



IBIS-AMI Model QCD Certification Report

ADI/Tgen3v1 Rev 1.0

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Introduction

This IBIS-AMI Model Report is provided by Signal Integrity Software, Inc. (SiSoft) to indicate compliance with the current IBIS standard and compatibility of IBIS-AMI model files with SiSoft's Quantum Channel Designer (QCD) simulator. Simulation results are included where possible using test conditions designed to exercise basic model behavior and controls.

This report **Certifies** this model for use with SiSoft's tools. It defines the simulation setup needed to ensure correct simulation results. The model's **Correlation** to golden reference data has also been assessed, and is documented in a separate report.

Scope of Work Performed

- ✔ Compliance with the IBIS 5.1 specification has been examined.
- ✔ Compatibility with QCD Network Characterization has been examined.
- ✔ Compatibility with QCD Statistical and Time-domain simulation has been examined.
- ✔ Compliance of algorithmic models with IBIS Specification requirements has been examined.
- ✔ Certification of models relative to manufacturer specifications has been performed.
- ✔ Correlation of simulation results to reference data has been performed.

Model(s) Tested and QCD Version

AMI models in the file(s) `sisoft_serdes.ibs`, `tgen3v1_serdes.ibs` were analyzed. The models were tested with SiSoft's 2012.08-SP8 Build 6 software release. Results are scored using the following markers:

- PASS** The feature works as expected.
- NOTE** The feature works with restrictions as noted.
- FAIL** There is a significant problem that can't be resolved.

Results Summary

Test Performed	TX Result	Comments
QCD Validation	PASS	The .ibs and .ami files PASS QCD validation with 0 errors and 0 warnings.
Latest IBIS Parser	PASS	The IBIS file(s) PASS the latest IBISCHK5 V5.1.4 with 0 errors.
QCD Released IBIS Parser	PASS	The IBIS file(s) PASS released with QCD 2012.08-SP8 Build 6 with 0 errors.
Network Characterization	PASS	The analog model is complete and extracts as a reasonable equivalent circuit.
Statistical Simulation	PASS	Statistical simulation produces reasonable results across all tests.
Time-Domain Simulation	PASS	Time-domain simulation produces reasonable results across all tests.
O/S Support	PASS	Models produce identical results across Windows and Linux.
Sim Farm Support	PASS	These models support simulation farms.

Crosstalk Support	PASS	These models support crosstalk simulations.
Jitter Budgets	PASS	Jitter budgets are present or methods to define them have been documented.
QCD Use Methodology	PASS	Requirements and recommendations for accurate simulation in QCD have been documented.
H/W Register Mapping	NOTE	Methods for mapping simulation settings to hardware settings are documented.
QCD Certification	PASS	This model is Certified for use with QCD 2012.08-SP8 Build 6.
QCD Design Kit	PASS	A QCD Design Kit is available for these models.

Results summary

Model Files

The files are listed below. SiSoft digital signature values have been added to IBIS and AMI files so that they can be verifiably associated with this report.

File	Signature	Notes
tgen3v1_tx.ami	17ca0c04ea839da005bb852964aaf1de0c248778	IBIS-AMI parameter file
tgen3v1_tx.linux.so	c90d314efebda099d37082786fa7a88258001a07	ELF 32-bit LSB shared object, Intel 80386, version 1 (SYSV), dynamically linked, not stripped
tgen3v1_tx.dll	8ef1db81d54ac9e9577994f820ef801305cff25d	PE32 executable for MS Windows (DLL) (GUI) Intel 80386 32-bit
tgen3v1_tx_64.linux.so	14c4211e8ce63e8bbc7a9555391c60f014ceff1c	ELF 64-bit LSB shared object, x86-64, version 1 (SYSV), dynamically linked, not stripped
tgen3v1_tx_64.dll	4e358d03b87ffa9a8f0334a898c3357cc8f99ecc	PE32+ executable for MS Windows (DLL) (GUI) Mono/.Net assembly
sisoft_serdes.ibs		IBIS part model file
tgen3v1_serdes.ibs	ffe3e589a8afb8b023c43598fab0dc176179fd1	IBIS part model file
tgen3_v1_tx_ff.s4p	1a4c6527fcdbaff8ff5078623ef608175f9716b	Touchstone on-die interconnect model
tgen3_v1_tx_tt.s4p	3dbc68549245329561e493282438775439a15669	Touchstone on-die interconnect model
tgen3_v1_tx_ss.s4p	eb2ac72c8b540d2d26427a154a7e4af98c82823f	Touchstone on-die interconnect model

Model files

The file tgen3v1_sha1sum.txt contains the SHA1 digest signatures above and is included for verifying the integrity of each file. To perform this check use the command:

```
sha1sum -c tgen3_sha1sum.txt
```

Model Changes

The following changes to models were made as part of this Certification process:

- No change required

QCD Validation

The file(s) **PASS** QCD Validation with 0 errors.

