

IBIS DNA: Decoding The Quality Gene

Tim Coyle

Signal Consulting Group LLC

IBIS Summit DesignCon 2009

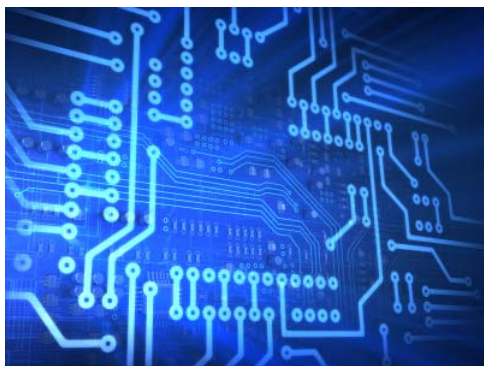
Santa Clara, CA

February 5, 2009

About SCG



Consulting



www.siconsultant.com

Software



www.sharksim.com

Education



www.xrosstalkmag.com

Reference

- “IBIS Quality Report: A Report On The State of IBIS Simulation Models for Signal Integrity Analysis” published by SGC
- Go to www.sharksim.com and request a copy of the whitepaper

How It All Started



Generate IBIS Models
Validate IBIS Models
Fix and Update IBIS Models
Run SI Sims
Do Timing Analysis
Feed the cat
Pay the bills
It goes on and on

This is me. I have a lot of
Signal Integrity work to
do.

Where It Was Going

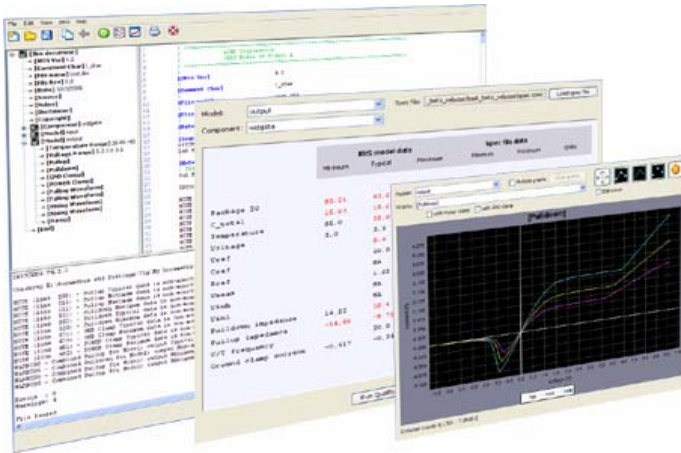


Spending a lot of time fixing and updating IBIS models

Using different tools, scripts, books, duct tape ...

Why don't I just make my own tool to make my life easier?

And So I Did



Built IBIS Modeling software tool

Called it SharkSim

Started using it, seemed good, start licensing to clients, and life is good ...

But Then I Hit A Wall



What issues are IBIS users facing?

Are there still quality issues with models?

How do I figure this out?

