

**3.3V High Speed 2 : 4 Differential Mux/Demux**

**Features**

- 2:4 Differential Multiplexer/Demultiplexer
- Bidirectional Operation
- Can be used in
  - Single 1:4 Configuration
  - Dual 1:2 Configuration
  - Fan out 1:2 Configuration
- High BW (1.2 GHz Typ)
- Low RON and CON:
  - 13 Ω RON Typ
  - 9 pF CON Typ
- ESD Performance (I/O Pins)
  - ±8-kV Contact Discharge (IEC61000-4-2)
  - 2-kV Human Body Model per JESD22-A114E (to GND)
- ESD Performance (All Pins)
  - 2-kV Human Body Model per JESD22-A114E
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. “Green” Device (Note 3)
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](https://www.diodes.com/quality/product-definitions/) or your local Diodes representative.  
<https://www.diodes.com/quality/product-definitions/>
- Package: 20-pin (TQFN) (3 x 3 mm, 0.4 mm pitch)

**Applications**

- Desktop/Notebooks Computers
- DisplayPort Auxiliary Channel Multiplexing
- DDC
- UART
- LSRX/LSTX for USB4/TBT
- USB 2.0 Multiplexing
- Netbooks/eBooks/Tablets

**Description**

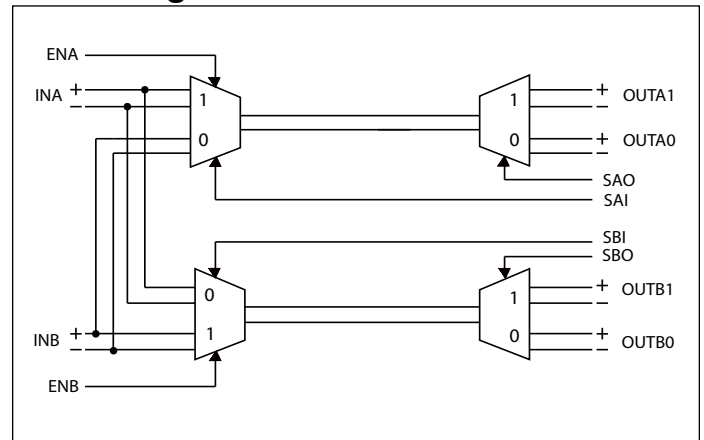
The PI3DBS3224 is a 2:4 bidirectional multiplexer for high-speed differential and single ended signal applications (up to 720 Mbps). The PI3DBS3224 can be used in a 1:4 or dual 1:2 multiplexer/demultiplexer configuration. The PI3DBS3224 offers a high BW of 1.2 GHz with channel RON of 13 Ω (Typ).

The PI3DBS3224 can also be used to fan out a differential or single ended signal pair to two ports simultaneously (fan-out configuration). The BW performance is lower in this configuration.

The PI3DBS3224 operates with a 3 to 3.6V power supply. It features ESD protection of up to ±8-kV contact discharge and 2-kV Human Body Model on its I/O pins.

The PI3DBS3224 provides fail-safe protection by isolating the I/O pins with high impedance when the power supply (V<sub>CC</sub>) is not present.

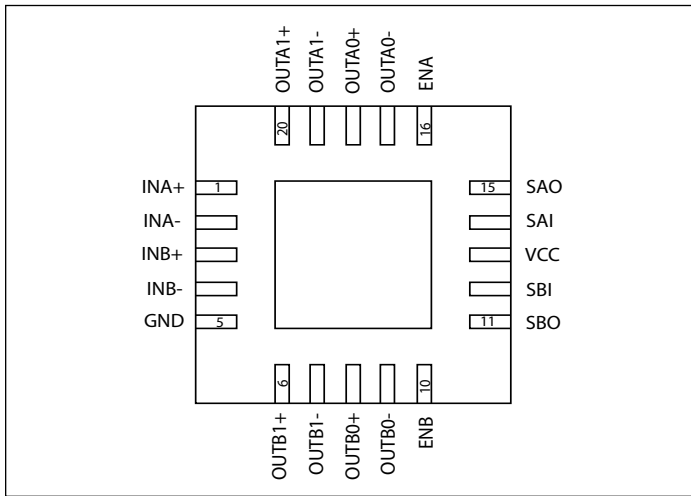
**Block Diagram**



**Notes:**

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, “Green” and Lead-free.
3. Halogen- and Antimony-free “Green” products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

