

**3.3V, PCI Express® 3.0, 1-Lane, 2-Channel, 8Gbps, 2:1 Mux/DeMux Switch w/ Single Enable**

**Features**

- 2 Differential Channel, 2:1 Mux/DeMux
- PCI Express® 3.0 performance, 8.0Gbps
- Bi-directional operation
- 3dB Bandwidth: 8.1GHz
- Low Bit-to-Bit Skew, 10ps max
- Low channel-to-channel skew: 20ps max
- Low insertion loss: -1.7dB @4GHz (8.0Gbps)
- Low return loss: -13.5dB @4GHz (8.0Gbps)
- Low Crosstalk: -32dB@4GHz (8.0Gbps)
- Low Off Isolation: -21dB@4GHz (8.0Gbps)
- Supply Voltage: 3.3V ± 10%
- Industrial Temperature Range: -40°C to 85°C
- Low Current: 0.2mA typ.
- Packaging (Pb-free & Green):
  - - 20-contact TQFN (2.5 × 4.5mm)
  - - 18 contact, X2QFN(XUA18), 2x2mm

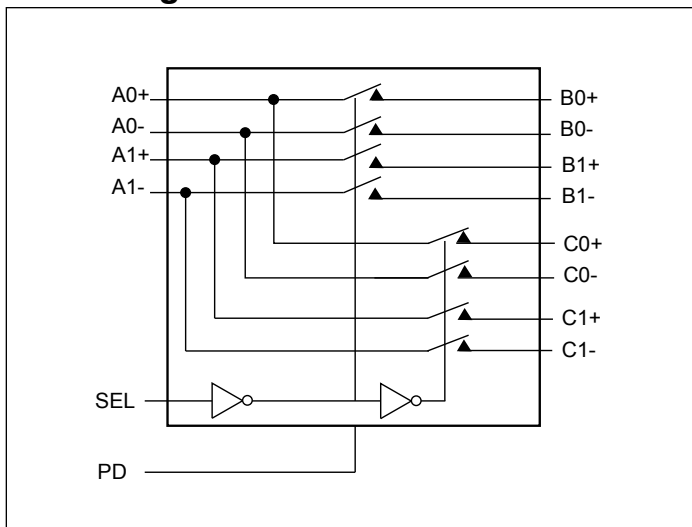
**Description**

The PI3PCIE3212 is a PCIe Gen3.0, 8Gbps, 4 to 2 differential, bi-directional channel multiplexer/demultiplexer switch. Due to its low bit-to-bit skew, high channel-to-channel noise isolation and bandwidth, this product is ideal for PCI Express® 3.0 signal switching at 8.0Gbps.

**Applications**

Switch a PCI Express 3.0 lane output between two PCI Express lane inputs. Applications include NBs, PCs, servers, and other embedded devices. Routing of PCI Express 3.0, DP1.2, USB3.0, SAS2.0, SATA3.0, XAUI, RXAUI signals with low signal attenuation.

