A Product Line of
Diodes Incorporated

PI3USB224

3.3V High Speed 2:2 Differential Mux/Demux

Description

The PI3USB224 is a 2:2 bidirectional multiplexer for high-speed differential and single ended signal applications (up to 720Mbps). The PI3USB224 offers a high BW of 1.2GHz with channel RON of 13Ω (Typical).

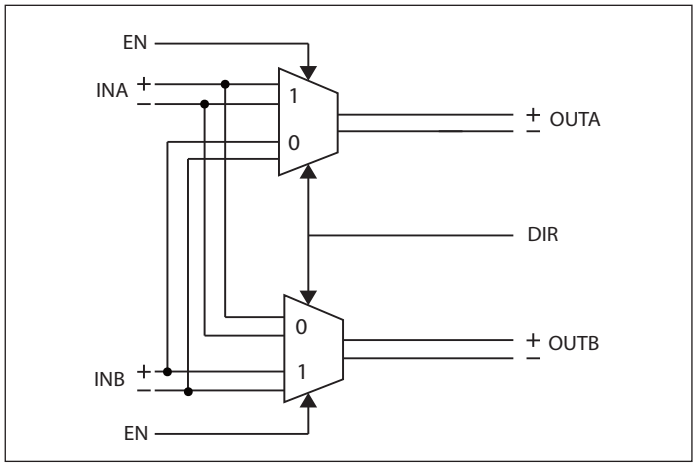
The PI3USB224 operates with a 3V to 3.6V power supply. It features ESD protection of up to ±8kV contact discharge and 2kV Human Body Model on its I/O pins.

The PI3USB224 provides fail-safe protection by isolating the I/O pins with high impedance when the power supply (V_{CC}) is not present.

Application(s)

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

Block Diagram



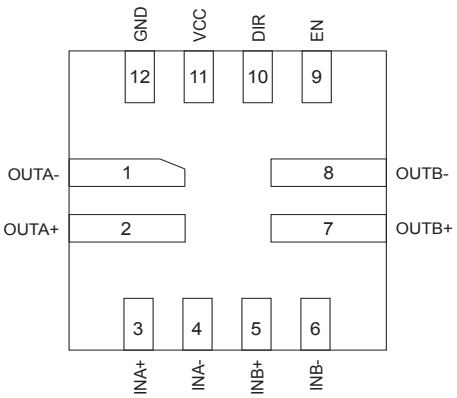
Features

- 2:2 Differential Multiplexer/Demultiplexer
- Bidirectional Operation
- High BW (1.2GHz Typical)
- Low RON and CON:
  - 13Ω RON Typical
  - 9pF CON Typical
- ESD Performance (I/O Pins)
  - ±8kV Contact Discharge (IEC61000-4-2)
  - 2kV Human Body Model per JESD22-A114E (to GND)
- ESD Performance (All Pins)
  - 2kV Human Body Model per JESD22-A114E
- Packaging (Pb-free & Green):
  - 12-Pin, 1.8mm x 1.8mm, 0.4mm pitch, WQFN (ZN)
- 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-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.
  https://www.diodes.com/quality/product-definitions/

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 Number	Pin Name	I/O Type	Description
1	OUTA-	I/O	Output A
2	OUTA+	I/O	Output A
3	INA+	I/O	I/O Input A
4	INA-	I/O	I/O Input A
5	INB+	I/O	I/O Input B
6	INB-	I/O	I/O Input B
7	OUTB+	I/O	Output B
8	OUTB-	I/O	Output B
9	EN	I	Control Input
10	DIR	I	Control Input
11	VCC	Power	Power Supply
12	GND	GND	Ground

Function Table

EN	Output A	Output B
0	Hi-Z	Hi-Z
1	—	—

DIR	OUTA	OUTB
0	INB	INA
1	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 50mA
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

T_A = -40°C to 85°C, Typical values are at Vcc = 3.3V, T_A= 25°C (unless otherwise noted)

