A Product Line of
Diodes Incorporated

PI3USB3102

USB3.0 and USB2.0 Combo Switch

Features

- 1:2 mux/demux for USB 3.0SS, 2.0HS, and 2.0FS signals
- Switches Tx, Rx, Dx, and USB_ID from USB3.0 connector
- Insertion Loss for super-speed channels @ 2.5 GHz: -1.7dB
- -3dB Bandwidth for super-speed channels: 4.7GHz
- Return loss for super-speed channels @ 2.5GHz: -16dB
- Low Bit-to-Bit Skew, 7ps max (between '+' and '-' bits)
- Low Crosstalk for super-speed channels: -25dB@5.0 Gbps
- Low Off Isolation for super-speed channels: -25dB@5.0 Gbps
- V_{DD} Operating Range: 3.3V +/-10%
- ESD Tolerance: 2kV HBM
- Low channel-to-channel skew, 35ps max
- 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/
- Packaging (Pb-free & Green):
  - 32 TQFN (ZL)

Application

Routing of USB3.0 signals with low signal attenuation between source and sink.

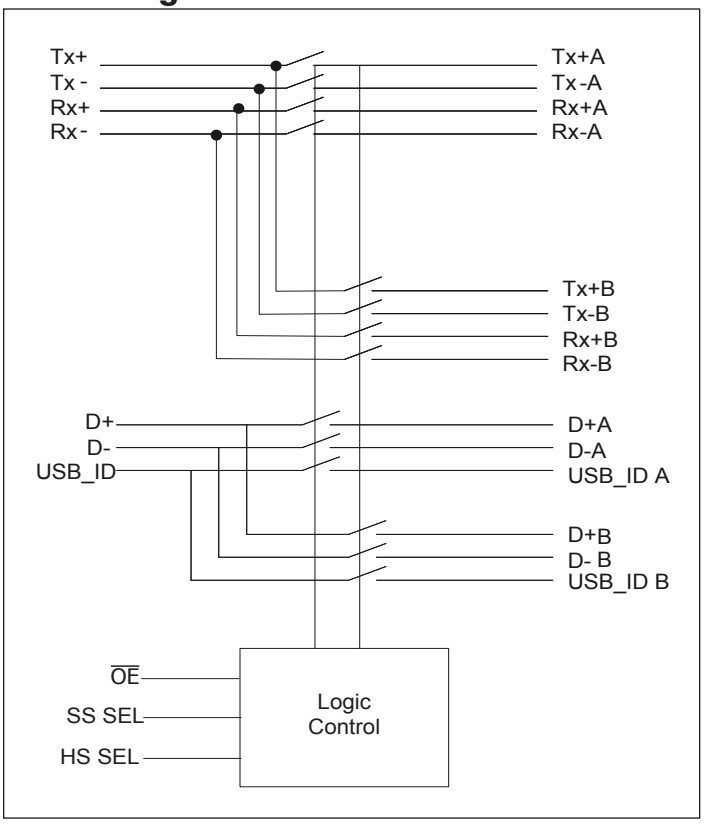
Description

The DIODES PI3USB3102 USB3.0 and USB2.0 Combo Switch is a complete 1:2 switching solution for SuperSpeed USB 3.0 signals. PI3USB3102 provides differential high-speed lanes for the USB3.0 4.8 Gbps TX and RX lanes as well as a differential lane for 480 Mbps USB 2.0 signals and the USB_ID signal.

PI3USB3102 can be used to connect two hosts to a single device or a single host to two devices.

PI3USB3102 offers excellent signal integrity for high-speed signals and low power dissipation. Insertion loss is 1.7 dB and return loss is -16 dB at 2.5 GHz. Power dissipation is 6.6 mW maximum.