**Block Diagram**

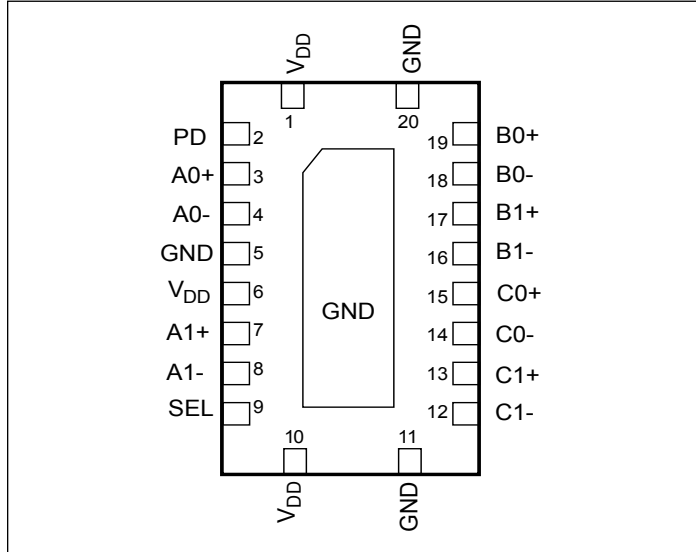


**Truth Table**

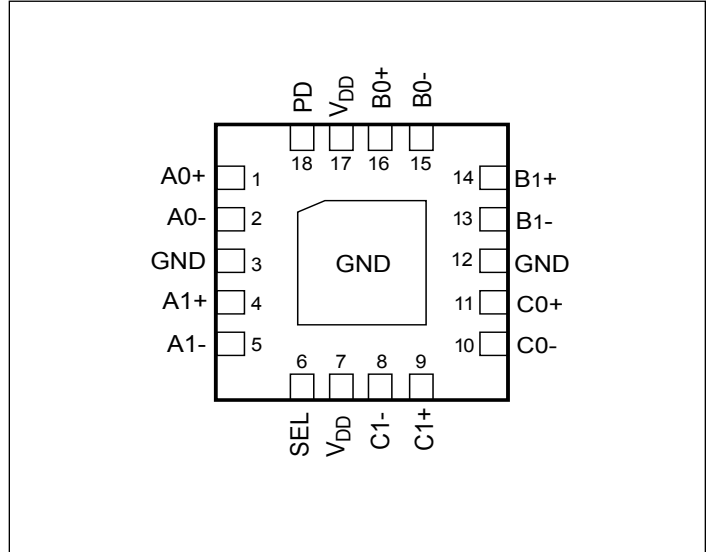
| Function                      | SEL | PD |
|-------------------------------|-----|----|
| A to B                        | L   | L  |
| A to C                        | H   | L  |
| All ports Hi-Z, IC Power Down | X   | H  |

**Pin Configuration (Top-side view)**

20-contact TQFN



18-contact X2QFN



**Pin Description**

| 20-TQFN Pin # | 18-X2QFN Pin #    | Pin Name        | I/O | Description   |
|---------------|-------------------|-----------------|-----|---|
| 3             | 1                 | A0+             | I/O | Signal I/O, Channel 0, Port A                               |
| 4             | 2                 | A0-             |     |   |
| 7             | 4                 | A1+             | I/O | Signal I/O, Channel 1, Port A                               |
| 8             | 5                 | A1-             |     |   |
| 19            | 16                | B0+             | I/O | Signal I/O, Channel 0, Port B                               |
| 18            | 15                | B0-             |     |   |
| 17            | 14                | B1+             | I/O | Signal I/O, Channel 1, Port B                               |
| 16            | 13                | B1-             |     |   |
| 15            | 11                | C0+             | I/O | Signal I/O, Channel 0, Port C                               |
| 14            | 10                | C0-             |     |   |
| 13            | 9                 | C1+             | I/O | Signal I/O, Channel 1, Port C                               |
| 12            | 8                 | C1-             |     |   |
| 9             | 6                 | SEL             | I   | Operation mode Select<br>(when SEL=0: A→B, when SEL=1: A→C) |
| 2             | 18                | PD              | I   | PD = 1, Power down is enabled. Please see Truth Table.      |
| 1, 6, 10      | 7, 17             | V <sub>DD</sub> | Pwr | 3.3V ±10% Positive Supply Voltage                           |
| 5, 11, 20     | 3, 12, Center Pad | 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 +4.6V  |
| Channel DC Input Voltage .....           | -0.5V to 1.5V   |
| DC Output Current .....                  | 120mA           |
| Power Dissipation .....                  | 0.5W            |
| SEL/PD DC Input Voltage .....            | -0.5V to 4.6V   |
| 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 = OV or V <sub>DD</sub> |      | 0.2  | 1    | mA               |
| I <sub>DD_PD</sub>   | Power down current                             | PD = 1                      |      | 20   | 40   | μA               |
| 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, PD | Input HIGH Voltage, SEL, PD Input                                    |   | 2    |                     | 3.6  | V     |
| V <sub>IL</sub> - SEL, PD | Input LOW Voltage, SEL, PD 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, PD  | V <sub>DD</sub> = Max., V <sub>IN</sub> = V <sub>DD</sub> |      |                     | ±5   | μA    |
| I <sub>IL</sub>           | Input LOW Current, SEL, PD   | V <sub>DD</sub> = Max., V <sub>IN</sub> = 0V              |      |                     | ±5   |       |
| 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>OZH</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>OZL</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    |

**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>  |                 |      | 25   | 30   | ns    |
| tPHZ, tPLZ         | Line Disable Time - SEL to A <sub>N</sub> , B <sub>N</sub> , C <sub>N</sub> |                 |      | 5    | 25   |       |
| tPLH               | Propagation Delay, LOW to HIGH  |                 | 17   |      | 36   | ps    |
| tPHL               | Propagation Delay, HIGH to LOW  |                 | 21   |      | 39   | ps    |
| 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    |

