PI3HDMI412AD

1:2 Active HDMI™ Compatible DeMux with Advanced Re-Driver Functionality for Enhanced Signal Integrity

Features

- Supply voltage, V_{DD} = 3.3V ±5%
- Compatible w/ DVI, HDMI™ 1.1, 1.2, and 1.3 signals
- Supports both AC-coupled and DC-coupled inputs
- 1:2 Demux
- Supports Deep Color™ Signals
- Configurable output swing control (500mV, 750mV, 1000mV)
- Configurable Pre-Emphasis levels (0dB, 1.5dB, 3.5dB, 6.0dB)
- Configurable De-Emphasis (0dB, -1.5dB, -3.5dB, -6.0dB)
- Configurable Equalization (1dB, 3.5dB, 6dB, 8dB)
- Data Rate = 2.5Gbps (Max)
- Inputs w/ built-in termination
- Propagation delay < 2ns input
- Uni-Directional
- 10kV HBM ESD protection on all high speed data channels (Supplemental contact ESD test results are available upon request)
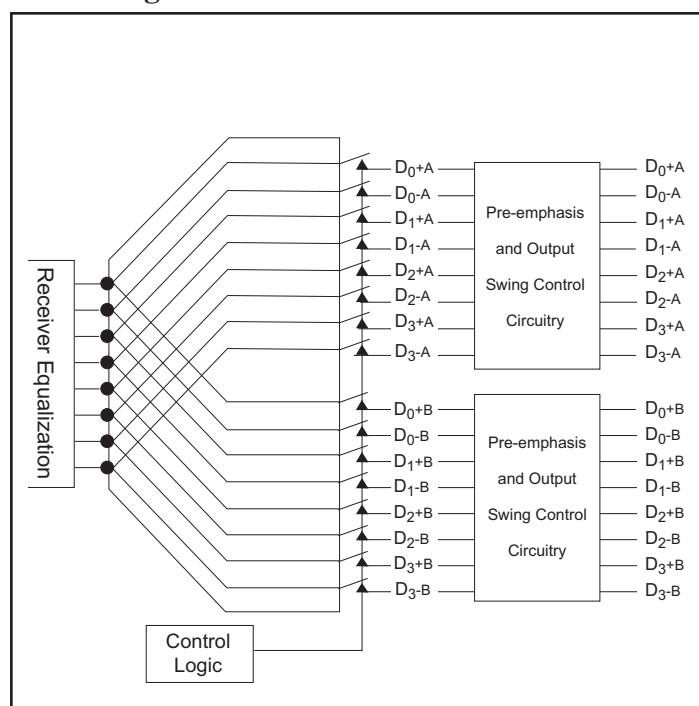- Packaging (Pb-free & Green): 56-pad TQFN (ZB56)

Description

Pericom Semiconductor's PI3HDMI412AD, active-drive switch solution is targeted for high-resolution video networks that are based on DVI/HDMI™ standards, and TMDS signal processing. The PI3HDMI412AD is an active single TMDS channel to two TMDS channel DeMux with Hi-Z outputs. The device drives differential signals to multiple video display units. It provides three controllable output swing levels that can be controlled through pin control or I²C control, depending on the mode select pin. The swing levels are 500mV, 700mV & 1000mV. This solution also provides a unique advanced pre-emphasis technique to increase rise and fall times which are reduced during transmission across long distances.
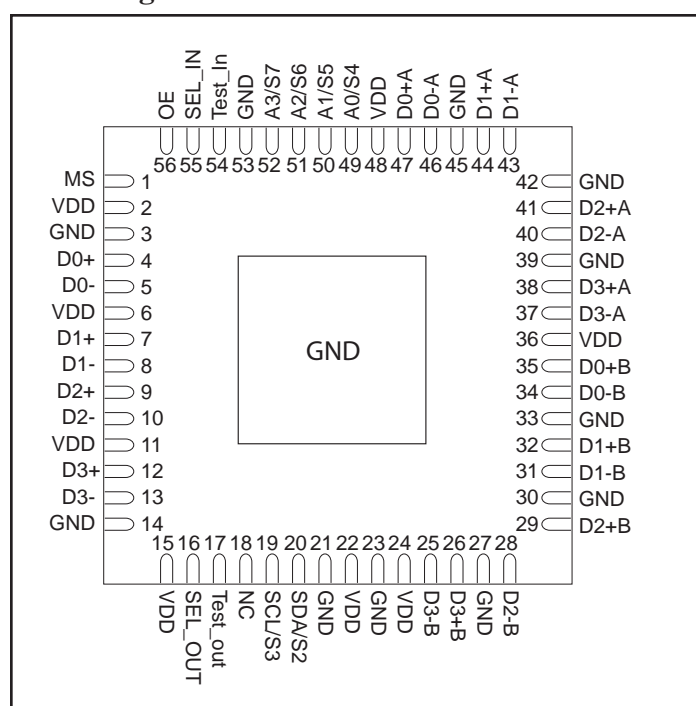
The maximum DVI/HDMI™ data rate of 1.65Gbps provides a 1920x1080 resolution required by the next Gen HDTV and PC graphics products. Due to its active uni-directional feature, this switch is de-signed for usage only for the video driver's side. For PC graphics application, the device sits at the driver's side to switch between multiple display units, such as PC LCD monitor, projector, TV, etc.

