

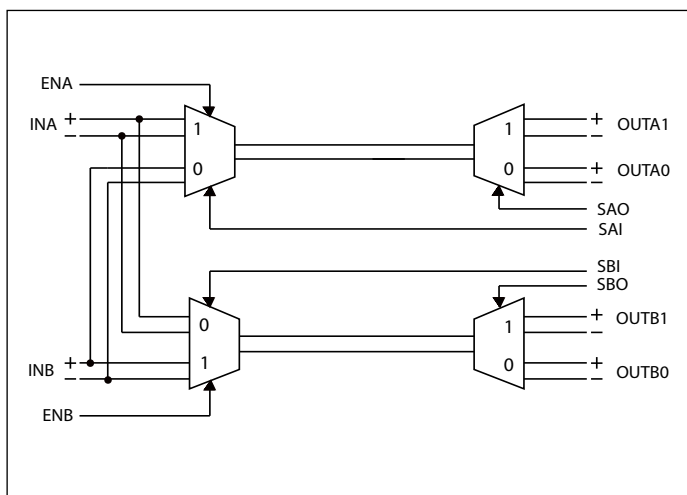
**PI3DBS3224**

**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)
- Small QFN package (3 x 3 mm, 0.4 mm pitch)

**Block Diagram**



**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.

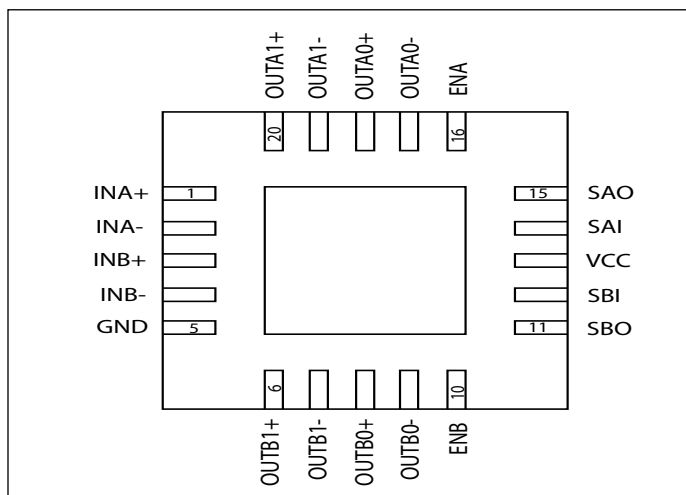
The PI3DBS3224 operates with a 3 to 3.6V power supply. It features ESD protection of up to ±8-kV contact discharge and 2-kV Human Body Model on its I/O pins.

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

**Applications**

- Desktop/Notebooks Computers
- DisplayPort Auxiliary Channel Multiplexing
- USB 2.0 Multiplexing
- Netbooks/eBooks/Tablets

**Pin Configuration**



**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.

**PI3DBS3224**

### 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.  $T_A = -40\text{ }^\circ\text{C}$  to  $85\text{ }^\circ\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $T_A = 25\text{ }^\circ\text{C}$  (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),  $T_A = 25\text{ }^\circ\text{C}$ .
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.  $T_A = -40\text{ }^{\circ}\text{C}$  to  $85\text{ }^{\circ}\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{V} \pm 10\%$  and  $T_A = 25\text{ }^{\circ}\text{C}$  (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,  $T_A = -40\text{ }^{\circ}\text{C}$  to  $85\text{ }^{\circ}\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$ ,  $GND = 0\text{ V}$  (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.  $T_A = -40\text{ }^{\circ}\text{C}$  to  $85\text{ }^{\circ}\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25\text{ }^{\circ}\text{C}$  (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	$V_{CC} = 3.6\text{ V}$ , $V_{IN} = 0\text{ to }3.6\text{ V}$			$\pm 2$	$\mu\text{A}$
$I_{OZ}^{(3)}$		$V_{CC} = 3.6\text{ V}$ , $V_O = 0\text{ V to }3.6\text{ V}$ , $V_I = 0\text{ V}$ , Switch OFF			$\pm 2$	$\mu\text{A}$
$I_{OFF}$	Power off leakage current	$V_{CC} = 0\text{ V}$ , $V_{IN} = V_{CC}$ or GND, $V_{IO} = 0\text{ V to }3.6\text{ V}$			$\pm 8$	$\mu\text{A}$
$I_{CC}$	Supply current	$V_{CC} = 3.6\text{ V}$ , $I_{IO} = 0$ , 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	$V_{CC} = 3.3\text{ V}$ , $V_{IO} = 3.3\text{ V}$ 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		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	$V_{CC} = 3\text{ V}$ , $V_I = 0\text{ to }V_{CC}$ , $I_O = -30\text{ mA}$		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),  $T_A = 25\text{ }^{\circ}\text{C}$ .
- For I/O ports, the parameter  $I_{OZ}$  includes the input leakage current.

