Ibischk4 Version 4.2.1 and Funny IBIS Models

Bob Ross
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Version 4.2.1 Release

• IBISCHK4 version 4.2.1 complete
  – Source code delivered
  – Executables uploaded
    • 1 for dos32 (for Windows)
    • 4 for Unix (Sun_5, Solaris_6, Solaris_8, HP_11i)
    • 2 for linux (Redhat, SUSE)
    • Details in changes_421.txt

• Major changes from 7 BUG reports
  – Monotonic checks – consistency for all versions
  – Caution flag – Quality Committee addition
  – [Receiver Thresholds] – correct a defect
  – Other – Model_type Warning to Error, etc.
Monotonic – Summations and Notes

• Warnings for non-monotonic summations only
  – E.g., [Pullup] and both clamp tables together for driving
  – For non-driving, both clamps together
  – Also for Submodel Clamps for the modes of interest
  – Model_type and submodel mode logic considered

• Notes for all individual tables
  – Still allows locating the specific problem for analysis
  – Notes are less serious than Warnings

• Check same for IBIS Version 2.0 through 4.2
  – Version 3.2 and below used to give Warnings for each table
Example

- [IBIS Ver] 3.2 code for combined non-monotonicity:

```
IBISCHK4 V4.2.0

Checking bug94.ibs for IBIS 3.2 Compatibility...

WARNING (line 29) - Pulldown Typical data is non-monotonic
WARNING (line 29) - Pulldown Minimum data is non-monotonic
WARNING (line 29) - Pulldown Maximum data is non-monotonic

Errors : 0
Warnings: 3

IBISCHK4 V4.2.1

Checking bug94.ibs for IBIS 3.2 Compatibility...

NOTE - Pulldown for Model: BUFFER Typical data is non-monotonic
NOTE - Pulldown for Model: BUFFER Minimum data is non-monotonic
NOTE - Pulldown for Model: BUFFER Maximum data is non-monotonic

Errors : 0
```
However ... Version 4.2.2

• BUG96
  – Line numbers not reported in NOTES
    • Post processing change versus first pass
    • Restore older Warning code and change to Notes

• BUG97
  – Larger file issue (Notes + Warnings) less than older Warnings
  – Need to understand
The –caution Flag

- Ibischk4 –caution syntax for .ibs, .pkg, and .ebd

Usage:

```
Usage: ibischk4 -caution <IBS filename>
: ibischk4 -caution -ebd <EBD filename>
: ibischk4 -caution -pkg <PKG filename>
```

- For all versions 2.0 through 4.2
- Placeholder for future tests
  - Caution because real exceptions exist such as with some PCIX models for Vmeas

IBISCHK4 V4.2.1

Checking bug90.ibs for IBIS 4.2 Compatibility...

CAUTION - Vmeas is >= Vinh for model DATA
Errors : 0
Cautions: 1

File Passed
[Receiver Thresholds] Logic Fixed

• Several serious defects
  – Combined test for DDRII with [Diff Pin], [Model Selector] and single-end or differential subparameters under [Receiver Thresholds] incorrect
    • Practical situation with DDRII and selectable on die terminations
  – Differential subparameters not allowed when needed
    • Impossible to put in complete information
    • Models with missing information passed
    • [Model Selector] indirection not handled

• Warning messages used instead of Error messages
  – Allows existing flawed models to still be loaded
  – Expect Warning messages with ibischk4 Version 4.2.1 and above

• Both single-ended and differential subparameters allowed
  – Some DDRII
  – USB models
BUG93 Test – Fixed in Version 4.2.1 with 0 Errors and 0 Warnings

IBISCHK4 V4.2.0

Checking bug93.ibs for IBIS 4.2 Compatibility...

