Obsolete – Part Discontinued

A product Line of
Diodes Incorporated

PI3USB223

USB 2.0 High-Speed and Audio Switches with Negative Signal Capability

Features

- Single +2.7V to +4.4V Supply Voltage
- Low 50µA Supply Current
- -3dB Bandwidth: 1500MHz (typ)
- Low 2.5Ω(typ)On-Resistance
- THD+N: 0.02%
- Shorting D+/R and D-/L to Vbus will not cause leakage when V_{DD} = 0
- Internal Shunt Resistors for Click-and-Pop Reduction
- VBUS Detection for Automatic Switch Path Selection
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- Packaging (Pb-free & Green available):
  - 10-pin contact UQFN, 1.4 x 1.8, (ZM10)

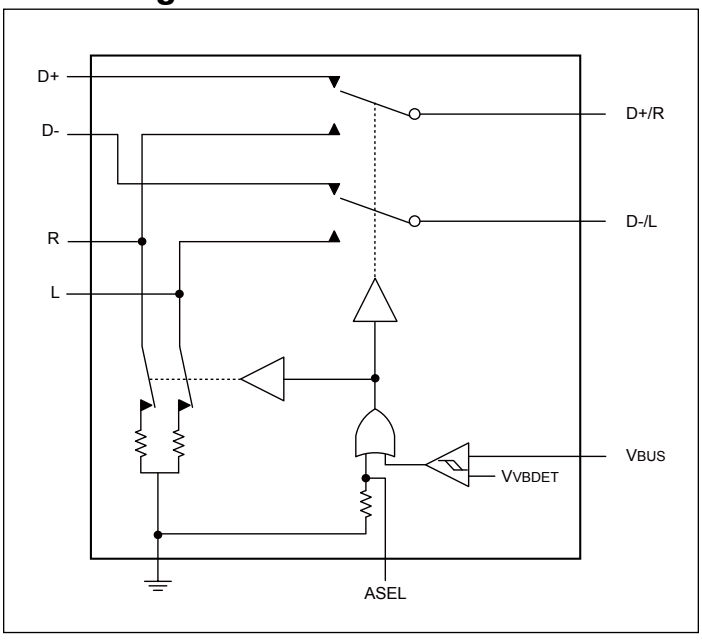
Description

The PI3USB223 combines AC coupled audio signals and USB2.0 HS (480Mbps) on the same pins. This enables users to use a single connector to drive either a USB end point or an audio end point.

PI3USB223 incorporates gate pump technology required to maintain low Ron for ideal audio THD while reducing the capacitance affect of high speed USB signals. The device also incorporates a substrate pump technology which allows -2V signals to pass through the switch without causing any leakage.

The PI3USB223 features protection on D+/R and D-/L to ensure no damage will happen to the IC if these pins are shorted accidentally to Vbus as well as ensuring there is no leakage when V_{DD} is on or off. Also, it includes VBUS detection (VB) to automatically switch to the USB signal path upon detection of a valid VBUS signal. It also features internal shunt resistors on the audio path to reduce clicks and pops heard during output. The device is available in a space-saving 10-pin, 1.4mm x 1.8mm UQFN package, and operate over the -40°C to +85°C temperature range.

Block Diagram



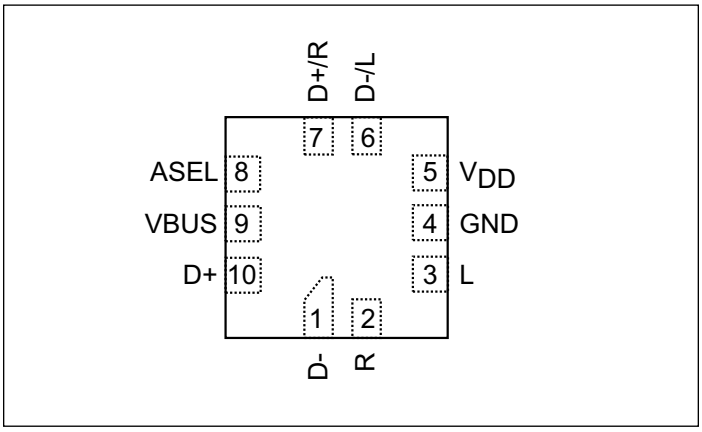
Truth Table

ASEL	V_{DD}	VBUS	L/R	D+/D-	L/R Shunt
X	L	L	OFF	OFF	OFF
X	H	L	OFF	OFF	ON
X	L	H	OFF	OFF	OFF
L	H	H	OFF	ON	ON
H	H	H	ON	OFF	OFF