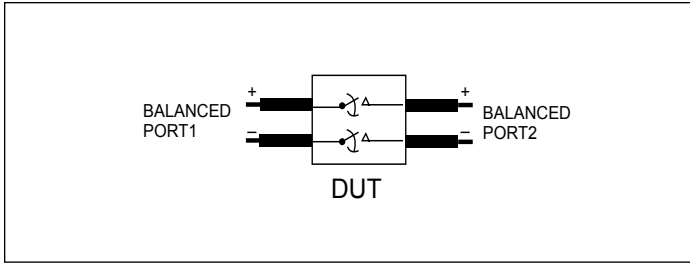
### Dynamic Electrical Characteristics

| Parameter                          | Description  | Test Conditions   | Min. | Typ. <sup>1</sup>                    | Max. | Units |
|------------------------------------|--|---|------|--------------------------------------|------|-------|
| DDIL <sup>2,3</sup>                | Differential Insertion Loss<br>(V <sub>IN</sub> = -10dBm, DC = 0V) | f = 100MHz<br>f = 100MHz-1.25GHz<br>f = 1.25GHz-2.5GHz<br>f = 2.5GHz-4GHz<br>f = 5GHz |      | -0.4<br>-0.6<br>-1.0<br>-1.7<br>-2.1 |      | dB    |
| DDIL <sub>OFF</sub> <sup>2,3</sup> | Differential Off Isolation   | f = 100MHz<br>f = 100MHz-1.25GHz<br>f = 1.25GHz-2.5GHz<br>f = 2.5GHz-4GHz             |      | -59<br>-37<br>-27<br>-21             |      | dB    |
| DDRL <sup>2</sup>                  | Differential Return Loss   | f = 100MHz<br>f = 100MHz-1.25GHz<br>f = 1.25GHz-2.5GHz<br>f = 2.5GHz-4GHz             |      | -27<br>-23.3<br>-23.3<br>-13.5       |      | dB    |
| DDNEXT <sup>2,3</sup>              | Near End Crosstalk   | f = 100MHz<br>f = 100MHz-1.25GHz<br>f = 1.25GHz-2.5GHz<br>f = 2.5GHz-4GHz             |      | -57<br>-38<br>-33<br>-32             |      | dB    |
| BW                                 | -3dB Bandwidth   |   |      | 8.1                                  |      | GHz   |

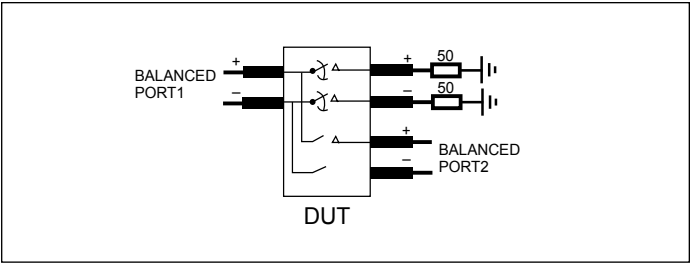
#### Notes:

- Guaranteed by design. Typical values are at V<sub>DD</sub> = 3.3V, T<sub>A</sub> = 25°C ambient and maximum loading.
- S parameters are measured with our evaluation board made with Rogers (R04350) material. Trace width is 30 mil, length 540 mil, trace impedance is 50 Ohm (+/-5%) and total insertion loss of the trace is 0.5dB@4GHz.
- Measurement done with fixture deembedding.

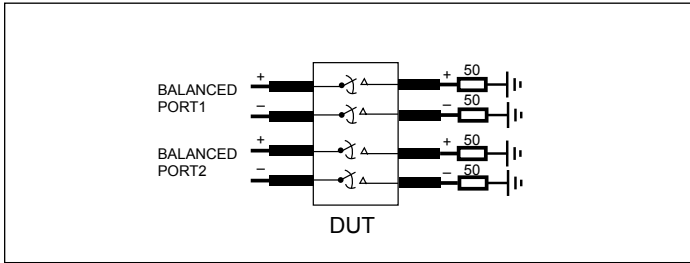
**PI3PCIE3212**



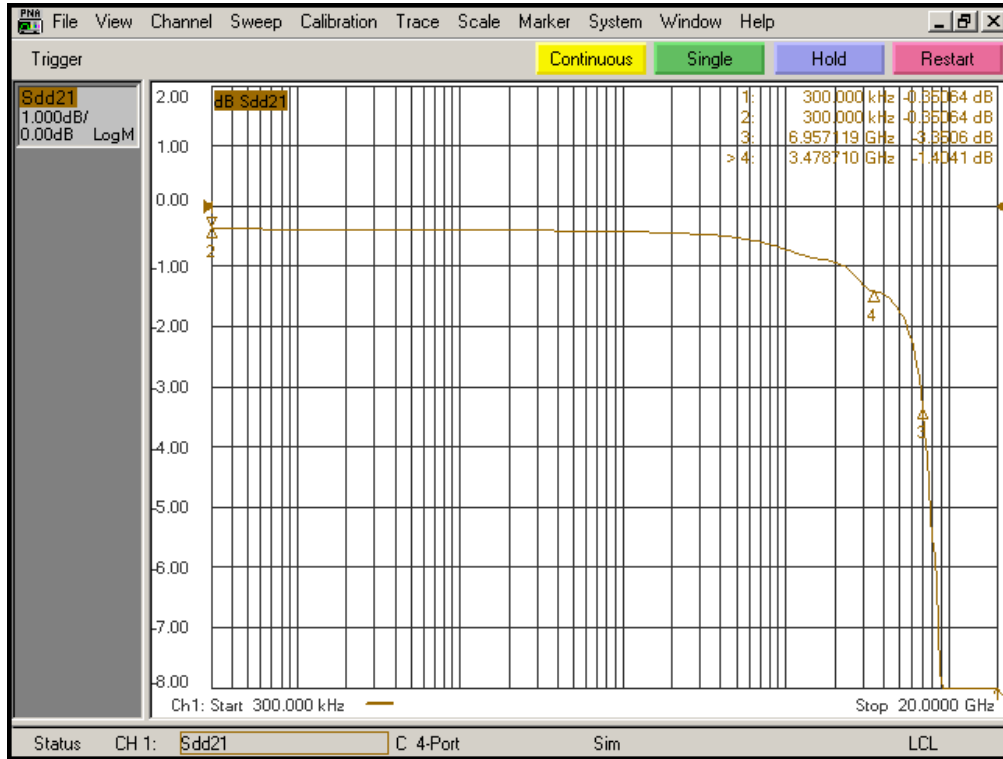
**Diff. Insertion Loss and Return Test Circuit**



