



**THE DATASHEET OF  
PI3PCIE3412AZHEX**



**PI3PCIE3412A**

**3.3V, PCI Express® 3.0 2-Lane, 2:1 Mux/DeMux Switch, with Single Enable**

**Features**

- 4 Differential Channel, 2:1 Mux/DeMux
- PCI Express® 3.0 Performance, 8.0Gbps
- Bi-directional Operation
- Low Bit-to-Bit Skew, 10ps max
- Low channel-to-channel skew, 20ps max
- Low Crosstalk: -35dB@4 GHz
- High Off Isolation: -22dB@4 GHz (8.0Gbps)
- Low insertion loss: -1.3dB@4 GHz (8.0Gbps)
- Return loss: -21dB@4 GHz
- ESD:1.5KV HBM
- Support for DP1.2 - HBR2, HBR, RBR
- Supply Voltage 3.3V
- Industrial Temperature Range: -40°C to 85°C
- Packaging (Pb-free & Green):
  - 42-contact, TQFN (ZH42), 3.5 x 9mm
  - 40-contact, TQFN (ZL40), 3 x 6mm

**Description**

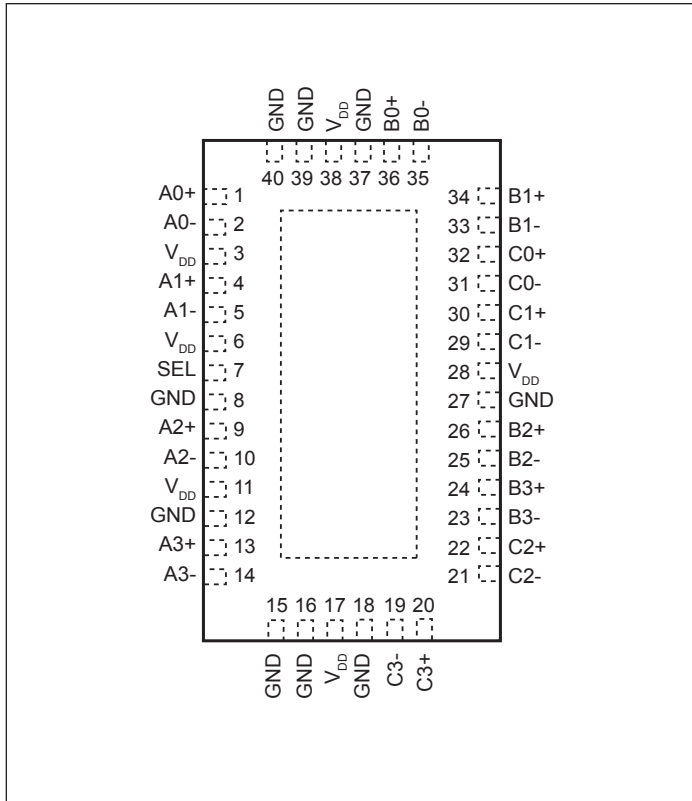
The PI3PCIE3412A is an 8 to 4 differential channel multiplexer/demultiplexer switch. This solution can switch 2 full PCI Express® 3.0, lanes to one of two locations. Using a unique design technique, Diodes Incorporated has been able to minimize the impedance of the switch such that the attenuation observed through the switch is minimal. The unique design technique also offers a layout targeted for PCI Express signals, which minimizes the channel to channel skew as well as channel to channel crosstalk as required by the PCI Express specification.

The PI3PCIE3412A can also be used for application up to 12Gbps.

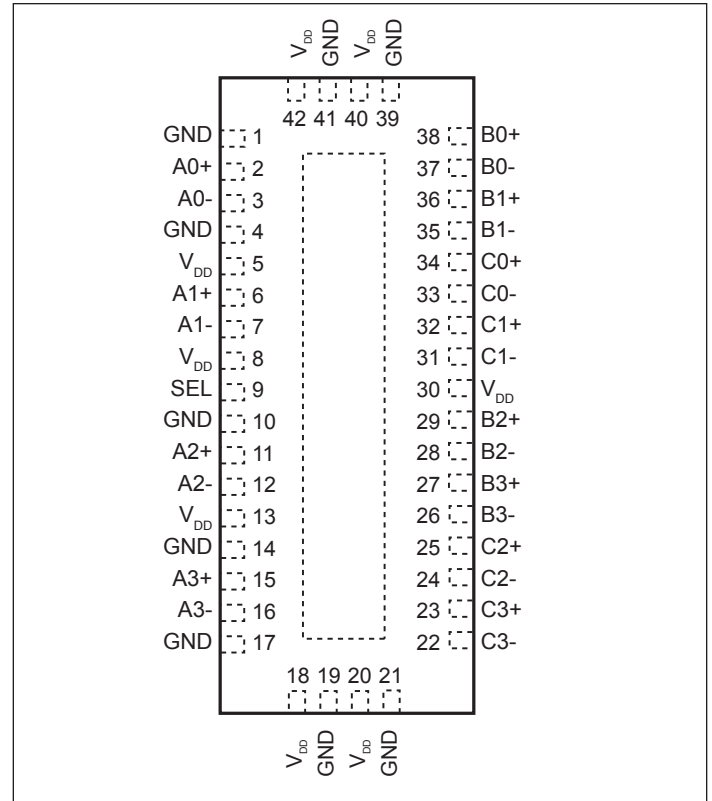
**Application**

Routing of PCI Express 3.0, DP1.2, USB3.0, SAS2.0, SATA3.0, XAUI, RXAUI signals with low signal attenuation.