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#	Name	Description
1	D-	USB D- from system side
2	R	Audio Input (Right)
3	L	Audio Input (Left)
4	GND	Ground
5	V_{DD}	Positive Supply Voltage Input. Bypass V_{DD} to GND with a 0.1µF capacitor as close to the device as possible.
6	D-/L	Common Terminal for D- or Left Audio
7	D+/R	Common Terminal for D+ or Right Audio
8	ASEL	Switch SEL to override VBUS detection when VBUS and $V_{DD}$are both high. If ASEL is HIGH, then audio path will be on If ASEL is LOW then USB path will be on ASEL has an internal 3M-ohm pull-down
9	VBUS	If ASEL is tied LOW, then VBUS detection can be used for auto switching. If ASEL is LOW VBUS = HIGH means USB path is active
10	D+	USB D+ from system side

Maximum Ratings

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

(Voltages referenced to GND.)

V_{DD}, ASEL ..... -0.3V to +5.0V

V_{BUS} ..... -0.3V to +5.5V

$V_{(R/D+)}$ and $V_{(L/D-)}$(1) ..... -2.0V to +5.0V

$V_{(R/D+)}$ and $V_{(L/D-)}$(2) ..... -0.3V to +5.0V

V_R and V_L ..... -2.0Vto (V_{DD}+ 0.3V)

V_{D+} and V_D ..... -0.3V to (V_{DD}+ 0.3V)

Continuous Current into Any Terminal ..... ±100mA

Continuous Power Dissipation (T_A= +70°C)10-Pin UQFN

(derate 6.9mW/°C above +70°C) 559mW

Junction-to-Case Thermal Resistance (θJC)(2)

10-Pin UQFN ..... 20.1°C/W

Junction-to-Ambient Thermal Resistance (θJA)(2)

10-Pin UQFN ..... 143.1°C/W

Operating Temperature Range ..... -40°C to +85°C

Junction Temperature Range ..... -40°C to +150°C

Storage Temperature Range ..... -65°C to +150°C

Lead Temperature (soldering, 10s ..... +300°C

Notes:
1. If Audio path is enabled
2. If USB path is enabled

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

(V_{DD} = 2.7V to 4.4V, T_A = –40°C to +85°C, unless otherwise noted. Typical values are at V_{DD} = 3.0V to 3.6V, T_A = 25°C)

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Operating Power-supply range	V_{DD}			2.7	–	4.4	V
Supply Current	I_{CC}	V_{DD} = 3.3V	ASEL = VBUS = 0V	–	–	50	µA
Power-supply Rejection Ratio	PSRR		f = 10kHz, V_{DD} = 3.0 ±0.3V, $R_{D+/R}$ =50Ω	–	60	–	dB
Analog Signal Range	$V_{D+/-}$			0		V_{DD}	V
	$V_{R/L}$			-2		V_{DD}	
R/L On-Resistance	$R_{ON(R/L)}$		V_{DD} = 3.0V, $V_{R/L}$ = -1.5V, +1.5V, $I_{D+/R \text{ and } D-/L}$ = 10mA		2	5	Ω
D+/D- On-Resistance	$R_{ON(D+/-)}$		V_{DD} = 3.0V, $V_{D+/-}$ = -0.4V to 0.6V, $I_{D+/R \text{ and } D-/L}$ = 10mA		3.5	6	
			V_{DD} = 3.0V, $V_{D+/R \text{ and } D-/L}$ = 0V to 3.0V, $I_{D+/R \text{ and } D-/L}$ = 10mA			12	
R/L On-Resistance Match between Channels	$\Delta R_{ON(R/L)}$		V_{DD} = 3.0V, $V_{R/L}$ = 0V, $I_{D+/R \text{ and } D-/L}$ = 10mA			0.2	
D+/- On-Resistance Match between Channels	$\Delta R_{ON(D+/D-)}$		V_{DD} = 3.0V, $V_{D+/-}$ = 0V, $I_{D+/R \text{ and } D-/L}$ = 10mA			0.2	
R/L On-Resistance Flatness	$R_{FLAT(R/L)}$		V_{DD} = 3.0V, $I_{D+/R \text{ and } D-/L}$ = 10mA, $V_{R/L}$ = -1.5V to+1.5V		0.3	0.5	