PI3HDMI412AD is the industry's first active DVI/HDMI™ compliant switch, which ensures transmitting high bandwidth video streams from PC graphics source to end display units. PI3HDMI412AD will also provide enhanced robust ESD/EOS protection, which is required by many consumer video networks today.
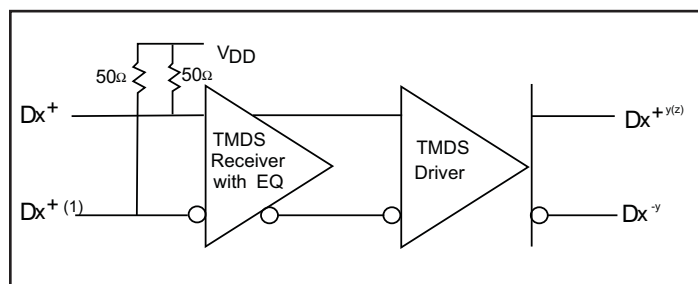
Block Diagram

Pin Configuration

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Function Block Description

Notes:
1. X = 0,1,2,3
2. Y = A,B

Maximum Ratings (Above which useful life may be impaired. For user guidelines, not tested.)

Storage Temperature......................................–65°C to +150°C	
Supply Voltage to Ground Potential.............–0.5V to +5V	
DC Input Voltage...–0.5V to V_{DD}	
DC Output Current......................................120mA	
Power Dissipation.......................................1.0W	

Note: Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Pin Description

Pin #	Pin Name	I/O	Description
2, 6, 11, 15, 22, 24, 36, 48	V_{DD}	Power	3.3V power supply
3, 14, 21, 23, 27, 30, 33, 39, 42, 45, 53	GND	Power	0V power supply
16	SEL_Out	O	Output bit, that provides information to user as to which port is active, if SEL_OUT = 'LOW', then Port A is active, if SEL_OUT = 'HIGH', then Port B is active. Only used when MS pin is 'HIGH'
19	SCL	I	I²C Clock Input Signal
20	SDA	I/O	I²C Data Input/Output Signal
18	NC	N/A	No Connect.
1	MS	I	Mode Select Pin. If MS = 'HIGH', then I²C control is active. Pins 49-52 are I²C address and pin 19 is SCL and pin 20 is SDA. If MS = 'LOW', then I²C control is inactive and pin programmability is active. Pins 49-52 are control pins only for Port A, S4-S7 and pin 19 is S2 and pin 20 is S3. If 'MS' = "LOW", Port B cannot be configured and is left as default. Port B default value is 0dB pre-emphasis, 0dB de-emphasis, and 500mV output swing
55	SEL_IN	I	Output port select. (Logically similar to I²C bit S1 - see page 3)
54	Test_in	I	Input pin for internal testing. Tie to GND for normal operation
56	OE	I	Output is enabled and normal when OE = 'HIGH'. If OE = 'LOW', both outputs, A and B, are disabled and at Hi-Z
17	Test_Out	O	Output pin for internal testing. Not used for normal operation
4, 5, 7, 8, 9, 10, 12, 13	Dx	I	Input TMDS high speed signals
28, 29, 31, 32, 34, 35, 40, 41, 43, 44, 46, 47, 25, 26, 37, 38	Dx ^{y}	O	Output TMDS high speed signals
49,50, 51, 52	A0, A1, A2, A3	I	I²C address inputs if MS = 'HIGH'.
49,50, 51, 52	S4, S5, S6, S7	I	If MS = 'LOW', then pins 49-52 are control bits S4-S7 for port A only, as shown in truth table on page 3 of datasheet
19	S3	I	If MS = 'LOW', then pins 19 is control bit S3, as shown in the truth table on page 3
20	S2	I	If MS = 'LOW', then pins 20 is control bit S2, as shown in the truth table on page 3

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I²C Truth Table

(At power up, default values are: Port A is active, signal swing is set to 500mV, pre-emphasis and de-emphasis are at 0dB, and equalization is at 1dB)

Byte 2: S[7:0]=00000001

Output Swing:	500mV
Pre-emphasis:	0dB
De-Emphasis:	0dB
Equalization:	1dB
Active Port:	port A

Byte 3: S[7:0]=00000001

Output Swing:	Defined by Byte 2
Pre-emphasis:	
De-Emphasis:	
Active Port:	port A, in normal mode

BYTE 1 (Address Assignment)

Address	A6	A5	A4	A3	A2	A1	A0	R/W
Value	1	1	0	A3	A2	A1	A0	R=1/W=0

BYTE 2 (1st Data byte - Port A control and input control)