**Pin Configuration**



**Pin Description**

Pin #	Pin Name	I/O Type	Description
14	SAI	Input	Control Input
15	SAO	Input	Control Input
12	SBI	Input	Control Input
11	SBO	Input	Control Input
16	ENA	Input	Enable
1	INA+	I/O	Input A
2	INA-	I/O	Input A
10	ENB	Input	Enable
3	INB+	I/O	Input B
4	INB-	I/O	Input B
9	OUTB0-	I/O	Output B0
8	OUTB0+	I/O	Output B0
7	OUTB1-	I/O	Output B1
6	OUTB1+	I/O	Output B1
5	GND	Ground	Ground
13	VCC	Power	Power Supply
17	OUTA0-	I/O	Output A0
18	OUTA0+	I/O	Output A0
19	OUTA1-	I/O	Output A1
20	OUTA1+	I/O	Output A1

**PI3DBS3224**

**Function Table**

ENA, ENB	OUTA0	OUTA1	OUTB0	OUTB1
00	Hi-Z	Hi-Z	Hi-Z	Hi-Z
01	Hi-Z	Hi-Z	-	-
10	-	-	Hi-Z	Hi-Z
11	-	-	-	-

SAI, SAO, SBI, SBO	OUTA0	OUTA1	OUTB0	OUTB1
0000	INB	-	INA	-
0001	INB	-	-	INA
0010	INB	-	INB	-
0011	INB	-	-	INB
0100	-	INB	INA	-
0101	-	INB	-	INA
0110	-	INB	INB	-
0111	-	INB	-	INB
1000	INA	-	INA	-
1001	INA	-	-	INA
1010	INA	-	INB	-
1011	INA	-	-	INB
1100	-	INA	INA	-
1101	-	INA	-	INA
1110	-	INA	INB	-
1111	-	INA	-	INB

## Maximum Ratings

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

Storage Temperature.....	-65°C to+155°C
Supply Voltage to Ground Potential.....	-0.3V to+4.0V
DC Input Voltage .....	-0.3V to+4.3V
DC Output Current .....	120mA
Power Dissipation .....	0.5W

### 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.

## DC Electrical Characteristics over Operating Range

For Single 1:4 or Dual 1:2 configurations.  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $T_A = 25^{\circ}\text{C}$  (unless otherwise noted)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{IK}$	Digital input clamp voltage	$V_{CC} = 3.6\text{ V}$ , $I_I = -18\text{ mA}$	-1.2	-0.9		V
$I_{IN}$	Digital input leakage current	$V_{CC} = 3.6\text{ V}$ , $V_{IN} = 0\text{ to }3.6\text{ V}$			±2	μA
$I_{OZ}^{(3)}$		$V_{CC} = 3.6\text{ V}$ , $V_O = 0\text{ V to }3.6\text{ V}$ , $V_I = 0\text{ V}$ , Switch OFF			±2	μA
$I_{OFF}$	Power off leakage current	$V_{CC} = 0\text{ V}$ , $V_{IN} = V_{CC}$ or GND, $V_{IO} = 0\text{ V to }3.6\text{ V}$			±8	μA
$I_{CC}$	Supply current	$V_{CC} = 3.6\text{ V}$ , $I_{IO} = 0$ , Switch ON or OFF		70	130	μA
$C_{IN}$	Digital input capacitance	$V_{CC} = 3.3\text{ V}$ , $V_{IN} = V_{CC}$ or GND		3	5	pF
$C_{I/O(OFF)}$	OFF capacitance	$V_{CC} = 3.3\text{ V}$ , $V_{IO} = 3.3\text{V}$ or 0, $f = 10\text{MHz}$ , Switch OFF		6	7	pF
$C_{I/O(ON)}$	ON capacitance	$V_{CC} = 3.3\text{ V}$ , $V_{IO} = 3.3\text{V}$ or 0, $f = 10\text{MHz}$ , Switch ON		9	10	pF
$r_{on}$	ON state resistance	$V_{CC} = 3.6\text{ V}$ , $V_I = V_{CC}$ , $I_O = -30\text{ mA}$		13	19	Ω
		$V_{CC} = 3.3\text{ V}$ , $V_I = 0.5\text{ V}$ , $I_O = -30\text{ mA}$		10		Ω
$\Delta r_{on}$	ON state resistance match between channel	$V_{CC} = 3\text{ V}$ , $V_I = 0\text{ to }V_{CC}$ , $I_O = -30\text{ mA}$		2	2.5	Ω
$r_{on(Flat)}$	ON state resistance flatness	$V_{CC} = 3\text{ V}$ , $V_I = 1.5\text{ V}$ and $V_{CC}$ , $I_O = -30\text{ mA}$		4	6	Ω

