

Ultra-High Voltage Protection USB2 1:2 Mux/DeMux

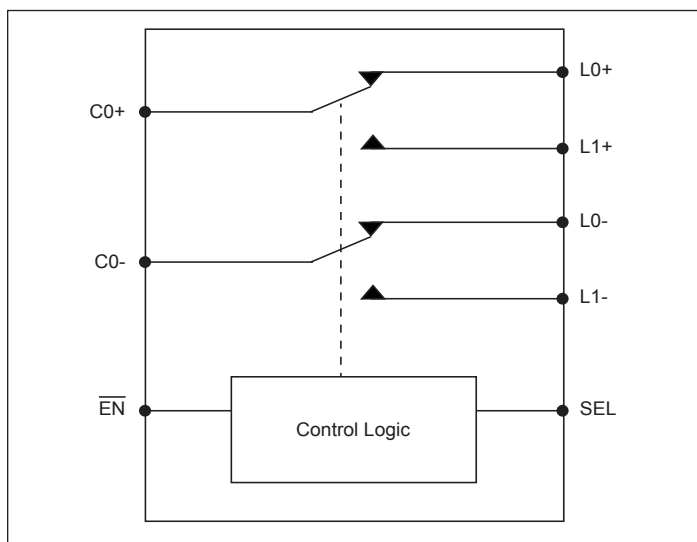
Description

The DIODES PI3USB4000A is a 2-to-1 differential channel multiplexer/demultiplexer switch. C0+/C0- pins can tolerate voltages up to 18V. Over-voltage protection (OVP) is implemented at 4.75V to immediately switch off the channels when over-voltage condition is detected. PI3USB4000A can pass USB2.0 signal with bandwidth 1GHz to maintain signal integrity and eye diagram open.

Application(s)

- Smart Phones
- Type-C Applications
- Tablets
- NBs
- PCs

Block Diagram



Features

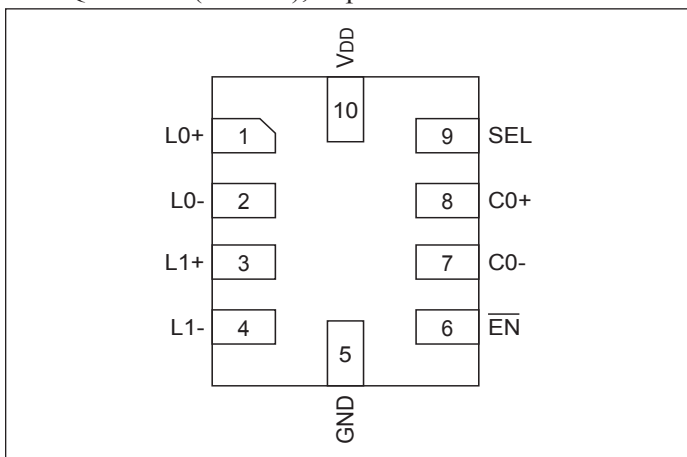
- Differential Bi-Directional 2:1 Mux/DeMux
- Wide Input Voltage Range: 0V to 5.5V
- Wide Bandwidth: 1GHz
 - Ultra-Low Con: 7pF
 - Ultra-Low Ron: 5Ω (typical)
- Low Propagation Delay, 0.25ns typical
- Low Off-Isolation, -30dB@240MHz
- Low Crosstalk: -35dB@240MHz,
- Low Power Consumption: 35μA typical
- Wide Supply Voltage 2.7-5.5V
- Supports 1.8V Logic on Control Pins
- Protection Feature
 - Off-Protection for Current Leakage in Power-Down Mode
 - All I/O Pins are High Voltage Tolerance
 - C0+/C0- Tolerance to 18V
 - Lx+/- Tolerance to 6V
 - V_{DD} Tolerance to 9V
 - Over-Voltage Protection when Vbus Short to C0-/C0+ When Device is Power-On and Enabled
- ESD Protection On (C0+/-)
 - IEC61000-4-2
- Wide Temperature Range: -40°C to 85°C
- 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](https://www.diodes.com/quality/product-definitions/) or your local Diodes representative.
- Packaging (Pb-free & Green):
 - 10-contact, UQFN (ZUA10), 1.5x2mm, 0.5mm(H), 0.6mm pitch
 - 10-contact, UQFN (ZM10), 1.4x1.8mm, 0.55mm(H), 0.4mm pitch