Than An Idea = This Presentation



Review a bunch of models and see what the issues are

Talk to IBIS model users and see what their issues are

Engineers Love Data

IBIS Model Quality Review



Reviewed 32 Models

Used IBIS Parser 4.2.2

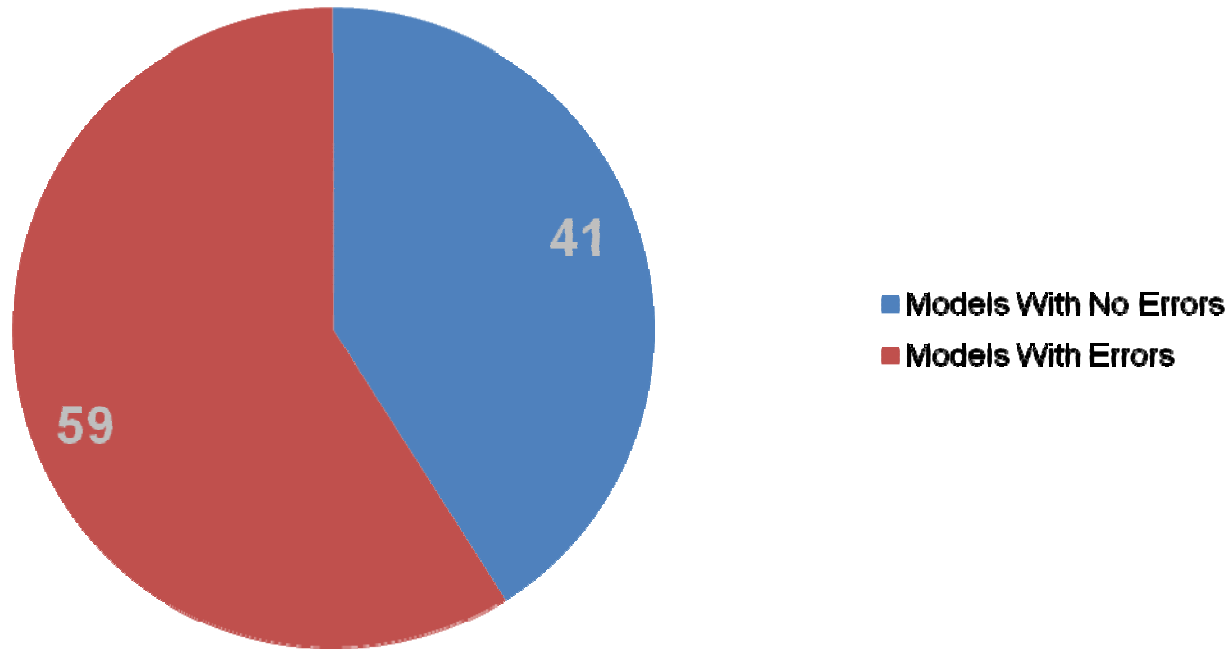
Categorized Warnings/Errors

* Flagged any warning/error that would not make an IBIS model suitable for Signal Integrity analysis

What Is A Quality Model

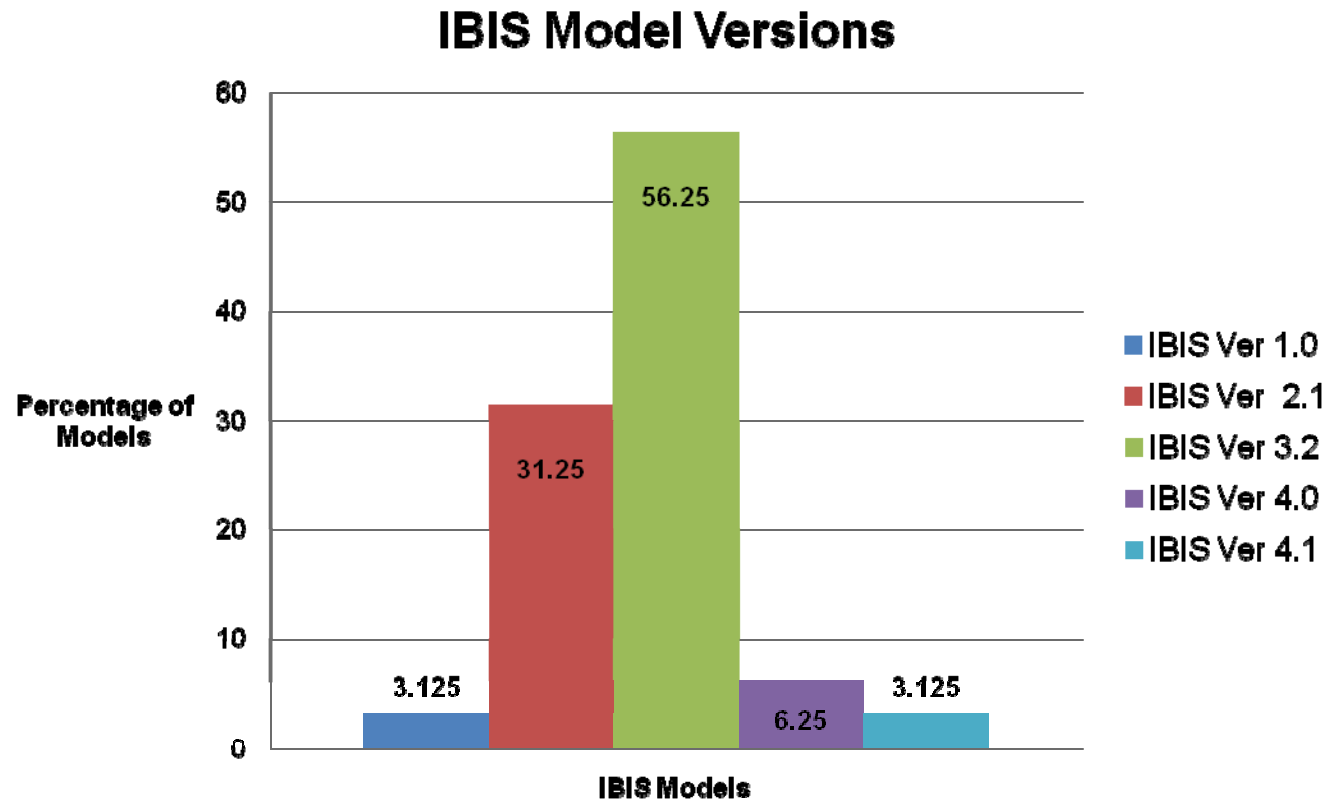
A quality model would be an IBIS model that has no errors or warnings that would stop an engineer from immediately running simulations.

