High-Speed USB2.0 1:2 Multiplexer/ DeMultiplexer Switch with Signal Enable

Features

- V_{DD} Operation at 2.5 V and 3.3 V
- $V_{I/O}$ Accepts Signals up to 5.5 V
- 1.8-V Compatible Control-Pin Inputs
- Low-Power Mode When $\overline{OE}$ Is Disabled (2 µA)
- r_{ON} = 6Ω Maximum
- Δr_{ON} = 0.2Ω Typical
- Cio(on) = 6 pF Maximum
- Low Power Consumption (50 µA Maximum)
- ESD > 8kV contact on USB signal path per IEC61000-4-2)
- High Bandwidth (1.1 GHz Typical)
- Packaging (Pb-free & Green):
  - 10-contact, TDFN (ZE10)
  - 10-contact, TLLGA (XA10)

Description

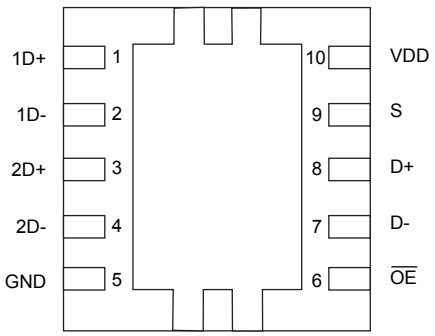
The PI3USB221 is a high-bandwidth switch specially designed for the switching of high-speed USB 2.0 signals in handset and consumer applications, such as cell phones, digital cameras, and notebooks with hubs or controllers with limited USB I/Os. The wide bandwidth (1.1 GHz) of this switch allows signals to pass with minimum edge and phase distortion. The device multiplexes differential outputs from a USB host device to one of two corresponding outputs. The switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. It is designed for low bit-to-bit skew and high channel-to-channel noise isolation, and is compatible with various standards, such as high-speed USB 2.0 (480 Mbps).

Applications

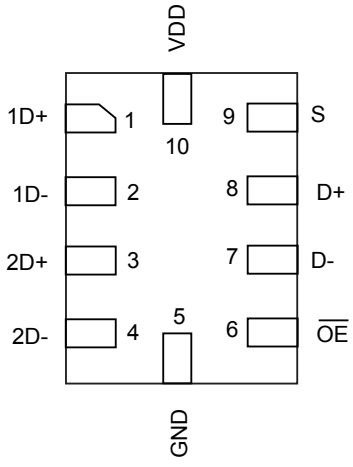
- Routes Signals for USB 1.0, 1.1, and 2.0
- Mobile Industry Processor Interface (MIPI) Signal Routing

Pin Configuration

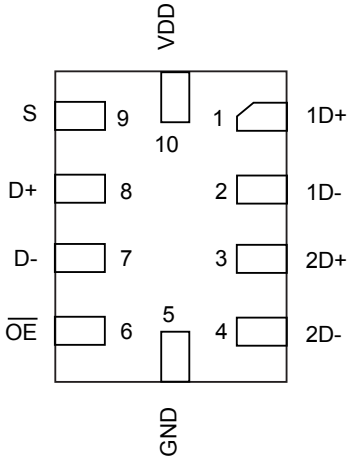
TDFN Package
(Top View)