Notes:

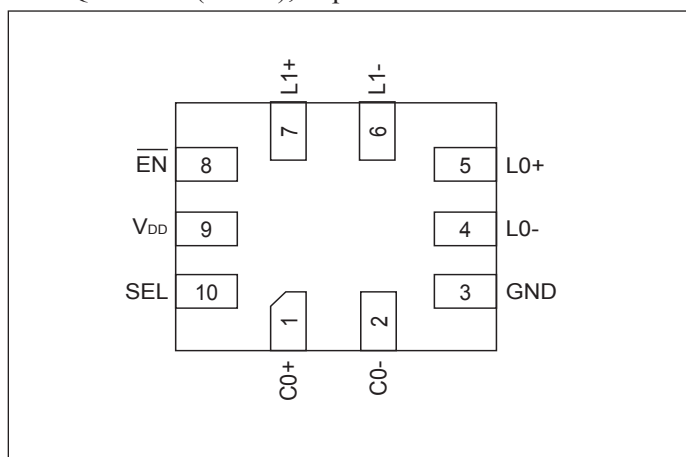
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated’s definitions of Halogen- and Antimony-free, “Green” and Lead-free.
3. Halogen- and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

Pin Configuration

10-UQFN Pin# (ZUA10), Top View



10-UQFN Pin# (ZM10), Top View



Pin Description

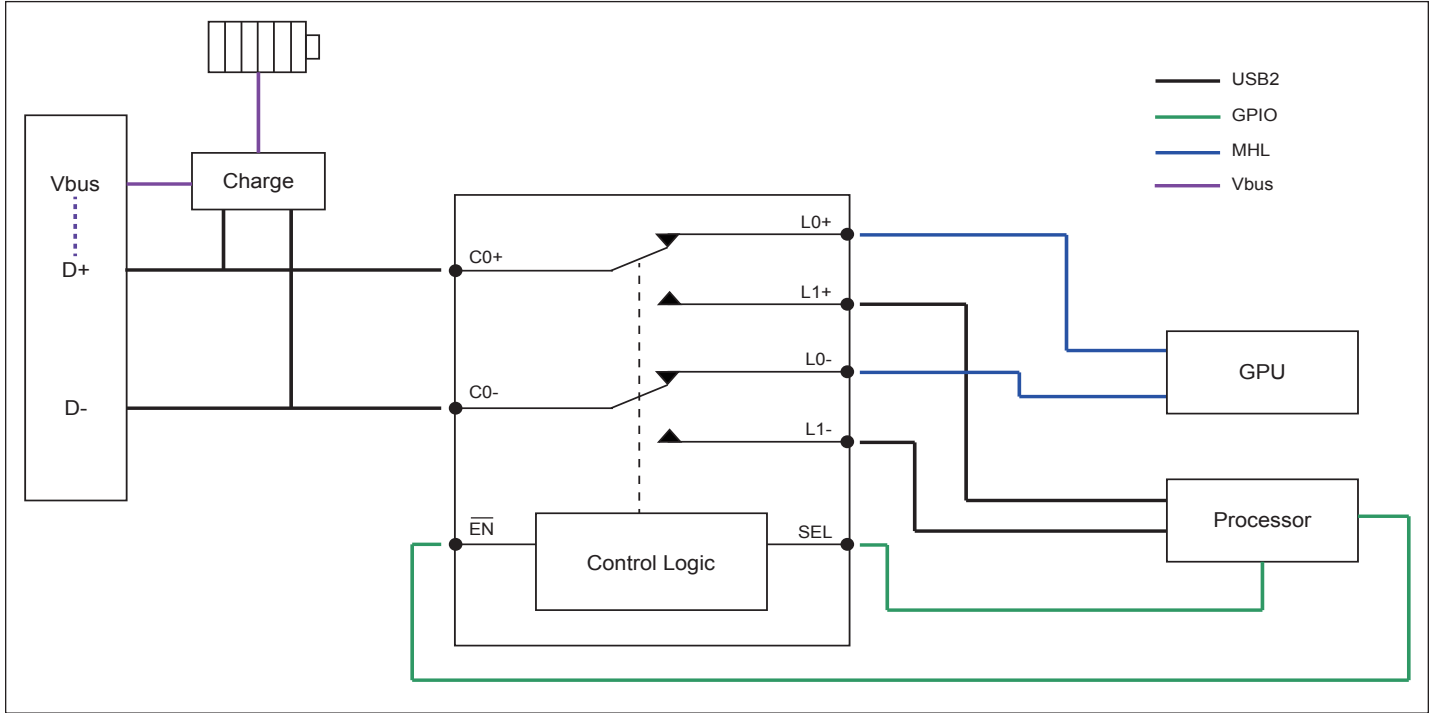
Pin# (ZUA10)	Pin# (ZM10)	Pin Name	Signal Type	Description
8, 7	1, 2	C0+, C0-	I/O	Signal I/O, Common Port
3, 4	7, 6	L1+, L1-	I/O	Signal I/O, Channel 1
1, 2	5, 4	L0+, L0-	I/O	Signal I/O, Channel 0
9	10	SEL	I	Operation mode Select (when SEL = 0: C0 → L0, when SEL = 1: C0 → L1)
6	8	$\overline{\text{EN}}$	I	$\overline{\text{EN}} = 1$, Power down is enabled. Please see Truth Table.
10	9	V _{DD}	Pwr	Positive Supply Voltage
5	3	GND	Pwr	Power ground