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	EN, DIR Pins	0.75V_{CC}		V_{CC}	V
V_{IL}	Low level input control voltage	EN, DIR Pins	0		0.6	V
V_{CC}	Supply voltage		3.0		3.6	V
V_{IK}	Digital input clamp voltage	V_{CC} = 3.6V, I_I = -18mA	-1.2	-0.9		V
I_{IN}	Digital input leakage current	V_{CC} = 3.6V, V_{IN} = 0V to 3.6V			±2	µA
I_{OZ}[3]		V_{CC} = 3.6V, V_O = 0V to 3.6V, V_I = 0V, Switch OFF			±2	µA
I_{OFF}	Power off leakage current	V_{CC} = 0V, V_{IN} = V_{CC} or GND, $V_{I/O}$ = 0V to 3.6V			±8	µA
I_{CC}	Supply current	V_{CC} = 3.6V, $I_{I/O}$ = 0, Switch ON or OFF		70	130	µA
C_{IN}	Digital input capacitance	V_{CC} = 3.3V, V_{IN} = V_{CC} or GND		3	5	pF
$C_{I/O(OFF)}$	OFF capacitance	V_{CC} = 3.3V, $V_{I/O}$ = 3.3V or 0V, f = 10MH$_Z$, Switch OFF		6	7	pF
$C_{I/O(ON)}$	ON capacitance	V_{CC} = 3.3V, $V_{I/O}$ = 3.3V or 0V, f = 10MH$_Z$, Switch ON		9	10	pF
r_{on}	ON state resistance	V_{CC} = 3.6V, V_I = V_{CC}, I_O = -30mA		13	19	Ω
		V_{CC} = 3.3V, V_I = 0.5V, I_O = -30mA		10		Ω
Δr_{on}	ON state resistance match between channel	V_{CC} = 3V, V_I = 0 to V_{CC}, I_O = -30mA		2	2.5	Ω
$r_{on(flat)}$	ON state resistance flatness	V_{CC} = 3V, V_I = 1.5V and V_{CC}, I_O = -30mA		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} = 3.3V (unless otherwise noted), T_A = 25 °C.
3. For I/O ports, the parameter I_{OZ} includes the input leakage current.

Dynamic Characteristics

T_A = -40°C to 85°C, Typical values are at Vcc = 3.3V ± 10% and T_A = 25°C (unless otherwise noted)

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

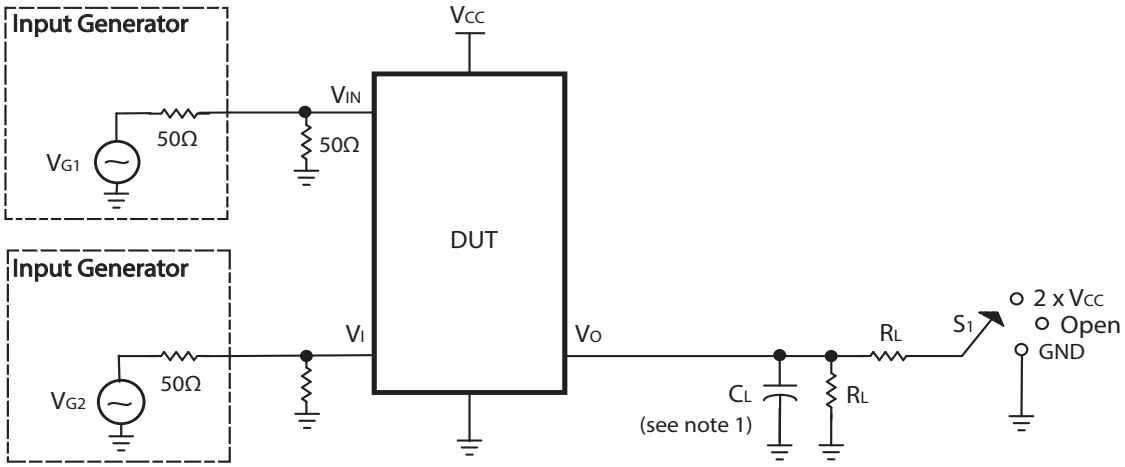
Switching Characteristics

Over operating range, T_A = -40°C to 85°C, Vcc = 3.3V ± 10%, GND = 0V (unless otherwise noted)