QCD Released IBIS Parser Checks

The TX IBIS file tgen3v1_serdes.ibs **PASSES** with 0 errors and 0 warnings. Output from IBISCHK:

```
IBISCHK5 V5.0.7
Checking tgen3v1_serdes.ibs for IBIS 5.0 Compatibility...
Checking tgen3v1_tx.ami for IBIS 5.0 Compatibility...
Checking tgen3v1_tx.ami for IBIS 5.0 Compatibility...
Checking tgen3v1_tx.ami for IBIS 5.0 Compatibility...
Checking tgen3v1_tx.ami for IBIS 5.0 Compatibility...
Errors : 0
File Passed
```

Latest IBIS Parser Checks

The TX IBIS file tgen3v1_serdes.ibs **PASSES** the latest IBISCHK5 V5.1.4 with 0 errors and 0 warnings. Output from IBISCHK:

```
IBISCHK5 V5.1.4
Checking tgen3v1_serdes.ibs for IBIS 5.1 Compatibility...
Checking tgen3v1_tx.ami for IBIS 5.1 Compatibility...
Checking tgen3v1_tx.ami for IBIS 5.1 Compatibility...
Checking tgen3v1_tx.ami for IBIS 5.1 Compatibility...
Checking tgen3v1_tx.ami for IBIS 5.1 Compatibility...
Errors : 0
File Passed
```

TX Model Description

The TX model tested is **tgen3v1_txm**, found in the IBIS file **tgen3v1_serdes.ibs**, revision 1.0 dated 27-September-2013. This model offers the following support:

Platform	Compiler	Bits	Executable	AMI File	Init	Getwave
Linux	gcc3.2.3	32	tgen3v1_tx.linux.so	tgen3v1_tx.ami	True	True
Linux	gcc3.2.3	64	tgen3v1_tx_64.linux.so	tgen3v1_tx.ami	True	True
Windows	ver	32	tgen3v1_tx.dll	tgen3v1_tx.ami	True	True
Windows	ver	64	tgen3v1_tx_64.dll	tgen3v1_tx.ami	True	True

TX model platform support

This model processes both impulse responses and waveform data. It supports Statistical simulation through the impulse response returned by AMI_Init() and Time-Domain simulation through the waveform data returned by AMI_Getwave(). Because AMI_Init() must return an LTI response and AMI_Getwave() can return a nonlinear and time-varying response, the correlation between Statistical and Time-Domain simulation results can vary. SiSoft recommends comparing the two sets of results to determine how well Statistical simulation results approximate their Time-Domain counterparts for your application.

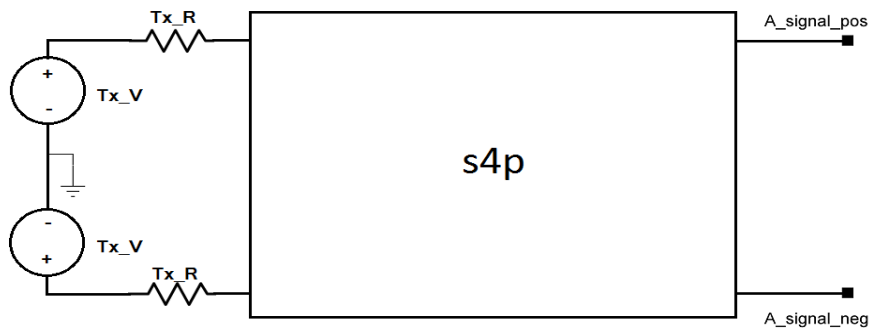
Parameter	Type	Usage	Values	Description
supporting_files	String	Info	List=tgen3_v1_tx_ss.s4p, tgen3_v1_tx_tt.s4p, tgen3_v1_tx_ff.s4p	Tx on-die s-parameter files
tf	Float	Info	Value=15e-12	Falling edge 0 to 100% time
tr	Float	Info	Value=15e-12	Rising edge 0 to 100% time
tstonefile	String	Info	Corner=tgen3_v1_tx_ss.s4p, tgen3_v1_tx_tt.s4p, tgen3_v1_tx_ff.s4p	Tx Matching network s-parameters
tx_corner	Integer	In	Default=0; Corner=0, -1, 1	Tx Process Corner: 0=TT -1=SS 1=FF
tx_dcd	Float	Info	Corner=2.42970e-13, 1.13735e-13, 4.59310e-14	TX Duty Cycle Distortion, expressed in seconds
tx_deemph	Integer	In	Default=0; Range=0, 0, 7	TX De-emphasis control, 0 to 7
tx_dj	Float	Info	Corner=4.05265e-12, 4.5453e-12, 3.30315e-12	TX Deterministic Jitter, expressed in seconds
tx_r	Float	Info	Value=0	Transmitter on-die s-parameter series

				resistance
tx_rj	Float	Info	Corner=3.9974e-13, 5.8524e-13, 5.1722e-13	TX Random Jitter RMS, expressed in seconds
tx_sj	Float	Info	Corner=8.393e-12, 1.1609e-12, 8.482e-13	TX Sinusoidal Jitter, expressed in seconds
tx_sj_frequency	Float	Info	Corner=1e9, 1e9, 1e9	TX Sinusoidal Jitter Frequency, expressed in Hz
tx_v	Float	Info	Value=1.0	Transmitter on-die s-parameter open circuit high voltage
tx_vswing	Integer	In	Default=7; Range=0, 0, 7	Output Drive Level Adjustment

TX model AMI parameters

TX Network Characterization

This model uses the "limited portability syntax" to define a broadband analog model that is portable between SiSoft's QCD and Agilent's ADS, using the equivalent circuit shown below:



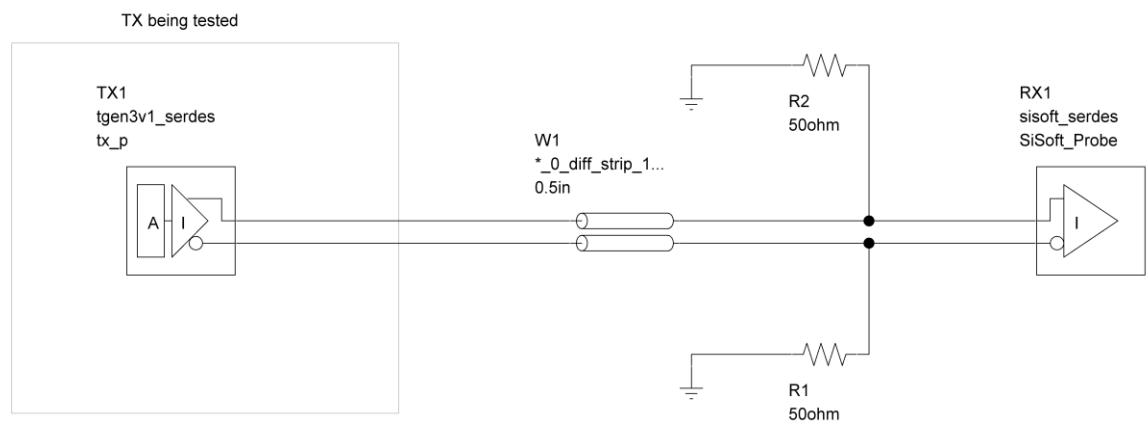
TX analog model equivalent circuit

QCD extracted the following values for the analog equivalent circuit. Elements without values listed below are absent from the circuit. Values not within reasonable limits are shown in red:

Analog Element	Typ Value	Slow Value	Fast Value
Tx_R	0.	0.	0.
Tx_V	1.	1.	1.
TstoneFile	tgen3_v1_tx_tt.s4p	tgen3_v1_tx_ss.s4p	tgen3_v1_tx_ff.s4p

TX Analog Model Parameters

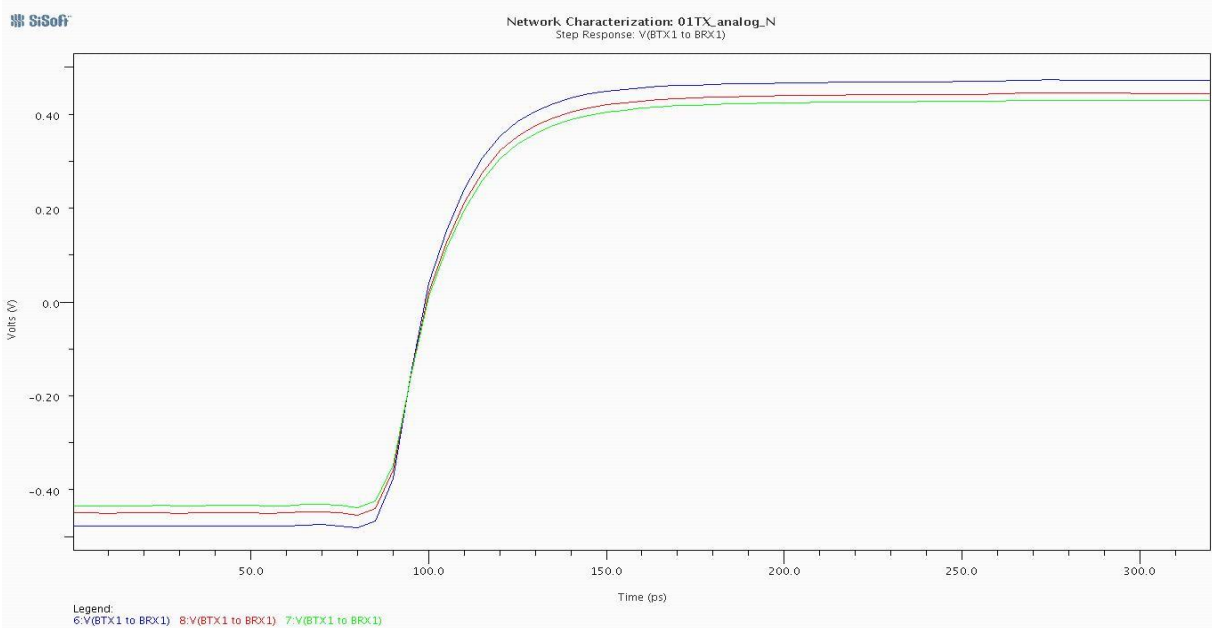
The following network was used to evaluate the behavior of the TX analog model. The SiSoft_Probe is an ideal receiver; it presents no load to the circuit being observed.



TX test topology

TX Network Characterization Results PASS

The TX analog model complies with the IBIS 5.1 spec. Network characterization yields the following step response:

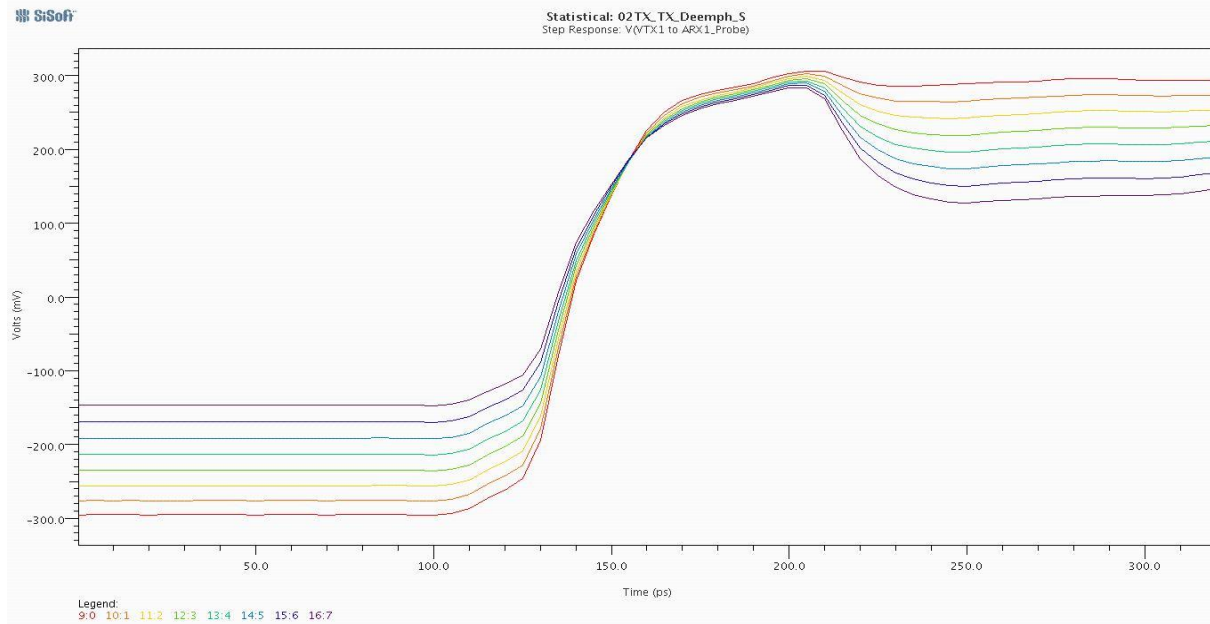


Network Characterization Step Response: TX, all analog settings

These waveforms are reasonable.

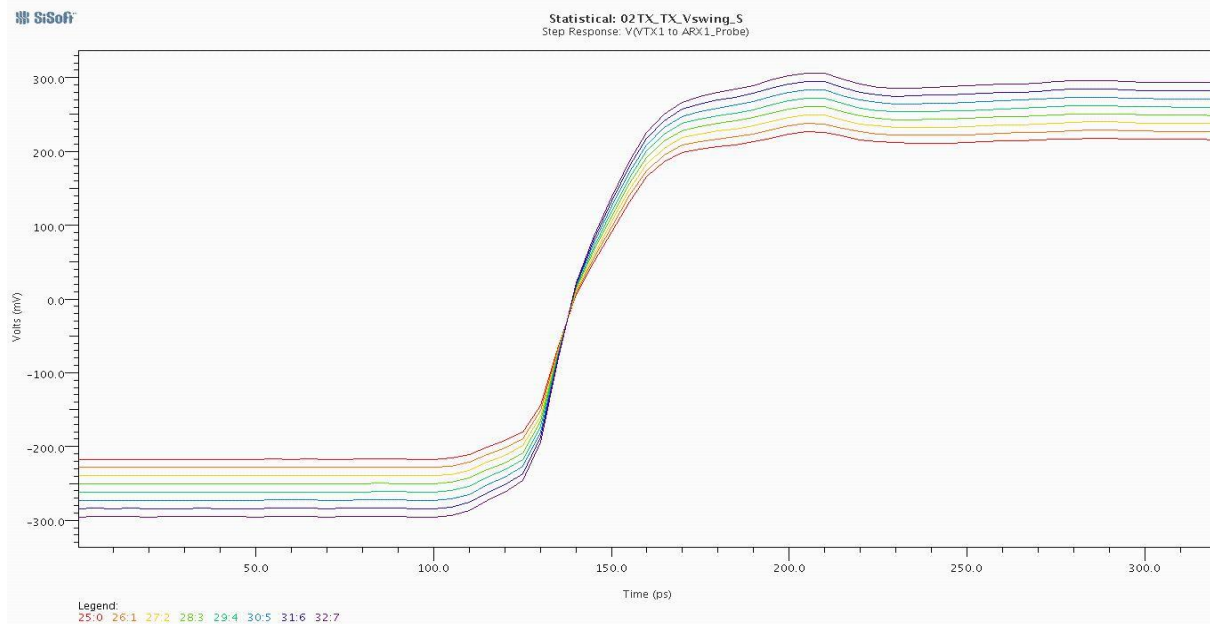
TX Statistical Simulation Tests PASS

Statistical simulations were run using the test topology at 12.500 Gb/s and 16 samples/bit to test the operation of each of the model's user-settable input controls.



Statistical Step Response: TX, all TX_Deemph settings

These waveforms are reasonable.