Truth Table

Function	SEL	$\overline{\text{EN}}$
C0+/- to L0+/-	L	L
C0+/- to L1+/-	H	L
All Switches Hi-z	x	H

PI3USB4000A

PI3USB4000A application in MHL Switching and provide overvoltage protection for D+/- when high voltage charging



Maximum Ratings

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

Storage Temperature	-65°C to +150°C
Supply Voltage (VDD) to Ground Potential	-0.3V to +9V
Channel Input/Output Voltage (Lx+/-)	-0.3V to +6V
Channel Input/Output Voltage (C0+/-)	-0.3V to +18V
Control Pins Input Voltage ($\overline{\text{EN}}/\text{SEL}$)	-0.3V to +6V
ESD (All Pins).....	2KV (HBM) and 1KV (CDM)
Channel Input/Output Current (Lx/C0).....	±50mA
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.

Recommended Operating Conditions

Symbol	Description	Test Conditions	Min.	Typ.	Max.	Units
V _{DD}	Power Supply		2.7	3.3	6.0	V
V _{IO}	Analog Voltage Range		0		5.5	V
V _I	Voltage Range for Control Pins		0		5.5	V
I _{DD}	Current Consumption in Normal Operation	V _{DD} = 3.3V, V _{IO} = 0V, SEL = GND or V _{DD} , $\overline{\text{EN}}$ = Low		35	45	μA
I _{DD_OVP}	Current Consumption in OVP	V _{DD} = 3.3V, V _{C0+} /V _{C0-} = 5.5V, SEL = GND or V _{DD} , $\overline{\text{EN}}$ = Low		35		μA
I _{DDQ}	Chip Disabled Current Consumption	V _{DD} = 3.3V, V _{IO} = 0V, SEL = GND or V _{DD} , $\overline{\text{EN}}$ = High		1	2	μA
T _A	Operating Temperature Range		-40		85	°C

DC Electrical Characteristics for Switching over Operating Range

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

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Units
Control Pins – $\overline{\text{EN}}/\text{SEL}$						
V _{IH} - cntrl signals	Input HIGH Voltage for SEL and $\overline{\text{EN}}$	V _{DD} = 2.7-5.5V	1.2			V
V _{IL} - cntrl signals	Input LOW Voltage for SEL and $\overline{\text{EN}}$	V _{DD} = 2.7-5.5V			0.6	V
I _{IH}	Input HIGH Current for SEL and $\overline{\text{EN}}$	V _I = 0-5.5V	-1		1	μA
I _{IL}	Input LOW Current for SEL and $\overline{\text{EN}}$	V _I = 0-5.5V	-1		1	μA
High Speed IO – L0/L1/C0						
V _{OVP}	OVP trigger voltage		4.6	4.75	5.0	V
R _{on}	ON resistance	V _{I/O} = 0V, 0.4V, I _{on} = -8 mA		5	8	Ω
Δ R _{on}	On resistance between + and - channel	V _{I/O} = 0V, 0.4V, I _{on} = -8 mA		0.5	1	Ω
R _{on_Flat}	ON resistance flatness	V _{I/O} = 0V, 0.4V, I _{on} = -8 mA		0.2	0.5	Ω
I _{off}	Power-off leakage	V _{DD} = 0V, V _{I/O} = 0 – 3.6V	-1		1	μA
I _{OC}	Channel off leakage current	$\overline{\text{EN}}$ = V _{DD} = 3.3V, V _{I/O} = 0-3.6V	-1		1	μA