ERROR - Model DQS_FULL Receiver Thresholds: Vth must be specified for single ended receivers
ERROR - Model DQS_FULL Receiver Thresholds: Vinh_ac must be specified for single ended receivers
ERROR - Model DQS_FULL Receiver Thresholds: Vinl_ac must be specified for single ended receivers
ERROR - Model DQS_FULL Receiver Thresholds: Vinh_dc must be specified for single ended receivers
ERROR - Model DQS_FULL Receiver Thresholds: Vinl_dc must be specified for single ended receivers
ERROR - Model DQS_FULL Receiver Thresholds: Tslew_ac must be specified for single ended receivers
WARNING - Model DQS_FULL Receiver Thresholds: Vcross_low must not be specified for single ended receivers
WARNING - Model DQS_FULL Receiver Thresholds: Vcross_high must not be specified for single ended receivers
WARNING - Model DQS_FULL Receiver Thresholds: Vdiff_ac must not be specified for single ended receivers
WARNING - Model DQS_FULL Receiver Thresholds: Vdiff_dc must not be specified for single ended receivers
WARNING - Model DQS_FULL Receiver Thresholds: Tdiffslew_ac must not be specified for single ended receivers
ERROR - Model DQS_HALF Receiver Thresholds: Vth must be specified for single ended receivers
ERROR - Model DQS_HALF Receiver Thresholds: Vinh_ac must be specified for single ended receivers
ERROR - Model DQS_HALF Receiver Thresholds: Vinl_ac must be specified for single ended receivers
ERROR - Model DQS_HALF Receiver Thresholds: Vinh_dc must be specified for single ended receivers
ERROR - Model DQS_HALF Receiver Thresholds: Vinl_dc must be specified for single ended receivers
ERROR - Model DQS_HALF Receiver Thresholds: Tslew_ac must be specified for single ended receivers
WARNING - Model DQS_HALF Receiver Thresholds: Vcross_low must not be specified for single ended receivers
WARNING - Model DQS_HALF Receiver Thresholds: Vcross_high must not be specified for single ended receivers
WARNING - Model DQS_HALF Receiver Thresholds: Vdiff_ac must not be specified for single ended receivers
WARNING - Model DQS_HALF Receiver Thresholds: Vdiff_dc must not be specified for single ended receivers
WARNING - Model DQS_HALF Receiver Thresholds: Tdiffslew_ac must not be specified for single ended receivers

Errors : 12
Warnings: 10

File Failed
However ... Version 4.2.2
New False Warning Problem

• BUG95: Incorrect Warnings not in earlier versions

IBISCHK4 V4.2.1

Checking bug95.ibs for IBIS 3.2 Compatibility...

WARNING - Pin A2 is not defined as a Diff Pin though the associated Model Selector INOUT was determined to be Differential
WARNING - Pin B3 is not defined as a Diff Pin though the associated Model Selector INOUT was determined to be Differential
WARNING - Pin Z3 is not defined as a Diff Pin though the associated Model IN was determined to be Differential
WARNING - Pin Z4 is not defined as a Diff Pin though the associated Model IN was determined to be Differential

Errors : 0
Warnings: 4
File Passed
[Receiver Thresholds]
De-rating Tables?

- Designed for single-ended and differential specifications
- Targeted for DDRII and above
- Needs de-rating tables for real adoption
  - Otherwise, vendor-specific syntax needed
  - Or code based de-rating (VHDL-AMS, etc.)
- A future BIRD?
Other Fixes

• Other minor fixes including a parser crash
• BUG91 for Model_type Open_* with non-zero content in the extra [Pullup] or [Pulldown] table
  – E.g., Open_drain with non-zero [Pullup]
  – Elevated from Warning to Error
    • Based on real issue since model is ambiguous and the waveform check may be misleading
  – Cannot rely on EDA tool defaults
Proposed ibischk4 Version 4.2.2

• BUG95 – Fix incorrect single-ended, differential Warnings
• BUG96 – Add line numbers to Notes
• BUG97 – Resolve differences in summation of Notes plus Warnings versus original Warnings
Investigate Parser Friendly Fixes

• Parser code suggestions for EDA tool integration
  – Unique file names (e.g., ibisxx_string.h versus string.h)
  – Printf for command line mode needs to be globally edited for parser integration
  – Filter Errors, Warnings for complete file for specific model of interest
  – Other issues with names, globals, undefined code, etc.