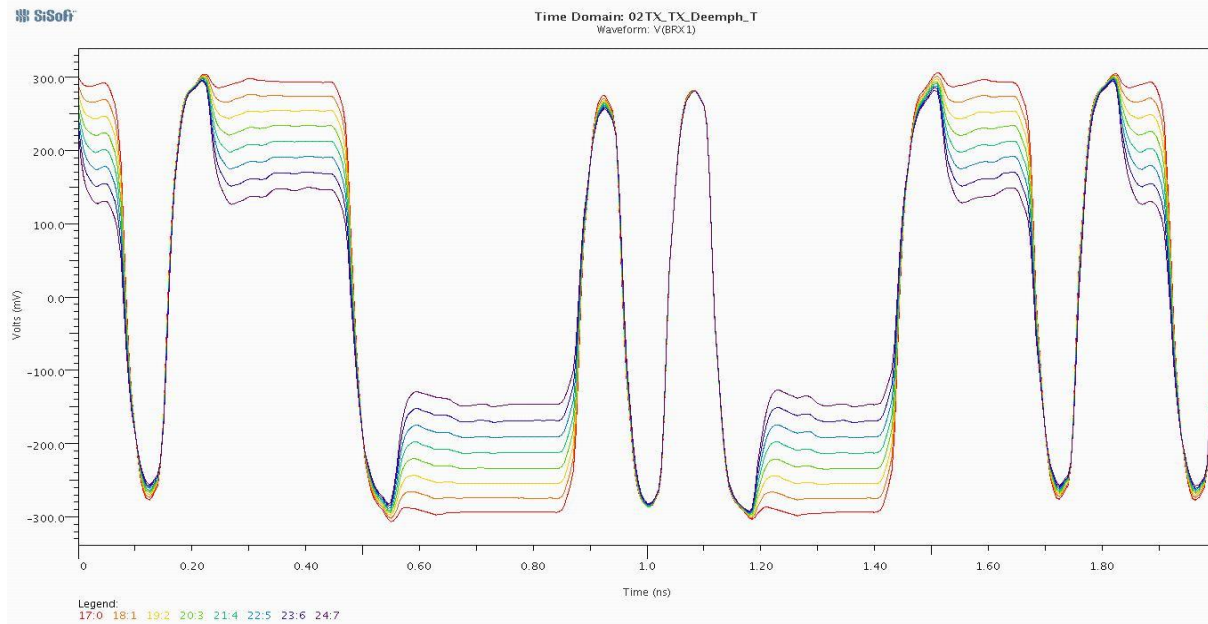


Statistical Step Response: TX, all TX_Vswing settings

These waveforms are reasonable.

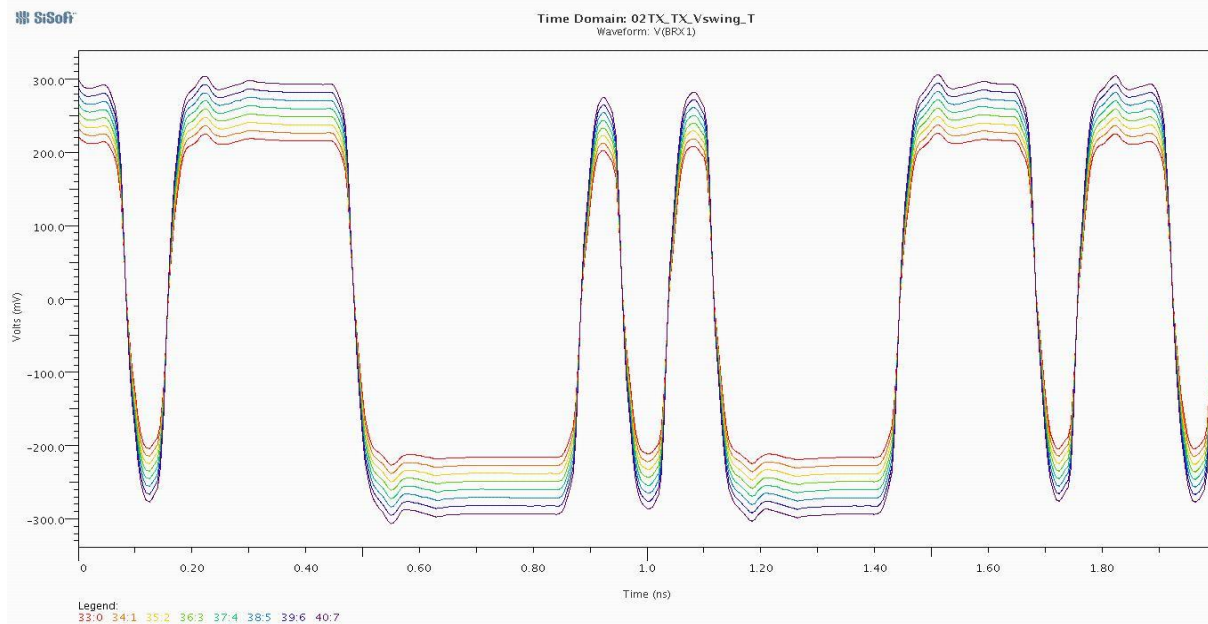
TX Time-Domain Simulation Tests PASS

Time-domain simulations were run using the test topology at 12.500 Gb/s and 16 samples/bit to test the operation of each of the model's user-settable input controls. 1002560 bits were simulated.



Time Domain Simulation Waveform: TX, all TX_Deemph settings

These waveforms are reasonable.