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Units
I _{ON}	Channel on leakage current	$\overline{EN} = 0V, V_{DD} = 3.3V, V_{I/O} = 0-3.6V$	-1		1	μA
I _{OVP}	Leakage current on C0+/C0- in OVP mode	$\overline{EN} = 0V, V_{DD} = 3.3V, V_{C0+} \text{ or } V_{C0-} = 14V$		3	15	μA

Dynamic Electrical Characteristics

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

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Units
Control Pins – \overline{EN}/SEL						
C _I	Input capacitance	F = 1MHz		5		pF
High Speed IO – L0/L1/C0						
C _{on}	ON Capacitance	f = 1MHz		7		pF
C _{off}	OFF Capacitance	f = 1MHz		9		pF
DDIL	Insertion Loss	f = 240MHz		-0.5		dB
DDRL	Differential Return Loss	f = 240MHz		-15		dB
DDOI	Differential OFF Isolation	f = 240MHz		-30		dB
		f = 100kHz		-80		dB
DDXT	Differential Crosstalk	f = 240MHz		-35		dB
BW	-3dB Bandwidth			1		GHz

Switching Characteristics⁽¹⁾

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

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Units
t _{OVP}	OVP Response Time ⁽¹⁾	R _{LX} = 600Ω, time from the voltage on C0± = 4~6V to the voltage on L _X ± = 4.75		0.5	1	μs
t _{PZH} , t _{PZL}	Line Enable Time	See Test Circuit for Electrical Characteristics		20		μs
t _{PHZ} , t _{PLZ}	Line Disable Time			50		ns
t _p	Propagation Delay			250		ps
t _{b-b}	Bit-to-bit Skew Within the Same Differential Pair ⁽¹⁾			8	20	ps
T _{on}	Device Enable Time				100	
T _{off}	Device Disable Time			50		ns

Note:

- Guaranteed by design.

