

The logo is a circular seal for the UMR/MS&T Electromagnetic Compatibility Laboratory. It features the acronym 'EMC' in large, bold, serif letters in the center. The words 'UMR/MS&T ELECTROMAGNETIC' are written along the top arc, and 'COMPATIBILITY LABORATORY' along the bottom arc, both in a smaller, sans-serif font.

S2IBISPY – A Python Rewrite SPICE-to-IBIS Converter

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Hybrid IBIS Summit at IEEE EMC+SIPI 2026

Dallas, Texas

August 6, 2026

Outline

- Introduction
 - Motivation
 - Limitations
- S2IBISPY
 - NCSU S2IBIS
 - S2IBISPY
- Future Works

How to Convert SPICE to IBIS?

- SPICE-to-IBIS conversion methods vary:
 - Manual preparation
 - Commercial
 - Open-source tool (NCSU S2IBIS)

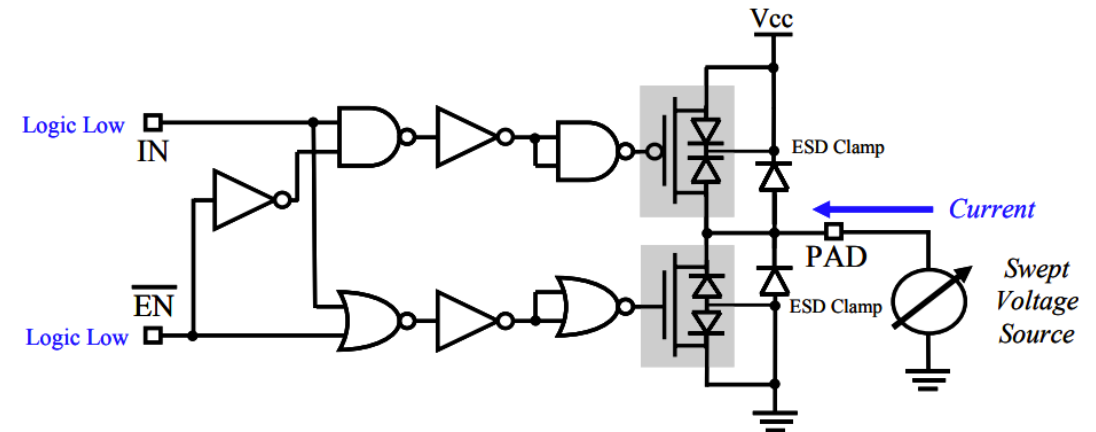


Figure 3.1 – Standard 3-state Buffer (Pulldown I-V Table Extraction Shown)

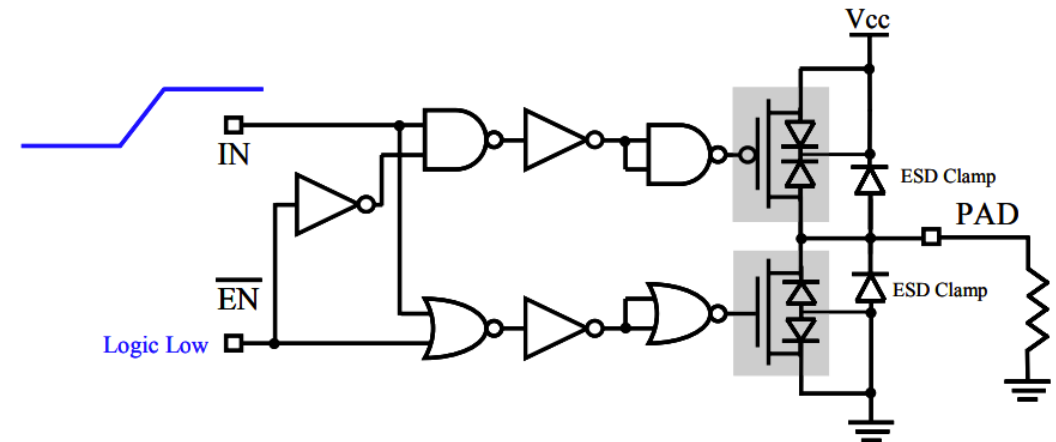
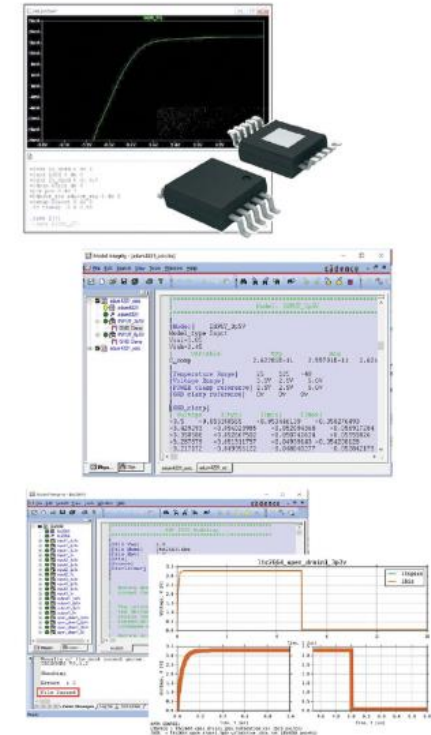
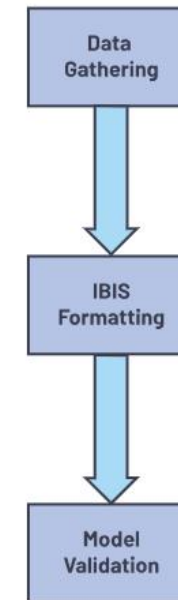


Figure 3.2 – Simulation Setup for Extracting Ramp Rate Information (Rising Edge Shown)

Source: IBIS Open Forum, IBIS Modeling Cookbook for IBIS Version 4.0, 2005.

Limitations of the Currently Available Methods

- Manual Preparation:
 - Requires strong IBIS knowledge; error-prone due to manual steps
- Commercial Tools:
 - Not everyone has a license
- Open-source tool (NCSU S2IBIS):
 - No longer maintained



The IBIS model generation process

Source: Analog Devices, Analog Dialogue, "IBIS Modeling Part 1"

