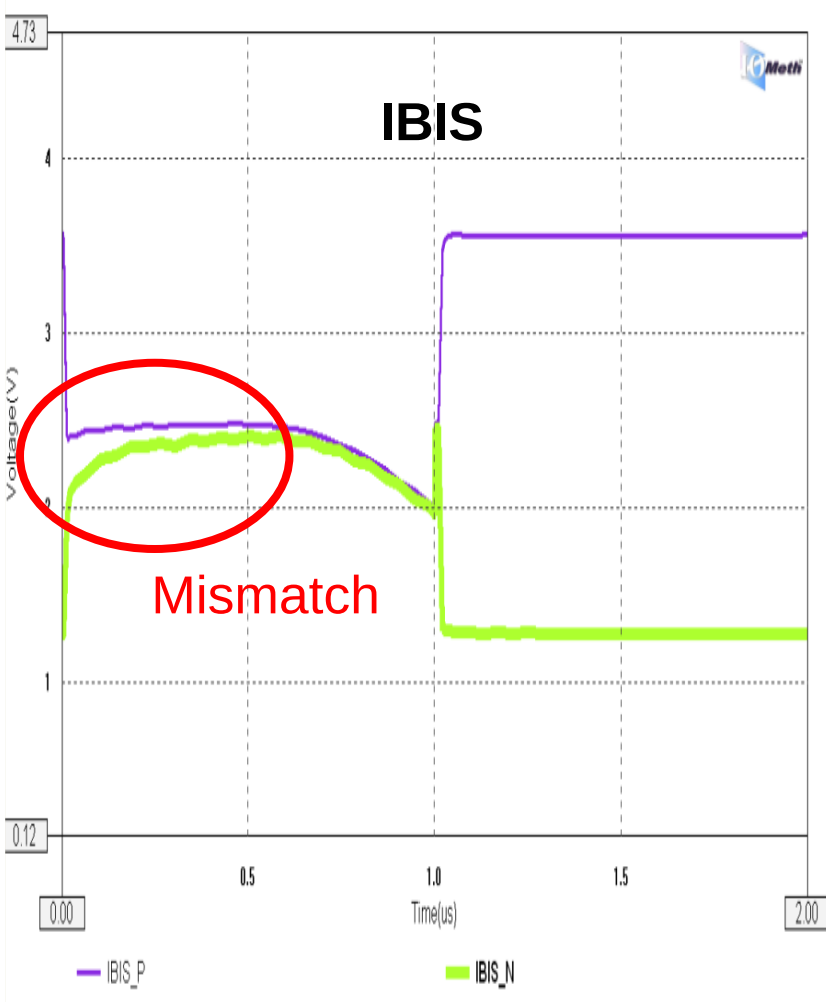


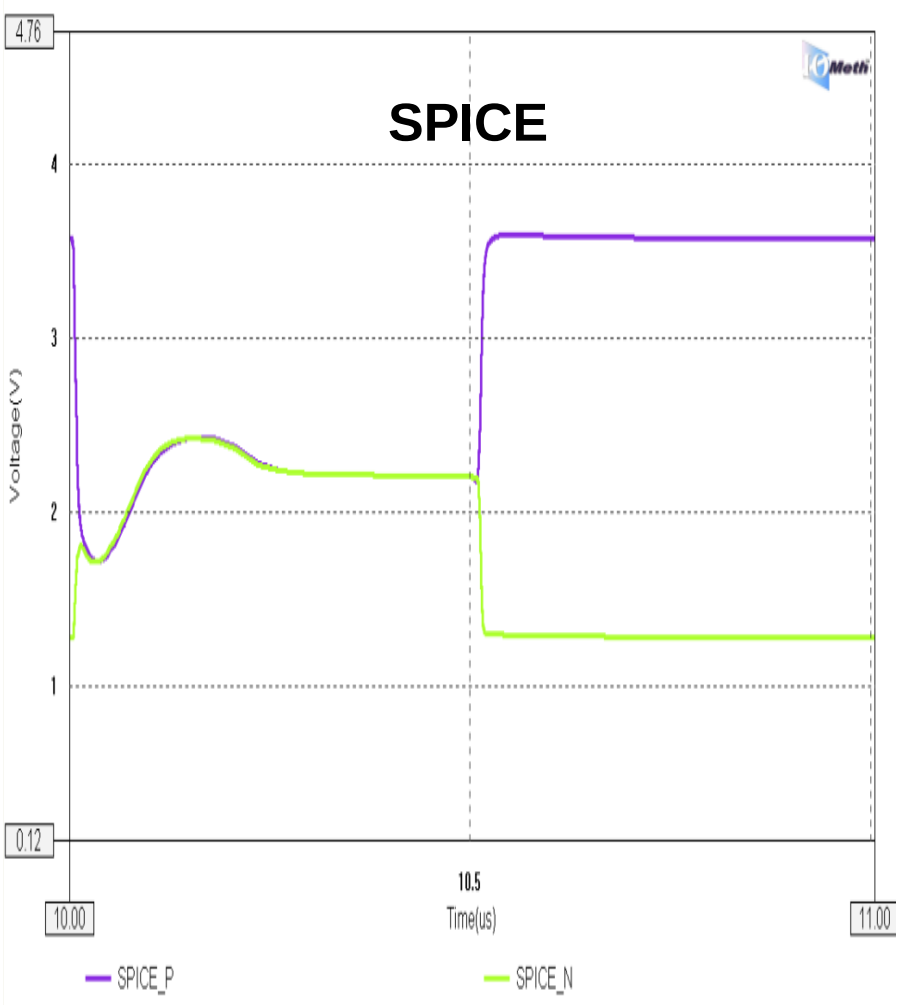
Let’s validate

The Topology for Validation



Validation Results





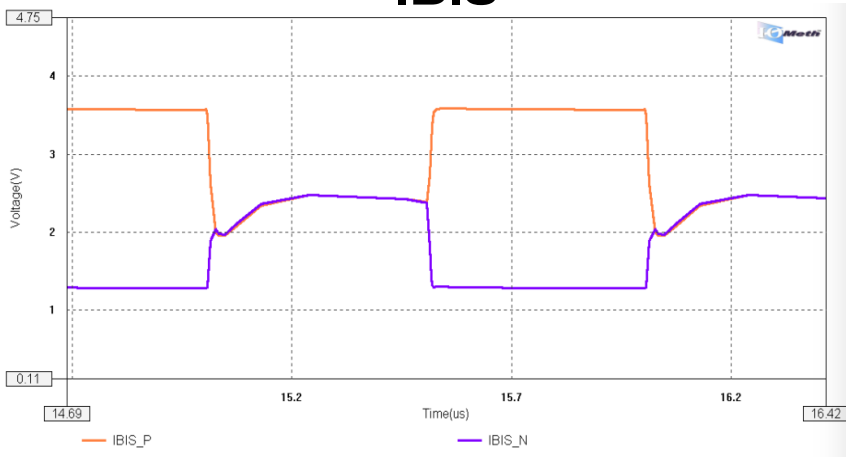
Root cause for mismatch and solution

- We missed some currents in the IBIS models