Port A and Input Control	S7	S6	S5	S4	S3	S2	S1	S0	Result		
									Swing (mV)	Pre-emphasis (dB)	De-emphasis (dB)
Swing Control	0	0	0	0	x	x	x	x	500	0	0
	0	0	0	1	x	x	x	x	750	0	0
	0	0	1	0	x	x	x	x	1000	0	0
	0	0	1	1	x	x	x	x	N/A	N/A	N/A
Pre-Emphasis	0	1	0	0	x	x	x	x	500	0	0
	0	1	0	1	x	x	x	x	500	1.5	0
	0	1	1	0	x	x	x	x	500	3.5	0
	0	1	1	1	x	x	x	x	500	6.0	0
De-Emphasis	1	0	0	0	x	x	x	x	750	0	0
	1	0	0	1	x	x	x	x	750	0	-1.5
	1	0	1	0	x	x	x	x	750	0	-3.5
	1	0	1	1	x	x	x	x	750	0	-6.0
Output Port Select	x	x	x	x	x	x	0	1	Port A is active		
	x	x	x	x	x	x	1	1	Port B is active		
	x	x	x	x	x	x	x	0	Port A = Hi-Z		
Equalization (dB)	x	x	x	x	0	0	x	x	1		
	x	x	x	x	0	1	x	x	3.5		
	x	x	x	x	1	0	x	x	6		
	x	x	x	x	1	1	x	x	8		

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BYTE 3 (2nd Data byte - Port B control)

Port B Control only	S7	S6	S5	S4	S3	S2	S1	S0	Result		
									Swing (mV)	**Pre-emphasis (dB)**	**De-emphasis (dB)**
Swing Control	0	0	0	0	x	x	x	x	500	0	0
	0	0	0	1	x	x	x	x	750	0	0
	0	0	1	0	x	x	x	x	1000	0	0
	0	0	1	1	x	x	x	x	N/A	N/A	N/A
Pre-Emphasis	0	1	0	0	x	x	x	x	500	0	0
	0	1	0	1	x	x	x	x	500	1.5	0
	0	1	1	0	x	x	x	x	500	3.5	0
	0	1	1	1	x	x	x	x	500	6.0	0
De-Emphasis	1	0	0	0	x	x	x	x	750	0	0
	1	0	0	1	x	x	x	x	750	0	-1.5
	1	0	1	0	x	x	x	x	750	0	-3.5
	1	0	1	1	x	x	x	x	750	0	-6.0
Output Port Select	x	x	x	x	x	x	0	1	Normal		
	x	x	x	x	x	x	1	1	TEST MODE		
	x	x	x	x	x	x	x	0	Port B = Hi-Z		

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TMDS Compliance Test Results

Item	HDMI™ 1.3 Spec	Pericom TMDS Product Spec
Operating Conditions		
Termination Supply Voltage, A_{VDD}	$3.3V \leq 5\%$	$3.30 \pm 5\%$
Terminal Resistance	50 Ohm $\leq 10\%$	45 to 55 Ohm
Source DC Characteristics at TP1		
Single-ended high level output voltage, V_H	$A_{VDD} \leq 10mV$	$A_{VDD} \leq 10mV$
Single-ended low level output voltage, V_L	$(A_{VDD} - 600mV) \leq VL \leq (A_{VDD} - 400mV)$	$(A_{VDD} - 600mV) \leq VL \leq (A_{VDD} - 400mV)$
Single-ended output swing voltage, V_{swing}	$400mV \leq V_{swing} \leq 600mV$	$400mV \leq V_{swing} \leq 600mV$
Single-ended standby (off) output voltage, V_{off}	$A_{VDD} \pm 10mV$	$A_{VDD} \pm 10mV$
Single-ended standby (off) output current, I_{off}	$\| I_{OFF} \| < 10uA$	$\| I_{OFF} \| < 10uA$
Transmitter AC Characteristics at TP1		
Risetime/Falltime (20%-80%)	$75ps \leq$ Risetime/Falltime ≤ 0.4 Tbit ($75ps \leq tr/tf \leq 242ps$) @ 1.65Gbps	240ps
Intra-Pair Skew at Transmitter Connector, max	0.15 Tbit (90.9ps @ 1.65Gbps)	60ps max
Inter-Pair Skew at Transmitter Connector, max	0.2 Tpixel (1.2ns @ 1.65Gbps)	100ps max
Clock Jitter, max	0.25 Tbit (151.5ps @ 1.65Gbps)	82ps max
Sink Operating DC Characteristics at TP2		
Input Differential Voltage Level, V_{diff}	$150 \leq Vdiff \leq 1200mV$	$150mV \leq V_{DIFF} \leq 1200mV$
Input Common Mode Voltage Level, V_{ICM}	$A_{VDD} -300mV \leq V_{ICM} < A_{VDD} -37.5mV$ or $A_{VDD} \pm 10\%$	$A_{VDD} -300mV \leq V_{ICM} < A_{VDD} - 37.5mV$ or $A_{VDD} \pm 10\%$
Sink DC Characteristics When Source Disabled or Disconnected at TP2		
Differential Voltage Level	$A_{VDD} \pm 10mV$	$A_{VDD} \pm 10mV$

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DC Electrical Characteristics (T$_A$ = –40°C to +85°C, unless otherwise noted. V$_{DD}$ = 3.3V ±0.3V)

Symbol	Parameter	Test Condition[1]	Min.	Typ.[2]	Max.	Units
V$_H$	Single-ended high level output voltage		V$_{DD}$ – 10mV	V$_{DD}$	V$_{DD}$ + 10mV	V
V$_L$	Single-ended low level output voltage		V$_{DD}$ – 600mV		V$_{DD}$ - 400mV	V
Vswing	Single-ended output swing voltage		400		600	mV
V$_{OFF}$	Single-ended standby (off) output voltage		V$_{DD}$ – 10mV	V$_{DD}$	V$_{DD}$ + 10mV	V
I$_{OFF}$	Single-ended standby (off) output current				10	μs
V$_{OS}$	Offset Voltage				V$_{DD}$ – 250mV	V
V$_{IH}$	Minimum Input High Voltage		1.8			V
V$_{IL}$	Minimum Input Low Voltage				0.8	
I$_{CC}$	Power Supply Current				280	mA