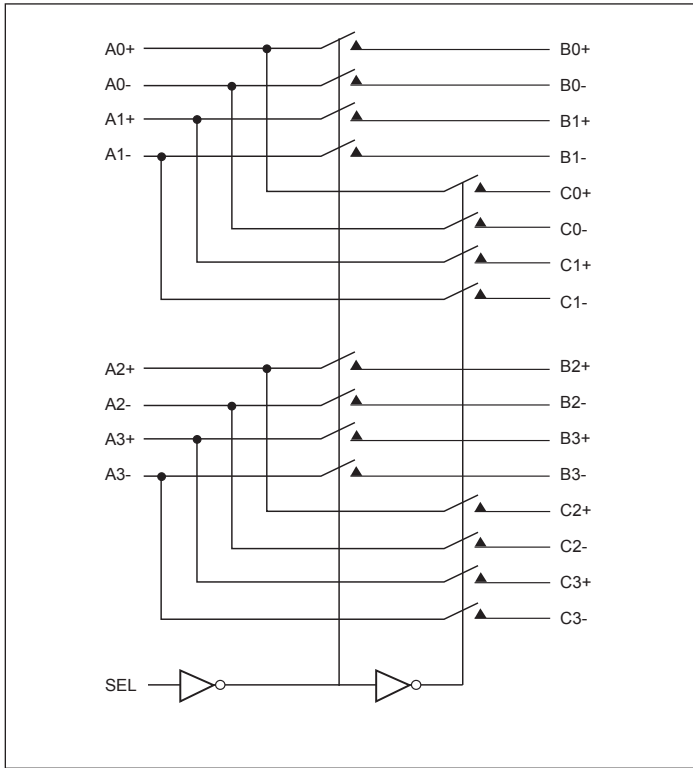
**Pin Configuration 40-Contact TQFN**



**Pin Configuration 42-Contact TQFN**



**Block Diagram**



**Truth Table**

Function	SEL
$A_N$ to $B_N$	L
$A_N$ to $C_N$	H

### Pin Description

Pin #		Pin Name	I/O	Description
42-TQFN	40-TQFN			
2 3	1 2	A0+ A0-	I/O	Signal I/O, Channel 0, Port A
6 7	4 5	A1+ A1-	I/O	Signal I/O, Channel 1, Port A
11 12	9 10	A2+ A2-	I/O	Signal I/O, Channel 2, Port A
15 16	13 14	A3+ A3-	I/O	Signal I/O, Channel 3, Port A
38 37	36 35	B0+ B0-	I/O	Signal I/O, Channel 0, Port B
36 35	34 33	B1+ B1-	I/O	Signal I/O, Channel 1, Port B
29 28	26 25	B2+ B2-	I/O	Signal I/O, Channel 2, Port B
27 26	24 23	B3+ B3-	I/O	Signal I/O, Channel 3, Port B
34 33	32 31	C0+ C0-	I/O	Signal I/O, Channel 0, Port C
32 31	30 29	C1+ C1-	I/O	Signal I/O, Channel 1, Port C
25 24	22 21	C2+ C2-	I/O	Signal I/O, Channel 2, Port C
23 22	20 19	C3+ C3-	I/O	Signal I/O, Channel 3, Port C
9	7	SEL	I	Operation mode Select (when SEL=0: A→B, when SEL=1: A→C)
5, 8, 13, 18, 20, 30, 40, 42	3, 6, 11, 17, 28, 38	V <sub>DD</sub>	Pwr	3.3V ±10% Positive Supply Voltage
1, 4, 10, 14, 17, 19, 21, 39, 41, Center Pad	8, 12, 15, 16, 18, 27, 37, 39, 40	GND	Pwr	Power ground

## 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 +3.7V
Channel DC Input Voltage .....	-0.5V to 1.5V
DC Output Current .....	120mA
Power Dissipation .....	0.5W
SEL DC Input Voltage .....	-0.5V to 3.7V
Junction Temperature .....	125°C

**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.

## Electrical Characteristics

### Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V <sub>DD</sub>	3.3V Power Supply		3.0	3.3	3.6	V
I <sub>DD</sub>	Total current from V <sub>DD</sub> 3.3V supply	SEL = 0V or V <sub>DD</sub>		0.15	1	mA
V <sub>I/O-DIF</sub>	Differential Voltage (differential pins)				1.6	V <sub>ppd</sub>
V <sub>I/O-CM</sub>	Common Mode Voltage (differential pins)		0		0.8	v
T <sub>A</sub>	Operating temperature range		-40		85	°C

## DC Electrical Characteristics for Switching over Operating Range

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(1)</sup>	Max.	Units
V <sub>IH</sub> - SEL	Input HIGH Voltage, SEL Input		2		3.6	V
V <sub>IL</sub> - SEL	Input LOW Voltage, SEL Input		0		0.8	
V <sub>IK</sub>	Clamp Diode Voltage	V <sub>DD</sub> = Max., I <sub>IN</sub> = -18mA		-0.7	-1.2	
I <sub>IH</sub>	Input HIGH Current, SEL	V <sub>DD</sub> = Max., V <sub>IN</sub> = V <sub>DD</sub>			±5	μA
I <sub>IL</sub>	Input LOW Current, SEL	V <sub>DD</sub> = Max., V <sub>IN</sub> = 0V			±5	
I <sub>IN</sub> - SEL	Input Leakage Current, SEL Input	V <sub>IN</sub> = V <sub>IH</sub> - SEL Max or V <sub>IL</sub> - SEL Min	-10		+10	μA
I <sub>IH</sub>	Input HIGH Current, A <sub>X</sub> , B <sub>X</sub> , C <sub>X</sub>	V <sub>DD</sub> = Max., V <sub>IN</sub> = 1.5V	-10		+10	μA
I <sub>IL</sub>	Input LOW Current, A <sub>X</sub> , B <sub>X</sub> , C <sub>X</sub>	V <sub>DD</sub> = Max., V <sub>IN</sub> = 0V	-10		+10	
I <sub>IOZH</sub>	HighZ HIGH Current, B <sub>X</sub> , C <sub>X</sub>	V <sub>DD</sub> = Max., V <sub>IN</sub> = 1.5V	-10		+10	μA
I <sub>IOZL</sub>	HighZ LOW Current, B <sub>X</sub> , C <sub>X</sub>	V <sub>DD</sub> = Max., V <sub>IN</sub> = 0V	-10		+10	μA
C <sub>I/O-ON</sub>	ON state I/O capacitance			1.5		pF
R <sub>ON</sub>	ON state resistance	V <sub>DD</sub> = 3.3V, I <sub>O</sub> = 8mA, V <sub>IN</sub> = 0.8V		5		Ω