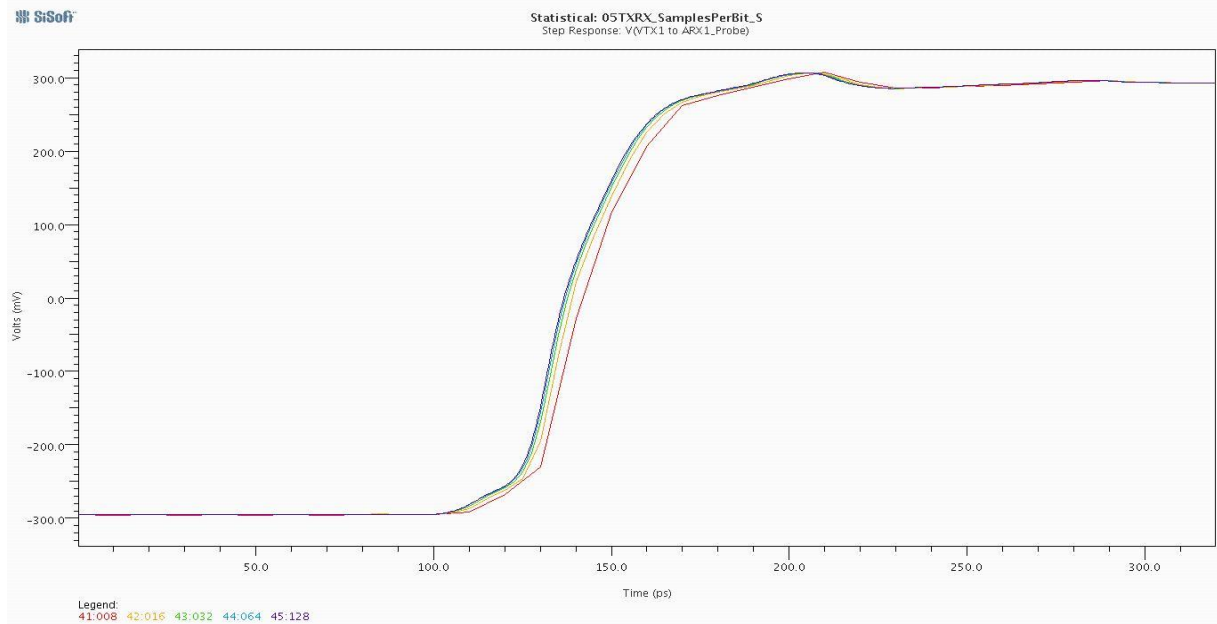


Time Domain Simulation Waveform: TX, all TX_Vswing settings

These waveforms are reasonable.

TX Statistical Simulation Compatibility Tests PASS

Statistical simulations were run in QCD, across all supported platforms and multiple samples per bit settings.

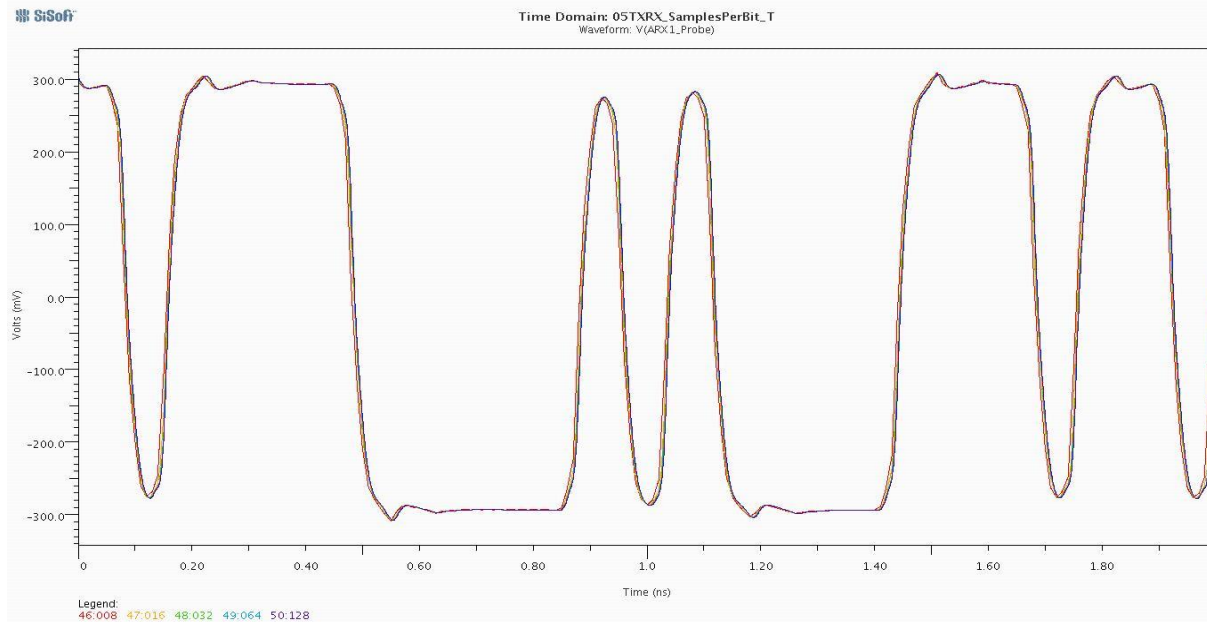


Statistical Step Response: TX, all SamplesPerBit settings

These waveforms appear to be reasonable. Some small variation is expected to result from the different time points chosen as resolution changes.