• If accepted, then targeted beyond Version 4.2.2
Funny Models

• 0.ibs
  – As many 0’s as possible (or 1f)
  – Ibischk4 does not check everything
  – Uncommon developer and customer issues
  – Pathological cases shows what can be missed

• inverse.ibs
```
• [IBIS Ver] 4.0
• [File Name] 0.ibs
• [File Rev] 0
• [Date] 0
• [Source] 0
• [Disclaimer] 0
• [Notes] 0
• [Copyright] 0
• [Component] 0
• [Manufacturer] 0
• [Package]
  • R_pkg 0 0 0
  • L_pkg 0 0 0
  • C_pkg 0 0 0
  • [Pin] signal_name model_name R_pin L_pin C_pin
    • 0 0 0 0 0 0
    • 00 0 0 0 0 0
  • [Diff Pin] inv_pin vdiff tdelay_typ tdelay_min tdelay_max
    • 0 00 0 0 0 0
    • 00 0 0 0 0 0
  • [Model] 0
  • Model_type I/O
  • Vinh = 0
  • Vinl = 0
  • Vmeas = 0
  • Rref = 0
  • Vref = 0
  • [C_comp] 0 0 0
  • [C_comp_pullup] 0 0 0
  • [C_comp_pulldown] 0 0 0
  • [C_comp_gnd_clamp] 0 0 0
  • [C_comp_power_clamp] 0 0 0
  • [Temperature Range] 0 0 0
  • [Voltage Range] 0 0 0
  • [Pullup Reference] 0 0 0
  • [Pulldown Reference] 0 0 0
  • [Gnd Clamp Reference] 0 0 0
  • [Power Clamp Reference] 0 0 0
  • [External Reference] 0 0 0
  • [TTgnd] 0 0 0
  • [TTpower] 0 0 0
  • [Pulldown]
    • 0 0 0 0
    • 1f 0 0 0
  • [Pullup]
    • 0 0 0 0
    • 1f 0 0 0
  • [Gnd Clamp]
    • 0 0 0 0
    • 1f 0 0 0
  • [Power Clamp]
    • 0 0 0 0
    • 1f 0 0 0
```
0.ibs Problems

- Problems
  - I-V tables 0.0 and voltage references 0.0
  - Waveform tables from 0.0 to 1f, passes waveform check
  - Redundant V-T tables not checked
  - All subparameters and text information set to 0

- 0.ibs – 0 Errors, 0 Warnings 0 Cautions
- But still produces waveform in some tools and errors in others!
- Not worth fixing
inverse.ibs

• Inspired by real IBIS file creation issue
  – Pulldown in [Pullup] table and visa-versa
    • $V_{table2} = V_{dd} - V_{table1}$
  – Gnd Clamp in [Power Clamp] table and visa-versa
    • $V_{table2} = V_{dd} - V_{table1}$
  – Rising Waveform in [Falling Waveform] table and visa-versa
    • Change Rising to Falling and Falling to Rising
  – Polarity Inverting
    • Moves “low” state to High, and “high” state to Low

• Passes IBISCHK4 Version 4.2.1
  – Cannot fix timing test load Warning

• Simulations identical
  – Brute force way to avoid the Polarity subparameter!

• Strange, but technically correct model
normal.ibs and inverse.ibs

[Pulldown] and [Pullup] Tables
normal.ibs and inverse.ibs

[Rising/Falling Waveform] Tables

[Rising Waveform]

inverse.ibs

normal.ibs

Opposite for

[Falling Waveform]
Conclusions

• Ibischk4 Version 4.2.1
• Fixes for expected Version 4.2.2
• Pathological cases show that
  – Ibischk4 does not check everything
  – EDA tools may trap some funny cases
  – Some might turn out to be tricks
  – Uncommon, not worth fixing