**Note:**

1. Typical values are at V<sub>DD</sub> = 3.3V, T<sub>A</sub> = 25°C ambient and maximum loading.

## Switching Characteristics

Parameters	Description	Test Conditions	Min.	Typ.	Max.	Units
tPZH, tPZL	Line Enable Time - SEL to A <sub>N</sub> , B <sub>N</sub> , C <sub>N</sub>		2	20	25	ns
tPHZ, tPLZ	Line Disable Time - SEL to A <sub>N</sub> , B <sub>N</sub> , C <sub>N</sub>		0.5	5	25	
t <sub>b-b</sub>	Bit-to-bit skew within the same differential pair			5	10	ps
t <sub>ch-ch</sub>	Channel-to-channel skew				20	ps

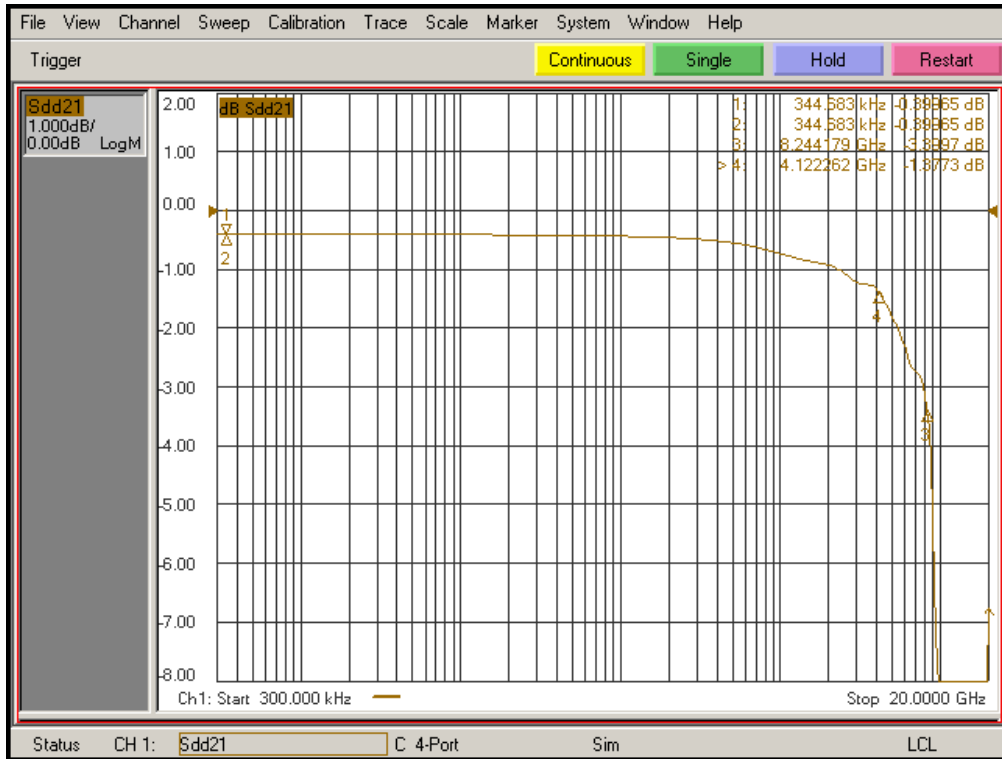
## Dynamic Electrical Characteristics

Parameter	Description	Test Conditions	Min.	Typ. <sup>(1)</sup>	Max.	Units
DDIL	Differential Insertion Loss (V <sub>IN</sub> = -10dBm, DC = 0V)	f= 50MHz - 1.25GHz f=1.25GHz - 2.5GHz f=2.5GHz - 4GHz f=5GHz		-0.8 -1.0 -1.3 -1.8	-1 -1.2 -1.6 -2.2	dB
DDIL <sub>OFF</sub>	Differential Off Isolation	f= 50MHz - 1.25GHz f=1.25GHz - 2.5GHz f=2.5GHz - 4GHz f=5GHz	-26.3 -21.4 -17.6 -16	-32.9 -26.7 -22 -20		dB
DDRL	Differential Return Loss	f= 50MHz - 1.25GHz f=1.25GHz - 2.5GHz f=2.5GHz - 4GHz f=5GHz	-20 -18.4 -16.8 -9.6	-25 -23 -21 -12		dB
DDNEXT	Near End Crosstalk	f= 50MHz - 1.25GHz f=1.25GHz - 2.5GHz f=2.5GHz - 4GHz f=5GHz	-34.1 -30.5 -28.1 -27.2	-42.6 -38.1 -35.1 -34		dB
V <sub>IF</sub>	Max Signal Frequency Range	Insertion loss 1.5dB, V <sub>IN</sub> =0.623V <sub>pp</sub> , DC=0V		4.0		GHz
		Insertion loss 1.5dB, V <sub>IN</sub> =0.623V <sub>pp</sub> , DC=0.9V		4.0		
		Insertion loss 3dB, V <sub>IN</sub> =0.623V <sub>pp</sub> , DC=0V		8.0		
		Insertion loss 3dB, V <sub>IN</sub> =0.623V <sub>pp</sub> , DC=0.9V		8.0		
BW	-3dB Bandwidth			8.2		GHz