PI3USB4000A

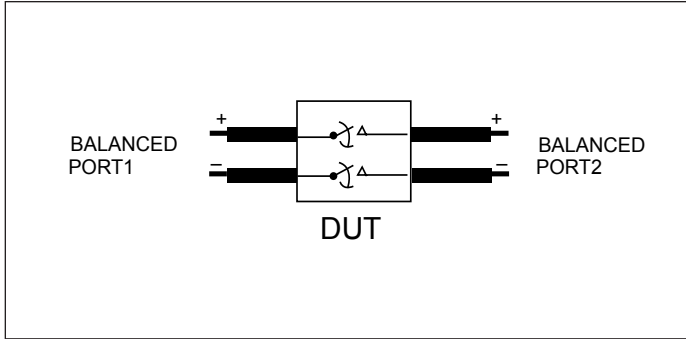


Figure 1. Differential Insertion Loss Setup

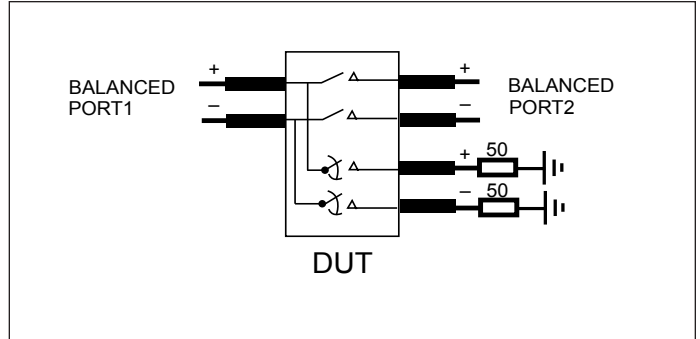


Figure 2. Off-Isolation Setup

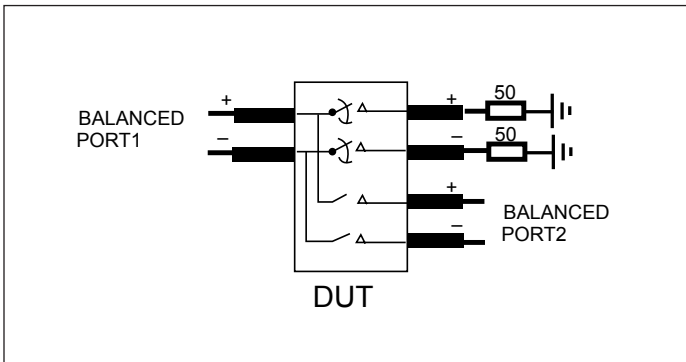


Figure 3. Crosstalk Setup

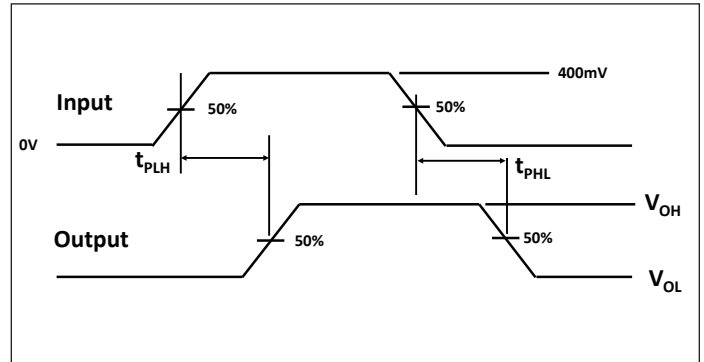


Figure 4. Propagation Delay

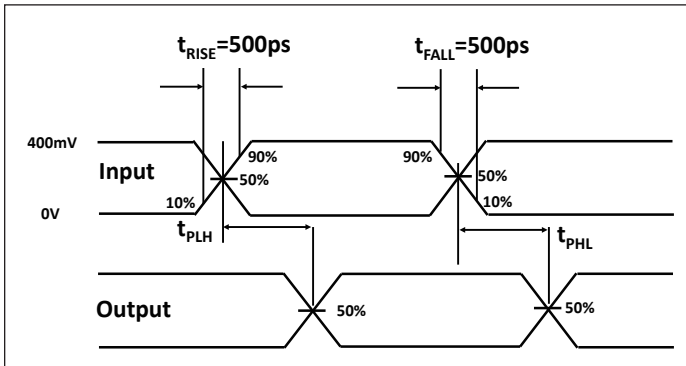
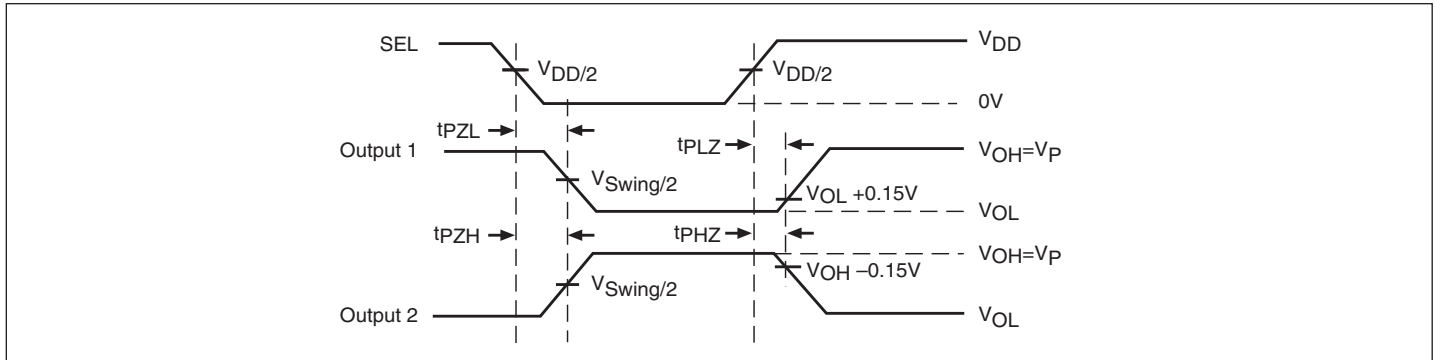