IBIS Model Quality Review



IBIS Model Quality Review Results

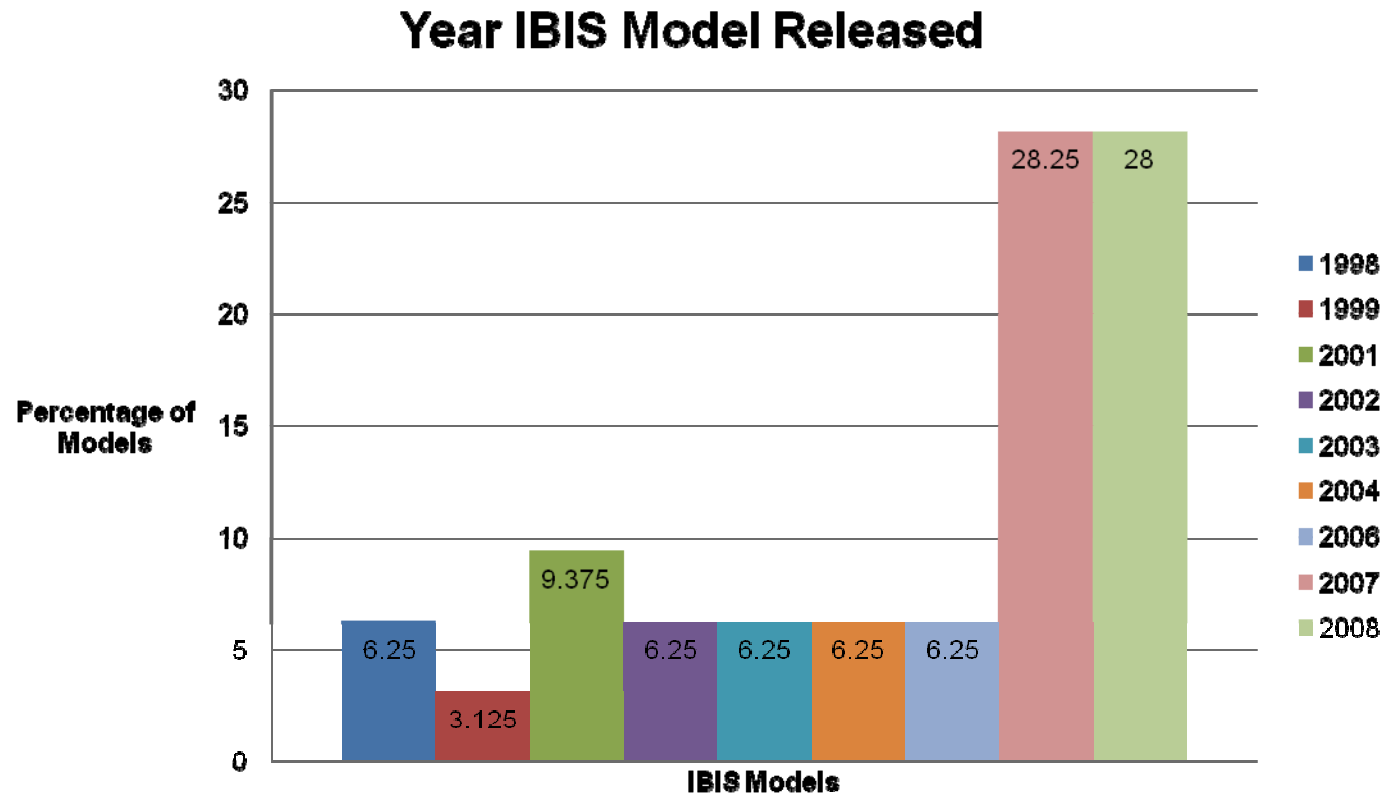
59% of IBIS Simulation Models Unsuitable for Signal Integrity Analysis