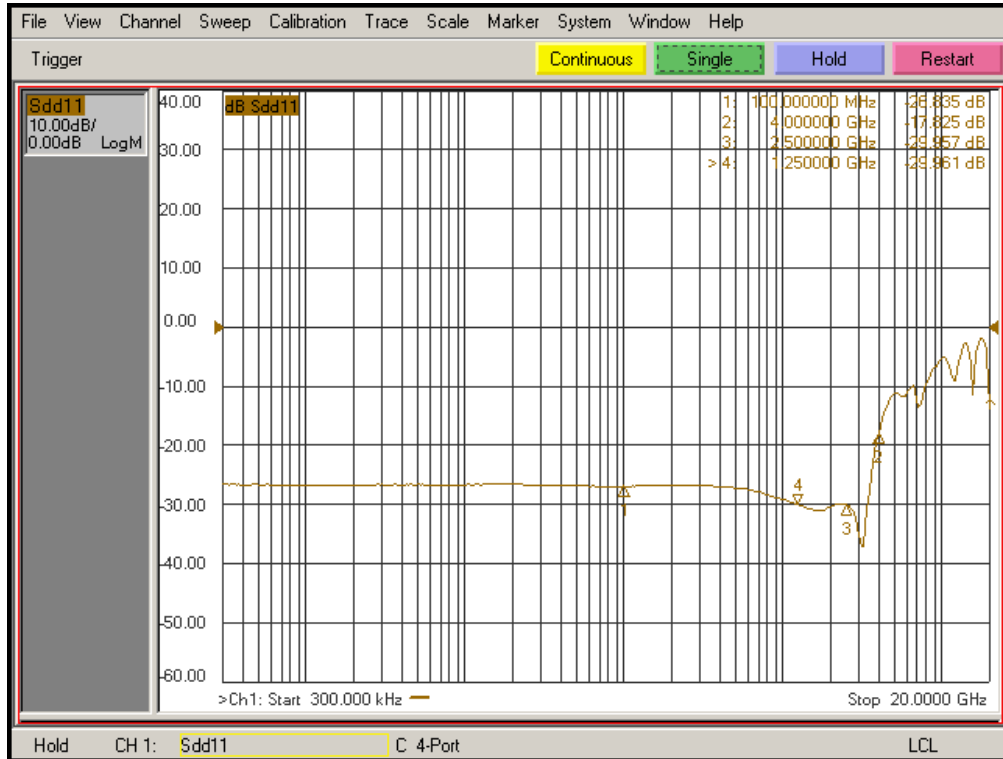
**Diff. Off Isolation Test Circuit**



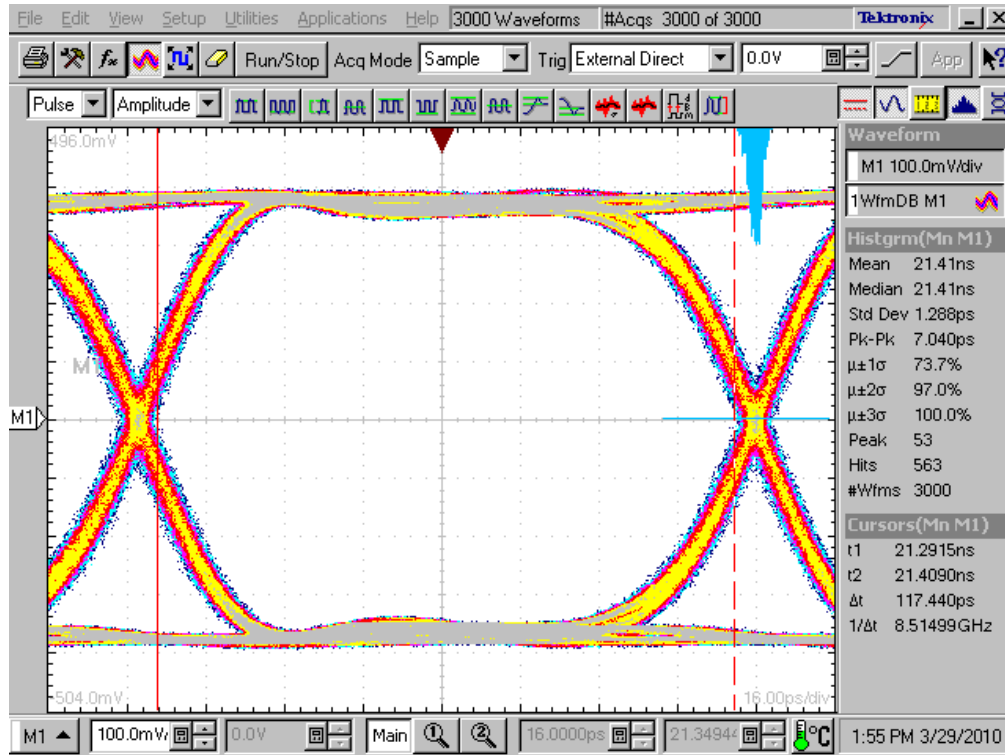
**Diff. Near End Xtalk Test Circuit**



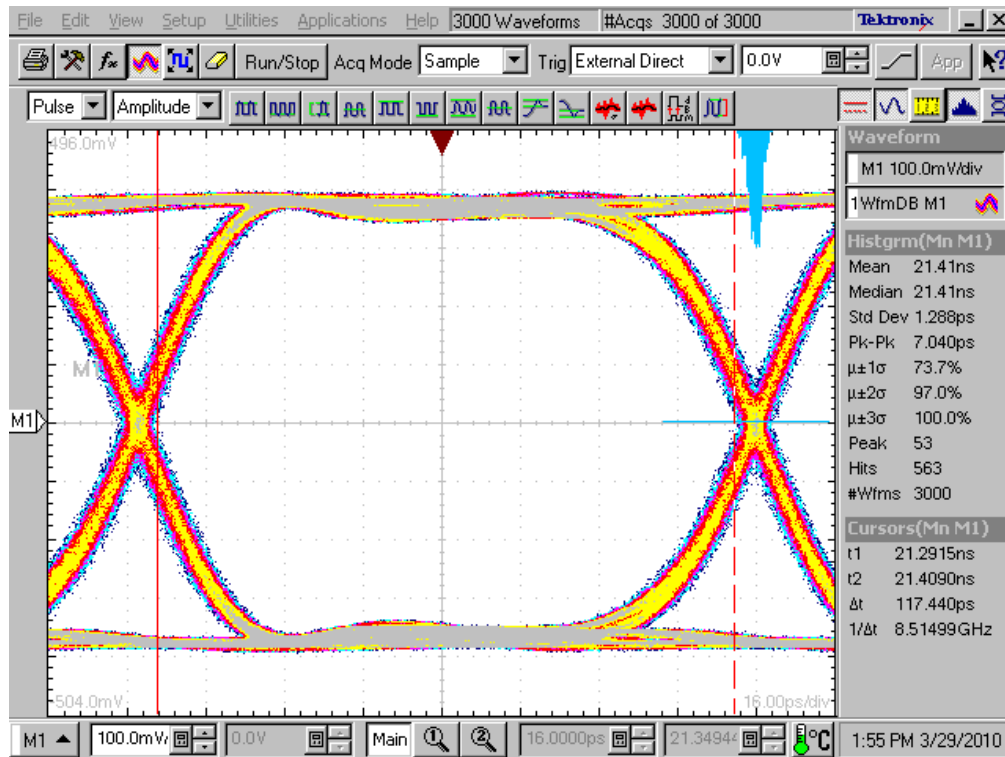