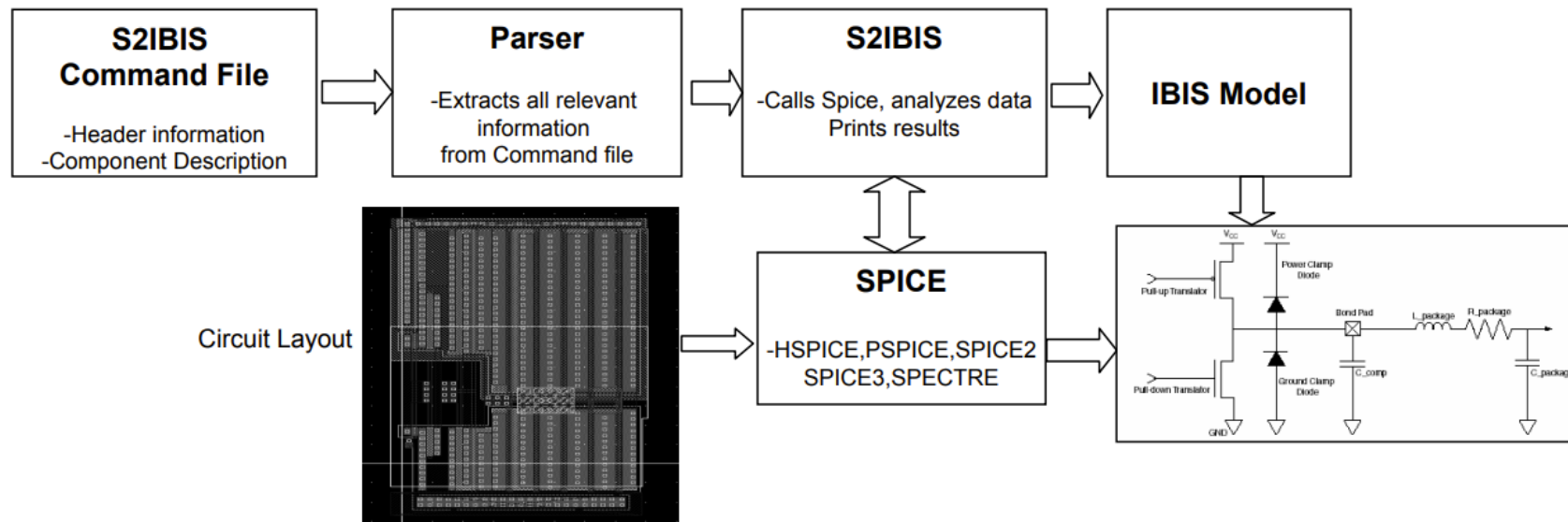
NCSU S2IBIS

- Covered IBIS versions: Ver 3.2, 2.1, and 1.0
- Need Java Development Kit (JDK) to run
- No GUI

NCSU S2IBIS (cont.)

- Full source code available

- **Tool flow**

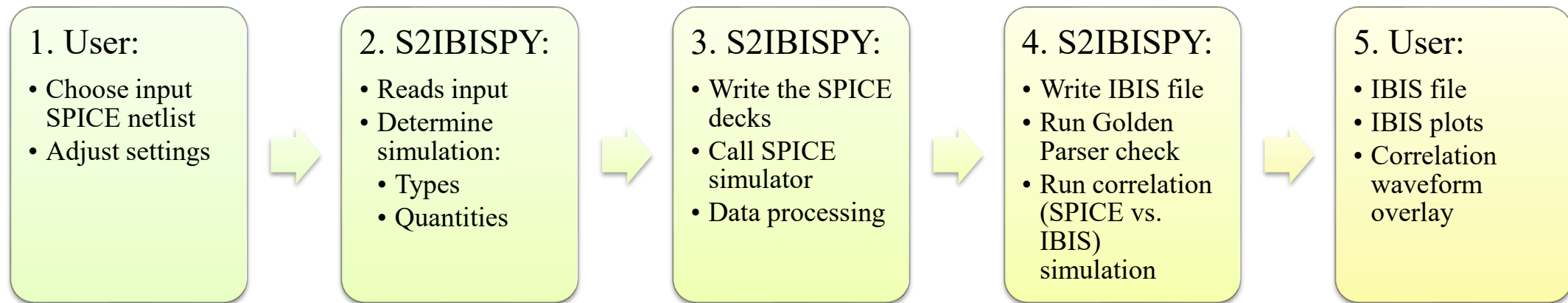


Source: A. Varma, "S2IBIS: Past, Present and Future," IBIS Summit, Oct. 2003.

S2IBISPY – Features & Workflow



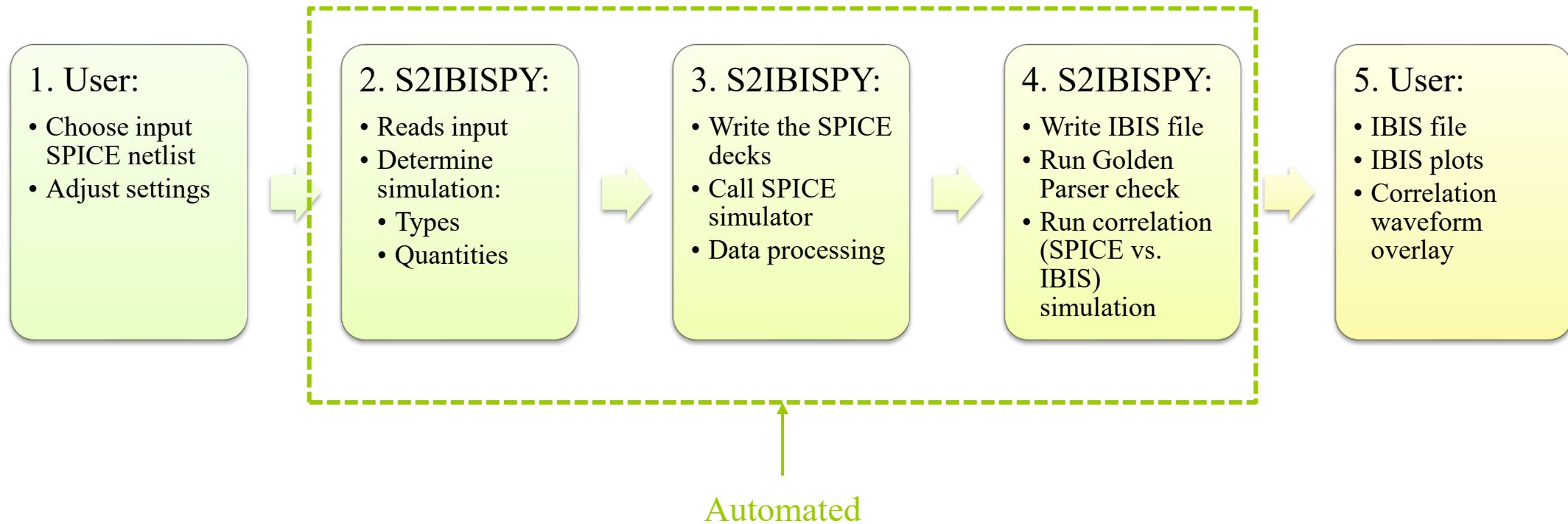
From SPICE Netlist to IBIS Model



S2IBISPY – Features & Workflow



From SPICE Netlist to IBIS Model



S2IBISPY – User Inputs & Setup



- Backward-compatible: supports NCSU S2IBIS input formats

s2ibispy — SPICE to IBIS Converter v2.1.0

File

Main IBIS Viewer Plots Correlation

Input File

Input Type: ☒ YAML Config ☐ Legacy .s2i

Input File: Browse

Output Directory: Browse

ibischk7 Path (optional): Browse

New YAML Save YAML Save As Parse SPICE

Global Defaults

Simulation

Sim Time (s): Rload (Ω):

Temperature Range [°C] *

Type: Min: Max:

Voltage Range [V] *

Type: Min: Max:

Pullup Ref [V]

Type: Min: Max:

Pulldown Ref [V]

Type: Min: Max:

Power Clamp Ref [V]

Type: Min: Max:

GND Clamp Ref [V]

Type: Min: Max:

Models

Name	Type	Enable	Polarity	NoModel
buffer	I/O	oe	Non-Inverting	

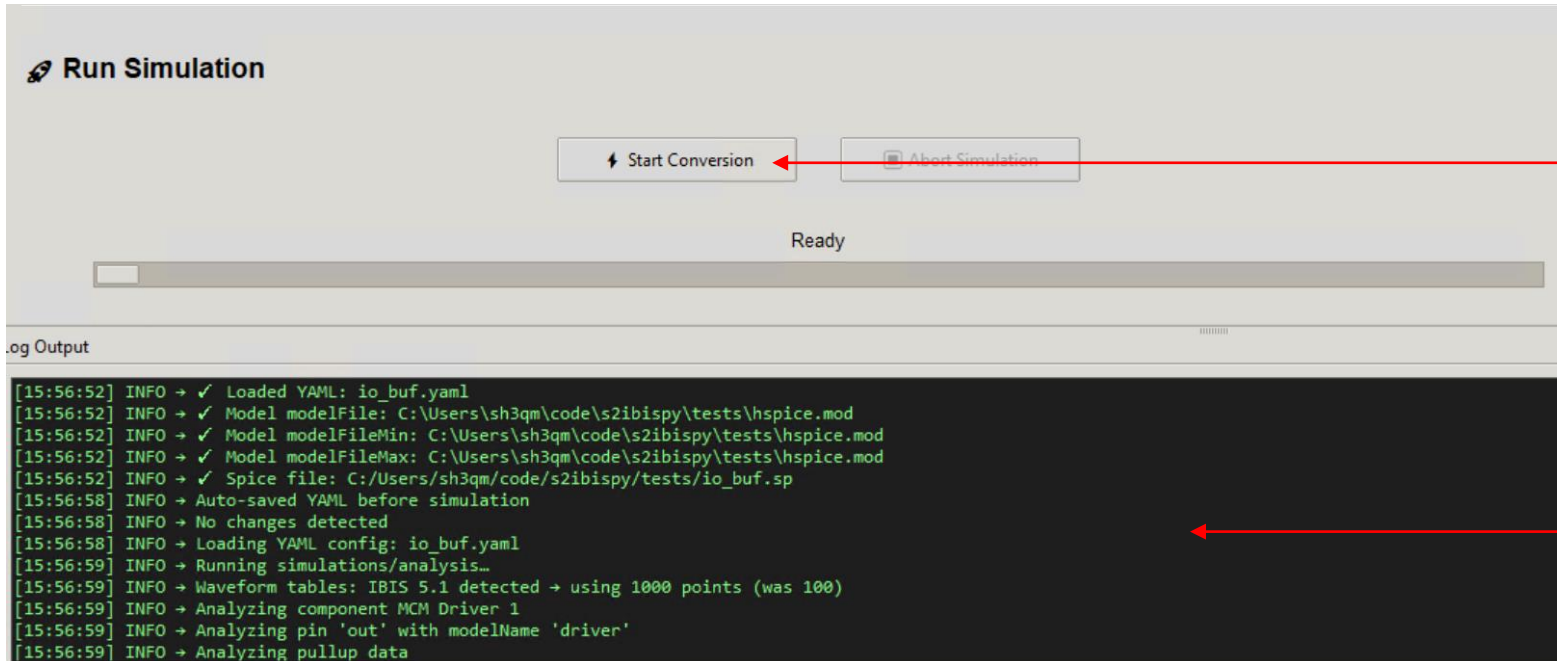
+ Add Model Edit Model Delete Selected

Pins

Pin	Signal	Model	Input Pin	Enable Pin
1	pad	buffer	in	oe
2	vdd	POWER		
3	vss	GND		

+ Add Pin Delete Selected

S2IBISPY – Conversion In Progress



1. Press start after completing the setup

2. Monitor progress in the log window

S2IBISPY – Conversion Completed



- Auto-check with Golden Parser

```
[15:59:58] INFO → Writing IBIS to \\minerfiles.mst.edu\dfs\users\sh3qm\Desktop\out\io_buf.ibs
[15:59:59] INFO → IBIS file written: \\minerfiles.mst.edu\dfs\users\sh3qm\Desktop\out\io_buf.ibs
[15:59:59] INFO → Running ibischk7 on \\minerfiles.mst.edu\dfs\users\sh3qm\Desktop\out\io_buf.ibs
[16:00:02] INFO → ibischk7: No errors – model passed syntax check
[16:00:02] WARNING → ibischk7 found 2 warning(s)
[16:00:02] INFO → ibischk7 issued 21 note(s)
[16:00:02] WARNING → ibischk7 reported 2 warning(s) – model is still valid
[16:00:02] INFO → GUI requested automatic correlation
[16:00:02] INFO → Flat netlist → creating subcircuit wrapper
[16:00:02] INFO → Wrapper created: \\minerfiles.mst.edu\dfs\users\sh3qm\Desktop\out\driver_wrapper.sp → DRIVER_WRAPPER in oe out in_sense vdd vss
[16:00:02] INFO → Correlation deck created: \\minerfiles.mst.edu\dfs\users\sh3qm\Desktop\out\correlate_driver.sp
[16:00:04] INFO → Correlation SPICE run succeeded for driver
[16:00:04] INFO → Correlation SUCCESS → correlate_driver.sp
[16:00:04] INFO → Correlation SUCCESS → correlate_driver.sp
[16:00:04] INFO → Correlation complete – 1 successful run(s)
[16:00:04] INFO → IBIS generated: io_buf.ibs
[16:00:04] INFO → Analysis engine attached → ready for plots & correlation
[16:00:04] INFO → Done.
[16:00:05] INFO → IBIS loaded: io_buf.ibs
[16:00:05] INFO → Plots tab: 14 curve(s) visible
[16:00:05] INFO → Plot engine ready – instant plotting!
[16:00:05] INFO → Plots tab updated with new curves
[16:00:05] INFO → Conversion completed!
```