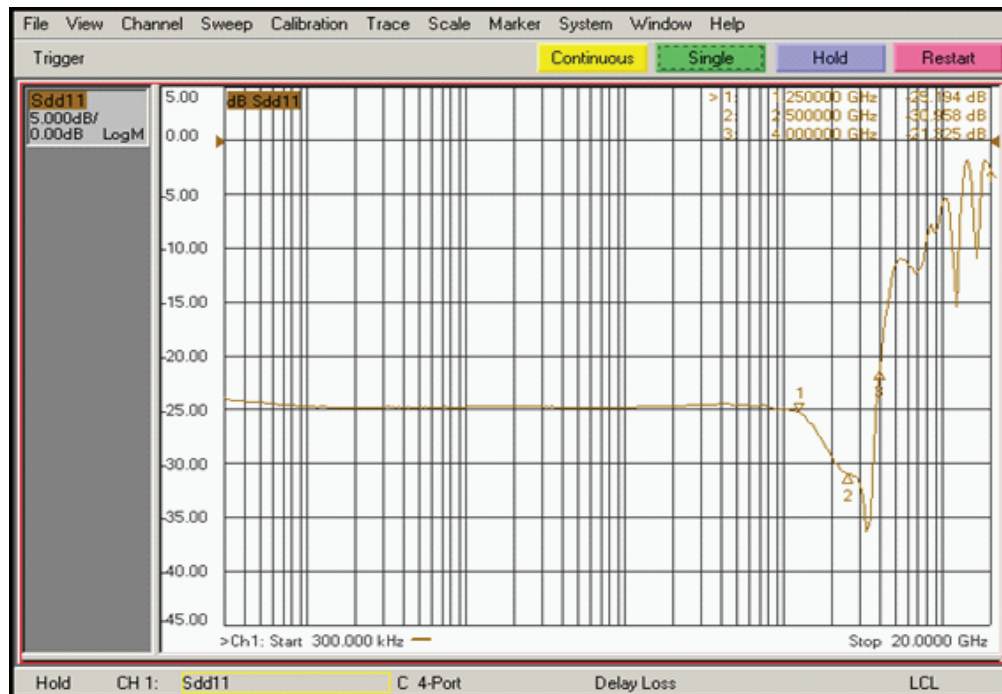
### Notes:

1. Guaranteed by design. Typical values are at V<sub>DD</sub> = 3.3V, T<sub>A</sub> = 25°C ambient and maximum loading.

**PI3PCIE3412A**

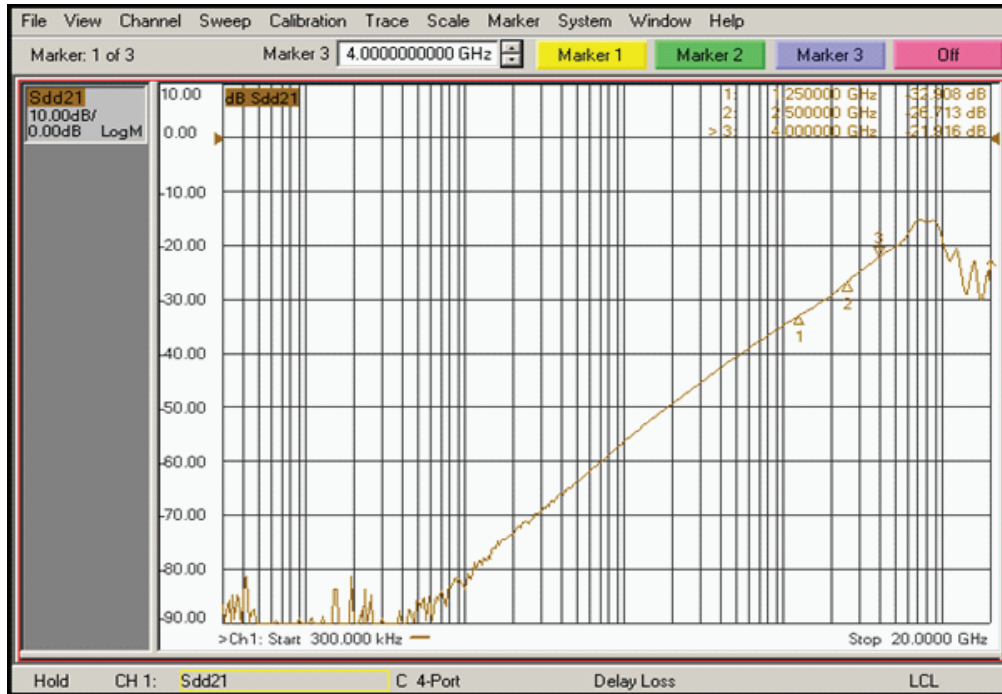


**Differential Insertion Loss**

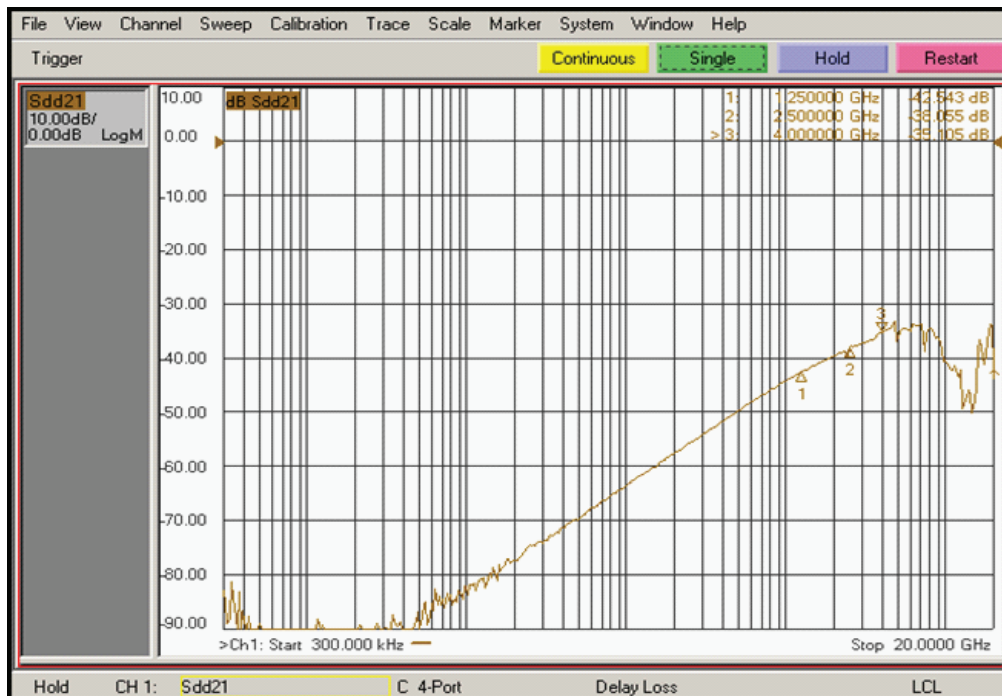


**Differential Return Loss**

**PI3PCIE3412A**

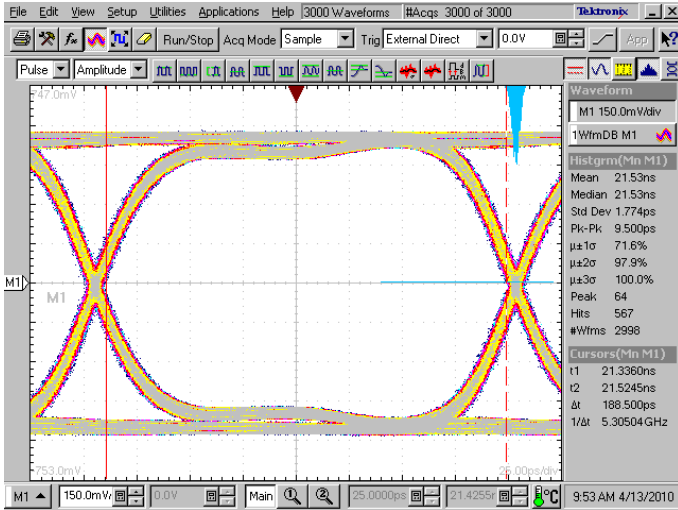


**Differential Off Isolation**

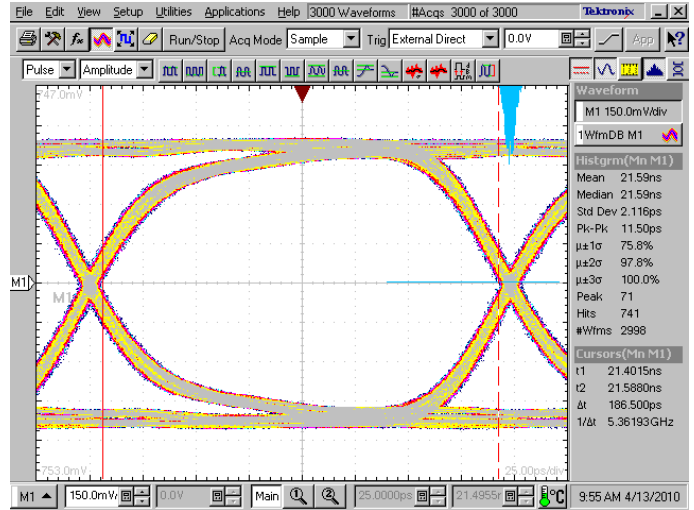


**Differential Crosstalk**

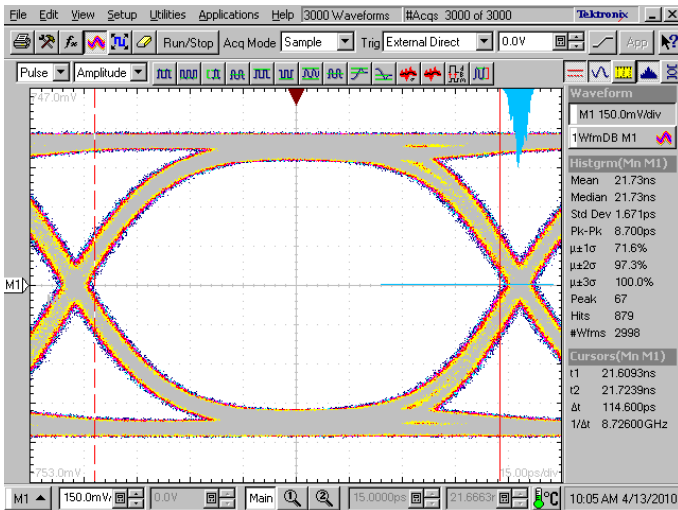
**PI3PCIE3412A**



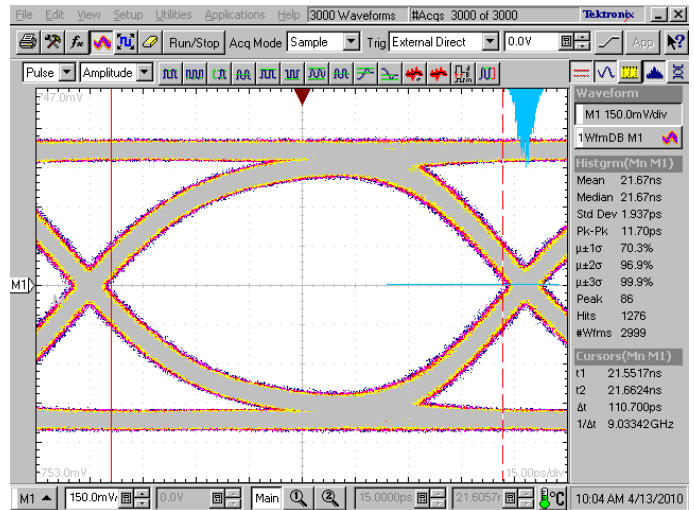
5.0 Gbps RX signal eye without PI3PCIE3412A



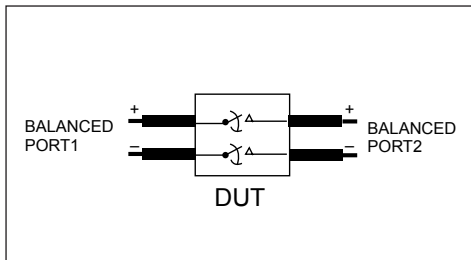
5.0 Gbps RX signal eye with PI3PCIE3412A



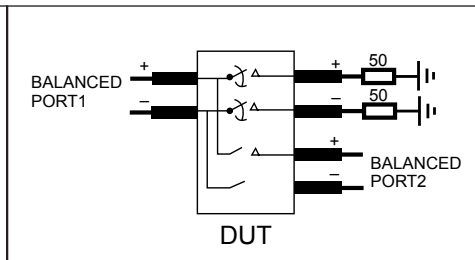
8.0 Gbps RX signal eye without PI3PCIE3412A