**Differential Insertion Loss**



**Differential Return Loss**

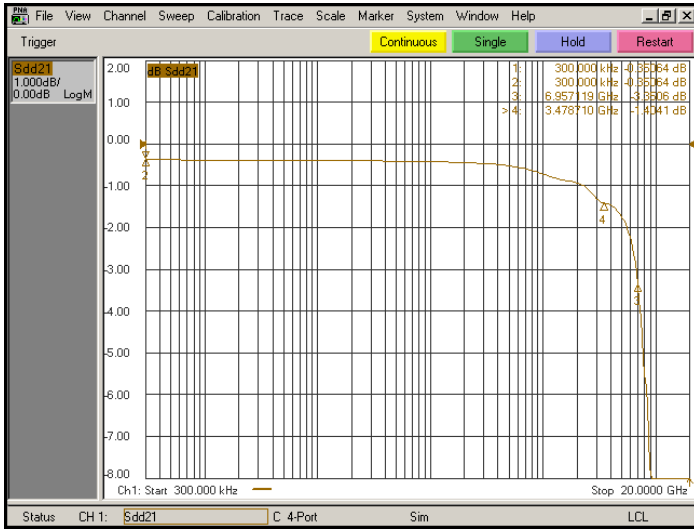


**Differential Off Isolation**

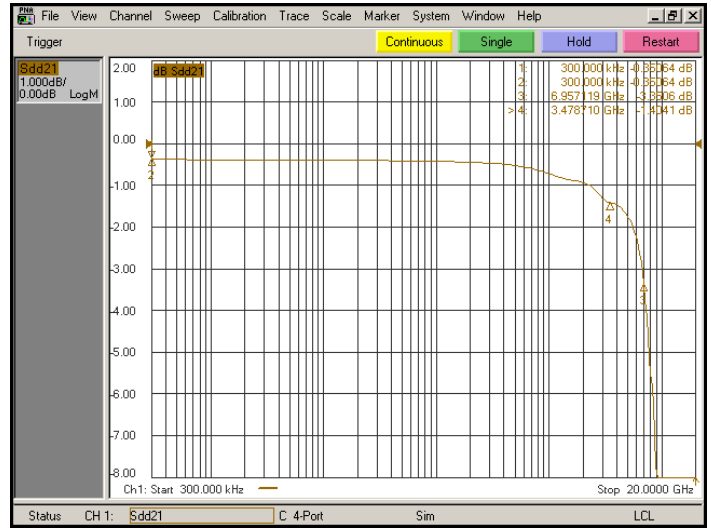


**Differential Crosstalk**

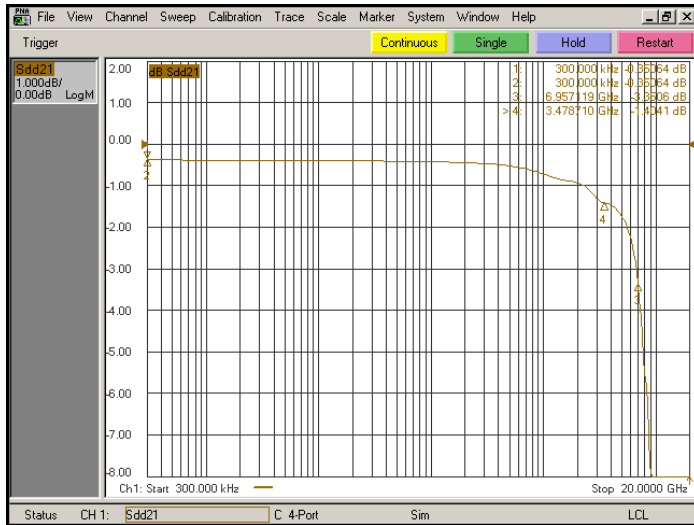