  - There is some current between P and N pins
  - IBIS Open_drain type model without Pullup curve. Assuming Pullup current is Zero

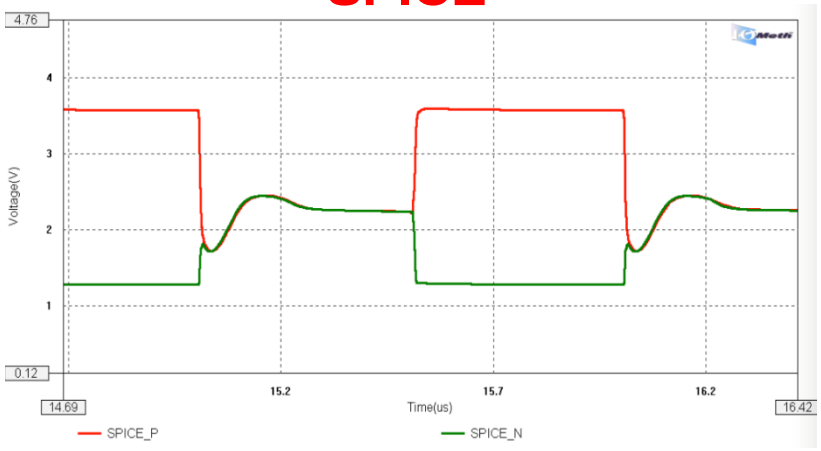
- Solution
  - We can use Output type model to capture all curve data
  - However, we need to use Open_drain type setting to capture the data