IBIS Model Versions of Reviewed Models

Almost 70% of Models Ver 3.2 or Later

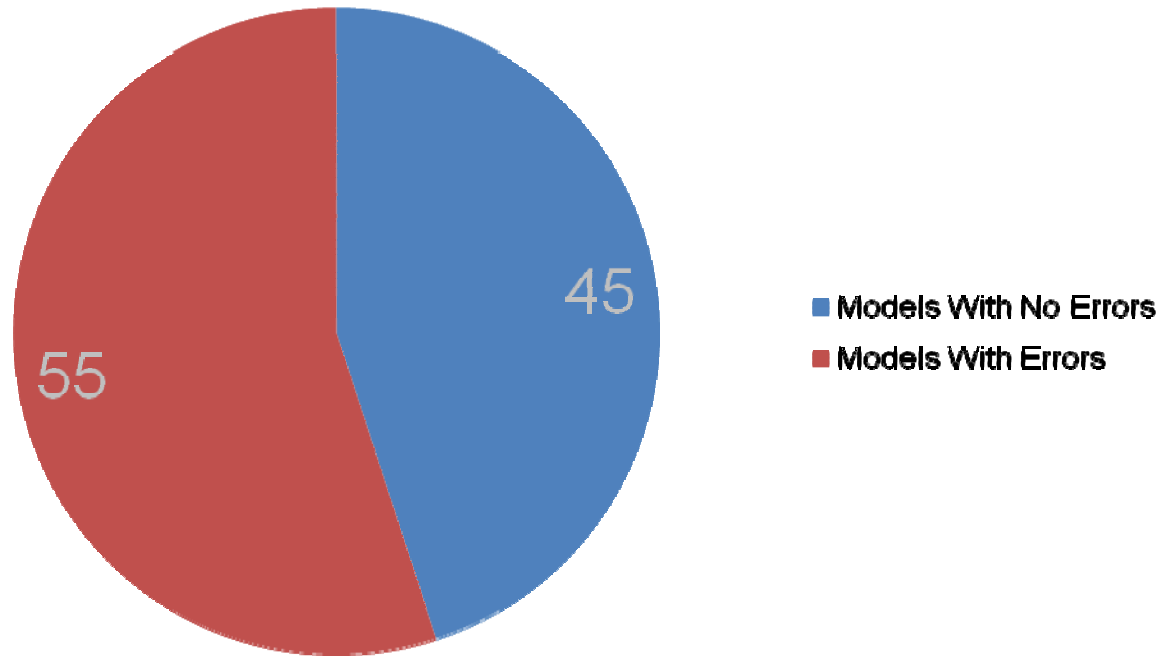
But less than 10% of Models Ver 4.0 or Later



Year IBIS Model Released

Almost 70% of IBIS Models Reviewed Released in Last 3 Years

IBIS Model Quality Review (2006 - 2008)



IBIS Model Quality Review (Last 3 Years)

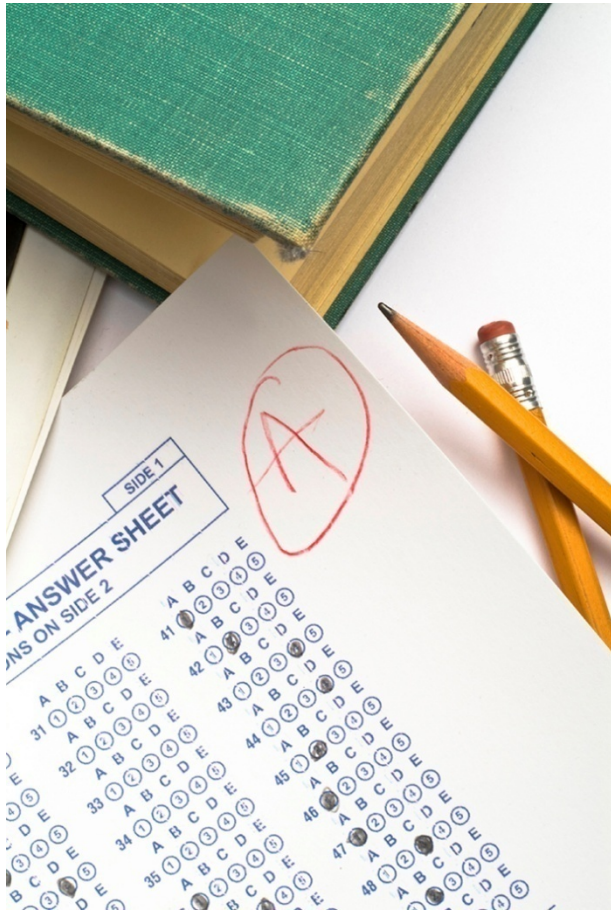
Still 55% of IBIS Models Not Suitable for Signal Integrity Analysis