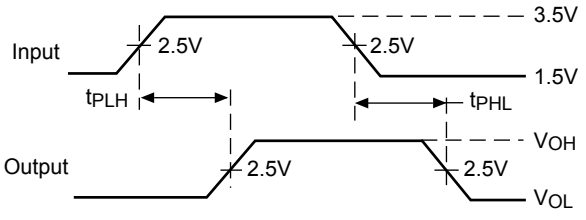
DC Electrical Characteristics Cont.

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
D+/D- On-Resistance Flatness	$R_{FLAT(D+/-)}$		V_{DD} = 3.0V, $I_{D+/R\ and\ D-/L}$ = 10m A, $V_{D+/-}$ = -0.4V to 0.6V		0.25	0.5	Ω
Shunt Switch Resistance	R_{SH}		Voltage on R or L = V_{DD}		25		kΩ
D+/- Off-Leakage Current	$I_{D+/-(OFF)}$		V_{DD} = 3.0V, $V_{D+/-}$ = 5V, $V_{D+/R\ and\ D-/L}$ = -1.5V, +2.5V	-1		1	µA
R/L Off-Leakage Current	$I_{R/L(OFF)}$		V_{DD} = 3.0V, $V_{R/L}$ = 0V, $V_{D+/R\ and\ D-/L}$ = 0V, +2.5V	-1		1	
D+/R and D-/L Off-Leakage Current	$I_{D+/R\ and\ D-/L(OFF)}$		V_{DD} = 3.0V, $V_{D+/R\ and\ D-/L}$ = 3.6V, $V_{D+/-}$ = $V_{R/L}$ = 0V			5	µA
			V_{DD} = 3.3V, $V_{D+/R\ and\ D-/L}$ = 0V, $V_{D+/-}$ = $V_{R/L}$ = 0V			5	
			V_{DD} = 0V, $V_{D+/R\ or\ D-/L}$ = 5.0V, $V_{D+/-}$ = $V_{R/L}$ = 0V			5	
System Bus Input Voltage	V_{BUS}			0		5.5	V
D+/R and D-/L On-Leakage Current	$I_{D+/R\ and\ D-/L(ON)}$	USB Mode	V_{DD} = 3.0V, $V_{R/L}$ = 0V,2.5V, unconnected, $V_{D+/R\ and\ D-/L}$ = 0V, 2.5V	-200		200	nA
		Audio Mode	V_{DD} = 3.0V, $V_{D+/-}$ = 0V, 2.5V, unconnected, $V_{D+/R\ and\ D-/L}$ = -1.5V, +2.5V	-200		200	
Turn-On Time	t_{ON}	R/L to D-/L or D+/R, V_{DD} = 3.0V, Fig. 2	$V_{R/L}$ = 1.5V, Z_L = 50-ohm//35pF, ASEL = V_{DD}, V_{BUS} = 5.0V to 0V		12	60	µs
		D+/- to D-/L or D+/R, V_{DD} = 3.0V, Fig. 2	$V_{R/L}$ = 1.5V, Z_L = 50-ohm//35pF, V_{VBUS} = 5.0V, ASEL = 0V to V_{DD}		12	60	
Turn-Off Time	t_{OFF}	R/L to D-/L or D+/R, V_{DD} = 3.0V, Fig. 2	$V_{R/L}$ = 1.5V, Z_L = 50-ohm//35pF, ASEL = V_{DD}, V_{BUS} = 5.0V to 0V		1.4	5	
		D+/- to D-/L or D+/R, V_{DD} = 3.0V, Fig. 2	$V_{R/L}$ = 1.5V, Z_L = 50-ohm//35pF, V_{VBUS} = 5.0V, ASEL = 0V to V_{DD}		0.7	5	
Break-Before-Make Time Delay	t_D	Z_L = 50Ω // 35pF			13.5		