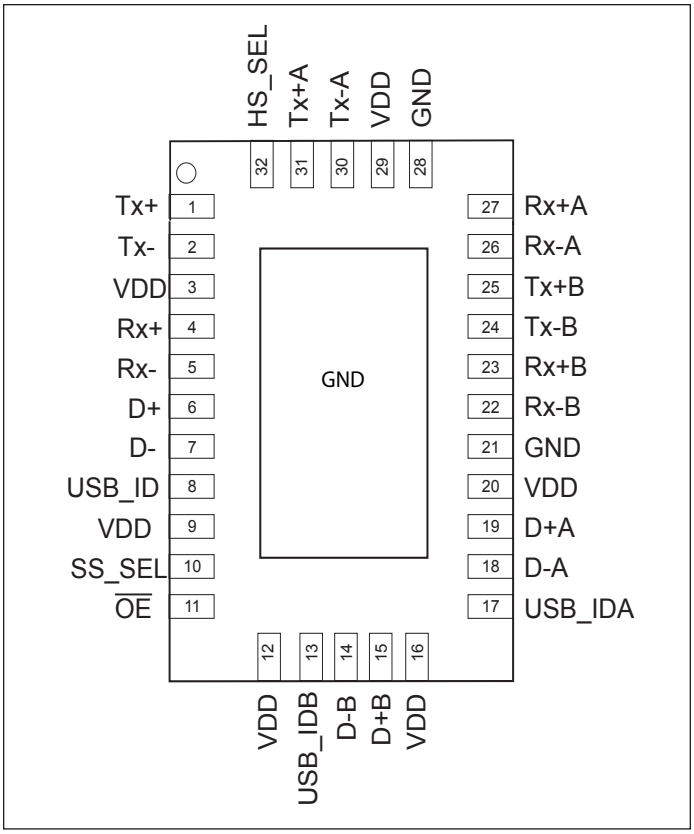
Block Diagram



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



Truth Table

$\overline{OE}$	SS_SEL	HS_SEL	Function
Low	Low	Low	Port A active for all channels
Low	Low	High	Port A for SS, port B for HS and ID
Low	High	Low	Port B for SS, port A for HS and ID
Low	High	High	Port B active for all channels
High	x	x	I/O's are hi-z and IC is power down

Pin Description

Pin#	Pin Name	Signal Type	Description
1	Tx+	I/O	Positive differential USB3.0 Tx signal for COM port
2	Tx-	I/O	Negative differential USB3.0 Tx signal for COM port
3	VDD	Power	3.3V +/-10% power supply
4	Rx+	I/O	Positive differential USB3.0 Rx signal for COM port
5	Rx-	I/O	Negative differential USB3.0 Rx signal for COM port
6	D+	I/O	Positive differential USB2.0 signal for COM port
7	D-	I/O	Negative differential USB2.0 signal for COM port
8	USB_ID	I/O	USB_ID for COM port
9	VDD	Power	3.3V +/-10% power supply
10	SS_SEL	I	Switch logic control for SuperSpeed Path If HIGH, then path B is selected for SuperSpeed channels only If LOW, then path A is selected for SuperSpeed channels only
11	$\overline{OE}$	I	Output enable. if $\overline{OE}$ is low, IC is enabled. If $\overline{OE}$ is high, then IC is power down and all I/Os are Hi-Z
12	VDD	Power	3.3V +/-10% power supply
13	USB_IDB	I/O	USB_ID for port B
14	D-B	I/O	Negative differential USB2.0 signal for port B
15	D+B	I/O	Positive differential USB2.0 signal for port B
16	VDD	Power	3.3V +/-10% power supply
17	USB_IDA	I/O	USB_ID for port A
18	D-A	I/O	Negative differential USB2.0 signal for port A
19	D+A	I/O	Positive differential USB2.0 signal for port A
20	VDD	Power	3.3V +/-10% power supply
21	GND	Ground	Ground
22	Rx-B	I/O	Negative differential USB3.0 Rx signal for port B
23	Rx+B	I/O	Positive differential USB3.0 Rx signal for port B
24	Tx-B	I/O	Negative differential USB3.0 Tx signal for port B
25	Tx+B	I/O	Positive differential USB3.0 Tx signal for port B
26	Rx-A	I/O	Negative differential USB3.0 Rx signal for port A
27	Rx+A	I/O	Positive differential USB3.0 Rx signal for port A
28	GND	Ground	Ground
29	VDD	Power	3.3V +/-10% power supply
30	Tx-A	I/O	Negative differential USB3.0 Tx signal for port A
31	Tx+A	I/O	Positive differential USB3.0 Tx signal for port A
32	HS_SEL	I	Switch logic control for USB2.0 (D+/-) and USB_ID path If High, path B is selected If LOW, path A is selected