IBIS Quality Error	Percentage of Occurrences
Incorrect Filename	25
Missing Timing Load	34
Incorrect Receiver Threshold	9
Clamp Curve Doesn't Reach Zero	25
AC/DC Mismatch Error < 10%	13
Combined Data Non-Monotonic	22
Extreme Current In Clamp Curve	6
Unreferenced Model	6
Exceeds Line Character Limit	3
Series Mosfet Decreasing Current	3
IV Curve Can't Drive Load	3
Incorrect Ramp Data	3

IBIS Quality Error Occurrences

#1 Offender -> Missing Timing Load (V_{ref} , C_{ref} , R_{ref} , V_{meas})

What Did We Find Out



1. Over 50% of IBIS Models Not Suitable for Signal Integrity Analysis
2. Newer IBIS version models not abundant
3. Still Need Improvement

But We Can Fix These Errors



Most of These Quality Issues Can Be Fixed

Some Easier Than Others

Read the Report for Full Details

Because There's Still A Problem

Going Beyond The Parser



Quality Control Does Not Stop
With the IBIS Parser

Parser Does Not Check For A
Lot Of Things

Parser Does Not **VALIDATE** that
IBIS Parameters Are Correct

IBIS Model Quality Review 2.0



Took 45% of IBIS Models With No Errors and Ran Through Next Level Of Quality Checking

Picked 5 Parameters To Compare Against Data Sheet:

1. Only Typical Data
2. Not Enough Data Points
3. Inadequate Voltage Sweep
4. Incorrect Timing Load
5. Invalid C_Comp

And The Results

22% of IBIS Models Passed

Second Level of Quality Checking

So What Do The Users Think



Informal Survey of 22 IBIS
Model Users

Asked A Bunch Of Questions

Came Up With Some
Conclusions

0 to 25% Have Errors -> **23%**

25 to 50% Have Errors -> **23%**

50 to 75% Have Errors -> **45%**

75 to 100% Have Errors -> **9%**

Question 1

What percentages of IBIS models have an error or warning that makes it unsuitable for simulation?

No -> 13%

IQ Checklist -> 13%

Internal -> 65%

Measurement -> 9%

Question 2

Do you use a formal IBIS quality checking procedure?

43% of Respondents said Yes IBIS

Models Matter

Question 3

Does the availability of quality IBIS models influence your company's purchase decisions of components in any way?

23% of Respondents said Vendors
Are Doing A Good Job

Question 4

Do you feel that the silicon vendors are doing a good job of delivering quality IBIS models?