S2IBISPY – IBIS Viewer



- Quick text-based check of the generated IBIS file

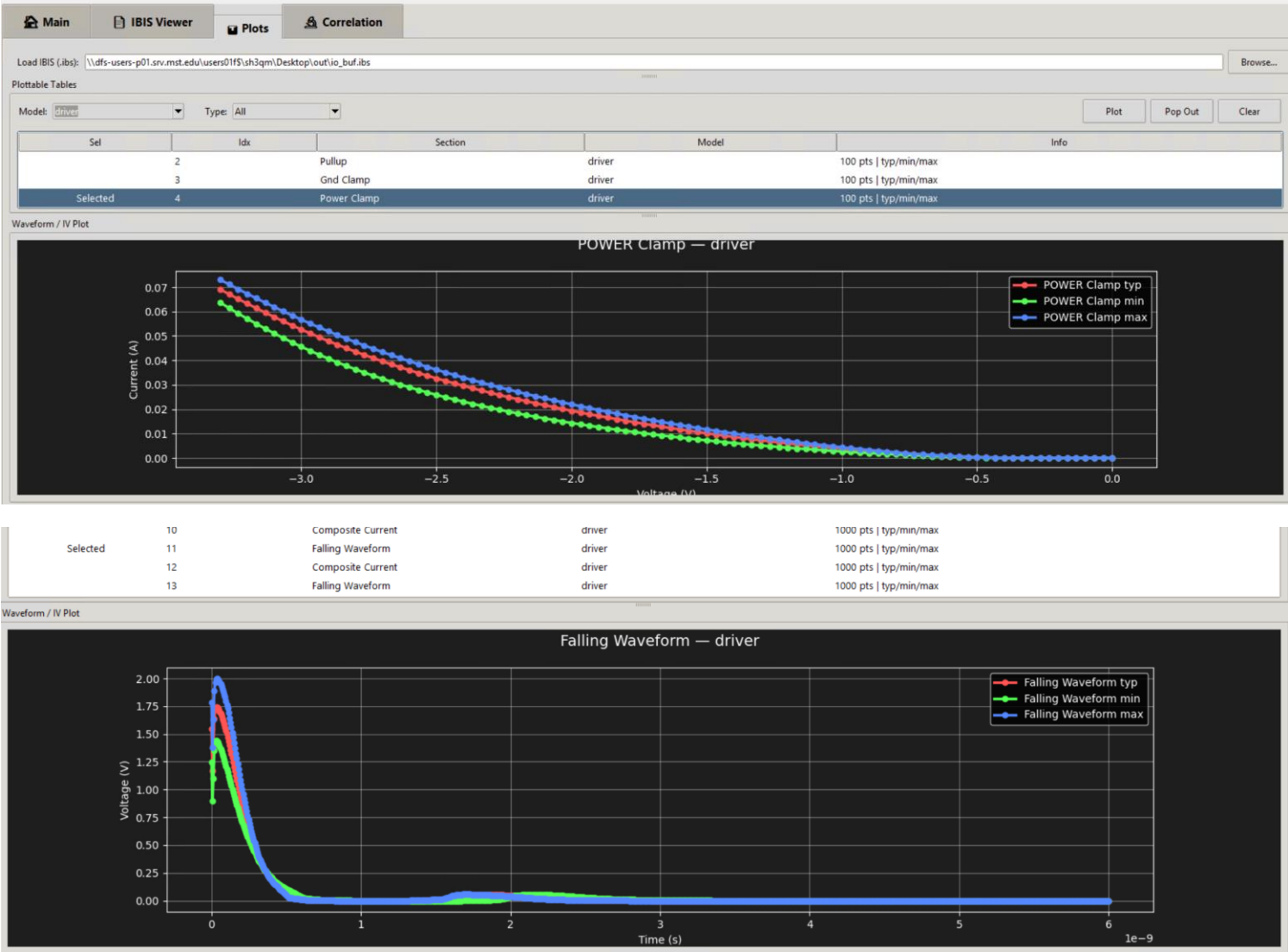
Load IBIS (.ibs):

IBIS Sections

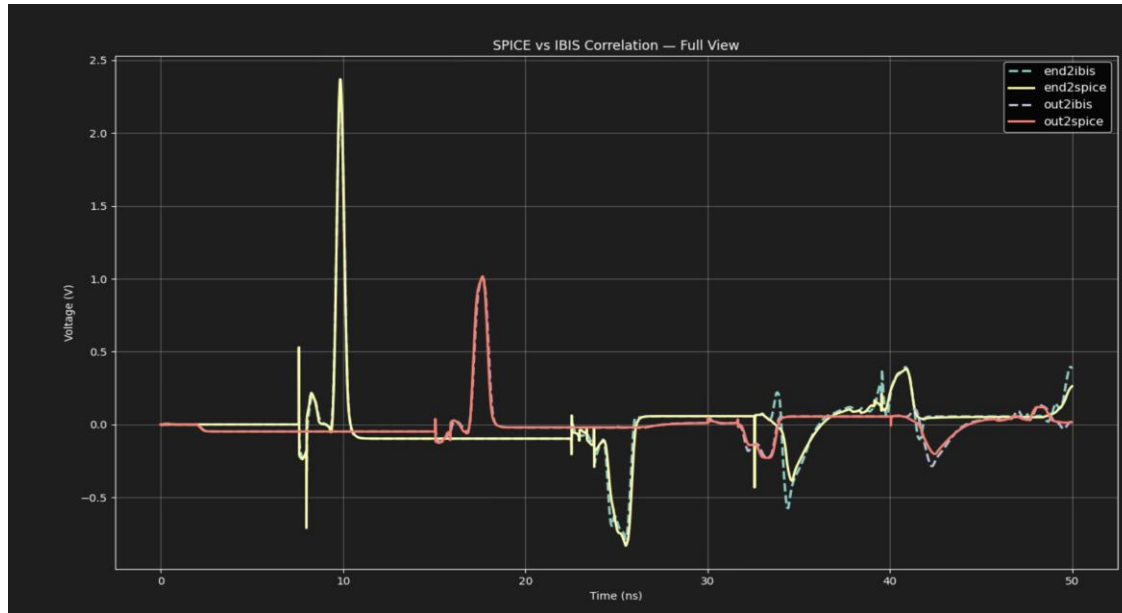
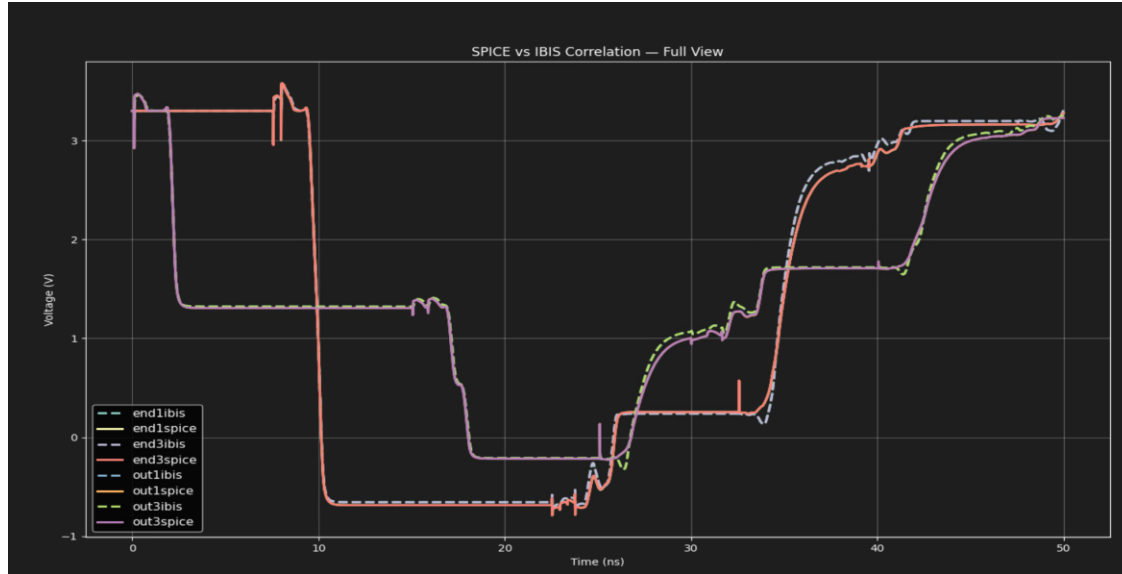
[Copyright] Missouri S&T EMC Lab
[Component] MCM Driver 1
[Manufacturer] MegaFLOPS Inc.
[Package]
[Pin] signal_name model_name R_pin L_pin C_pin
[Model] driver
[Temperature Range] 27.0000 100.0000 0.0000
[Voltage Range] 3.3000V 3.0000V 3.6000V
[Pulldown]
[Pullup]
[GND Clamp]
[POWER Clamp]
[ISSO_PU]
[ISSO_PD]
[Ramp]
[Rising Waveform] Vf=0 Rf=50
[Composite Current]