AC Electrical Characteristics (T$_A$ = –40°C to +85°C, V$_{DD}$ = 3.3V ±0.3V)

Symbol	Paramter	Test Conditions[1]	Min.	Typ.[2]	Max.	Units
T$_{20-80}$	Rise time/fall time (20% - 80%)		75		240	ps
	Overshoot				15% of V$_{swing}$ * 2	
	Undershoot				25% of V$_{swing}$ * 2	
	Intra-Pair Skew at Source Connector				60	ps
	Inter-Pair Skew at Connector				100	ps
	Clock duty cycle		40%	50%	60%	
	Through connection impedance		85	100	115	ps
	TMDS differential clock Jitter				82	ps
	At Termination impedance		90	100	110	ps
t$_{PHLD}$	Differenital Propagation Delay High to Low			1.0		ns
t$_{PLHD}$	Differential Propagation Delay Low to High			1.0		ns
t$_{SKD}$	Differential Skew | t$_{PHLD}$ - t$_{PLHD}$ |			25		ps
t$_{PHZ}$	Disable Time High to Z			5		ns
t$_{PLZ}$	Disable Time Low to Z			5		ns
t$_{PZH}$	Enable Time Z to High			1		μs
t$_{PZL}$	Enable Time Z to Low			1		μs

Notes:
1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
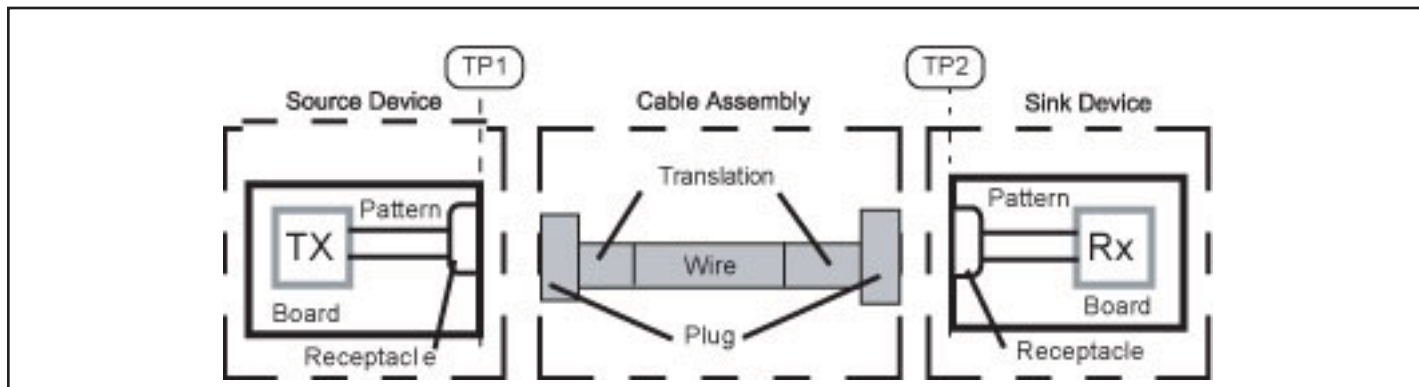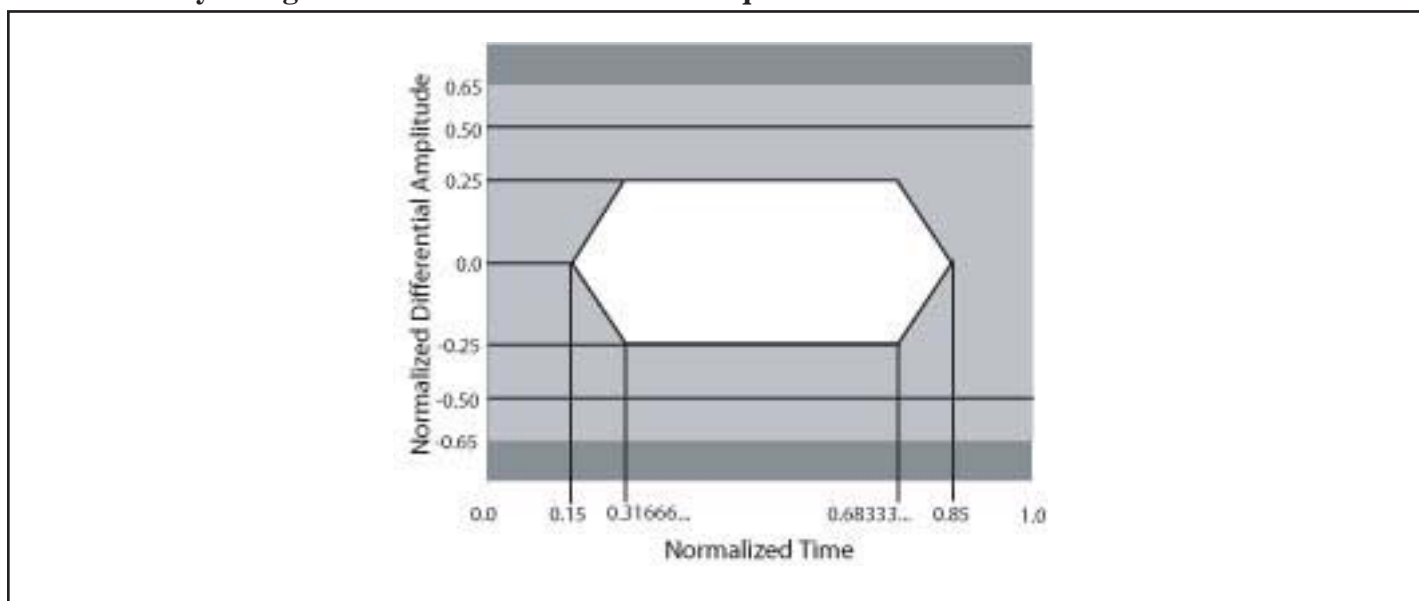2. Typical values are at V$_{DD}$ = 3.3V, T$_A$ = 25°C ambient and maximum loading.