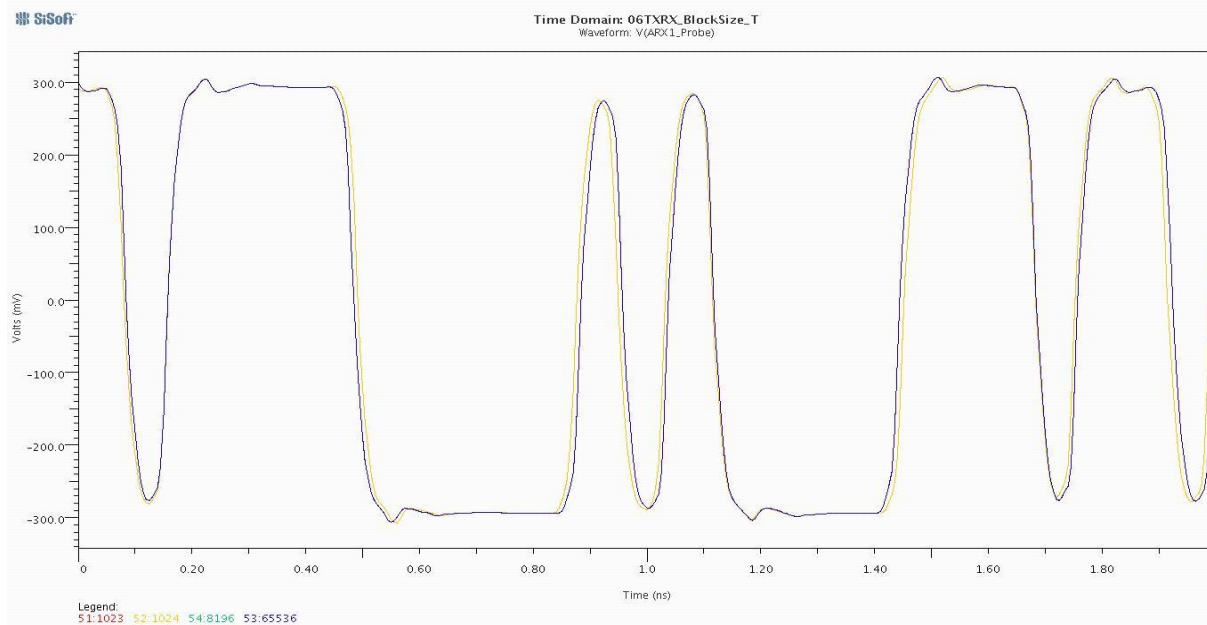
TX Time-Domain Simulation Compatibility Tests PASS

Time-domain simulations were run in QCD, across all supported platforms and multiple settings of block size and samples per bit. 1002560 bits were simulated; the last 2,500 were recorded for display.



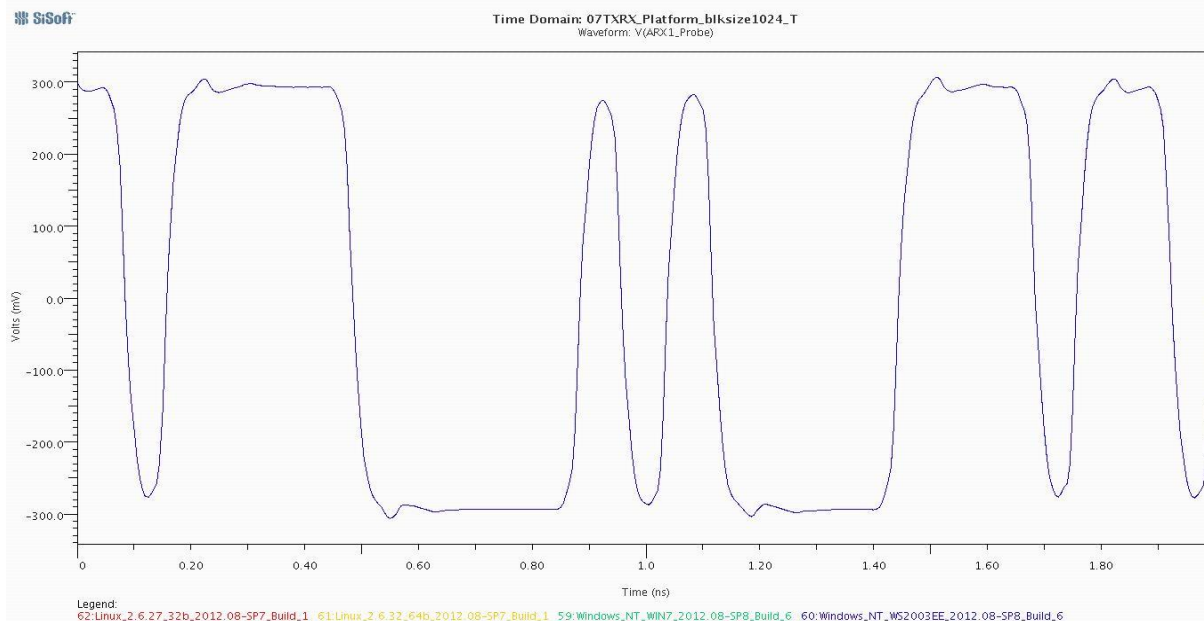
Time Domain Simulation Waveform: TX, all SamplesPerBit settings

These waveforms appear to be reasonable. Some small variation is expected to result from the different time points chosen as resolution changes.



Time Domain Simulation Waveform: TX, all BlockSize settings

These waveforms appear to be reasonable, showing that block size has no effect on results as expected.



Time Domain Simulation Waveform: TX, all Platform_blksize1024 settings

These waveforms appear to be reasonable, showing that platform has no effect on results as expected.

TX Jitter Budgets PASS

The TX model includes the Tx_Rj, Tx_Dj, Tx_Sj, Tx_Sj_Frequency AMI parameters, introduced by BIRD 123, incorporated into IBIS 6.0. These instruct the EDA tool to jitter the stimuli applied to the TX.

Parameter	Type	Usage	Values	Description
tx_dcd	Float	Info	Corner=2.42970e-13, 1.13735e-13, 4.59310e-14	TX Duty Cycle Distortion, expressed in seconds
tx_dj	Float	Info	Corner=4.05265e-12, 4.5453e-12, 3.30315e-12	TX Deterministic Jitter, expressed in seconds
tx_rj	Float	Info	Corner=3.9974e-13, 5.8524e-13, 5.1722e-13	TX Random Jitter RMS, expressed in seconds
tx_sj	Float	Info	Corner=8.393e-12, 1.1609e-12, 8.482e-13	TX Sinusoidal Jitter, expressed in seconds
tx_sj_frequency	Float	Info	Corner=1e9, 1e9, 1e9	TX Sinusoidal Jitter Frequency, expressed in Hz

TX Jitter AMI Parameters

The IBIS 6.0 specification defines these as Reserved_Parameters. However, IBIS 6.0 was ratified 20 Sep 2013, and until an IBISCHK6 parser is released they cannot appear in the

Reserved_Parameters section. QCD and other IBIS EDA tools will recognize the parameters if they are found in the Model_Specific section, which is where they are found in this model.

