

NB7NPQ1104M

IBIS-AMI Model Manual

ON Semiconductor's Timing Products

Current Revision: V2020.04-rev1

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This document describes the organization and structure of the IBIS-AMI model of the **NB7NPQ1104M**, (USB3.1 Gen-2 10Gbps Quad Channel / Dual Port Linear Redriver):

- a. Model files: Contains the IBIS-AMI model files
- b. Silicon vs. Simulation: Contains Silicon measurement vs. channel simulation results
- c. Datasheet: NB7NPQ1104M-D
- d. Documentation: Contain documentation for the IBIS-AMI model manual














• Model Files

a. IBIS-AMI model files

The table below shows the key IBIS-AMI model files as part of the compressed archive, NB7NPQ1104M_wrk.7zads

File Name	Type	Description
NB7NPQ1104M_IBIS_AMI_Manual_ADS_rev2.pdf	PDF	IBIS-AMI model manual
NB7NPQ1104M.ibs	IBS	Top-level IBIS models and wrappers for TX and RX AMI model.
NB7NPQ1104M.ami	AMI	Parameter file for the ami model as required by the IBIS-AMI standard. NB7NPQ1104M.idx and NB7NPQ1104M.ens will be used for table lookup.
NB7NPQ1104M.ens	ENS	Encrypted table data for NB7NPQ1104M.ami
NB7NPQ1104M.idx	IDX	NB7NPQ1104M.ami plain text index file
NB7NPQ1104M_Win32.dll NB7NPQ1104M_Win64.dll NB7NPQ1104M_LX64.so	DLL/SO	Compiled shared library for the model.
NB7NPQ1104M_P.ami	AMI	Parameter file for RX pass through model. This is for RX side of redriver.
NB7NPQ1104M_Win32P.dll NB7NPQ1104M_Win64P.dll NB7NPQ1104M_LX64P.so	DLL/SO	Compiled shared library for RX pass-through model.

b. IBIS-AMI data files

Name	Date modified	Type	Size
 fr4_diff_strip_8_9dB_10Gbs	12/18/2017 7:48 A...	S4P File	1,448 KB
 NB7NPQ1104M	5/22/2019 3:32 PM	AMI File	3 KB
 NB7NPQ1104M	10/25/2018 2:38 PM	ENS File	355 KB
 NB7NPQ1104M	5/22/2019 3:15 PM	IBIS Simulation M...	31 KB
 NB7NPQ1104M	5/22/2019 3:15 PM	IDX File	7 KB
 NB7NPQ1104M_LX64	10/25/2018 2:38 PM	SO File	6,726 KB
 NB7NPQ1104M_LX64P	10/25/2018 2:38 PM	SO File	8 KB
 NB7NPQ1104M_P	5/22/2019 3:37 PM	AMI File	2 KB
 NB7NPQ1104M_Win32.dll	10/25/2018 2:38 PM	Application extens...	3,023 KB
 NB7NPQ1104M_Win32P.dll	10/25/2018 2:38 PM	Application extens...	9 KB
 NB7NPQ1104M_Win64.dll	10/25/2018 2:38 PM	Application extens...	4,047 KB
 NB7NPQ1104M_Win64P.dll	10/25/2018 2:38 PM	Application extens...	10 KB
 snp_port_names_w_pin_numbers	5/22/2019 3:38 PM	Microsoft Excel Co...	1 KB

c. IBIS files

The table below shows the top-level ibs file's pin, signal, model names and their usage.

Pin	Signal	Model	Description
3, 7, 14, 21, 25, 32, 36	VCC	POWER	For power supply connection
EXPOSED PAD	GND	GND	For ground connection
2, 20	EN	Control Pins	Enabling AB and CD
1, 10, 11, 18, 19, 28, 29, 42	FG/EQ	Control Pins	Flat-Gain (GF) and Equalization (GP)
8, 17, 26, 35	x_TXP	TX	P terminal of the analog driver (with TX AMI), where x is A, B, C or D
9, 16, 27, 34	x_TXN	TX	N terminal of the analog driver (with TX AMI), where x is A, B, C or D
4, 13, 22, 31	x_RXP	RX	P terminal of the analog receiver (with RX AMI model), where x is A, B, C or D
5, 12, 23, 30	x_RXN	RX	N terminal of the analog receiver (with RX AMI model), where x is A, B, C or D

d. AMI model parameters

NB7NPQ1104M AMI model is a redriver model which includes both a transmitter and a receiver model. The following tables list the selectable variables within NB7NPQ1104M.ami models.

NB7NPQ1104M_P.ami does not contain any user selectable parameter.