Power Supply Characteristics

Parameters	Description	Test Conditions[1]	Min.	Typ.[2]	Max.	Units
I$_{CC}$	Quiescent Power Supply Current	V$_{DD}$ = Max., V$_{IN}$ = V$_{DD}$, OE = 'LOW'		1		mA

Notes:
1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V$_{DD}$ = 3.3V, T$_A$ = 25°C ambient and maximum loading.

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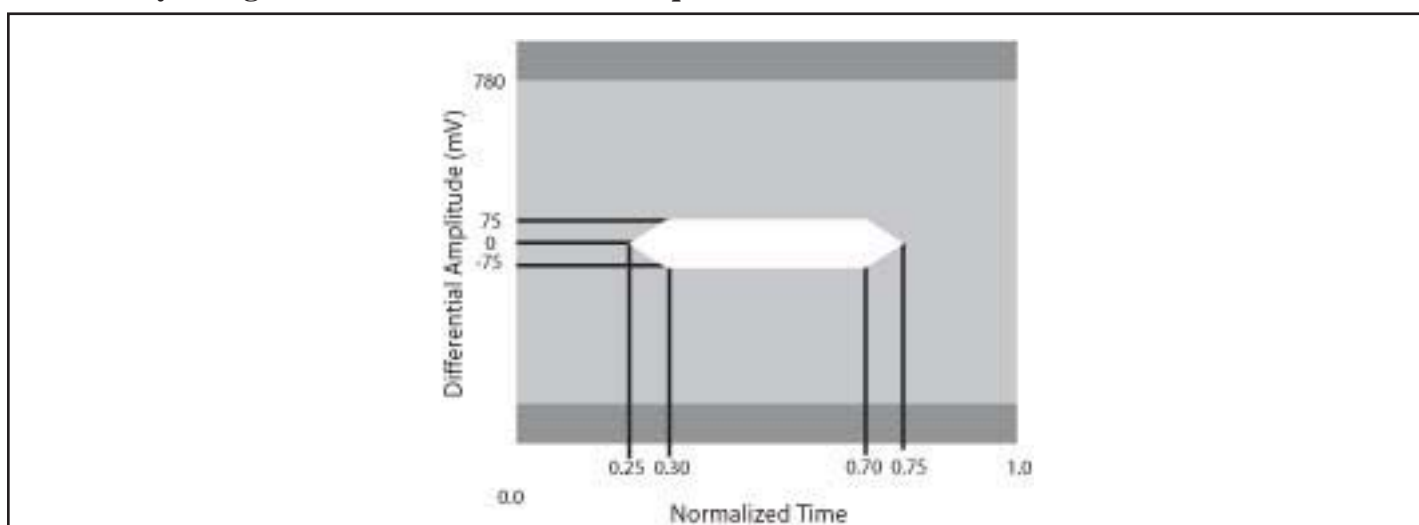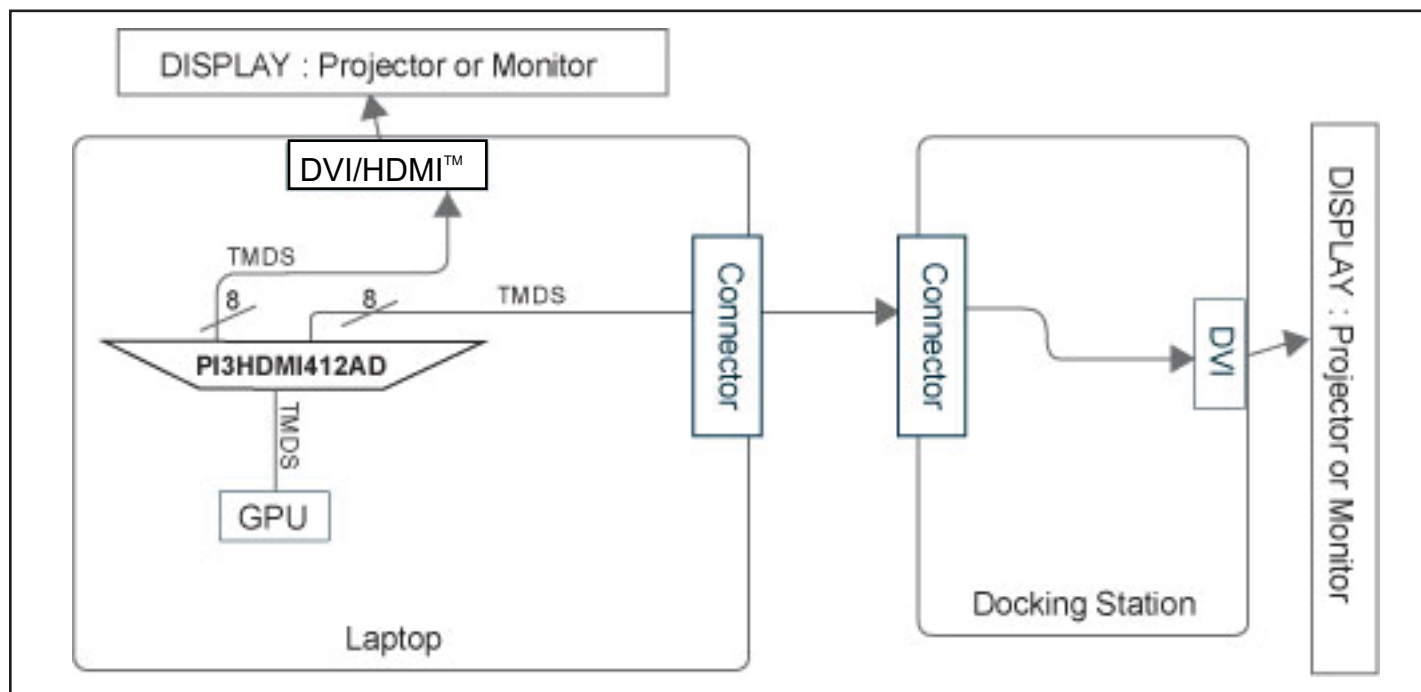## TMDS Link Test Points