### Notes:

1.  $V_{IN}$  and  $I_{IN}$  refer to control inputs.  $V_I$ ,  $V_O$ ,  $I_I$  and  $I_O$  refer to data pins.
2. All typical values are at  $V_{CC} = 3.3\text{V}$  (unless otherwise noted),  $T_A = 25^{\circ}\text{C}$ .
3. For I/O ports, the parameter  $I_{OZ}$  includes the input leakage current.

### Dynamic Characteristics

For Single 1:4 or Dual 1:2 configurations.  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{V} \pm 10\%$  and  $T_A = 25^{\circ}\text{C}$  (unless otherwise noted)

Symbol	Parameter	Test Condition	Typ.	Unit
BW	Bandwidth	$R_L = 50 \Omega$ , Switch ON	1.2	GHz
$O_{ISO}$	OFF Isolation	$R_L = 50 \Omega$ , $f = 250 \text{ MHz}$	-30	dB
$X_{TALK}$	Crosstalk	$R_L = 50 \Omega$ , $f = 250 \text{ MHz}$	-35	dB

### Switching Characteristics

For Single 1:4 or Dual 1:2 configurations. Over operating range,  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$ ,  $GND = 0\text{V}$  (unless otherwise noted)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$t_{pd}^{(1)}$		$R_L = 50 \Omega$ , $C_L = 2 \text{ pF}$		50		ps
$t_{ON}$	SAI/SAO/SBI/SBO to OUTAx/OUTBx	$R_L = 50 \Omega$ , $C_L = 2 \text{ pF}$		40	100	ns
$t_{OFF}$	SAI/SAO/SBI/SBO to OUTAx/OUTBx	$R_L = 50 \Omega$ , $C_L = 2 \text{ pF}$		20	30	ns
$t_{sk(o)}^{(2)}$		$R_L = 50 \Omega$ , $C_L = 2 \text{ pF}$		40		ps
$t_{sk(p)}^{(3)}$		$R_L = 50 \Omega$ , $C_L = 2 \text{ pF}$		40		ps

**Notes:**

1. The propagation delay is the calculated RC time constant of the typical ON-State resistance of the switch and the specified load capacitance when driven by an ideal voltage source (zero output impedance).
2. Output skew between center channel and any other channel.
3. Skew between opposite transitions of the same output ( $|t_{PHL} - t_{PLH}|$ ).

### DC Electrical Characteristics over Operating Range

For fan-out 1:2 configurations.  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $T_A = 25^{\circ}\text{C}$  (unless otherwise noted)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{IK}$	Digital input clamp voltage	$V_{CC} = 3.6\text{ V}$ , $I_I = -18\text{ mA}$	-1.2	-0.9		V
$I_{IN}$	Digital input leakage current	$V_{CC} = 3.6\text{ V}$ , $V_{IN} = 0$ to $3.6\text{ V}$			$\pm 2$	$\mu\text{A}$
$I_{OZ}^{(3)}$		$V_{CC} = 3.6\text{ V}$ , $V_O = 0\text{ V}$ to $3.6\text{ V}$ , $V_I = 0\text{ V}$ , Switch OFF			$\pm 2$	$\mu\text{A}$
$I_{OFF}$	Power off leakage current	$V_{CC} = 0\text{ V}$ , $V_{IN} = V_{CC}$ or GND, $V_{I/O} = 0\text{ V}$ to $3.6\text{ V}$			$\pm 8$	$\mu\text{A}$
$I_{CC}$	Supply current	$V_{CC} = 3.6\text{ V}$ , $I_{I/O} = 0$ , Switch ON or OFF		70	130	$\mu\text{A}$
$C_{IN}$	Digital input capacitance	$V_{CC} = 3.3\text{ V}$ , $V_{IN} = V_{CC}$ or GND		3	5	pF
$C_{I/O(OFF)}$	OFF capacitance	$V_{CC} = 3.3\text{ V}$ , $V_{I/O} = 3.3\text{ V}$ or $0$ , $f = 10\text{ MHz}$ , Switch OFF		6	7	pF
$C_{I/O(ON)}$	ON capacitance	$V_{CC} = 3.3\text{ V}$ , $V_{I/O} = 3.3\text{ V}$ or $0$ , $f = 10\text{ MHz}$ , Switch ON		12	13	pF
$r_{on}$	ON state resistance	$V_{CC} = 3.6\text{ V}$ , $V_I = V_{CC}$ , $I_O = -30\text{ mA}$		13	19	$\Omega$
$\Delta r_{on}$	ON state resistance match between channel	$V_{CC} = 3\text{ V}$ , $V_I = 0$ to $V_{CC}$ , $I_O = -30\text{ mA}$		2	2.5	$\Omega$
$r_{on(Flat)}$	ON state resistance flatness	$V_{CC} = 3\text{ V}$ , $V_I = 1.5\text{ V}$ and $V_{CC}$ , $I_O = -30\text{ mA}$		4	6	$\Omega$