Maximum Ratings

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

Storage Temperature	–65°C to +150°C
Junction Temperature	125°C
Supply Voltage to Ground Potential	–0.5V to +4.2V
DC Input Voltage	–0.5V to V_{DD}
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 for Switching over Operating Range

(TA = –40°C to +85°C, VDD = 3.3V ±10%)

Parameter	Description	Test Conditions(1)	Min.	Typ.(1)	Max.	Units
VIH	Input HIGH Voltage	Guaranteed HIGH level	1.5			V
VIL	Input LOW Voltage	Guaranteed LOW level			0.75	
VIK	Clamp Diode Voltage, Dx	V_{DD} = Max., I_{IN} = –18mA		–0.8	–1.1	
IIH	Input HIGH Current	V_{DD} = Max., V_{IN} = V_{DD}			±5	µA
IIL	Input LOW Current	V_{DD} = Max., V_{IN} = GND			±5	
$I_{OFF\_HS/ID}$	I/O leakage when part is off for D+, D- and USB_ID signals only	V_{DD} = 0V, V_{INPUT} = 0V to 3.6V			20	
R_{ON_SS}	On resistance between input to output for SuperSpeed signals	V_{DD} = 3.3V, Vinput = 0V to 1V, I_{INPUT} = 20mA		10	13	Ohm
R_{ON_FS}	On resistance between input to output for USB2.0 FS signals (D+/D-)	V_{DD} = 3.3V, Vinput = 0 to 3.3V, I_{INPUT} = 20mA		7	9	Ohm
R_{ON_HS}	On resistance between input to output for USB2.0 HS signals (D+/D-)	V_{DD} = 3.3V, Vinput = -0.4V to +0.4V, I_{INPUT} = 20mA		4	6	Ohm
USB_ID_I	Input voltage tolerance on USB_ID path				5.5	V
USB_ID_O	Output voltage on USB_ID path	USB_ID input from 0V to 5.25V			3.6	V

Power Supply Characteristics (TA = –40°C to +85°C)

Parameter	Description	Test Conditions(1)	Min.	Typ.(1)	Max.	Units
I_{CC}	Quiescent Power Supply Current	V_{DD} = Max., V_{IN} = GND or V_{DD}			2	mA

Dynamic Electrical Characteristics over Operating Range (TA = -40° to +85°C, VDD = 3.3V ±10%)

Parameter	Description	Test Conditions		Typ.	Max.	Units
X_{TALK}	Crosstalk on SuperSpeed Channels	See Fig. 1 for Measurement Setup	f= 2.5 GHz	-25dB		dB
O_{IRR}	OFF Isolation on SuperSpeed Channels	See Fig. 2 for Measurement Setup,	f= 2.5 GHz	-22dB		
I_{LOSS}	Differential Insertion Loss on SuperSpeed Channels	@5.0Gbps (see figure 3)		-1.7		dB
R_{loss}	Differential Return Loss on SuperSpeed channels	@ 2.5GHz		-16		dB
BW_SS	Bandwidth -3dB for SuperSpeed path (Tx±/ Rx±)	See figure 3		4.7		GHz
BW_HS	-3dB BW for USB high speed path (D+/-)	See figure 3		1.5		GHz
Tsw a-b	Time it takes to switch from port A to port B				1	us
Tsw b-a	Time it takes to switch from port B to port A				1	us
Tstartup	Vdd valid to channel enable				10	us
Twakeup	Enabling output by changing $\overline{OE}$ from low to High				10	us

Note:

1. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{DD} = 3.3V, T_A = 25°C ambient and maximum loading.