## Dynamic Characteristics

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

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

## Switching Characteristics

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

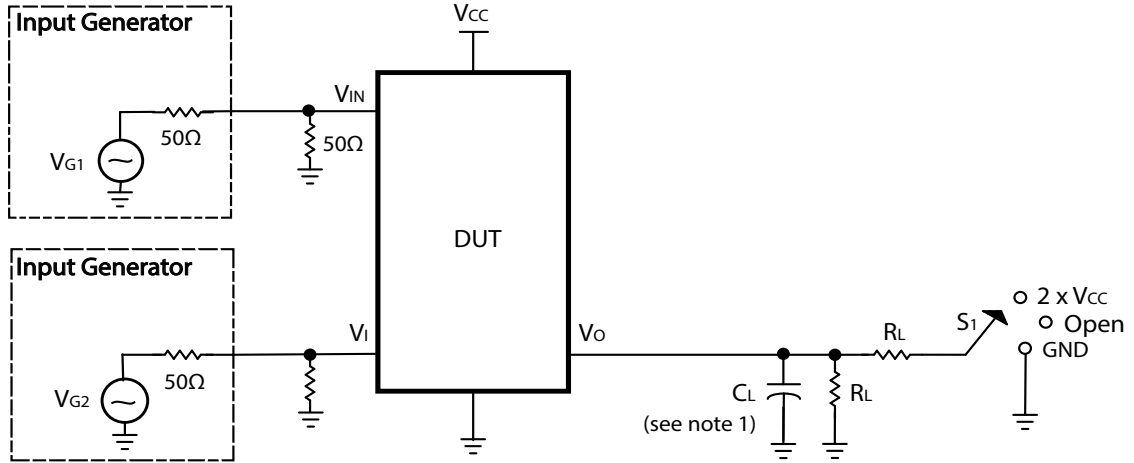
- The propagation delay is the calculated RC time constant of the typical ON-State resistance of the switch and the specified load capacitance when driven by an ideal voltage source (zero output impedance).
- Output skew between center channel and any other channel.
- Skew between opposite transitions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

## DC Electrical Characteristics over Operating Range

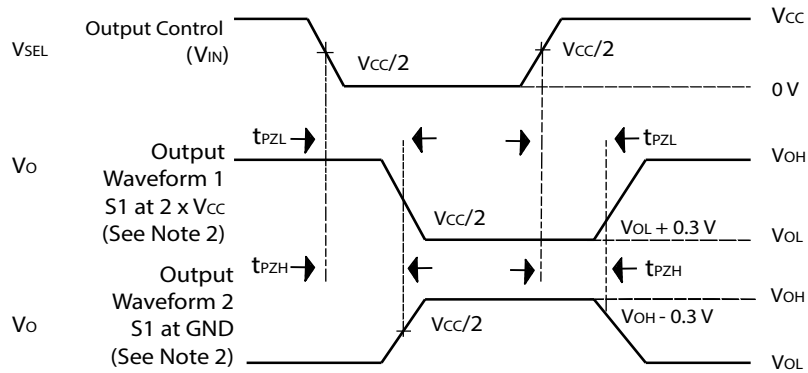
$T_A = -40\text{ }^{\circ}\text{C}$  to  $85\text{ }^{\circ}\text{C}$ , Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $T_A = 25\text{ }^{\circ}\text{C}$

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



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIME

**Notes:**

- C<sub>L</sub> includes probe and jig capacitance.
- 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.
- 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.
- The outputs are measured one at a time, with one transition per measurement.
- t<sub>PLZ</sub> and t<sub>PHZ</sub> are the same as t<sub>OFF</sub>.
- 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

**VOLTAGE WAVEFORMS  
OUTPUT SKEW [t<sub>sk(o)</sub>]**

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

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

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

**Notes:**

- C<sub>L</sub> includes probe and jig capacitance.
- 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.
- The outputs are measured one at a time, with one transition per measurement.

**PI3DBS3224**

**Part Marking**

ZNA Package



YY: Year

WW: Workweek

1st X: Assembly Code

2nd X: Fab Code

**PI3DBS3224**

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

The diagrams show the mechanical specifications for the 20-TQFN (ZNA) package. The top view shows a square package with side length D and a shaded PIN1 index area. The bottom view shows 20 contacts in a 4x5 grid with dimensions D2, E2, and a 0.35x45 degree chamfer. The side view shows the package height A, lead height A1, and lead thickness e. The recommended land pattern shows contact dimensions of 0.40 BSC and 0.20 (20X), with a 0.70 (20X) pitch and overall dimensions of 1.65 and 2.90.

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 packaging 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

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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.

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