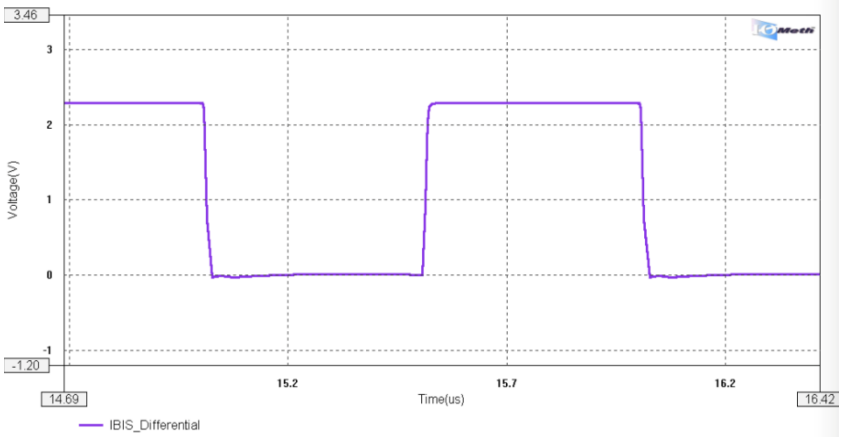
New solution validation result

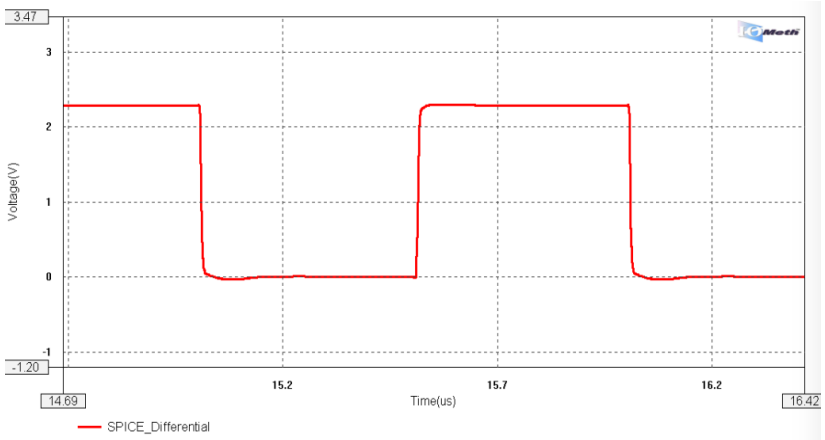
IBIS



SPICE





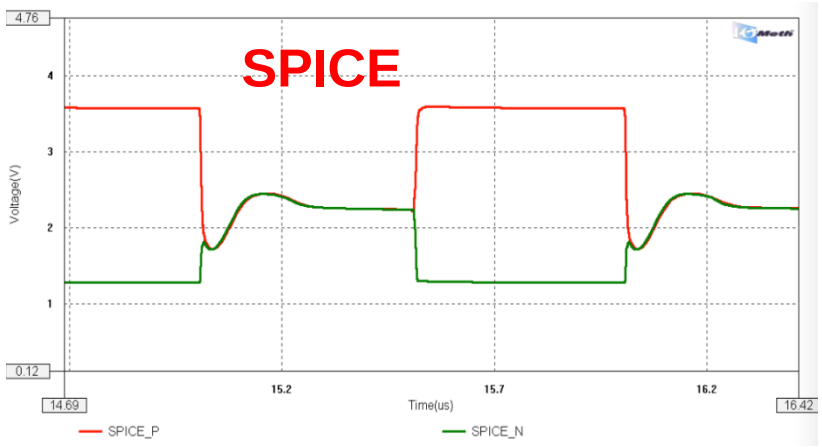


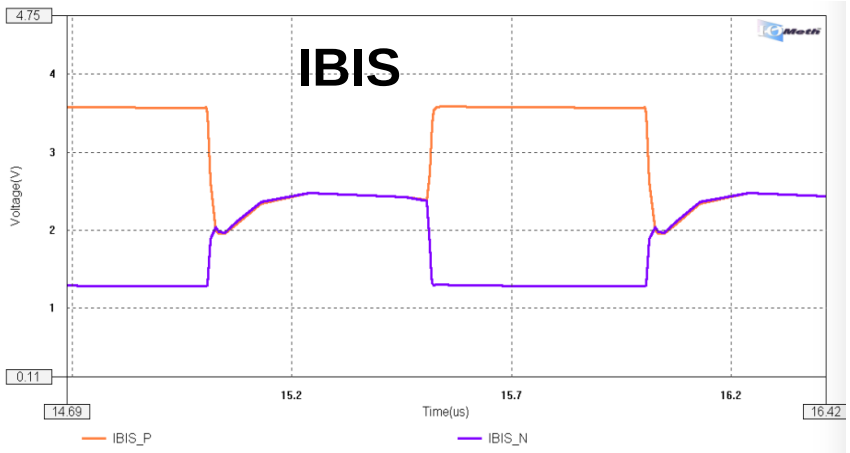
Conclusion

- Open_drain differential pair is a special case for IBIS modeling
  - IBIS Open_drain model is without the Pullup data
  - We need to use Output/IO type IBIS model to capture the Pullup data for this kind of differential pair buffer
    - However we need to IBIS Open_drain modeling setting for extractions
- IBIS C_comp needs to improve to be matched better

C_comp

- Currently, IBIS Spec only allows 4 values at the most
- We might need to have more C_comp values according DC levels and frequency changes
- Study is in process …





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