#### Notes:

- $V_{IN}$  and  $I_{IN}$  refer to control inputs.  $V_I$ ,  $V_O$ ,  $I_I$  and  $I_O$  refer to data pins.
- All typical values are at  $V_{CC} = 3.3\text{V}$  (unless otherwise noted),  $T_A = 25^{\circ}\text{C}$ .
- For I/O ports, the parameter  $I_{OZ}$  includes the input leakage current.

### Dynamic Characteristics

For fan-out 1:2 configurations.  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{V} \pm 10\%$  and  $T_A = 25^{\circ}\text{C}$  (unless otherwise noted)

Symbol	Parameter	Test Condition	Typ.	Unit
BW	Bandwidth	$R_L = 50\ \Omega$ , Switch ON	500	MHz
$O_{ISO}$	OFF Isolation	$R_L = 50\ \Omega$ , $f = 250\text{ MHz}$	-30	dB
$X_{TALK}$	Crosstalk	$R_L = 50\ \Omega$ , $f = 250\text{ MHz}$	-35	dB

### Switching Characteristics

For fan-out 1:2 configuration. Over operating range,  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$ ,  $GND = 0\text{V}$   
(unless otherwise noted)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$t_{pd}^{(1)}$		$R_L = 50\ \Omega$ , $C_L = 2\ \text{pF}$		140		ps
$t_{ON}$	SAI/SAO/SBI/SBO to OUTAx/OUTBx	$R = 50\ \Omega$ , $C_L = 2\ \text{pF}$		40	100	ns
$t_{OFF}$	SAI/SAO/SBI/SBO to OUTAx/OUTBx	$R_{LL} = 50\ \Omega$ , $C_L = 2\ \text{pF}$		20	30	ns
$t_{sk(o)}^{(2)}$		$R_L = 50\ \Omega$ , $C_L = 2\ \text{pF}$		60		ps
$t_{sk(p)}^{(3)}$		$R_L = 50\ \Omega$ , $C_L = 2\ \text{pF}$		60		ps