**PI3PCIE3212**



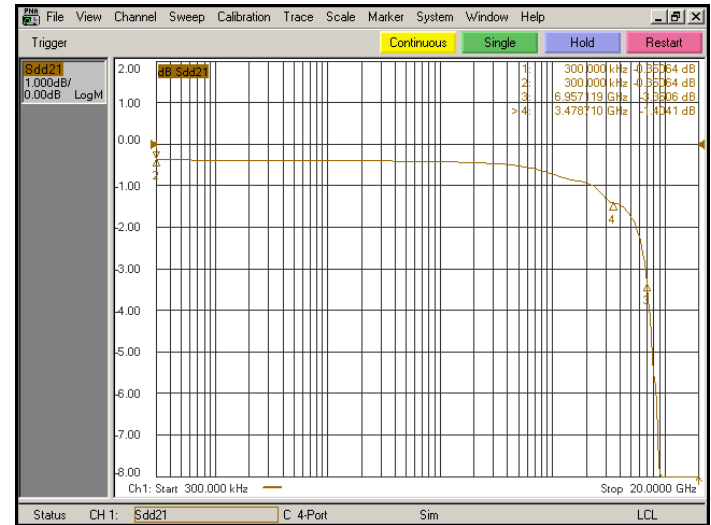
**5.0 Gbps RX signal eye without PI3PCIE3212**



**5.0 Gbps RX signal eye with PI3PCIE3212**



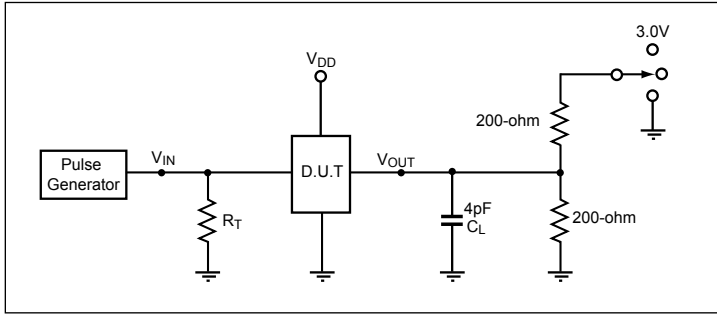
**8.0 Gbps RX signal eye without PI3PCIE3212**