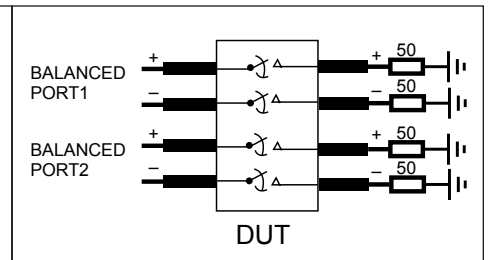
8.0 Gbps RX signal eye with PI3PCIE3412A



Diff. Insertion Loss and Return Test Circuit

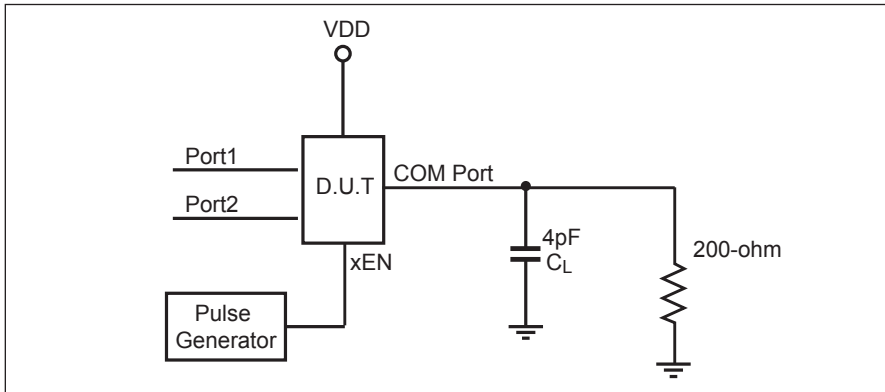


Diff. Off Isolation Test Circuit



Diff. Near End Xtalk Test Circuit

**Test Circuit for Electrical Characteristics<sup>(1-5)</sup>**



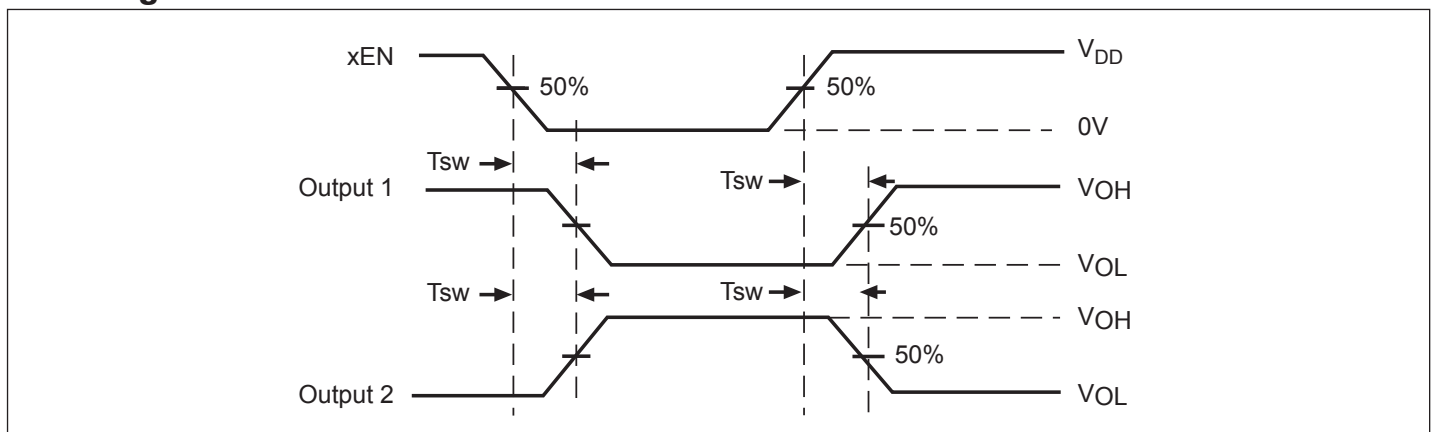
**Notes:**

1.  $C_L$  = Load capacitance: includes jig and probe capacitance.
2.  $R_T$  = Termination resistance: should be equal to  $Z_{OUT}$  of the Pulse Generator
3. Output 1 is for an output with internal conditions such that the output is low except when disabled by the output control.  
Output 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
4. All input impulses are supplied by generators having the following characteristics:  $PRR \leq \text{MHz}$ ,  $Z_O = 50\Omega$ ,  $t_R \leq 2.5\text{ns}$ ,  $t_F \leq 2.5\text{ns}$ .
5. The outputs are measured one at a time with one transition per measurement.