**Notes:**

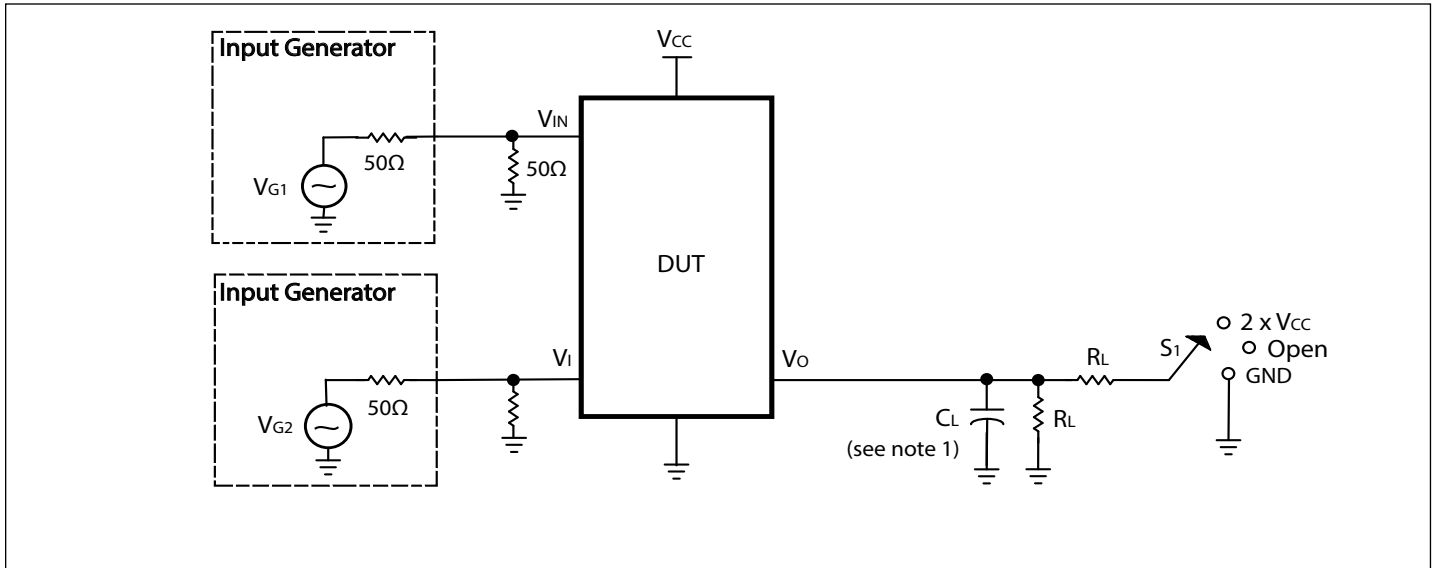
1. The propagation delay is the calculated RC time constant of the typical ON-State resistance of the switch and the specified load capacitance when driven by an ideal voltage source (zero output impedance).
2. Output skew between center channel and any other channel.
3. Skew between opposite transitions of the same output ( $|t_{PHL} - t_{PLH}|$ ).

### DC Electrical Characteristics over Operating Range

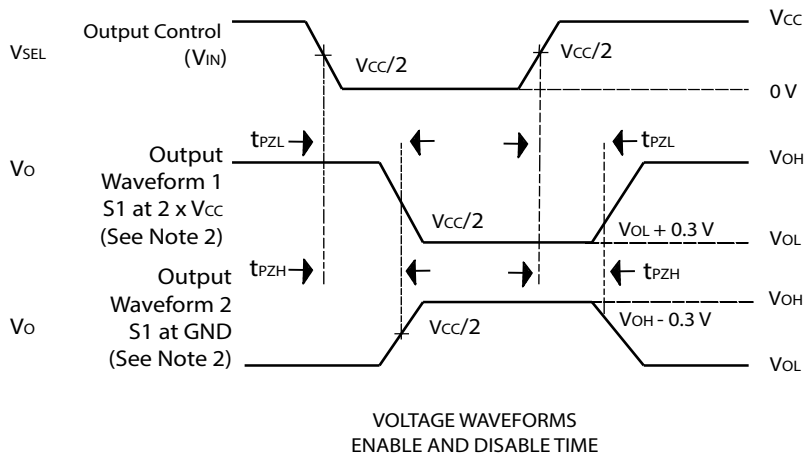
$T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $T_A = 25^{\circ}\text{C}$

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
$V_{IO}$	Analog I/O voltage		0		$V_{CC}$	V
$V_{IH}$	High level input control voltage	ENx, SAx, SBx Pins	$0.75V_{CC}$		$V_{CC}$	V
$V_{IL}$	Low level input control voltage	ENx, SAx, SBx Pins	0		0.6	V
$V_{CC}$	Supply voltage		3.0		3.6	V

**Test Circuit For Electrical Characteristics**



TEST	V <sub>CC</sub>	S1	R <sub>L</sub>	V <sub>in</sub>	C <sub>L</sub>	V <sub>Δ</sub>
t <sub>PLZ</sub> /t <sub>PZL</sub>	3.3 V ± 0.3 V	2 x V <sub>CC</sub>	50Ω	GND	2 pF	0.3 V
t <sub>PHZ</sub> /t <sub>PZH</sub>	3.3 V ± 0.3 V	GND	50Ω	V <sub>CC</sub>	2pF	0.3 V