**8.0 Gbps RX signal eye with PI3PCIE3212**



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



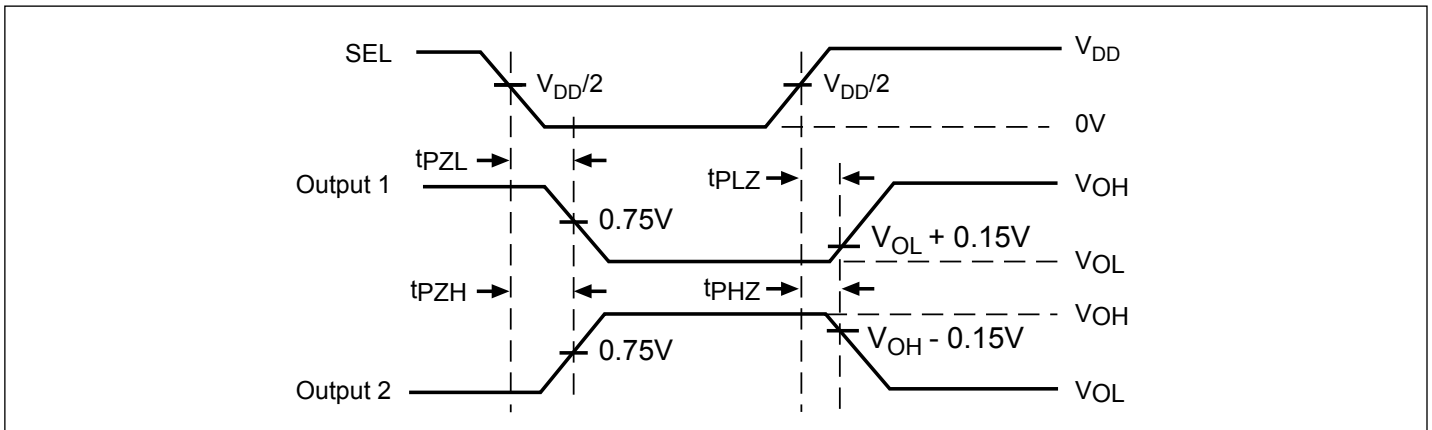
**Notes:**

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**

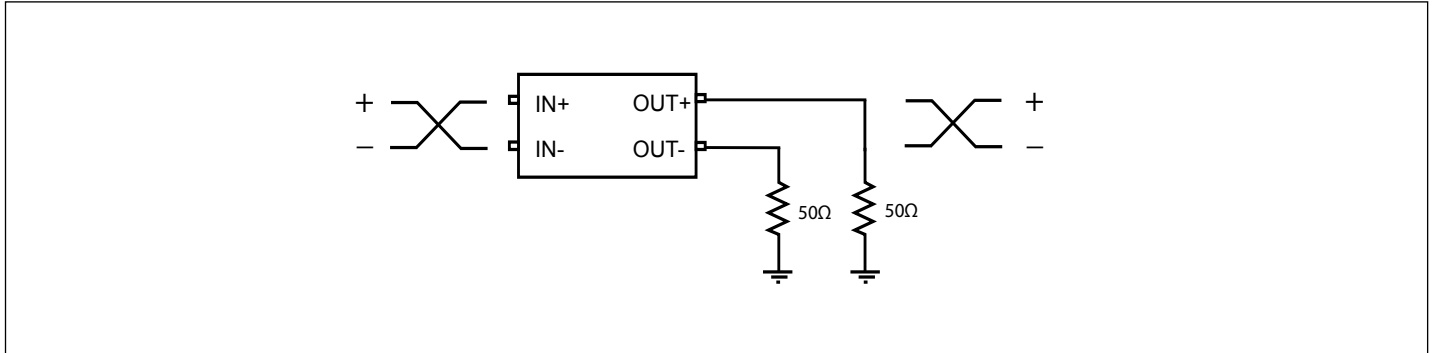
| Test                  | Switch |
|-----------------------|--------|
| $t_{PLZ}$ , $t_{PZL}$ | 3.0V   |
| $t_{PHZ}$ , $t_{PZH}$ | GND    |