[ISSO_PD]	I (typ)	I (min)	I (max)
-3.3000	1.4500n	9.8190n	0.5989n
-3.2000	1.4250n	9.6830n	0.5880n
-3.1000	1.4010n	9.5490n	0.5774n
-3.0000	1.3770n	9.4170n	0.5668n
-2.9000	1.3530n	9.2870n	0.5565n
-2.8000	1.3300n	9.1600n	0.5463n
-2.7000	1.3070n	9.0350n	0.5363n
-2.6000	1.2850n	8.9140n	0.5264n
-2.5000	1.2630n	8.7960n	0.5167n
-2.4000	1.2410n	8.6840n	0.5072n
-2.3000	1.2200n	8.5800n	0.4979n
-2.2000	1.1990n	8.4910n	0.4887n
-2.1000	1.1790n	8.4290n	0.4797n
-2.0000	1.1600n	8.4270n	0.4710n
-1.9000	1.1420n	8.5660n	0.4626n
-1.8000	1.1270n	9.0890n	0.4550n
-1.7000	1.1190n	10.9200n	0.4492n
-1.6000	1.1440n	28.0000n	0.4500n
-1.5000	1.3720n	93.2700m	0.4930n
-1.4000	47.0100u	94.1600m	2.2810n
-1.3000	71.9800m	92.0200m	72.3800m
-1.2000	72.6900m	88.9400m	74.1700m
-1.1000	72.0100m	85.3500m	74.2700m
-1.0000	70.6500m	81.5300m	73.5300m
-0.9000	68.8200m	77.7400m	72.1800m

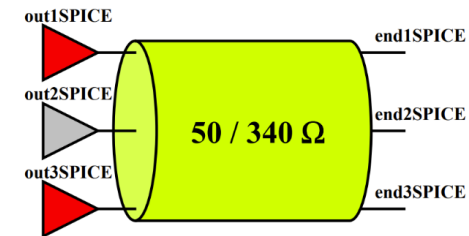
S2IBISPY – Visual Plots



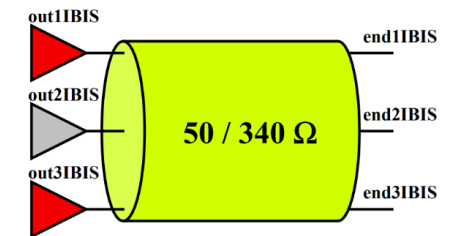
S2IBISPY – Correlation



SPICE and IBIS simulation comparison

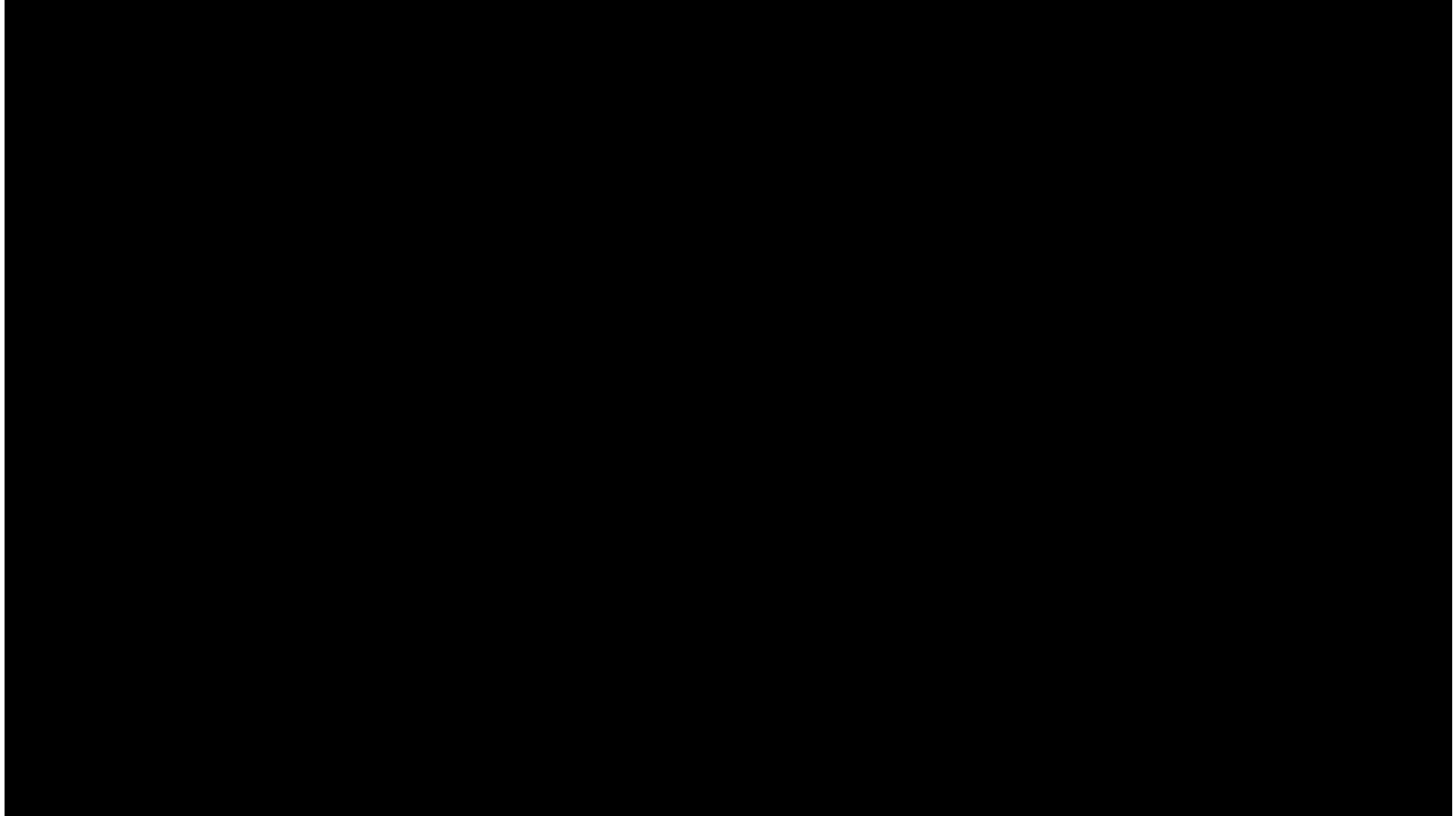


The IBIS model's waveforms were generated with a 50 Ω load for these buffers



Source: A. Muranyi, "Introduction to IBIS models and IBIS model making", November 2003

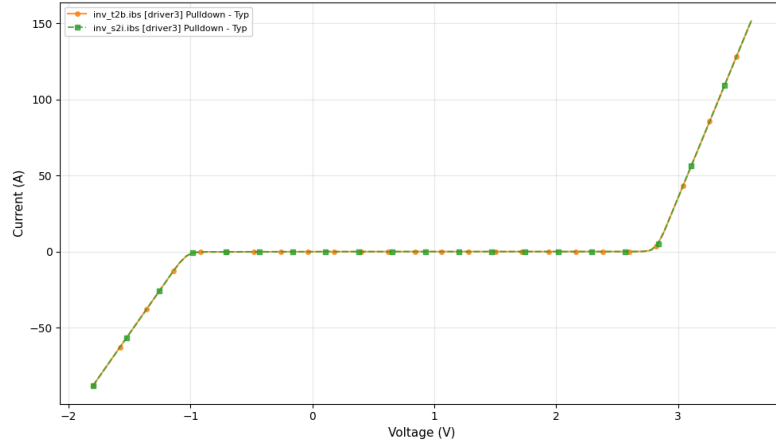
Demo Video



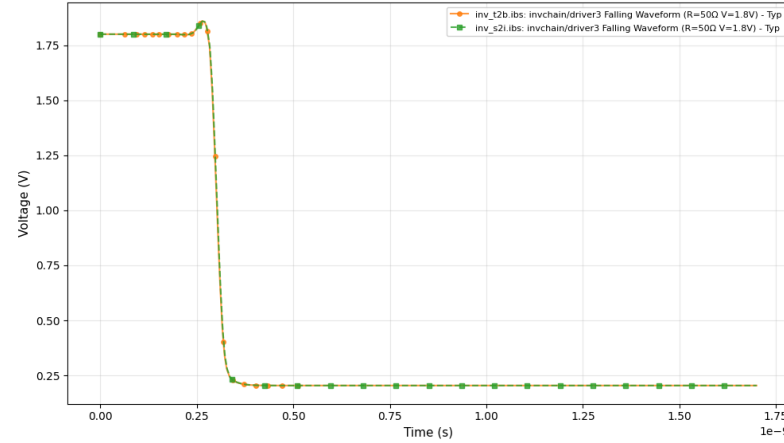
Validation: Correlation with Commercial Tools – Case 1