Normalized Eye Diagram Mask at TP1 for Source Requirements

Absolute Eye Diagram Mask at TP2 for Sink Requirements

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Application Information (Please see application note for important design information.)
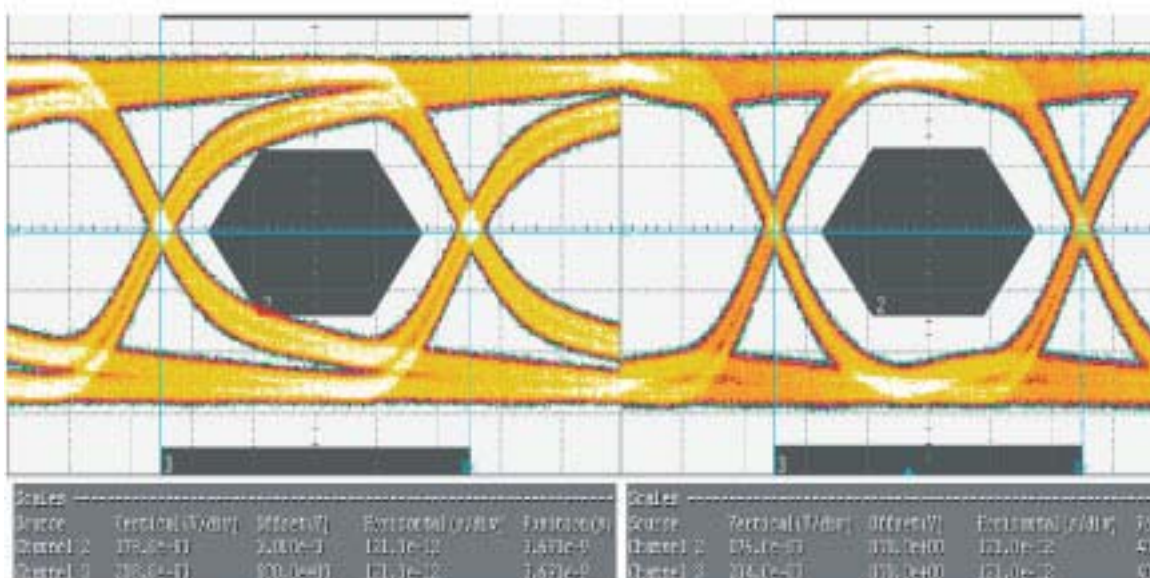