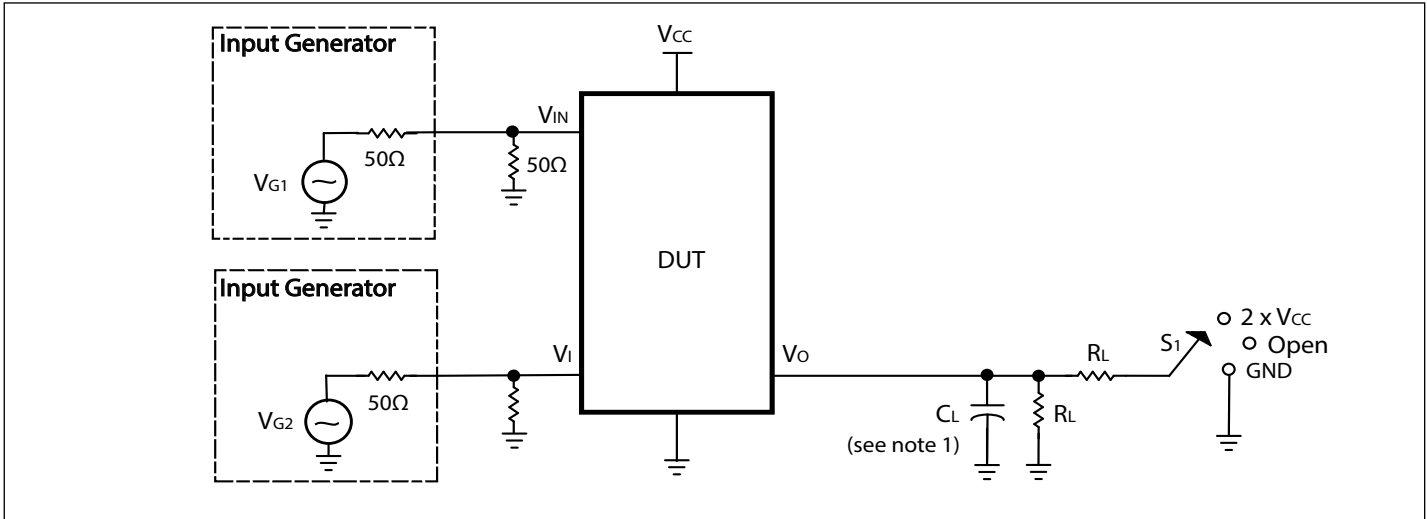
**Notes:**

1. C<sub>L</sub> includes probe and jig capacitance.
2. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.
3. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50 Ω, t<sub>r</sub> ≤ 2.5 ns, t<sub>f</sub> ≤ 2.5 ns.
4. The outputs are measured one at a time, with one transition per measurement.
5. t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>OFF</sub>.
6. t<sub>PZL</sub> and t<sub>PZH</sub> are the same as t<sub>ON</sub>.