Wisdom Of Crowds



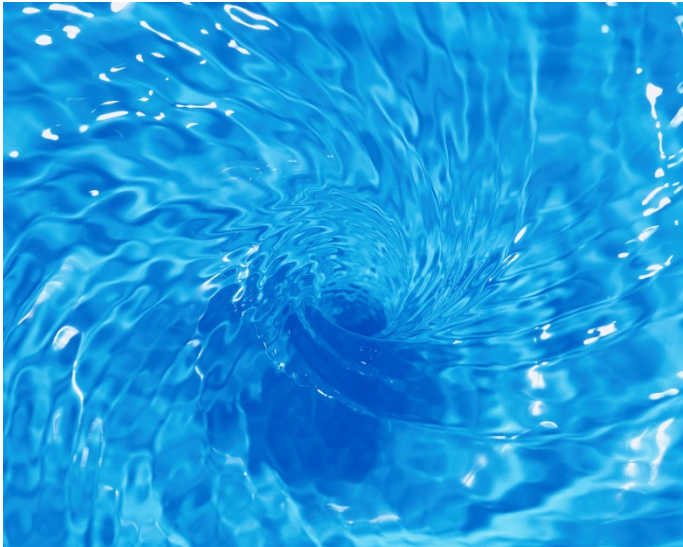
Users Told Us A Few Things

They Know IBIS Model Quality Is
Less Than 50%

They Are Basing Business And
Design Decisions on IBIS Models

Not Happy With Quality of Models

A Process Flow Is Needed



Generate

Validate

Correlate

Process Flow: Generate

Automate the Process of
SPICE to IBIS

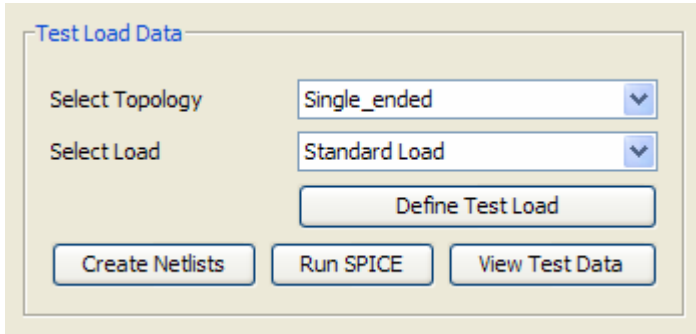
Extract C_{Comp}

Get the Test Data

The screenshot shows the 'SPICE to IBIS Translation' dialog box, which is organized into several sections:

- Define Pins:** Includes fields for 'Select Buffer Type' (set to 'Output'), 'SPICE File Name', 'SPICE Subcircuit Call', 'Input Pin (non-inverting)', 'Output Pin (non-inverting)', 'Enable Pin' (set to 'Active High'), 'IO Power Pin', 'IO Ground Pin', 'Core Power Pin', 'Core Ground Pin', and 'Vref Pin'. There are also checkboxes for 'only TYP corner', 'same subcircuit for all', 'enable differential pair', and 'exclude core power'. A 'Differential Output Load' section contains fields for 'R_load', 'V_typ', 'V_min', and 'V_max'.
- Process Settings:** Includes fields for 'IO Voltage', 'Core Voltage', 'Temperature', 'Vref Voltage', and 'IO Voltage Variation'. A 'C_{comp} Extraction' section has an 'Extraction Method' dropdown (set to 'Transient Sawtooth') and buttons for 'Create Extraction Netlists', 'Run SPICE', and 'View Data'.
- Simulation Options:** Includes a dropdown for 'IV Data Simulation' (set to 'DC Analysis'), a field for 'VT Data Time Window' (set to 'nsec'), and a 'Test Load Data' section with 'Select Topology' (set to 'Single ended') and 'Select Load' (set to 'Standard Load') dropdowns. There are buttons for 'Define Test Load', 'Create Netlists', 'Run SPICE', and 'View Test Data'. An 'Embedded Clock' section has fields for 'Clock Pin', 'Clock Delay', 'Clock Edge', and 'Clock Pwidth', with an 'enable clock' checkbox. A 'VT Reference Load' section has fields for 'R_load', 'V_typ', 'V_min', and 'V_max'.
- Generate IBIS Data:** Includes buttons for 'Generate IV Data' (with sub-buttons 'Create IV Netlists', 'Run SPICE', 'View IV Data', and 'close') and 'Generate VT Data' (with sub-buttons 'Create VT Netlists', 'Run SPICE', 'View VT Data', and 'close').