Switching Characteristics (T_A= -40° to +85°C, V_{DD} = 3.3V±10%)

Parameter	Description	Min.	Typ.	Max.	Units
T_{pd}	Propagation delay (input pin to output pin)		80		ps
tb-b	Bit-to-bit skew within the same differential pair		5		ps
tch-ch	Channel-to-channel skew			35	ps

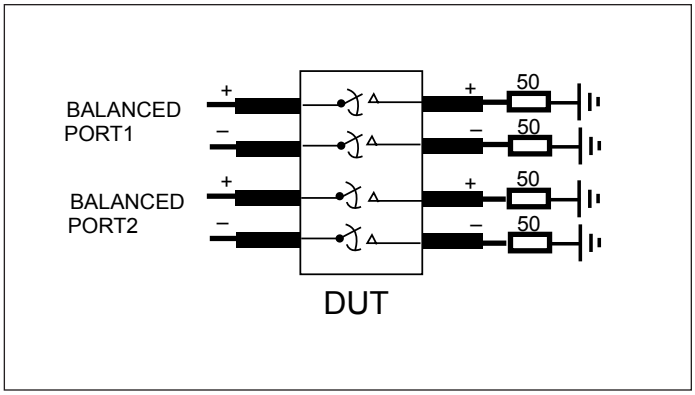


Fig 1. Crosstalk Setup

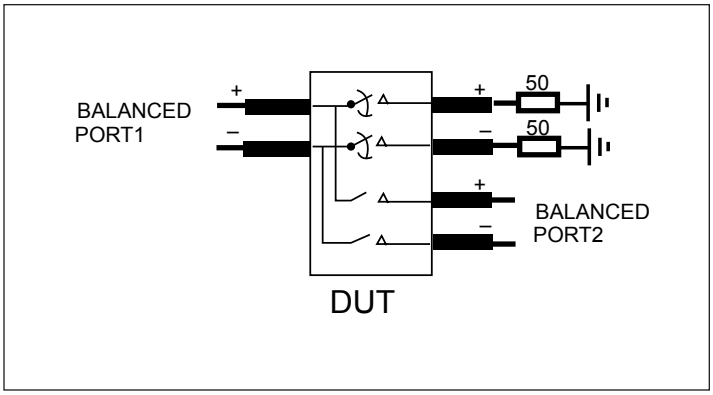