DVI TP2 (Tx) Compliance Test Setup
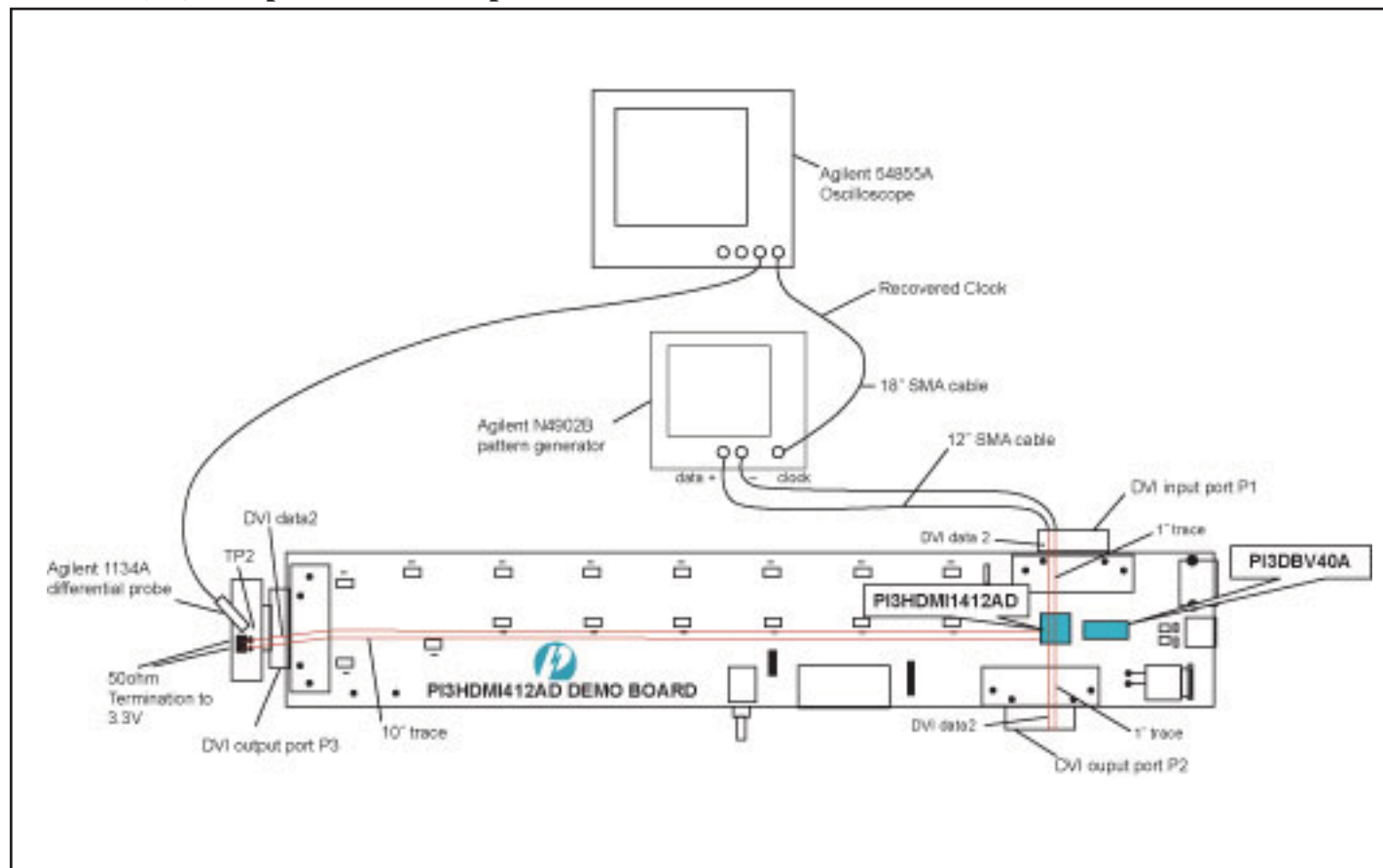
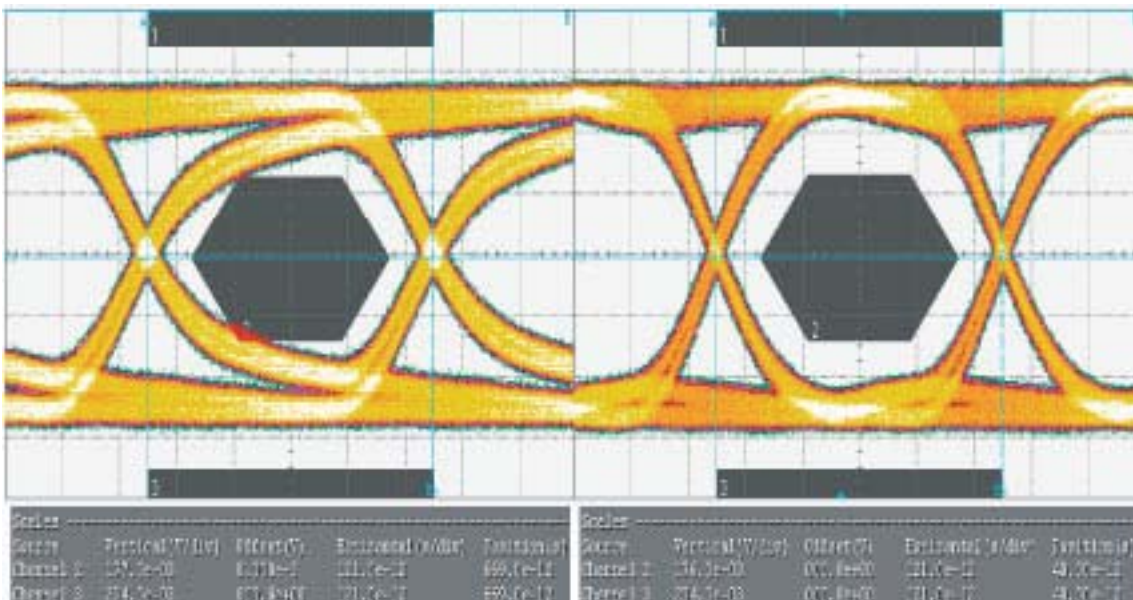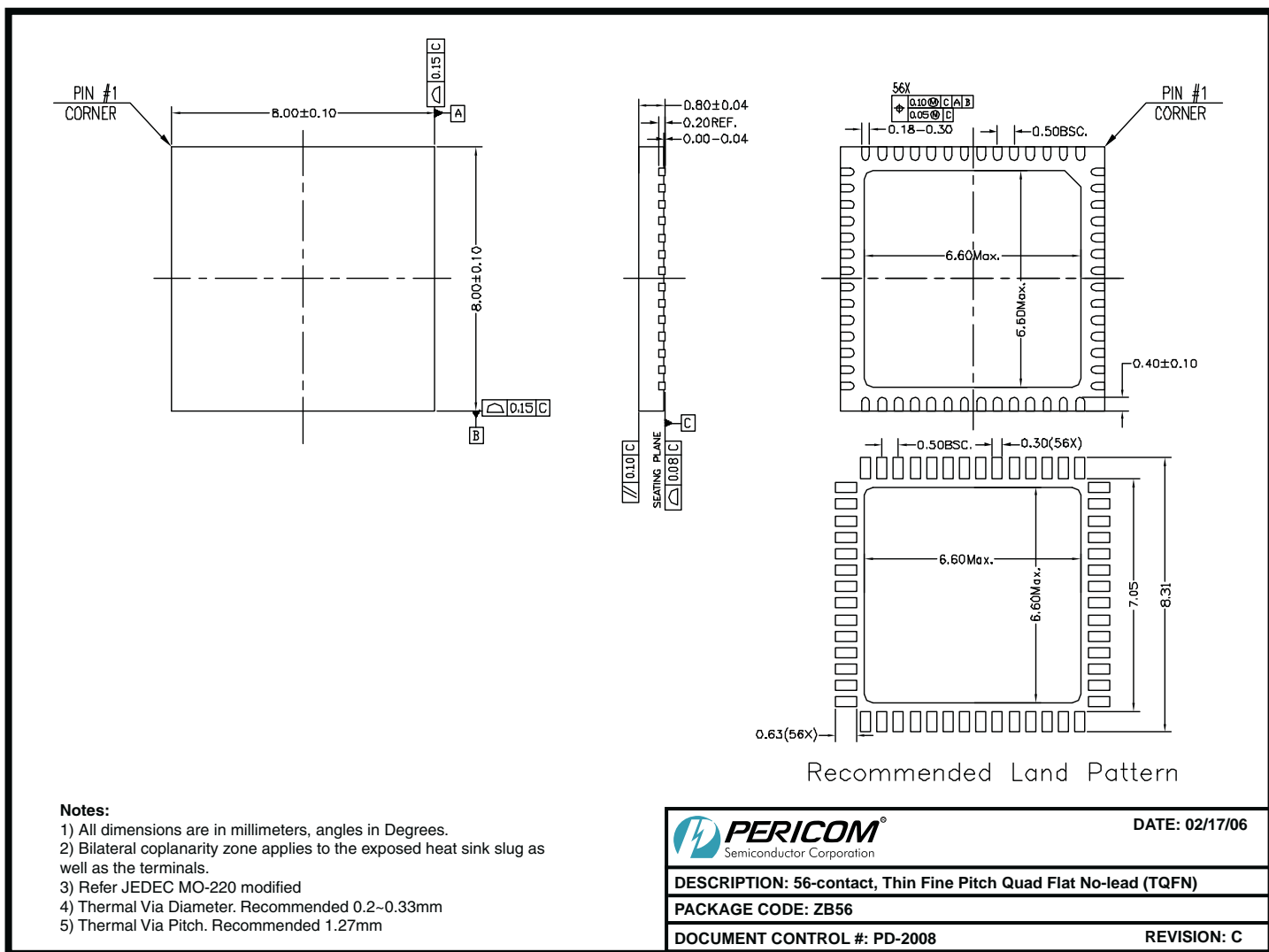## Pre-Emphasis Validation

Measured at ouput DVI port, P3; Right eye is with pre-emphasis, left eye is without pre-emphasis

De-Emphasis Validation

Measured at ouput DVI port, P3; Right eye is with de-emphasis, left eye is without de-emphasis

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Recommended Land Pattern

Notes:
1) All dimensions are in millimeters, angles in Degrees.
2) Bilateral coplanarity zone applies to the exposed heat sink slug as well as the terminals.
3) Refer JEDEC MO-220 modified
4) Thermal Via Diameter. Recommended 0.2~0.33mm
5) Thermal Via Pitch. Recommended 1.27mm

PERICOM Semiconductor Corporation	**DATE: 02/17/06**
DESCRIPTION: 56-contact, Thin Fine Pitch Quad Flat No-lead (TQFN)	
PACKAGE CODE: ZB56	
DOCUMENT CONTROL #: PD-2008	**REVISION: C**

Ordering Information

Ordering Code	Package Code	Package Description
PI3HDMI412ADZBE	ZB	56-pin, Pb-free & Green TQFN

Notes:

• Thermal characteristics can be found on the company web site at www.pericom.com/packaging/

• E = Pb-free and Green

• Adding an X Suffix = Tape/Reel

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