.AMI File	Variable	Format/Usage Descriptions
NB7NPQ1104M.ami	MDL_IDX_FILE	path to the parameter file “NB7NPQ1104M.idx”
	EN	either 0 or 1
	CORNER	“TYP”, “MIN” or “MAX”
	GP	Equalization settings, value should be “H”, “R”, “F” or “L” (See section “e” for the NB7NPQ1104M equalization truth table)
	GF	Flat-Gain settings, value should be “H”, “R”, “F” or “L”

e. NB7NPQ1104M Truth Tables

Below tables corresponding to Equalization (EQ), Flat-Gain (FG) and EN setting as well as the variations.

Gp	Peaking gain (Compensation at 5 GHz, relative to 100 MHz, 100 mVp-p sine wave input)	EQx = L		11.5		dB
		EQx = R		7.4		
		EQx = F		9.9		
		EQx = H		13.1		
		Variation around typical	-3		+3	dB
GF	Flat Gain (<100 MHz, EQx=F)	FGx = L		-1.2		dB
		FGx = R		0		
		FGx = F		+1.0		
		FGx = H		+2.0		
		Variation around typical	-3		+3	dB

EQ A/B/C/D are the selection pins for the equalization.

EQA/B/C/D	Equalizer Setting (dB)	
	@2.5 GHz	@5 GHz
L (Tie 0-Ω to GND)	5.0	11.5
R (Tie Rext to GND)	2.7	7.4
F (Leave Open)	4.0	9.9 (Default)
H (Tie 0-Ω to VDD)	6.5	13.1

FGA/B/C/D are the selection pins for the DC gain.

FGA/B/C/D	Flat Gain Settings (dB)
L (Tie 0-Ω to GND)	-1.2
R (Tie Rext to GND)	0
F (Leave Open)	+1.0 (Default)
H (Tie 0-Ω to VDD)	+2.0

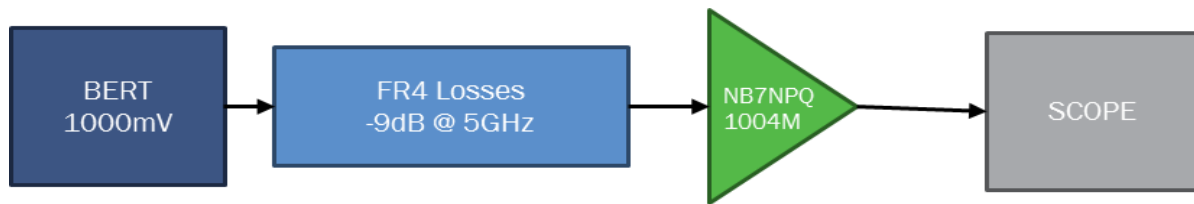
EN_AB / EN_CD are the channel enable pins for channels A&B and C&D respectively.

EN	Channel Enable Setting
0	Disabled
1	Enabled (Default)

• Silicon vs. ADS simulation

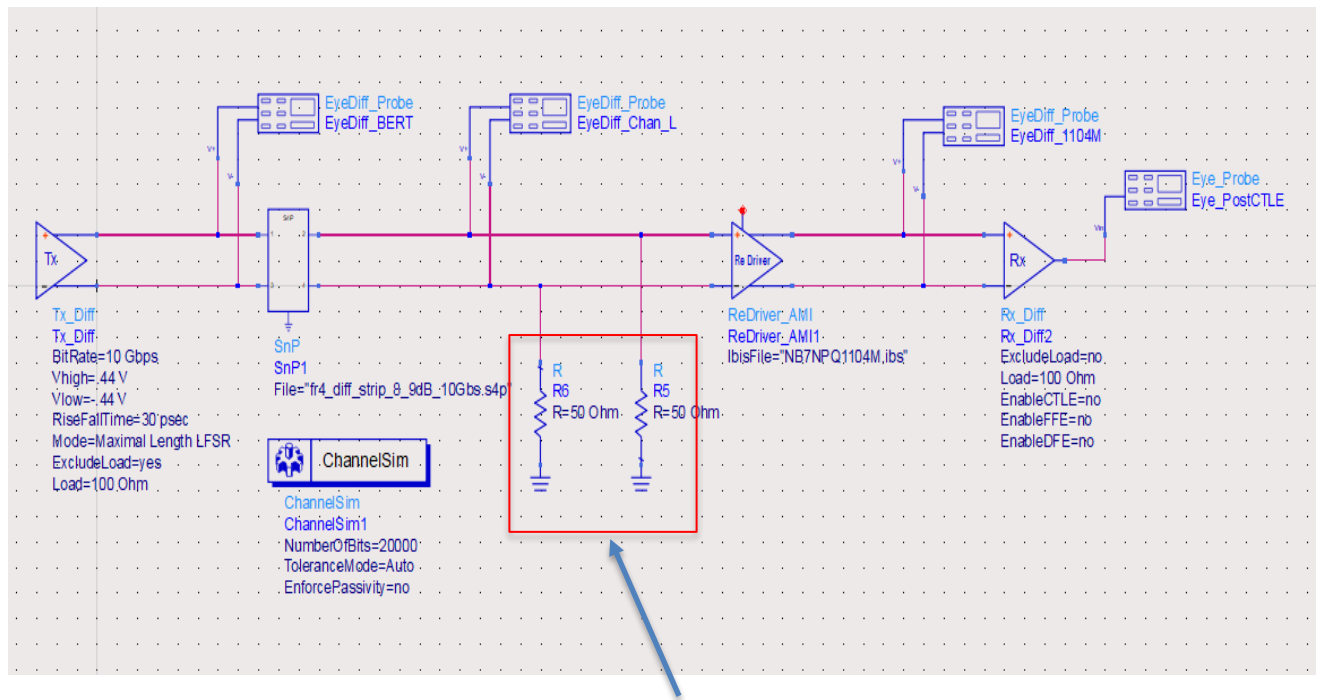
Below here is a comparison between Silicon measurement and ADS simulation (test bench is included in the NB7NPQ1104M.wrk.7zads). It's assumed that user is familiar with Advanced Design System (ADS) 2020 or later revision. Please notice, to match the BERT 1000mV, the ADS input has been set at $\pm 0.44\text{V}$.