Figure 5. Skew Test

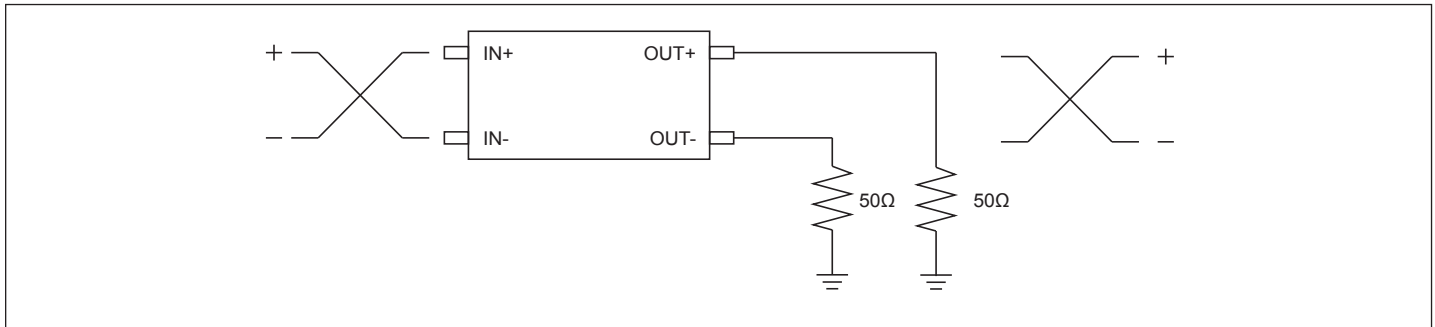
PI3USB4000A

Switching Waveforms



Voltage Waveforms Enable and Disable Times

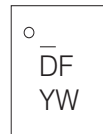
Test Circuit for Propagation Delay



Part Marking

ZM and ZUA Package

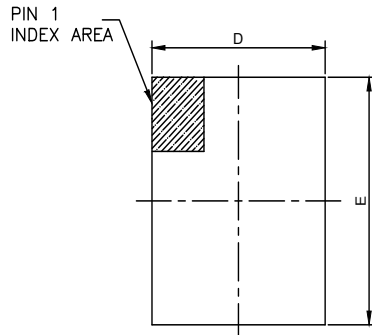
DF: PI3USB4000A



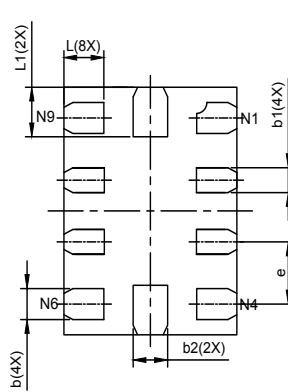
Y: Year
W: Workweek

Packaging Mechanical

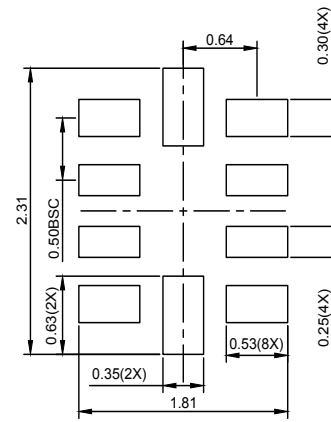
10-UQFN (ZUA)



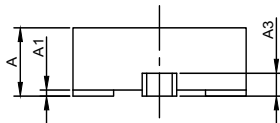
TOP VIEW



BOTTOM VIEW



RECOMMENDED LAND PATTERN(unit:mm)