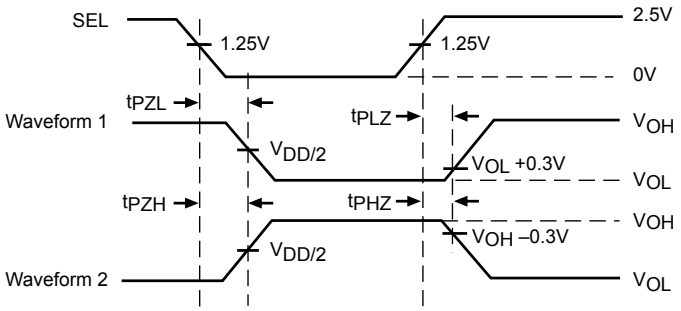
DC Electrical Characteristics Cont.

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Output Skew Same Switch	$t_{SK(P)}$	Figure 3		10		ps
Output Skew Between Switches	$t_{SK(O)}$	Figure 3		10		
R/L Off-Capacitance	$C_{R/L(OFF)}$	$V_{D+/R \text{ and } D-/L}$ = 0.5V_{PP}, DC Bias = 0V, f = 1MHz,		3		pF
D+/- Off-Capacitance	$C_{D+/-(OFF)}$	$V_{D+/R \text{ and } D-/L}$ = 1.5V_{PP}, DC Bias = 0V, f = 240MHz,		2.5		
On-Capacitance	$C_{D+/R \text{ and } D-/L(ON)}$	USB Path, F = 240MHz, DC bias = 0V		9		
		Audio path, f = 100kHz, DC bias = 0V		8		
AC PERFORMANCE						
R/L -3dB Bandwidth	$BW_{R/L}$	R_S = R_L = 50Ω, $V_{R/L}$ = 0dBm, Figure 4		1100		MHz
D+/- -3dB Bandwidth	$BW_{D+/-}$	R_S = R_L = 50Ω, $V_{D+/-}$ = 0dBm, Figure 4		1500		
Insertion Loss	$I_{N((USB Path)}$	Frequency = 240MHz		-0.5		dB
Off Isolation	I_{SO}	Figure 4, f = 240MHz		-35		
Crosstalk	X_{TALK}	f = 100kHz, V_{COM} = 1V_{RMS}, R_S = R_L = 50Ω, Figure 4		-80		
Total Harmonic Distortion + Noise	THD + N (for audio path)	R/L to D+/R and D-/L, f = 20Hz to 20kHz, $V_{D+/R \text{ and } D-/L}$ = 0.5V_{PP}, DC Bias = 0V, R_L =600Ω		0.02		%
LOGIC INPUT						
Input Logic High	V_{IH} for ASEL		1.6			V
Input Logic Low	V_{IL} for ASEL				0.4	
	V_{IH} for Vbus		3.5		5.5	
	V_{IL} for Vbus		0		0.6	
Input Leakage Current	I_{IN}	VASEL and VVbus = 0V or V_{DD}	-10		10	µA
ESD PROTECTION						
All Pins		Human Body Model		±2		kV
D+/R, D-/L, and VBUS		Human Body Model		±12		
D+/R, D-/L, and VBUS		Contact, IEC61000-4-2		±8		