**Switching Waveforms**

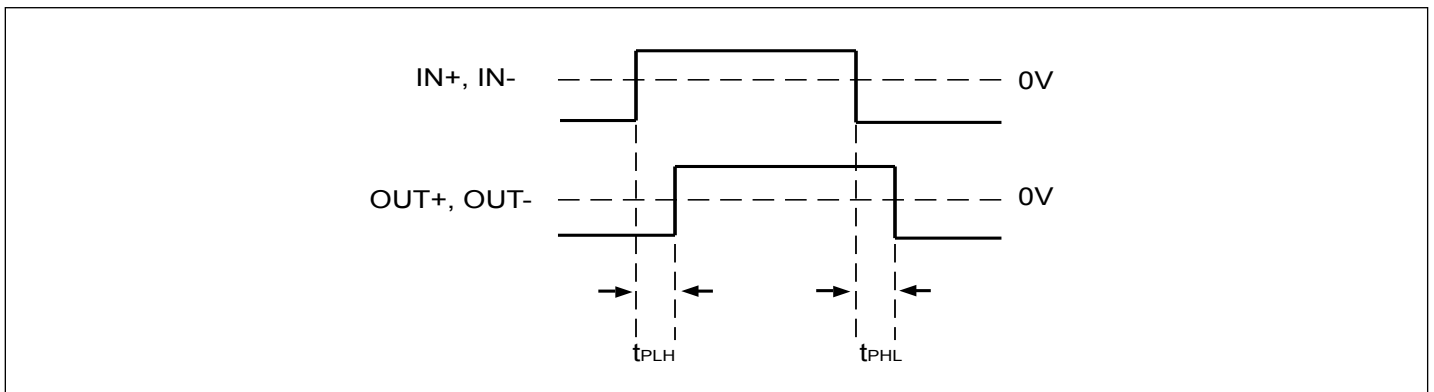


**Voltage Waveforms Enable and Disable Times**

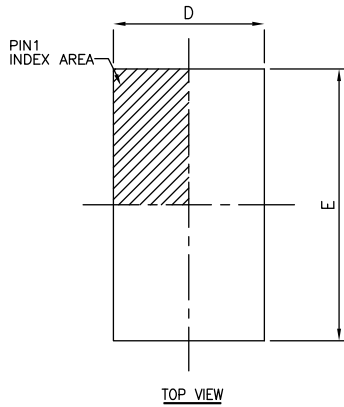
**Test Circuit for Propagation Delay**



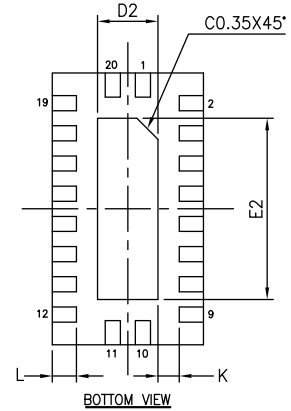
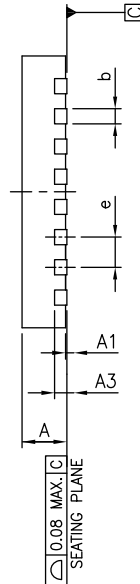
**Differential Input/Output Signal Waveform**



**Packaging Mechanical: 20-Contact TQFN (ZB)**

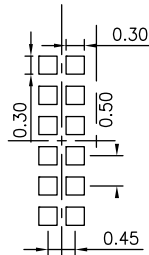


TOP VIEW

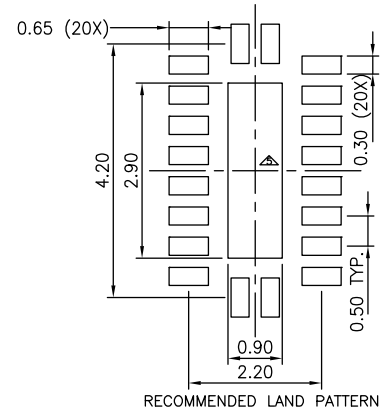


BOTTOM VIEW

| SYMBOLS | MIN.      | NOM. | MAX. |
|---------|-----------|------|------|
| A       | --        | --   | 1.00 |
| A1      | 0.00      | 0.02 | 0.05 |
| A3      | 0.20 REF. |      |      |
| b       | 0.18      | 0.25 | 0.30 |
| D       | 2.40      | 2.50 | 2.60 |
| E       | 4.40      | 4.50 | 4.60 |
| e       | 0.50 BSC  |      |      |
| L       | 0.30      | 0.40 | 0.50 |
| K       | 0.20      | --   | --   |
| D2      | 0.90      | 1.00 | 1.10 |
| E2      | 2.90      | 3.00 | 3.10 |



RECOMMENDED STENCIL DESIGN for EPAD  
(0.125mm THICK STENCIL)



RECOMMENDED LAND PATTERN

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-241
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.
5. THERMAL PAD SOLDERING AREA (MESH STENCIL DESIGN IS RECOMMENDED).

14-0265

**Packaging Mechanical: 18-Contact XUA (X2QFN)**

| SYMBOLS | MIN.       | NOM. | MAX. |
|---------|------------|------|------|
| A       | 0.30       | 0.35 | 0.40 |
| A1      | 0.00       | 0.02 | 0.05 |
| A3      | 0.127 REF. |      |      |
| b       | 0.15       | 0.20 | 0.25 |
| D       | 1.95       | 2.00 | 2.05 |
| E       | 1.95       | 2.00 | 2.05 |
| e       | 0.40 BSC   |      |      |
| L       | 0.15       | 0.25 | 0.35 |
| D2      | 0.95       | 1.00 | 1.05 |
| E2      | 0.95       | 1.00 | 1.05 |

**NOTE :**  
 1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.  
 2. REFER JEDEC MO-288  
 3. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.  
 MESH STENCIL DESIGN IS RECOMMENDED.

**PERICOM**  
Enabling Serial Connectivity

DATE: 03/31/14

DESCRIPTION: 18-Pin, X2QFN 2X2mm

PACKAGE CODE: XUA (XUA18)

DOCUMENT CONTROL #: PD-2184

REVISION: --

14-0039

**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 Type  |
|------------------|--------------|---|
| PI3PCIE3212ZBEX  | ZB           | 20-contact, Very Thin Quad Flat No-Lead (TQFN), Tape & Reel |
| PI3PCIE3212XUAEX | XUA          | 18-Pin, 2x2mm (X2QFN), Tape & Reel                          |

**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
- Adding an X suffix = Tape/Reel

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