Fig 2. Off-Isolation Setup

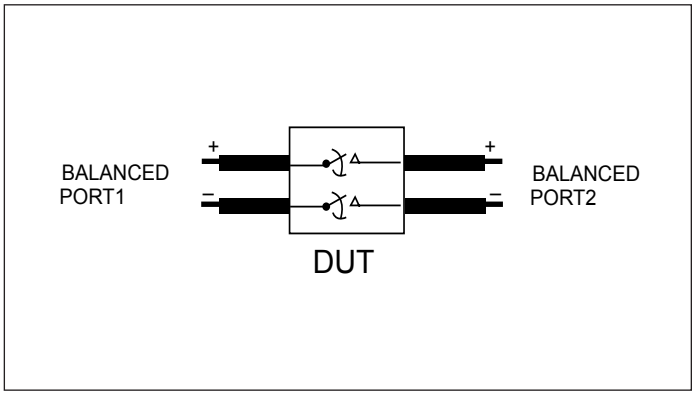


Fig 3. Differential Insertion Loss Setup

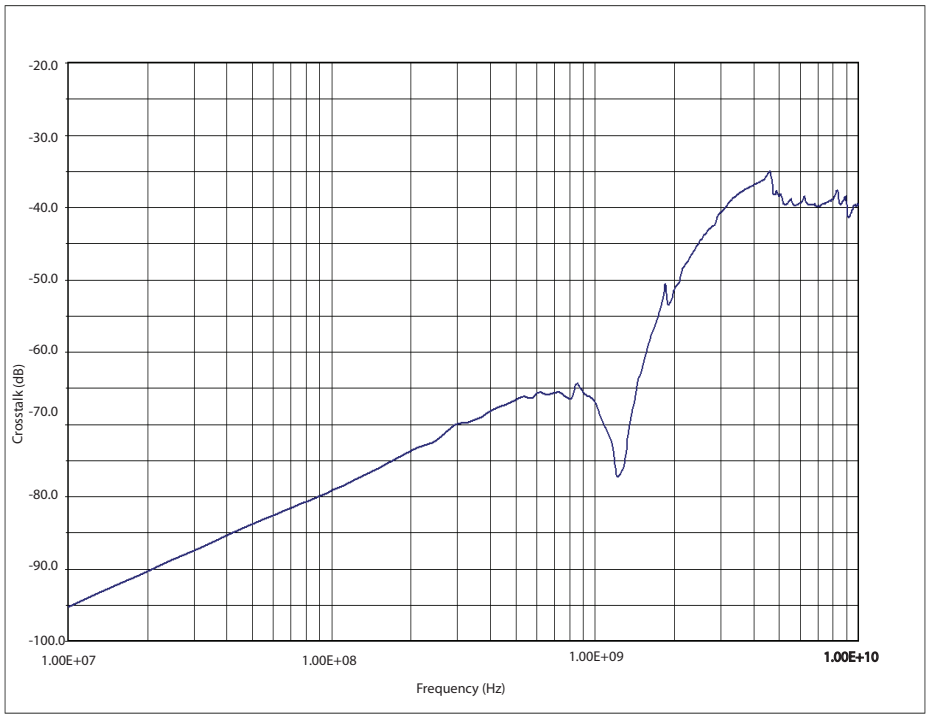


Fig 4. Xtalk for SuperSpeed Channels (Tx/Rx)

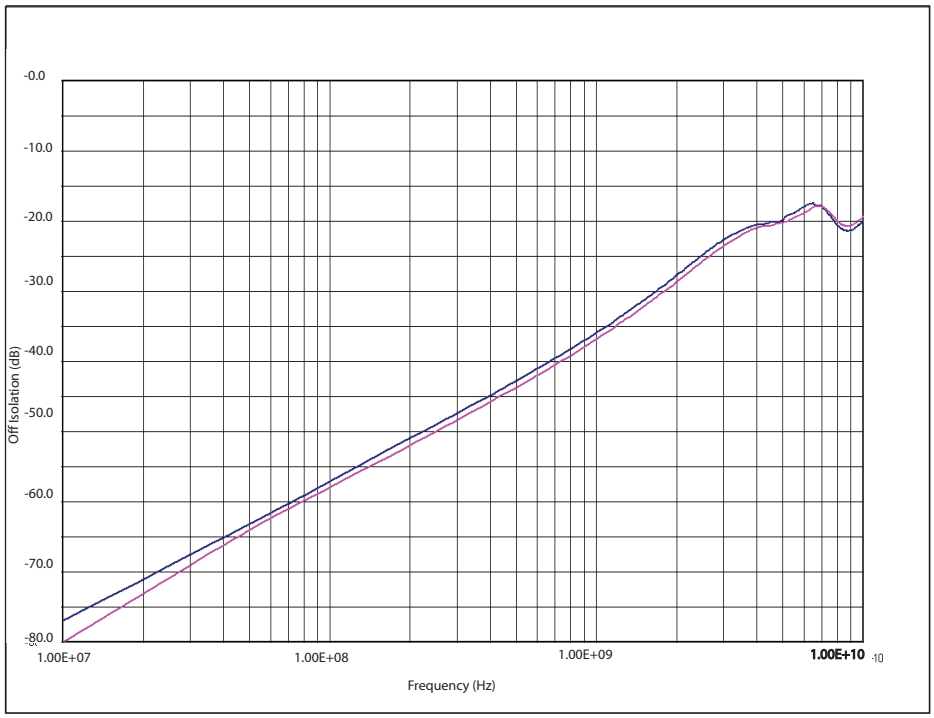


Fig 5. Off Isolation for SuperSpeed Channels (Tx/Rx). Red is for path B and Blue is for path A