Why Test Data Is Important



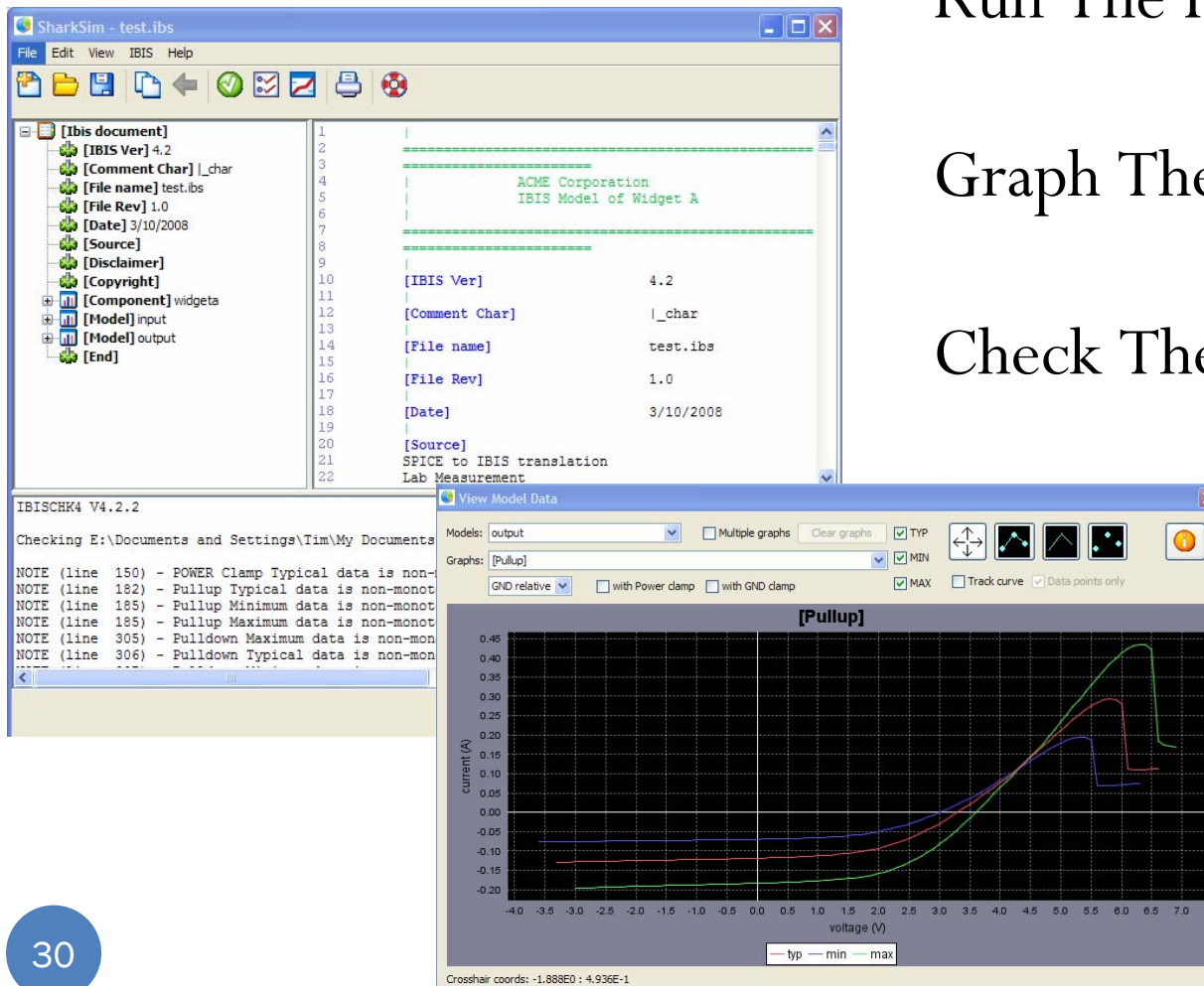
1. Correlate IBIS Model Before Released
2. Correlation Data Automatically Given To Customer
3. Customer Sees Your Correlation, Has the Correlation Data
4. You're Done!