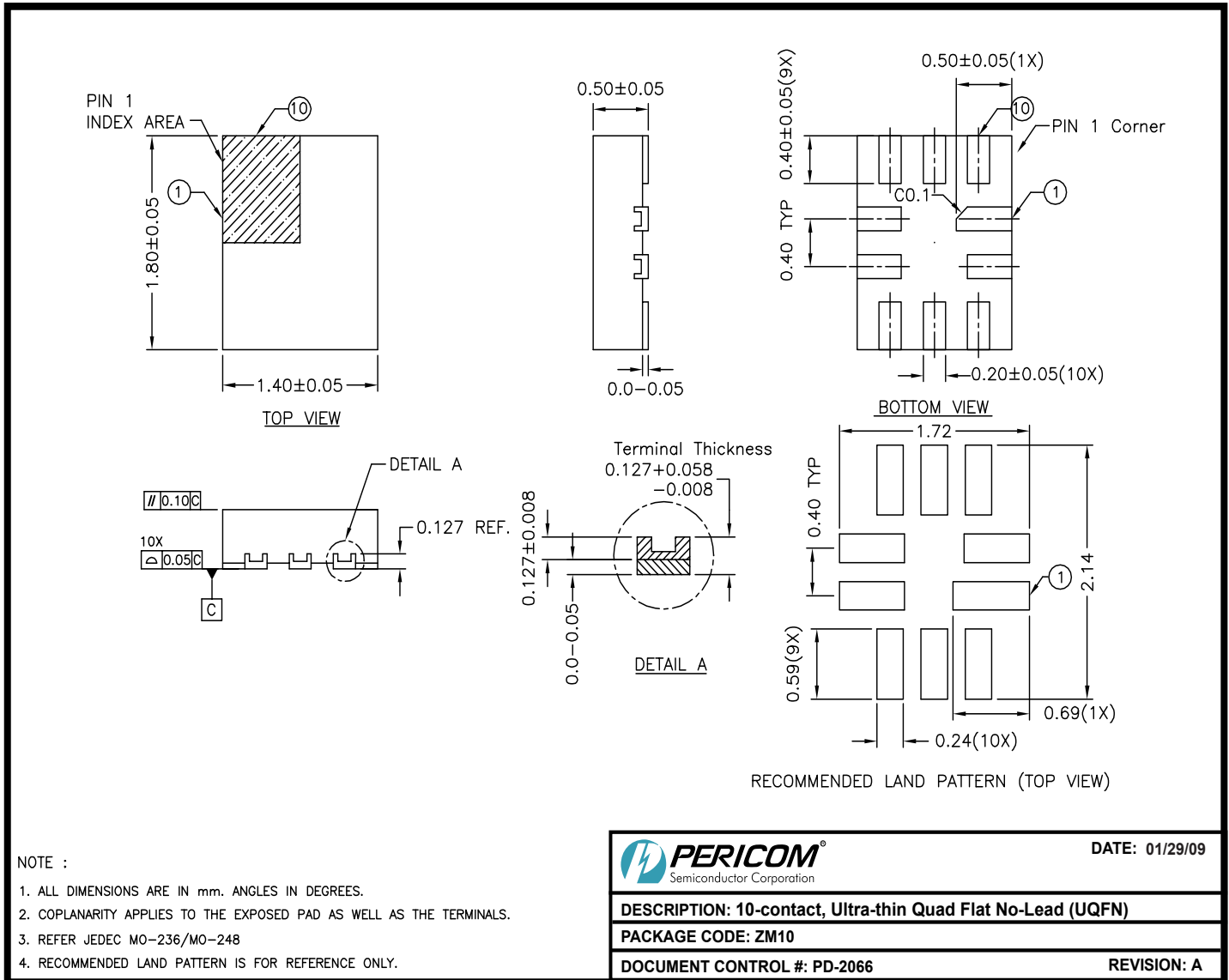
SIDE VIEW

PKG. DIMENSIONS(MM)			
SYMBOL	Min	NOM	Max
A	0.50	0.60	0.65
A1	0.00	0.02	0.05
A3	0.15 REF		
D	1.45	1.50	1.55
E	1.95	2.00	2.05
b	0.20	0.25	0.30
b1	0.15	0.20	0.25
b2	0.25	0.30	0.35
e	0.50 BSC		
L	0.25	0.35	0.45
L1	0.30	0.40	0.50

Notes:

1. Ref: JEDEC MO-288B.

10-UQFN (ZM)



	DATE: 01/29/09
DESCRIPTION: 10-contact, Ultra-thin Quad Flat No-Lead (UQFN)	
PACKAGE CODE: ZM10	
DOCUMENT CONTROL #: PD-2066	REVISION: A

09-0072

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
PI3USB4000AZUAEX	ZUA	10-Pin, 1.5x2.0 (UQFN)
PI3USB4000AZMEX	ZM	10-contact, Ultra-thin Quad Flat No-Lead (UQFN)

Notes:

- No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
- 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.
- Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
- E = Pb-free and Green
- 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>

The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.



All other trademarks are the property of their respective owners.

© 2023 Diodes Incorporated. All Rights Reserved.

www.diodes.com

Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

-  [View PI3USB4000AZUAEX-37 on WIN SOURCE](#)
-  [Diodes Incorporated Information](#)

Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management