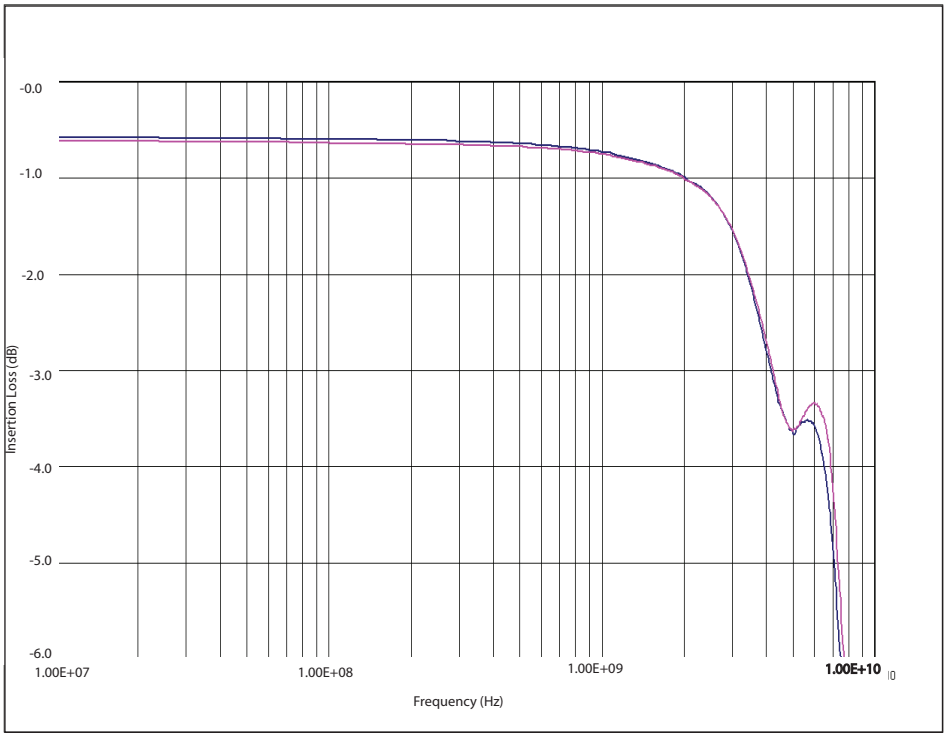
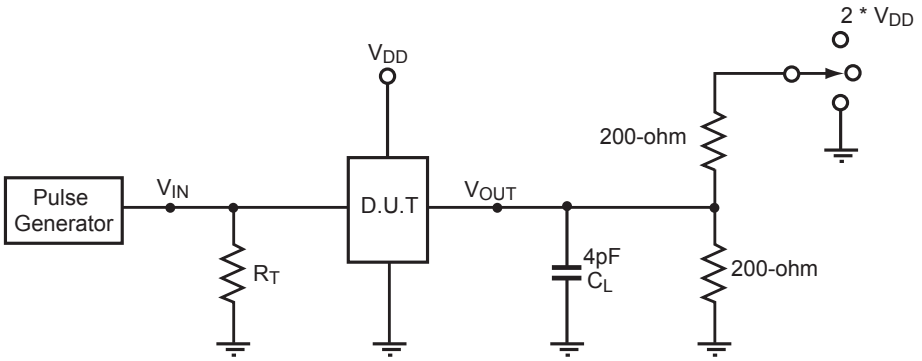


Fig 6. Insertion Loss for SuperSpeed Channels (Tx/Rx). Red is for path B and Blue is for path A

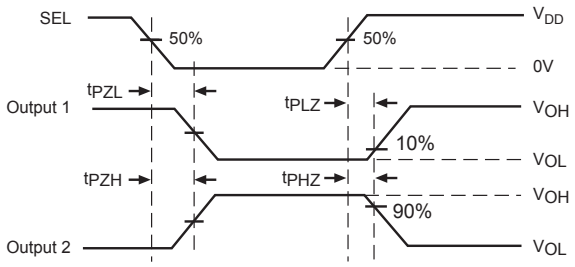
Test Circuit for Electrical Characteristics(1-5)



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.
4. Output 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
5. All input impulses are supplied by generators having the following characteristics: PRR ≤ MHz, $Z_O = 50\Omega$, $t_R \leq 2.5$ns, $t_F \leq 2.5$ns.
6. The outputs are measured one at a time with one transition per measurement.