Switching Waveforms



Voltage Waveforms Propagation Delay Times



Voltage Waveforms Enable and Disable Times

Test Circuits and Timing Diagrams

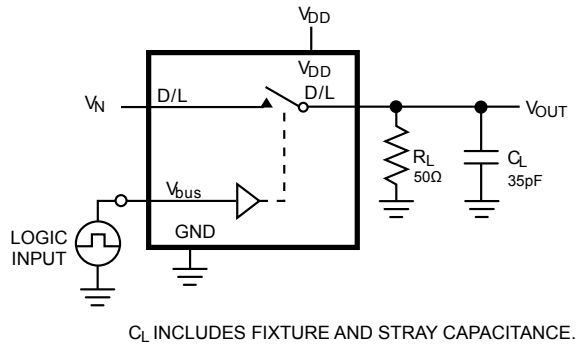


Figure 1. AC Test Circuit

Note:
1. Unused input (NC or NO) must be grounded.

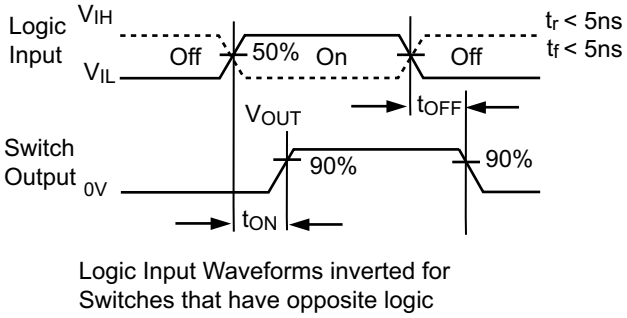


Figure 2. AC Waveforms

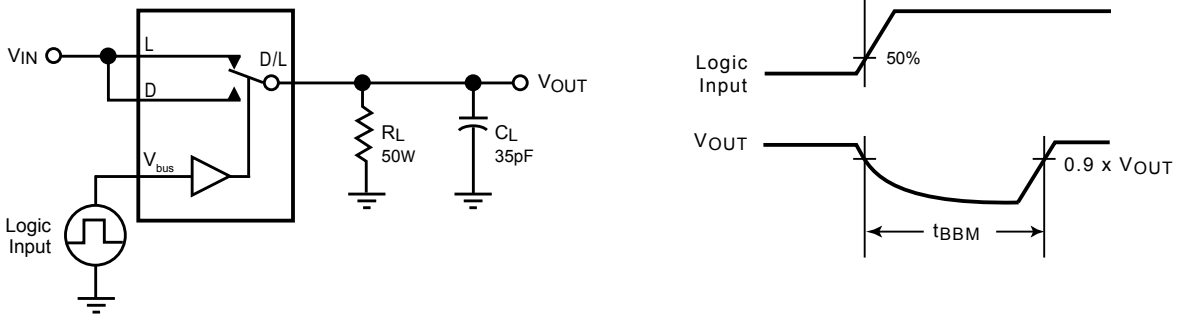


Figure 3. Break Before Make Interval Timing

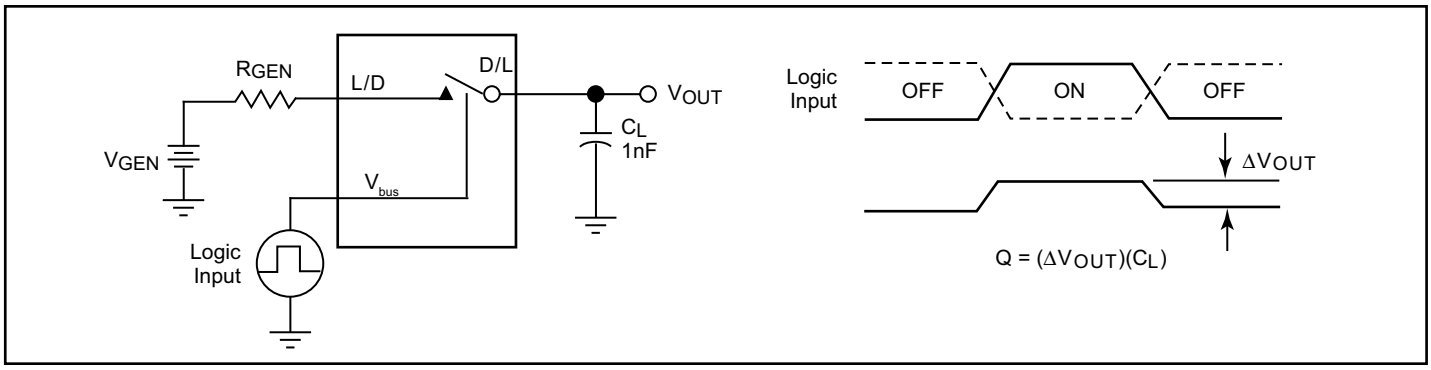


Figure 4. Charge Injection Test

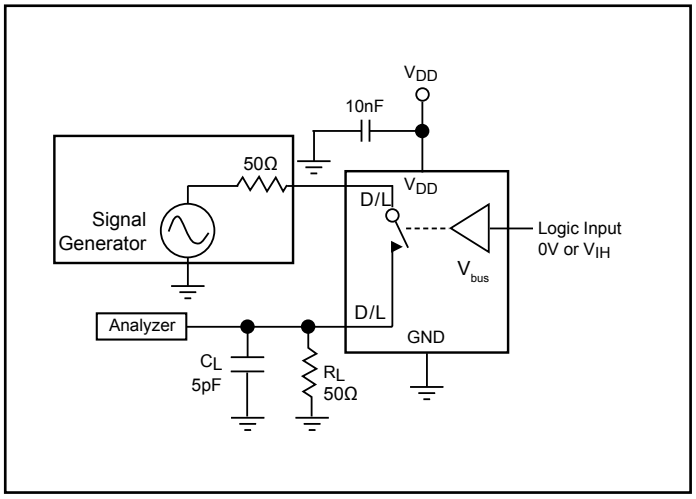


Figure 5. Off Isolation