a. Silicon Measurement – Setup



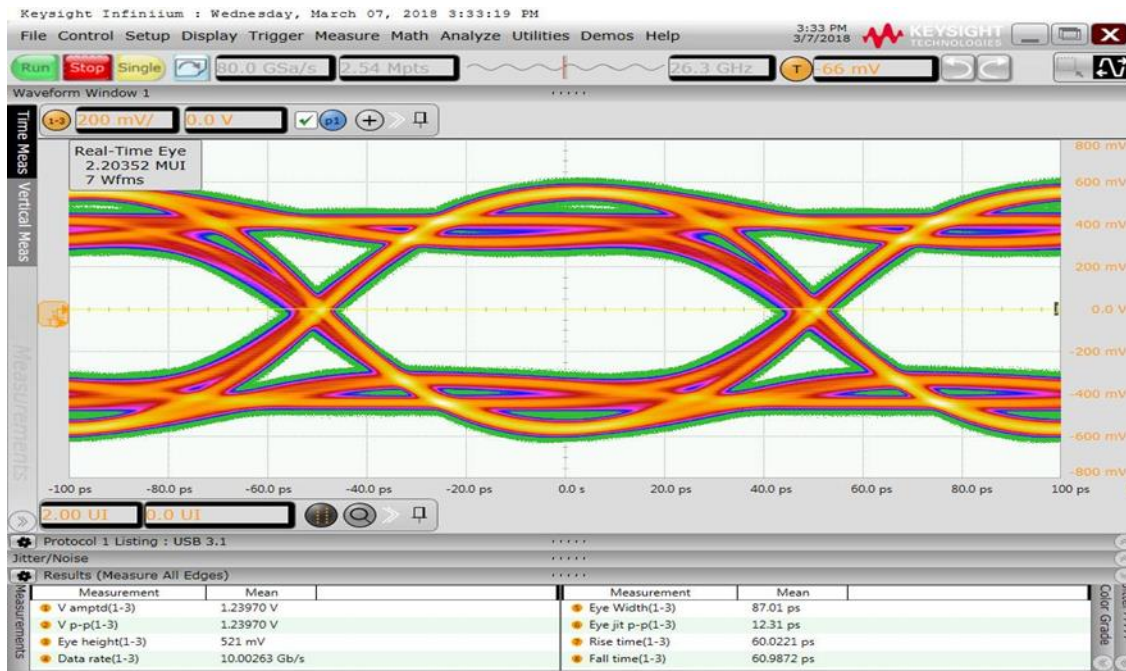
- BERT Amplitude = 1000mV Differential (No De-Emphasis nor Pre-Shoot)
- Data Signal = 2^7 PRBS @ 10Gbps
- Loss = -9dB (8" FR4 @ 10Gbps)