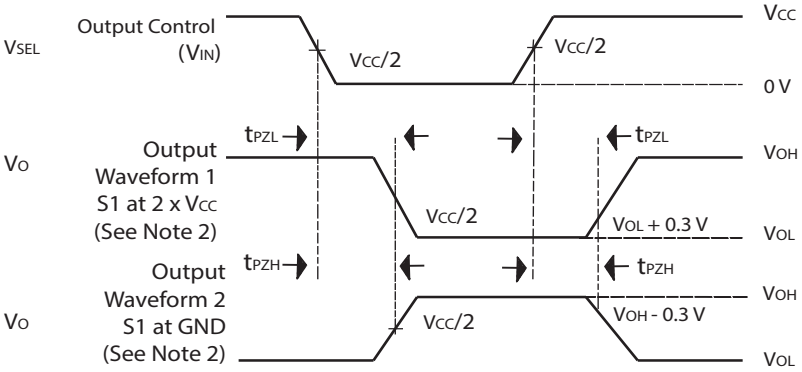
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
t_{pd} (1)		R_L = 50Ω, C_L = 2pF		50		ps
t_{ON}	DIR to OUTAx/OUTBx	R_L = 50Ω, C_L = 2pF		40	100	ns
t_{OFF}	DIR to OUTAx/OUTBx	R_L = 50Ω, C_L = 2pF		20	30	ns
$t_{sk(o)}$ (2)		R_L = 50Ω, C_L = 2pF		40		ps
$t_{sk(p)}$ (3)		R_L = 50Ω, C_L = 2pF		40		ps

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 ($|t_{PHL} - t_{PLH}|$).

Test Circuit For Electrical Characteristics



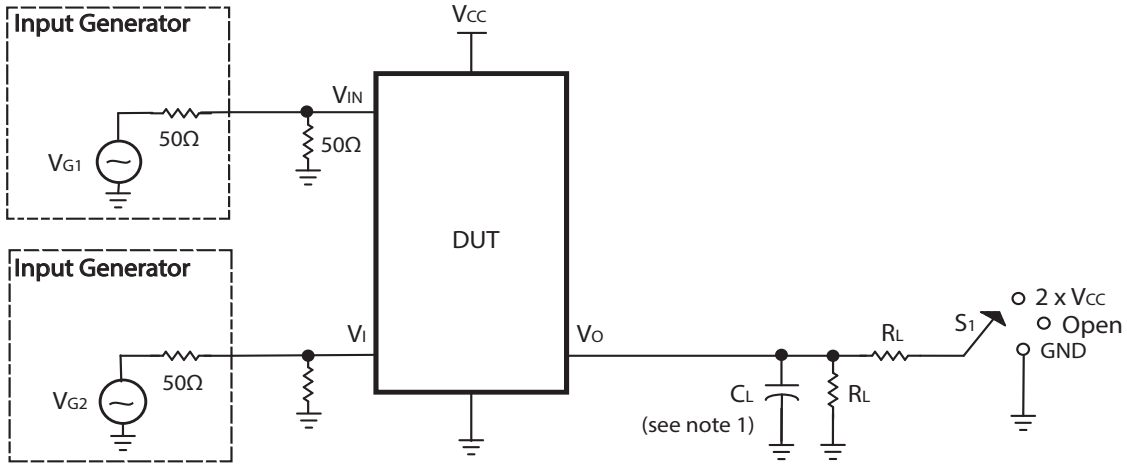
TEST	V_{CC}	S1	R_L	V_{in}	C_L	V_Δ
t_{PLZ}/t_{PZL}	3.3V ± 0.3V	2 x V_{CC}	50Ω	GND	2pF	0.3V
t_{PHZ}/t_{PZH}	3.3V ± 0.3V	GND	50Ω	V_{CC}	2pF	0.3V



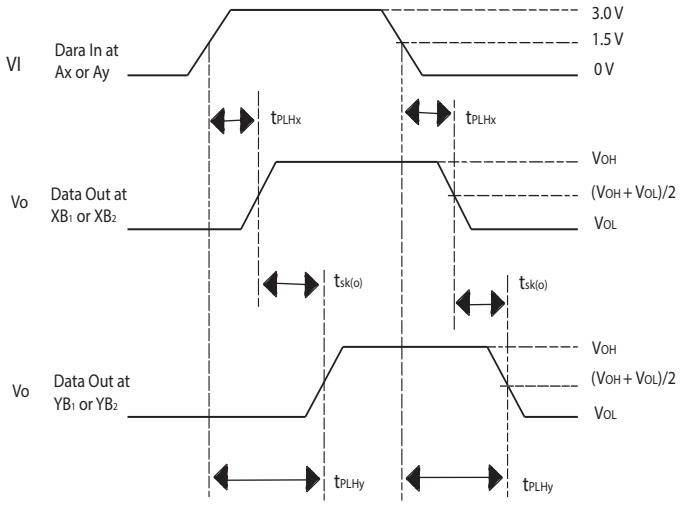
VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIME

Notes:

1. C_L 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 MH_Z, ZO = 50 Ω, t_r ≤ 2.5 ns. t_f ≤ 2.5 ns.
4. The outputs are measured one at a time, with one transition per measurement.
5. t_{PLZ} and t_{PHZ} are the same as t_{OFF}.
6. t_{PZL} and t_{PZH} are the same as t_{ON}.