Commercial tool generated
S2IBISPY generated

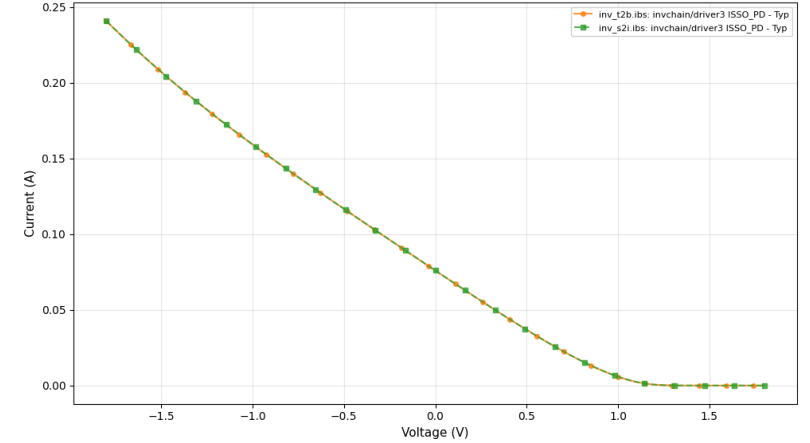
Pulldown



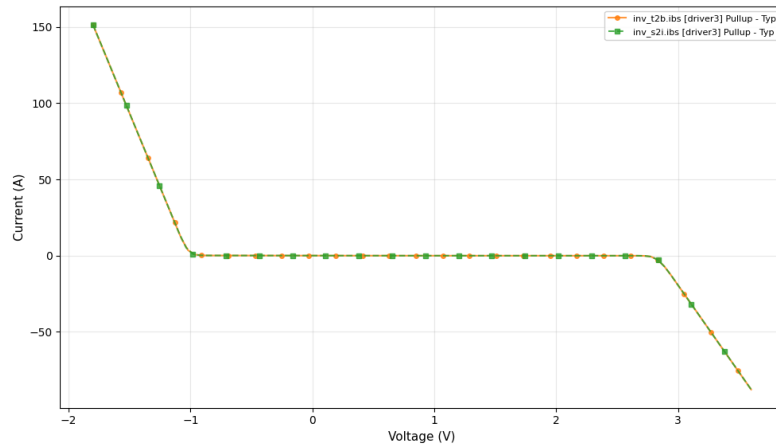
Falling



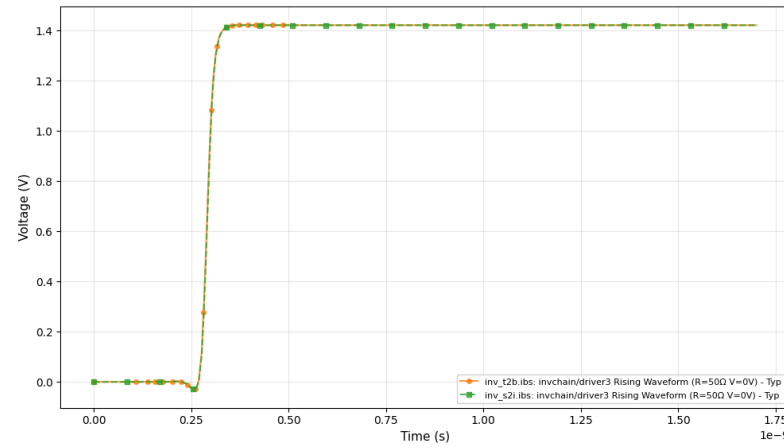
ISSO_PD



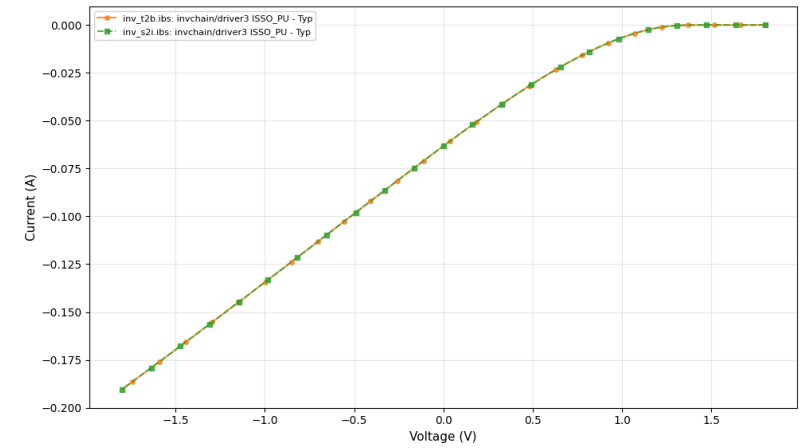
Pullup



Rising



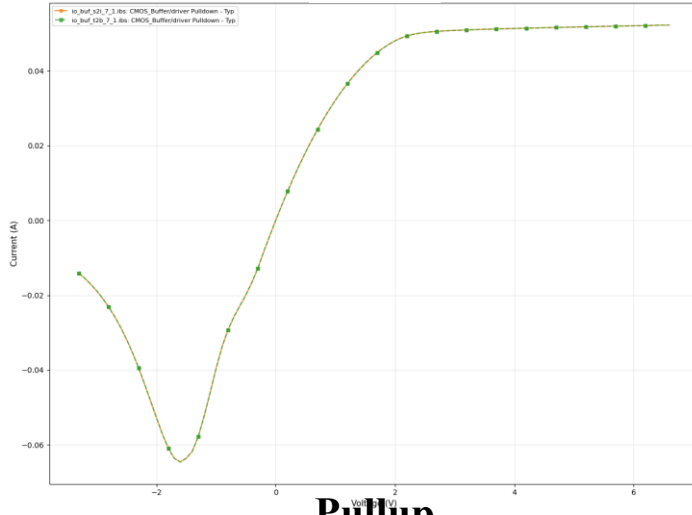
ISSO_PU



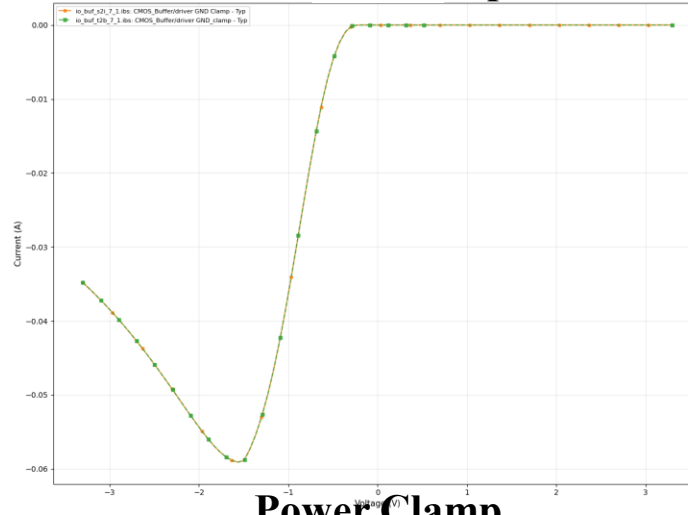
Validation: Correlation with Commercial Tools – Case 2