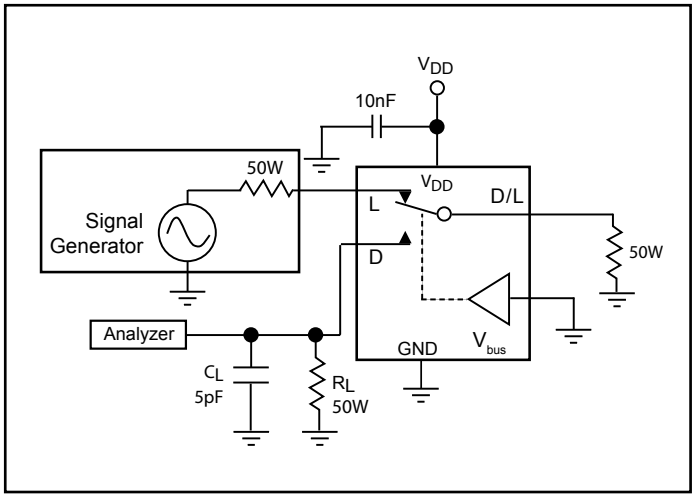


Figure 6. Crosstalk

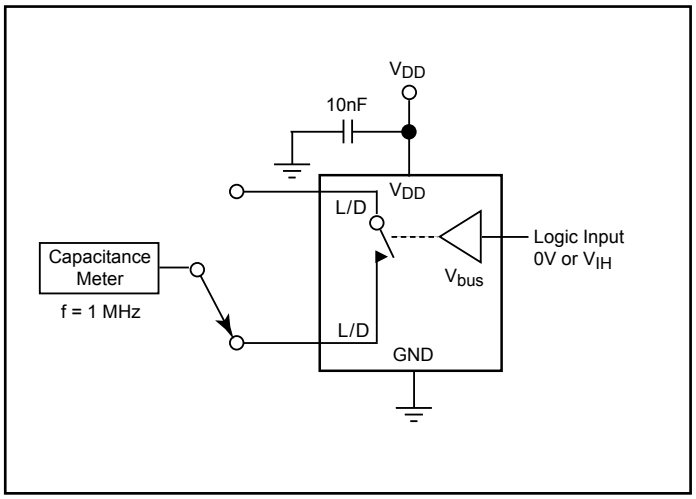


Figure 7. Channel Off Capacitance

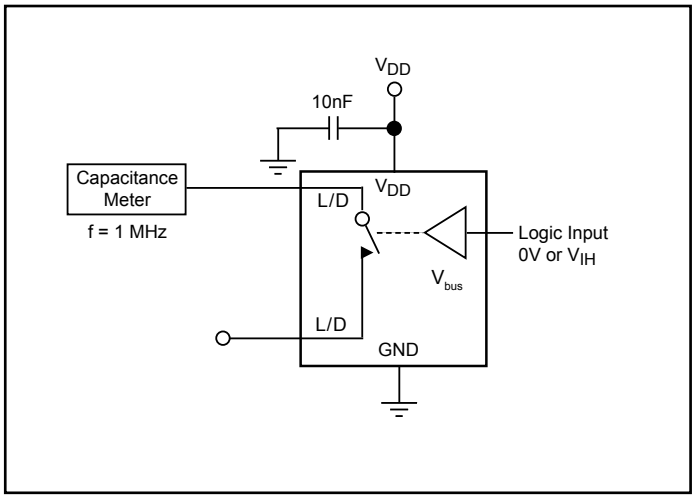


Figure 8. Channel On Capacitance

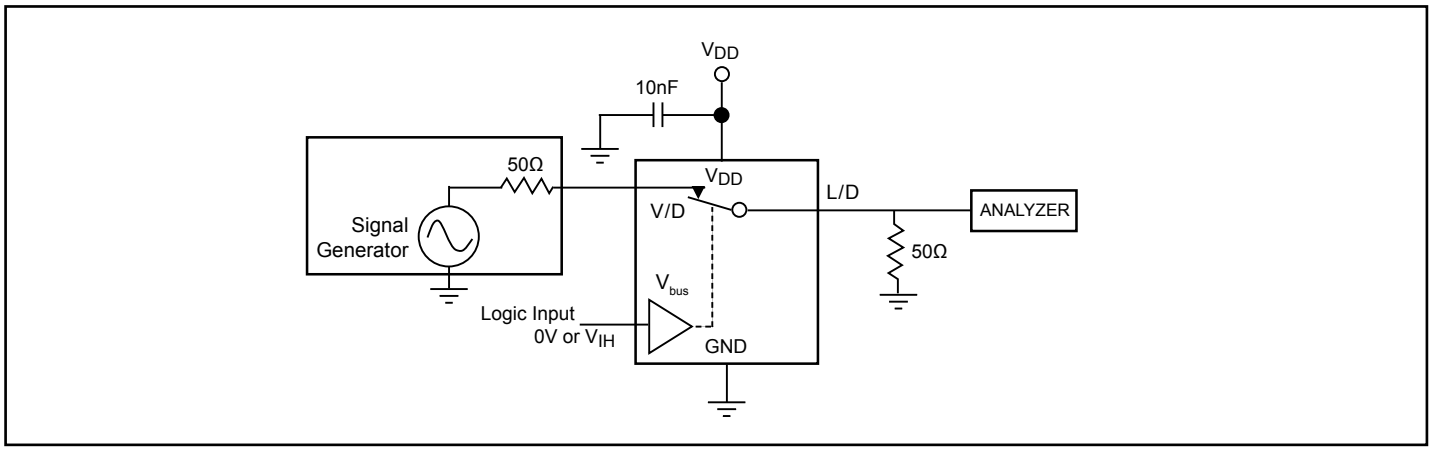
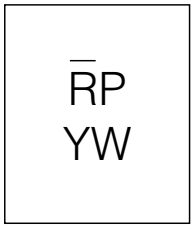