**Switch Positions**

Test	Switch
$t_{PLZ}$ , $t_{PZL}$	3.0V
$t_{PHZ}$ , $t_{PZH}$	GND
Prop Delay	Open

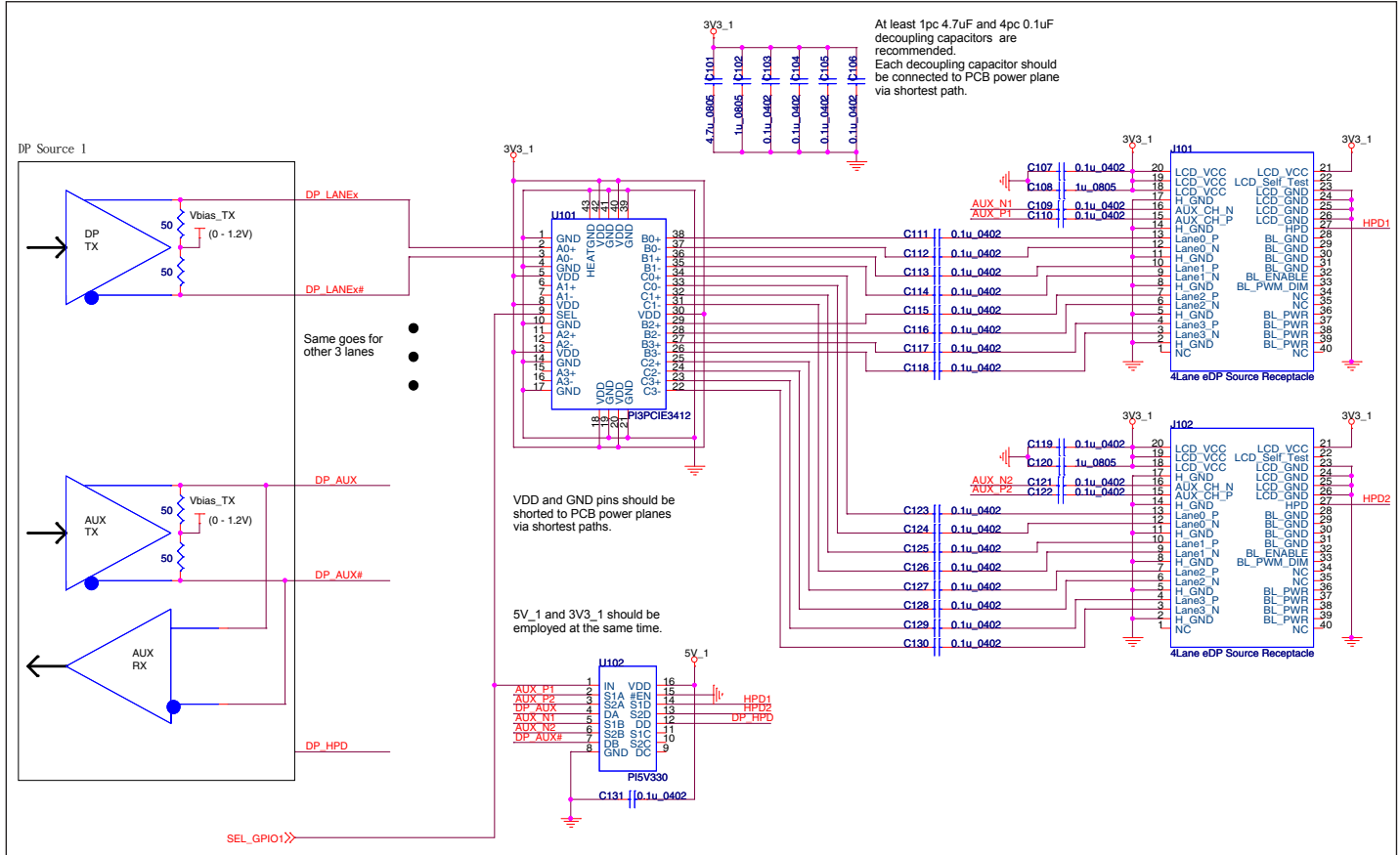
**Switching Waveforms**



**Voltage Waveforms Enable and Disable Times**

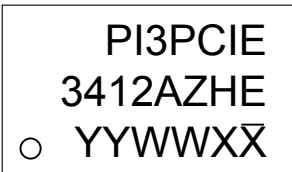
**PI3PCIE3412A**

**DP1.2 Application**



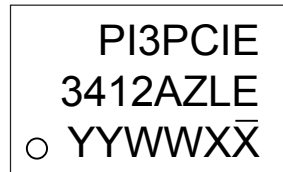
**Part Marking Information**

**ZH Package**



Y : Year  
W : Workweek  
1st X: Assembly Code  
2nd X: Fab Code

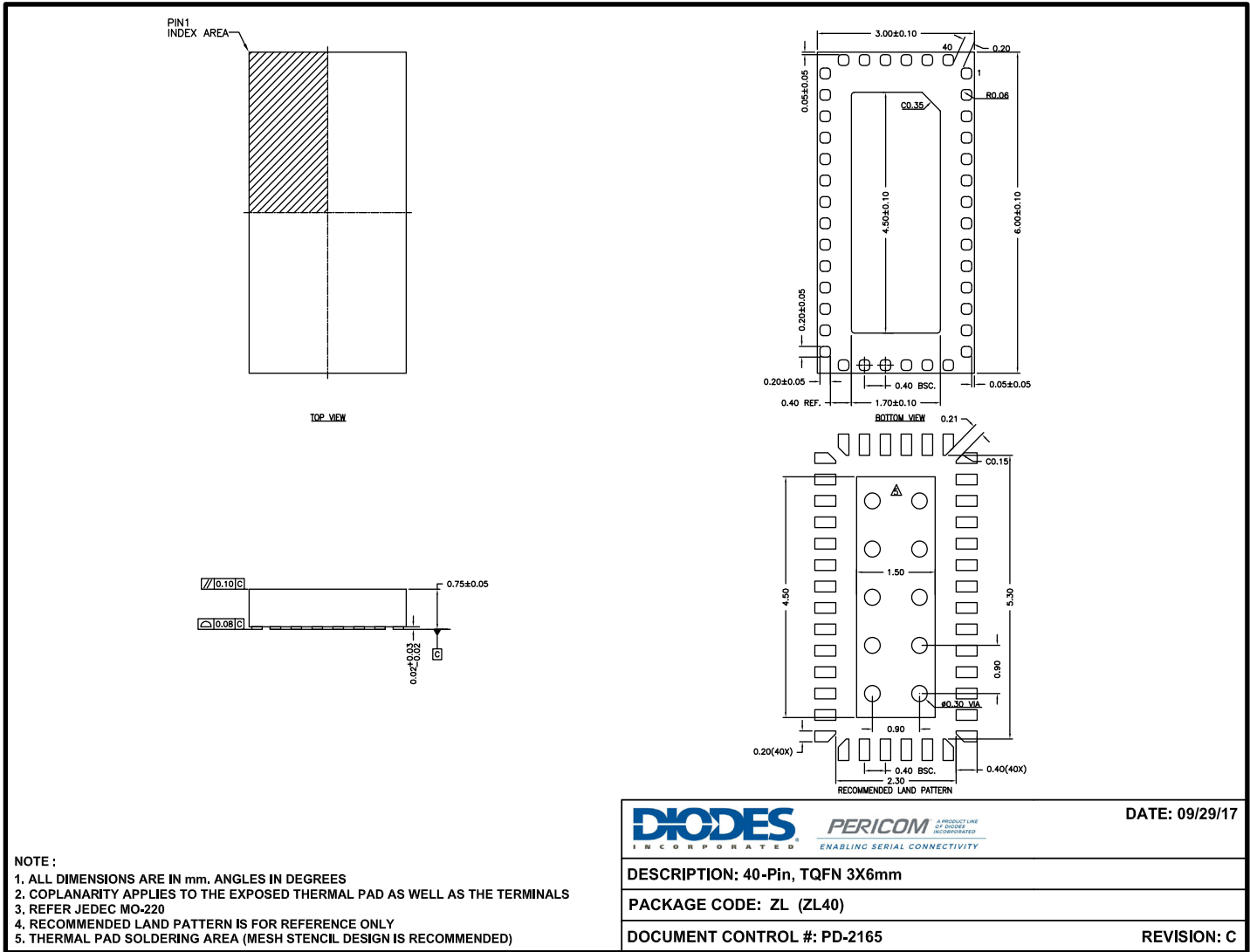
**ZL Package**



Y : Year  
W : Workweek  
1st X: Assembly Code  
2nd X: Fab Code

**PI3PCIE3412A**

**Packaging Mechanical : 40-TQFN (ZL)**

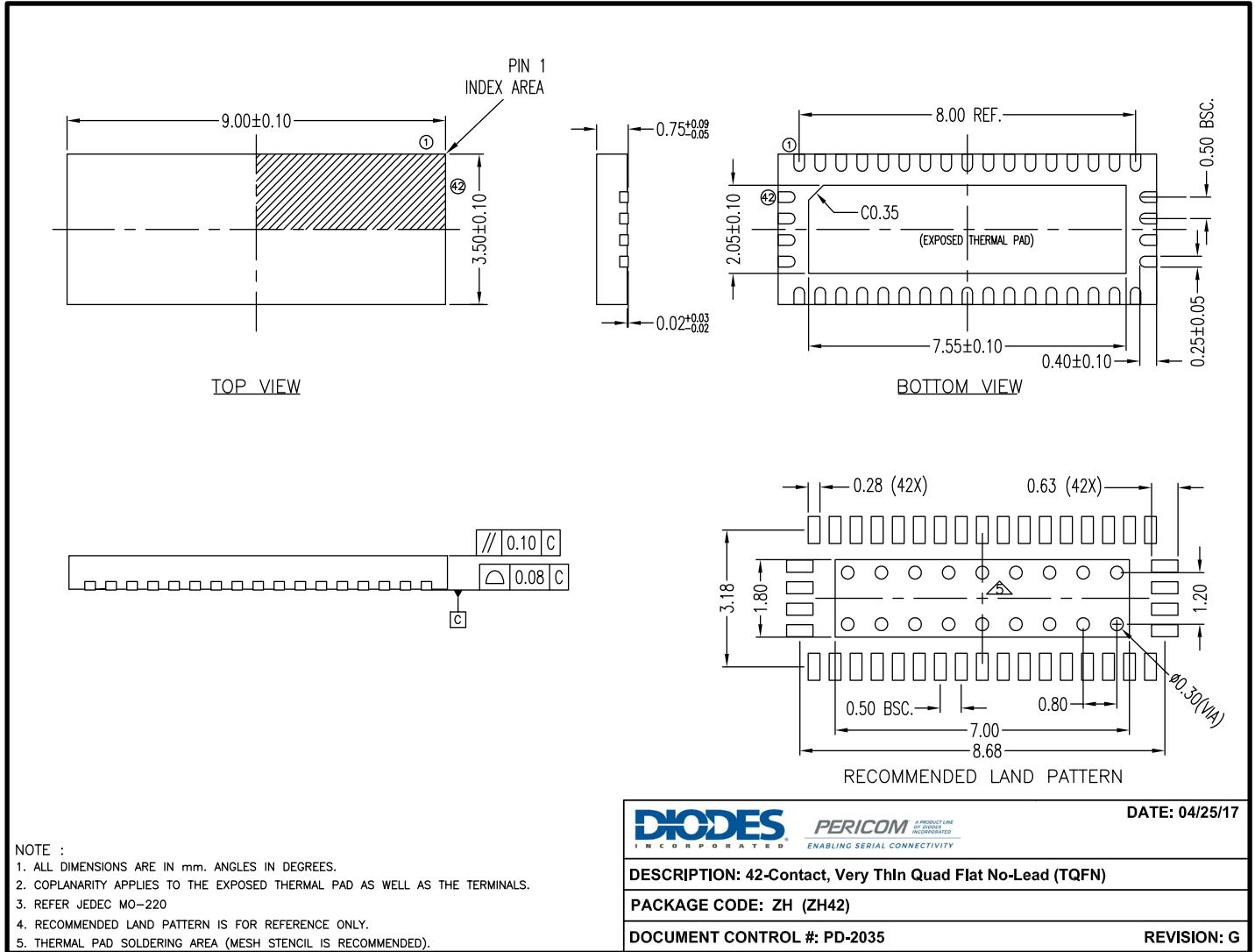


**NOTE:**

1. ALL DIMENSIONS ARE IN mm, ANGLES IN DEGREES
2. COPLANARITY APPLIES TO THE EXPOSED THERMAL PAD AS WELL AS THE TERMINALS
3. REFER JEDEC MO-220
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY
5. THERMAL PAD SOLDERING AREA (MESH STENCIL DESIGN IS RECOMMENDED)

**PI3PCIE3412A**

**Packaging Mechanical : 42-TQFN (ZH)**



17-0266

**For latest package info.**

please check: <http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/>

**Ordering Information**

Ordering Code	Package Code	Package Description
PI3PCIE3412AZLEX	ZL	40-pin, 3x6mm(TQFN)
PI3PCIE3412AZHEX	ZH	42-contact, Very Thin Quad Flat No-Lead (TQFN)

**Notes:**

- Thermal characteristics can be found on the company web site at [www.diodes.com/design/support/packaging/](http://www.diodes.com/design/support/packaging/)
- E = Pb-free and Green
- X suffix = Tape/Reel

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