Commercial tool generated
S2IBISPY generated

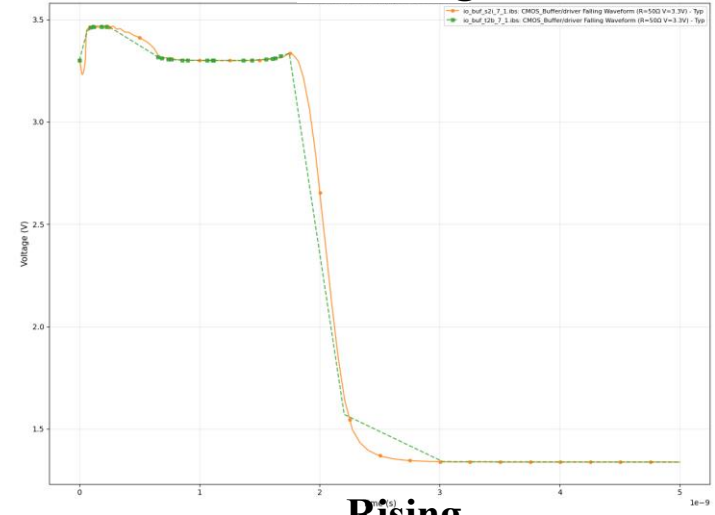
Pulldown



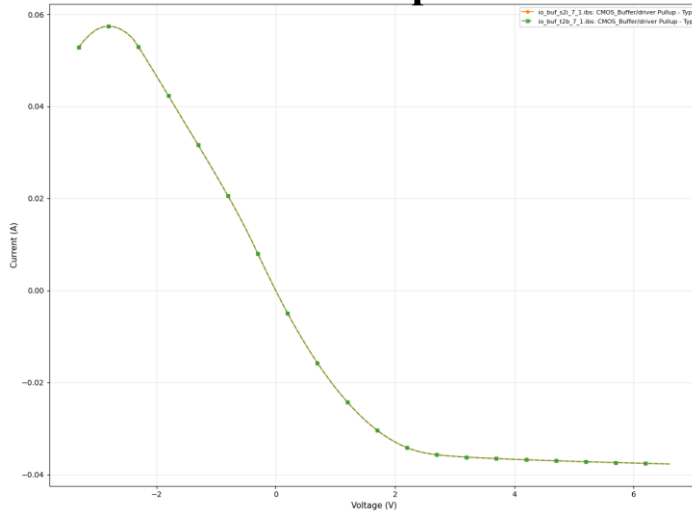
Ground Clamp



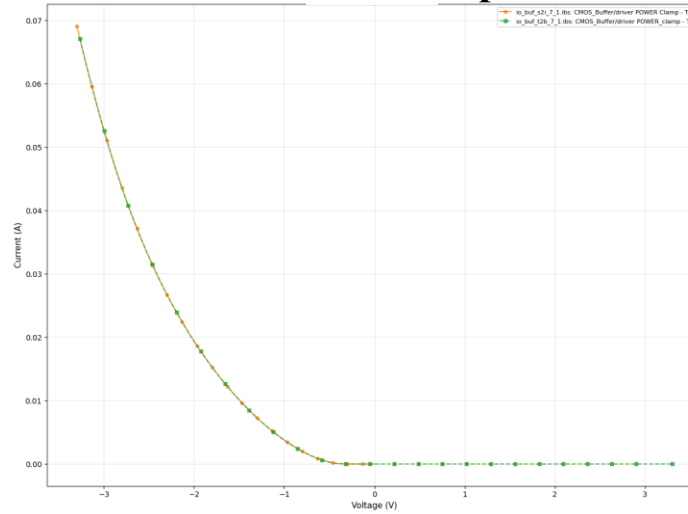
Falling



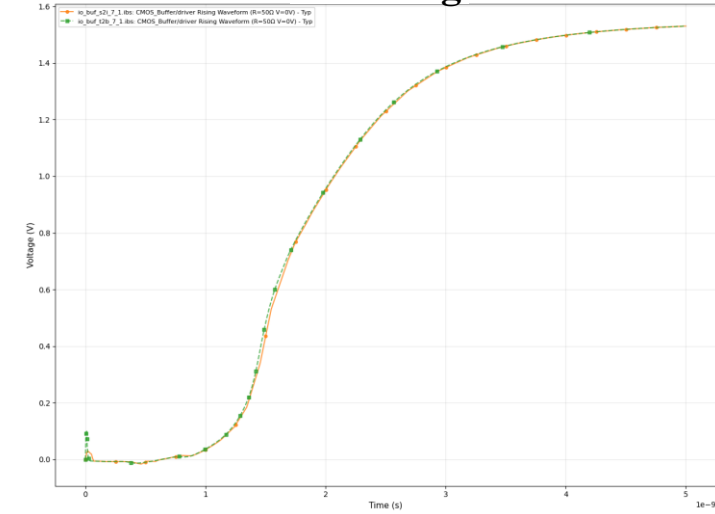
Pullup



Power Clamp



Rising

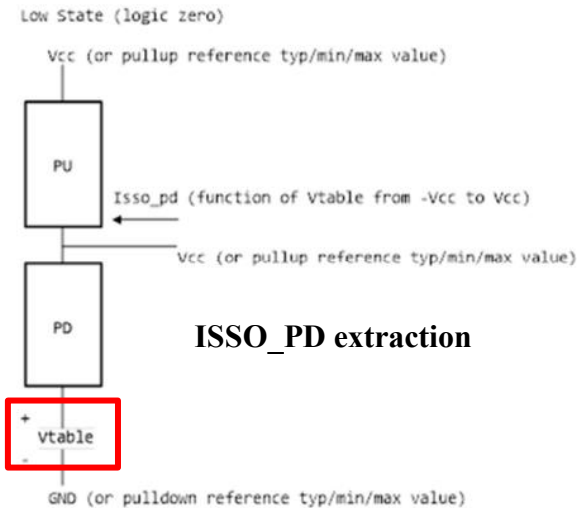


S2IBISPY vs. NCSU S2IBIS

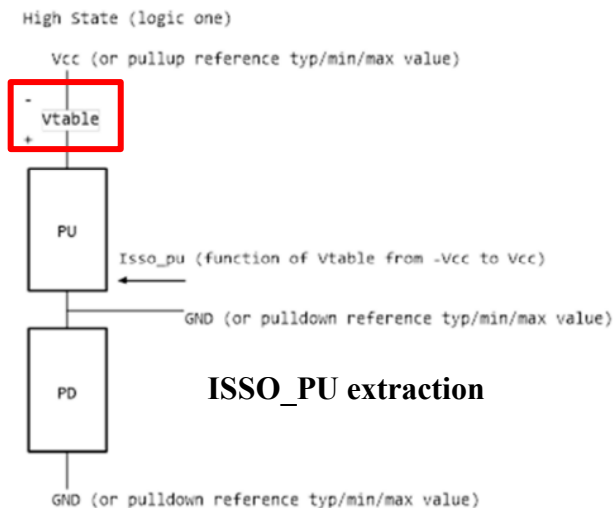
Feature	NCSU S2IBIS	S2IBISPY
IBIS versions supported	3.2, 2.1, and 1.0	5.0+ (actively developing)
Waveform viewing	No	Yes
IBISCHK	No	Yes
Correlation	No	Yes
Dependency	Java	Run on any machine