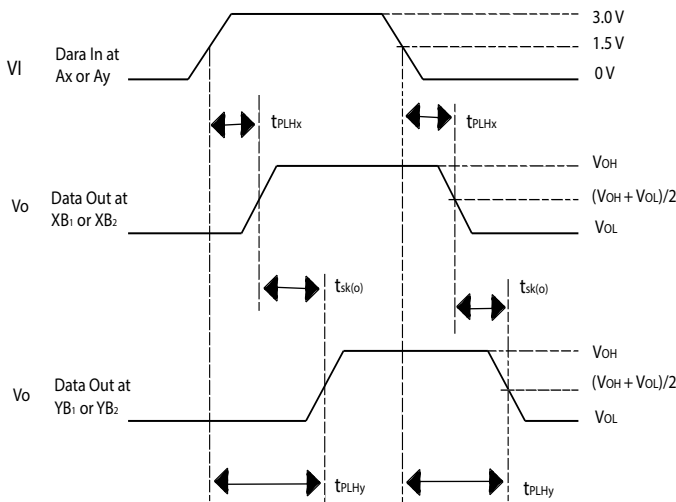


**PI3DBS3224**

**Test Circuit For Electrical Characteristics**

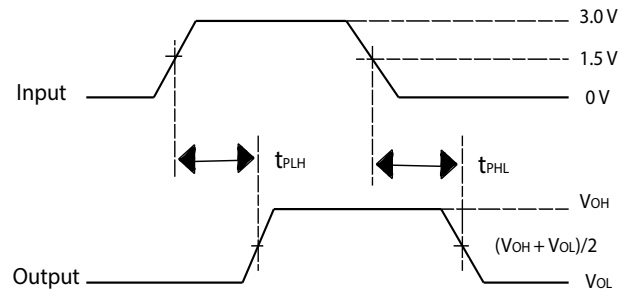


TEST	V <sub>CC</sub>	S1	R <sub>L</sub>	V <sub>in</sub>	C <sub>L</sub>
t <sub>sk(o)</sub>	3.3 V ± 0.3 V	Open	50Ω	V <sub>CC</sub> or GND	2 pF
t <sub>sk(p)</sub>	3.3 V ± 0.3 V	Open	50Ω	V <sub>CC</sub> or GND	2pF



$t_{sk(o)} = t_{PLHy} - t_{PLHx} \text{ OR } t_{PHLy} - t_{PHLx}$

VOLTAGE WAVEFORMS  
OUTPUT SKEW (t<sub>SK(o)</sub>)



$t_{sk(p)} = t_{PHL} - t_{PLH}$

VOLTAGE WAVEFORMS  
PULSE SKEW [t<sub>SK(p)</sub>]

**Notes:**

1. C<sub>L</sub> includes probe and jig capacitance.
2. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z<sub>O</sub> = 50 Ω, t<sub>r</sub> ≤ 2.5 ns. t<sub>f</sub> ≤ 2.5 ns.
3. The outputs are measured one at a time, with one transition per measurement.

**PI3DBS3224**

**Part Marking**

PDBS32  
24ZNAE  
YYWWXX  
○

YY: Year  
WW: Workweek  
1st X: Assembly Code  
2nd X: Fab Code

**PI3DBS3224**

**Packaging Mechanical: 20-TQFN (ZNA)**

SYMBOLS	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.203 REF.		
b	0.15	0.20	0.25
D	2.95	3.00	3.05
E	2.95	3.00	3.05
D2	1.55	1.65	1.75
E2	1.55	1.65	1.75
L	0.30	0.40	0.50
e	0.40 BSC		

**Notes:**  
 1. All dimensions are in mm. Angles in degrees.  
 2. Refer JEDEC MO-220.  
 3. Recommended land pattern is for reference only.

**PERICOM**  
Enabling Serial Connectivity

**DATE: 09/19/13**

**DESCRIPTION: 20-contact, Thin Fine Pitch Quad Flat No lead Package (TQFN)**

**PACKAGE CODE: ZNA**

**DOCUMENT CONTROL #: PD-2169**

**REVISION: --**

13-0240

**For latest package info.**

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

**Ordering Information**

Ordering Code	Packaging Code	Package Description
PI3DBS3224ZNAEX	ZNA	20-contact, Thin Fine Pitch Quad Flat No Lead Package (TQFN)

**Notes:**

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. E = Pb-free and Green
5. X suffix = Tape/Reel

**IMPORTANT NOTICE**

DIODES INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

Diodes Incorporated and its subsidiaries reserve the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. Diodes Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does Diodes Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold Diodes Incorporated and all the companies whose products are represented on Diodes Incorporated website, harmless against all damages.

Diodes Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

Should Customers purchase or use Diodes Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold Diodes Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.

This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and definitive format released by Diodes Incorporated.

**LIFE SUPPORT**

Diodes Incorporated products are specifically not authorized for use as critical components in life support devices or systems without the express written approval of the Chief Executive Officer of Diodes Incorporated. As used herein:

A. Life support devices or systems are devices or systems which:

1. are intended to implant into the body, or

2. support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in significant injury to the user.

B. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or to affect its safety or effectiveness.

Customers represent that they have all necessary expertise in the safety and regulatory ramifications of their life support devices or systems, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of Diodes Incorporated products in such safety-critical, life support devices or systems, notwithstanding any devices- or systems-related information or support that may be provided by Diodes Incorporated. Further, Customers must fully indemnify Diodes Incorporated and its representatives against any damages arising out of the use of Diodes Incorporated products in such safety-critical, life support devices or systems.

Copyright © 2016, Diodes Incorporated

[www.diodes.com](http://www.diodes.com)