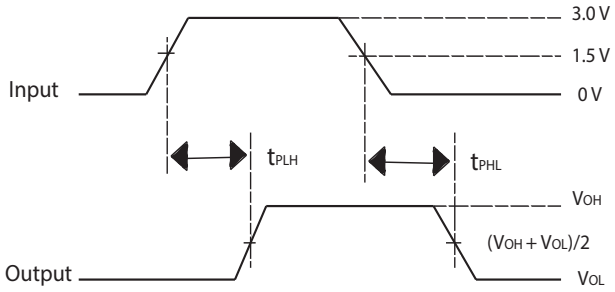


TEST	V_{CC}	S1	R_L	V_{in}	C_L
$t_{sk(o)}$	3.3V ± 0.3V	Open	50Ω	V_{CC} or GND	2pF
$t_{sk(p)}$	3.3V ± 0.3V	Open	50Ω	V_{CC} or GND	2pF



$t_{sk(o)} = t_{PLHy} - t_{PLHx}$ or $t_{PHLy} - t_{PHLx}$

VOLTAGE WAVEFORMS
OUTPUT SKEW ($t_{SK(O)}$)



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

VOLTAGE WAVEFORMS
PULSE SKEW [$t_{SK(p)}$]

Notes:

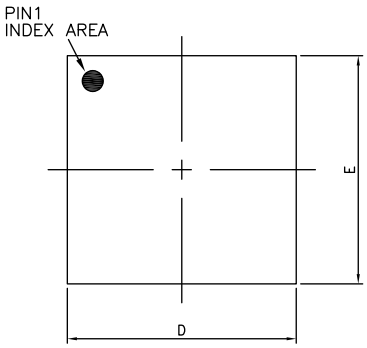
1. C_L includes probe and jig capacitance.
2. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MH_Z, ZO = 50 Ω, t_r ≤ 2.5 ns. t_f ≤ 2.5 ns.
3. The outputs are measured one at a time, with one transition per measurement.

Part Marking

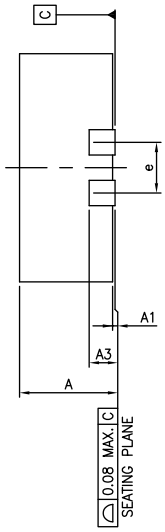
Y: Date Code (Year)
W: Date Code (Workweek)
Line above “H” denotes Lead-free & Green

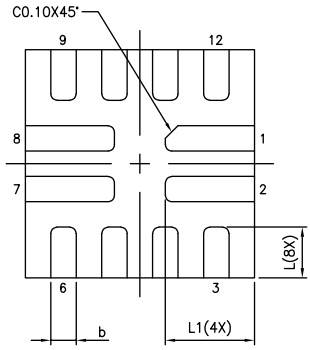
Packaging Mechanical

12-WQFN (ZN)



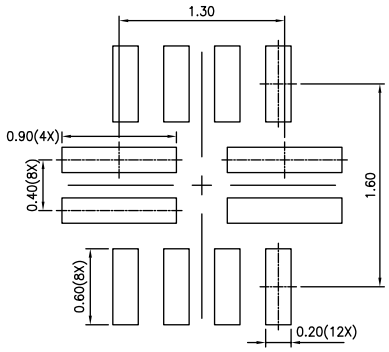
TOP VIEW





BOTTOM VIEW

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	1.70	1.80	1.90
E	1.70	1.80	1.90
e		0.40 BSC	
L	0.35	0.40	0.45
L1	0.65	0.70	0.75



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-220
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY
5. THERMAL PAD SOLDERING AREA (MESH STENCIL DESIGN IS RECOMMENDED)

DATE: 01/13/23

DESCRIPTION: W-QFN1818-12

PACKAGE CODE: ZN (ZN12)

DOCUMENT CONTROL #: PD-2282 REVISION: –

For latest package info.

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

Ordering Information

Orderable Part Number	Package Code	Package Description
PI3USB224ZNEX	ZN	12-Contact, W-QFN1818-12

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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