TX Crosstalk Tests PASS

The TX model was simulated with 2-aggressor coupled channels, both in far end crosstalk (FEXT) and near end crosstalk (NEXT) driver arrangements. The model correctly processes aggressor responses, producing the expected eye closures from case to case.

TX Mapping of Simulation Settings to Hardware NOTE

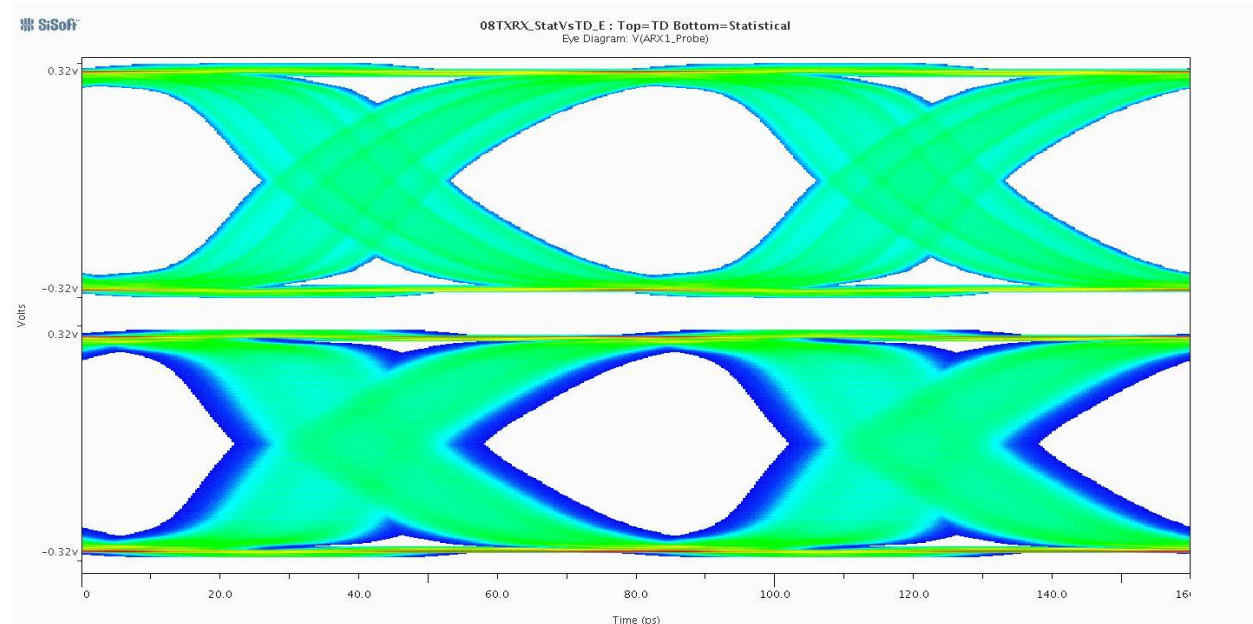
Mapping of AMI parameter settings to hexadecimal hardware register values is not documented explicitly. However, the Tx_Deemph and Tx_Vswing AMI parameters use decimal values corresponding to vendor specifications.

TX Model Certification for QCD PASS

This TX model is **Certified** for use with SiSoft's 2012.08-SP8 Build 6 release when simulations are setup and run as outlined in the QCD Usage Methodology section of this document.

Statistical and Time-Domain Eye Results PASS

Eye diagrams were derived from both statistical and time domain simulations, for comparison. Both eye diagrams below are taken from simulations using the DUT (Device Under Test) TX and an ideal RX model with base case settings. Ideally the statistical inner eye should be nearly identical to the time domain persistent eye, or at least not larger.



Eye Diagram: TXRX, Top=Persistent TD, Bottom=Statistical

These eye diagrams appear to be reasonable. The statistical eye is at least as pessimistic as the time domain persistent eye, and the difference is not excessive.

Performance Metrics

Performance measures for the DUT TX and a generic, fast RX working together are shown below. For statistical simulations times are given in seconds. For time domain simulations times are given in minutes per million bits. Speed relative to a generic AMI TX/RX (REF) model pair is provided for reference. For example, a relative speed of 0.5 means the tested model is half as fast as the reference model, taking twice as long to simulate. Statistical and time domain simulations with different samples/bit settings are included.

Performance Test	Simulation Time	Reference Time	Relative Speed
TX Statistical	4 sec	3 sec	0.750x
TX TimeDomain_008spb	0.88 min/Mbit	0.88 min/Mbit	1.000x
TX TimeDomain_016spb	1.21 min/Mbit	0.76 min/Mbit	0.630x
TX TimeDomain_032spb	2.11 min/Mbit	1.18 min/Mbit	0.559x
TX TimeDomain_064spb	6.10 min/Mbit	1.68 min/Mbit	0.275x
TX TimeDomain_128spb	22.04 min/Mbit	5.57 min/Mbit	0.253x

Performance Metrics

Recommendations

When IBISCHK6 is released this model can be reissued with jitter AMI parameters moved from the Model_Specific section to the Reserved_Parameters section.