Switching Waveforms

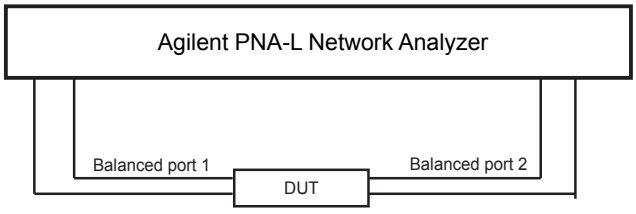


Voltage Waveforms Enable and Disable Times

Switch Positions

Test	Switch
t_{PLZ}, t_{PZL} (output on B-side)	2 * Vdd
t_{PHZ}, t_{PZH} (output on B-side)	GND
Prop Delay	Open

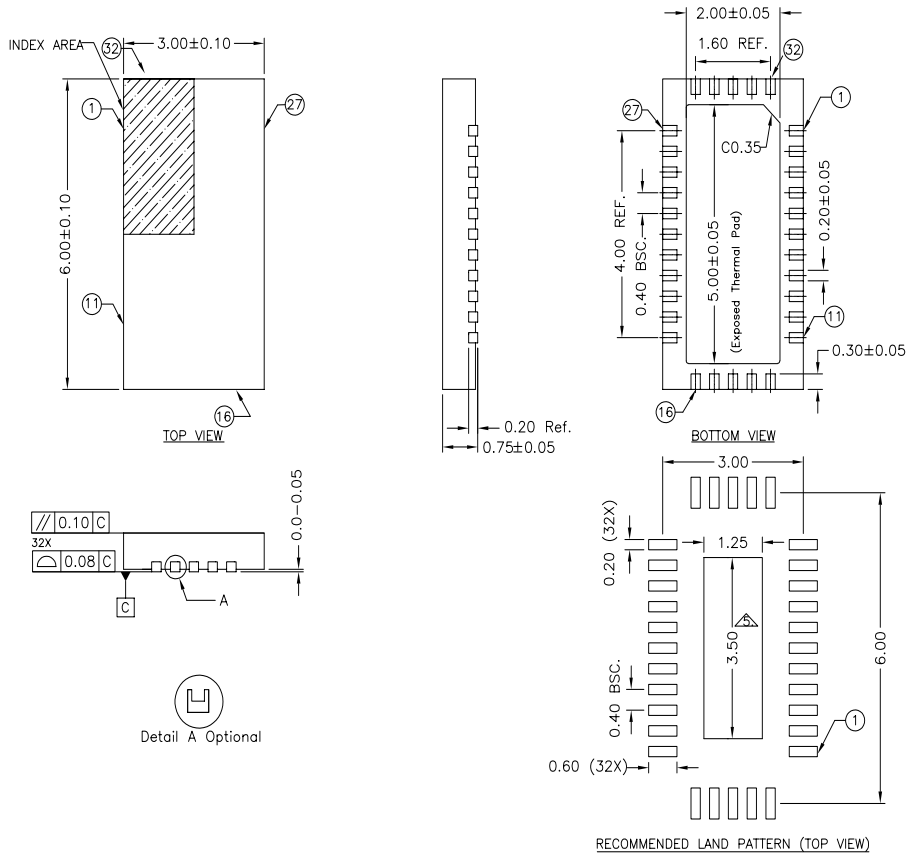
Test Circuit for Dynamic Electrical Characteristics



Part Marking

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

Packaging Mechanical: 32-TQFN (ZL)



DIODES INCORPORATED / PERICOM A PRODUCTLINE OF DIODES INCORPORATED — ENABLING SERIAL CONNECTIVITY	DATE: 04/01/20
DESCRIPTION: 32-Contact, Very Thin Quad Flat No-Lead (TQFN)	
PACKAGE CODE: ZL (ZL32)	
DOCUMENT CONTROL #: PD-2044	REVISION: D

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).

20-1240

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
PI3USB3102ZLEX	ZL	32-contact, Very Thin Quad Flat No-Lead (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

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.

3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.

4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.

5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.

6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.

7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. 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 determinative format released by Diodes.

8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.

9. This Notice may be periodically updated with the most recent version available at https://www.diodes.com/about/company/terms-and-conditions/important-notice

www.diodes.com