b. ADS schematic - test bench



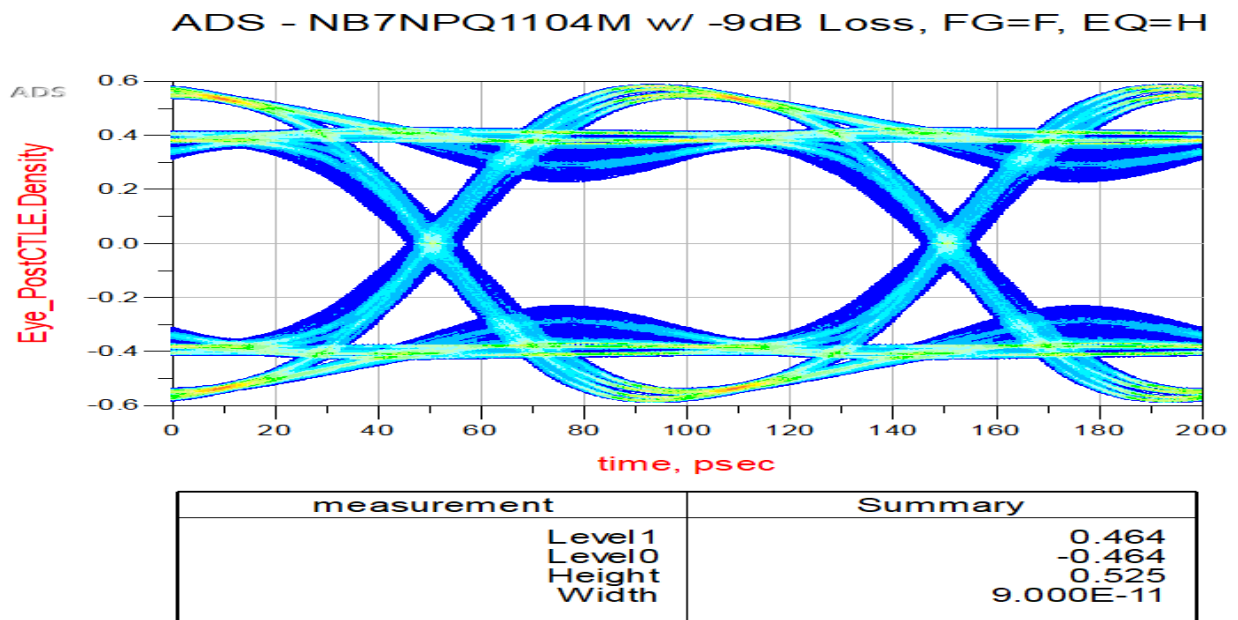
50 ohm connections to GND are required for the AMI model

c. Silicon Measurement FG=F, EQ=H

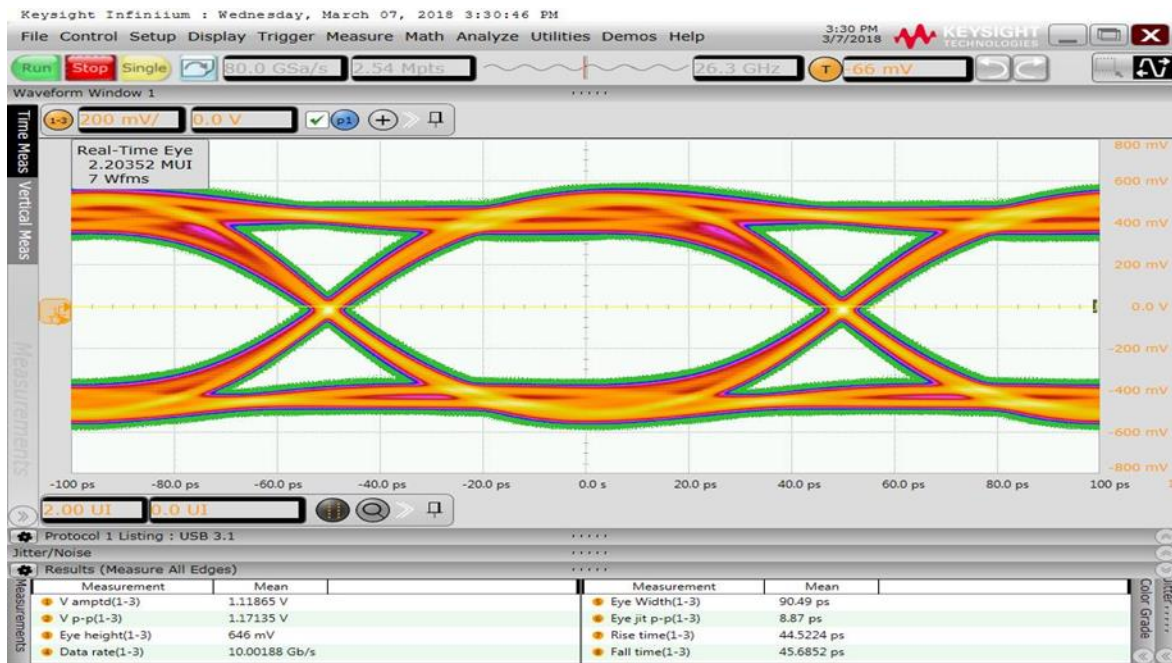


EyeH=521mV EyeW=87.01pS

d. ADS Simulation Result FG=F, EQ=H



e. Silicon Measurement FG=H, EQ=F



EyeH=646mV EyeW=90.49pS

f. ADS Simulation Result FG=H, EQ=F