[ISSO_PD], [ISSO_PU]

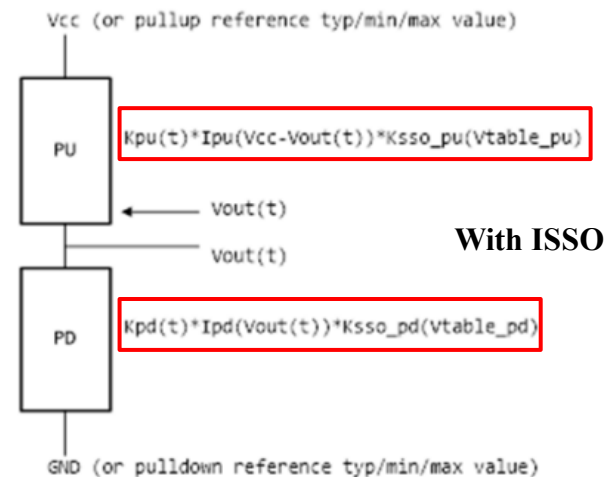
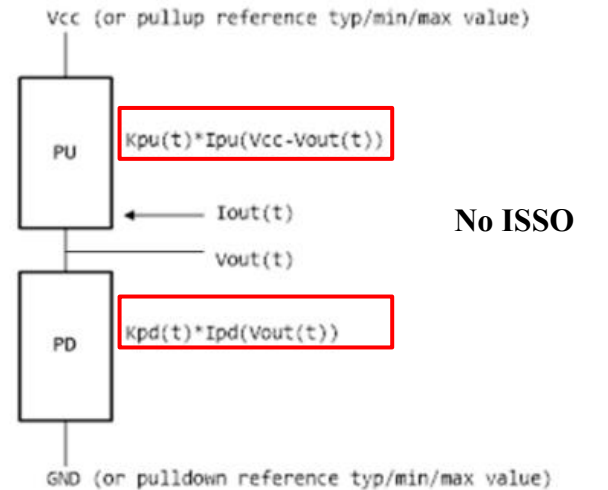
- “Aiming to overcome the IBIS “ V_{gs} /gate modulation effect”, where $V_{gs}=V_{dd}$ is always assumed.”



ISSO_PD extraction

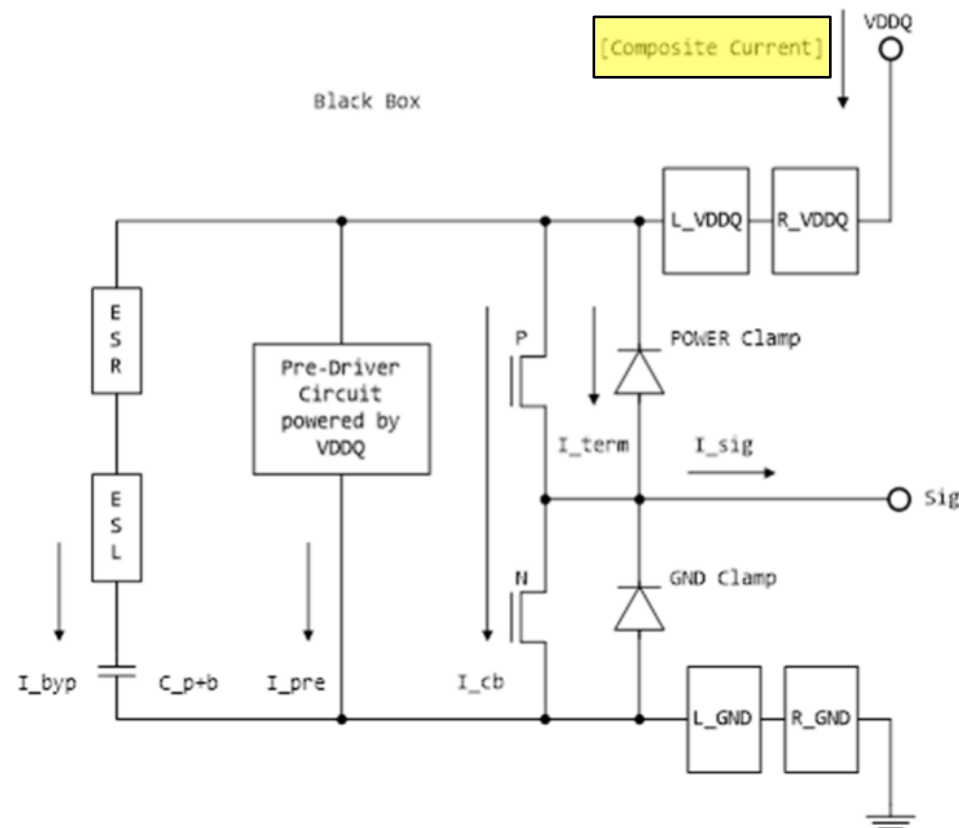


ISSO_PU extraction



[Composite Currents]

- Describes the shape of the rising and falling edge current waveforms from the power reference terminal of the buffer
- Additional “lead-in” time may need to be added to all V-T waveforms, as a portion of the I-T waveform data describes pre-driver current that may occur earlier in time than the V-T rising or falling edge transitions



Future Work

- Feedback needed from the industry
- Currently supports HSPICE only; NGSPICE support is planned

References

- IBIS Open Forum, "Free tools." [Online]. Available: <https://ibis.org/tools/>
- North Carolina State University, Electronic Research Lab, "S2IBIS3," ver. 1.1, Mar. 27, 2006. [Online]. Available: <https://archives.ece.ncsu.edu/erl/ibis/s2ibis3/s2ibis3.htm>
- Arpad Muranyi, "Introduction to IBIS models and IBIS model making", November 2003
- Lynne Green, "IBIS Models Standards, Validation and Verification", September 2005
- The IBIS Open Forum, "IBIS MODELING COOKBOOK For IBIS Version 4.0", September 2005
- Arpad Muranyi and Luca Giacotto, "A VHDL-AMS buffer model using IBIS", June 2003
- Kishan Amratia, "pybis2spice - A python tool that converts IBIS models to SPICE models", November 2022
- Todd Westerhoff, "Things You Can Learn From V/I Curves", June 2005
- Lambert Simonovich, "Driver's Output Impedance From IBIS", December 2010
- Bob Ross, "IBIS EVOLUTION", September 2022
- A. Muranyi, A. Girardi, G. Bernardi, R. Izzi, and B. Ross, "BIRD98.3: Gate Modulation Effect", October 2007
- The IBIS Open Forum, "I/O Buffer Information Specification version 7.2", January 2023
- Jermaine Lim-Abroguena and Keith Francisco-Tapan, "IBIS Modeling—Part 1: Why IBIS Modeling Is Critical to the Success of Your Design", September 2021
- Ambrish Varma, "S2IBIS Past, Present and Future", October 2003



Thank you