Figure 9. Bandwidth

Part Marking

ZM Package

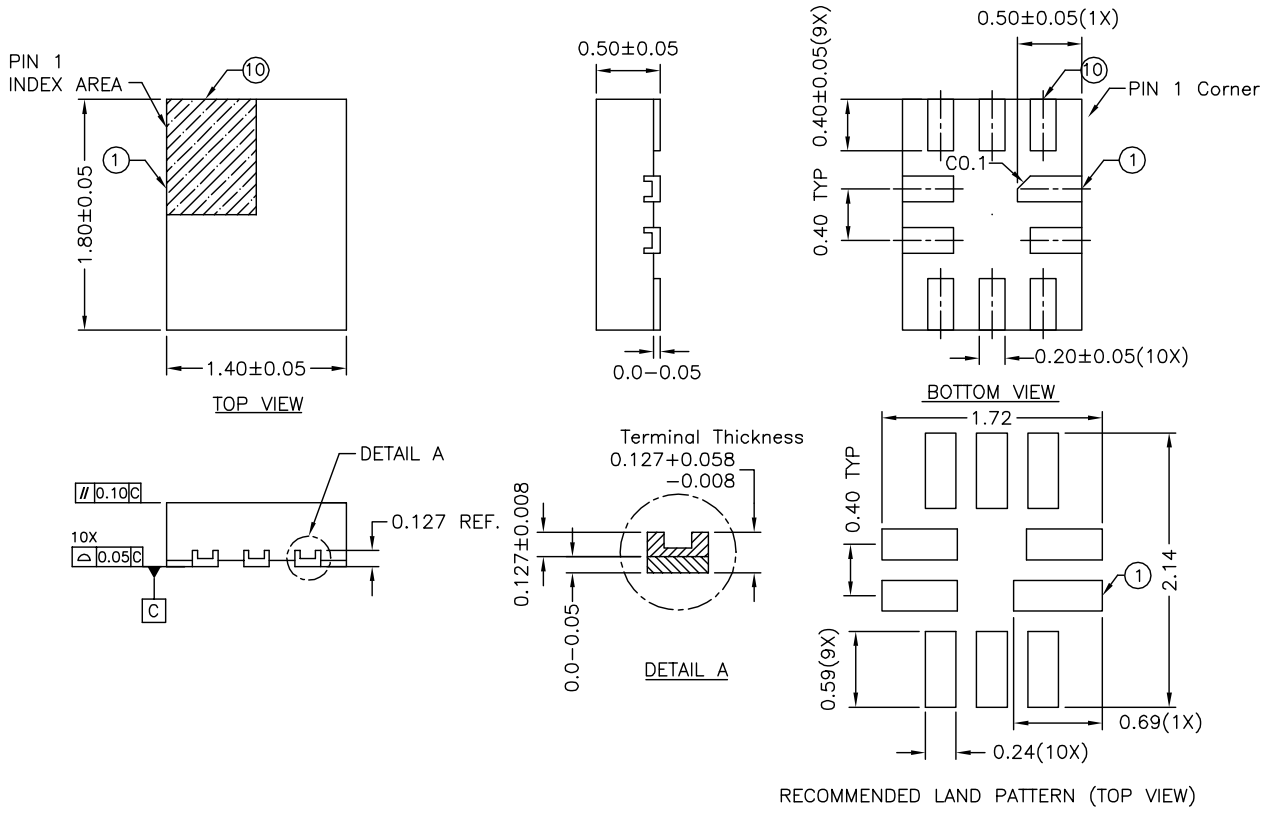
Line above first chatacter denotes
Lead-free and pin 1 indicator



RP: PI3USB223ZME
Y: Year
W: Workweek

Packaging Mechanical

10-UQFN (ZM)



NOTE :

1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
3. REFER JEDEC MO−236/MO−248
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.

PERICOM Semiconductor Corporation — 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	Description	Top Mark
PI3USB223ZMEX	ZM	10-contact, Ultra-thin Quad Flat No-Lead (UQFN)	RP

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
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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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