Process Flow: Validate

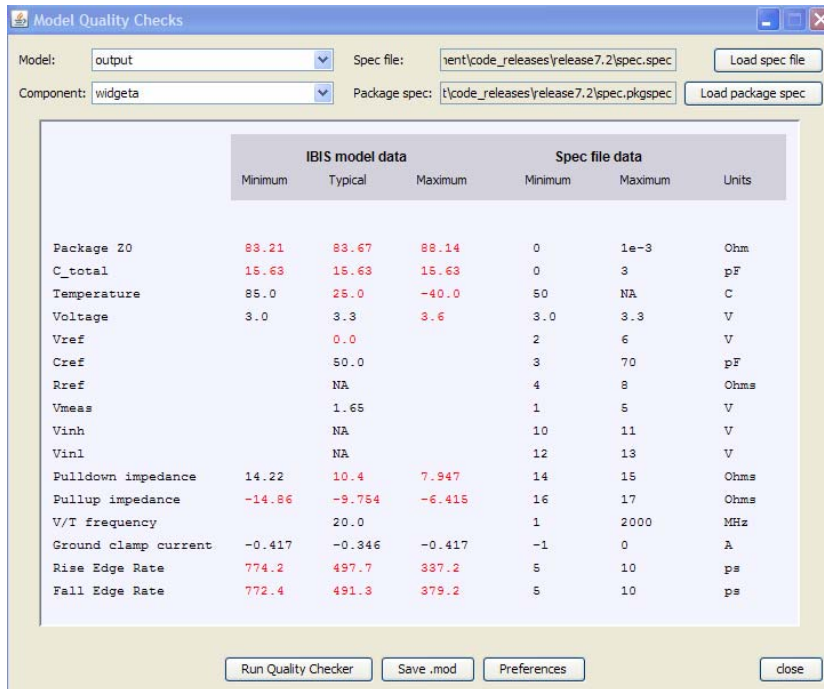
Run The Parser

Graph The Data

Check The Syntax



Going Beyond The Parser



The screenshot shows a software window titled "Model Quality Checks". It has two dropdown menus at the top: "Model:" set to "output" and "Component:" set to "widgeta". To the right, there are text fields for "Spec file:" and "Package spec:" with "Load spec file" and "Load package spec" buttons respectively. The main area contains a table comparing "IBIS model data" and "Spec file data". The table has columns for "Minimum", "Typical", "Maximum", "Minimum", "Maximum", and "Units". The rows list various parameters like Package ZO, C_total, Temperature, Voltage, Vref, Cref, Rref, Vmeas, Vinh, Vinl, Pullup impedance, Pullup impedance, V/I frequency, Ground clamp current, Rise Edge Rate, and Fall Edge Rate. At the bottom, there are buttons for "Run Quality Checker", "Save .mod", "Preferences", and "close".

	IBIS model data			Spec file data		
	Minimum	Typical	Maximum	Minimum	Maximum	Units
Package ZO	88.21	88.67	88.14	0	1e-3	Ohm
C_total	15.63	15.63	15.63	0	3	pF
Temperature	85.0	25.0	-40.0	50	NA	C
Voltage	3.0	3.3	3.6	3.0	3.3	V
Vref		0.0		2	6	V
Cref		50.0		3	70	pF
Rref		NA		4	8	Ohms
Vmeas		1.65		1	5	V
Vinh		NA		10	11	V
Vinl		NA		12	13	V
Pullup impedance	14.22	10.4	7.947	14	15	Ohms
Pullup impedance	-14.86	-9.754	-6.415	16	17	Ohms
V/I frequency		20.0		1	2000	MHz
Ground clamp current	-0.417	-0.346	-0.417	-1	0	A
Rise Edge Rate	774.2	497.7	337.2	5	10	ps
Fall Edge Rate	772.4	491.3	379.2	5	10	ps

Validate Against Datasheet

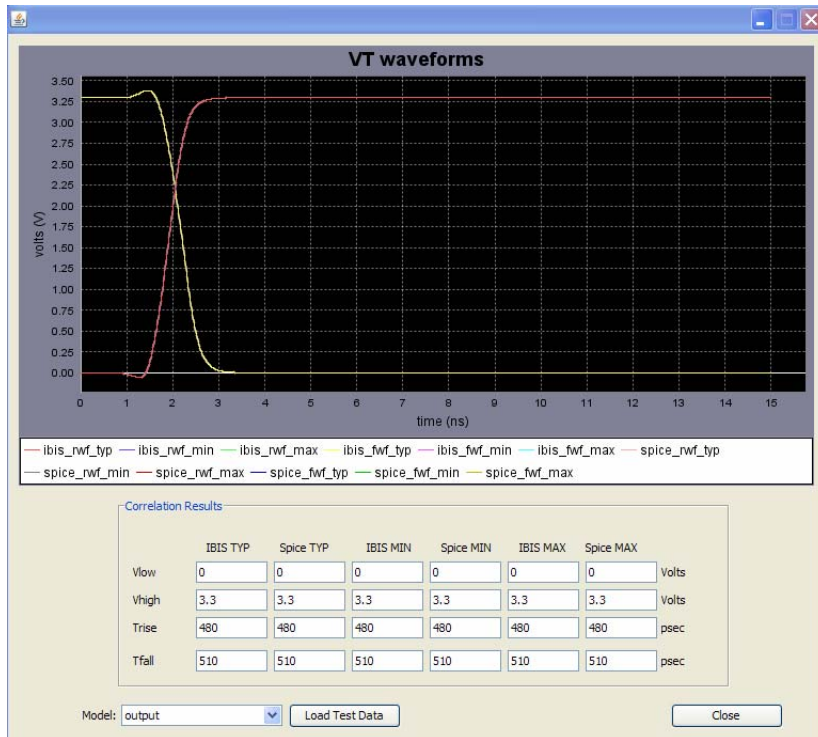
Check That Values Are There And Are Correct

Check Package Pin Out

Look For Over Clocking

Get The Output Impedance

Process Flow: Correlation



Always Simulate Buffer Into
Standard and System Loads

Use Test Data For Automatic
Correlation of Different Loads

Both Vendor and Customer Can
Use This Flow

We Can Do This



Still Quality Issues With IBIS

Models Today > **50%**

Users Not Happy **77%**

**Vendors AND Users
Together With Right Flow
Can Help Each Other
Solve the Problem**

Thanks For Your Time

Questions?

Comments?