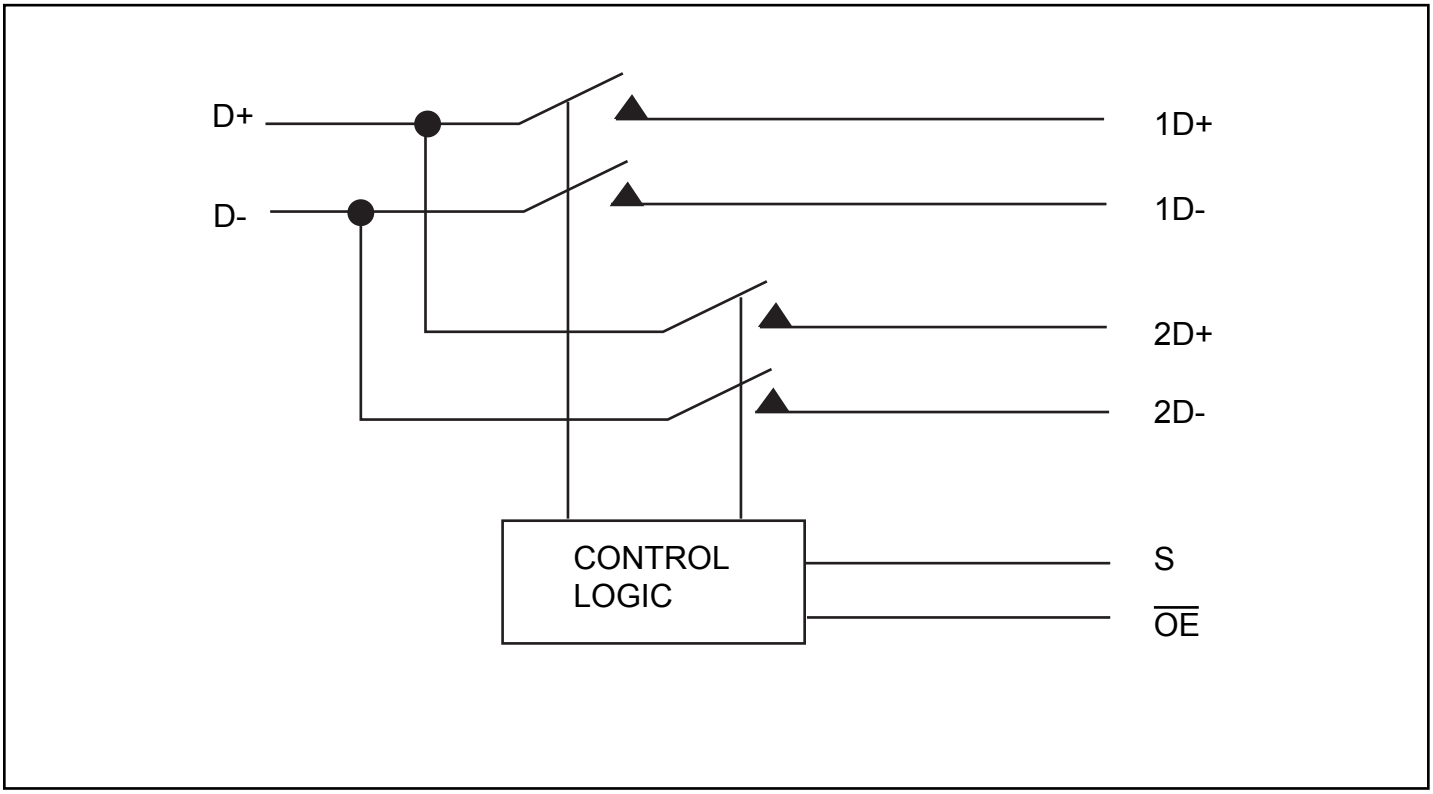
TLLGA Package
(Top View)



TLLGA Package
(Bottom View)



Block Diagram



Pin Description

NAME	DESCRIPTION
$\overline{OE}$	Active LOW, Output enable
S	Select input
D	COM port
nD	I/O for USB data path (port 1 and port 2)

Truth Table

S	$\overline{OE}$	FUNCTION
X	H	Disconnect
L	L	D = 1D
H	L	D = 2D

ABSOLUTE MAXIMUM RATINGS[1]

Over operating free-air temperature range (unless otherwise noted)

V_{DD} Supply Voltage Range ..... –0.5V to 4.6V
V_{IN} Control Input Voltage Range[2, 3] ..... –0.5V to 7V
$V_{I/O}$ Switch I/O Voltage Range[2, 3, 4] ..... –0.5V to 7V
I_{IK} Control Input Clamp Current (V_{IN} < 0) ..... –50mA
$I_{I/OK}$ I/O Port Clamp Current ($V_{I/O}$ < 0) ..... –50mA
$I_{I/O}$ ON-state Switch Current[5] ..... ±120mA
Continuous current through V_{DD} or GND ..... ±100mA
θ_{JA} Package Thermal Impedance
TLLGA Package ..... 48.7°C/W
TDFN Package ..... 243°C/W
T_{stg} Storage temperature range ..... –65 to 150°C

Notes:

1. Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
2. All voltages are with respect to ground, unless otherwise specified.
3. The input and output voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
4. VI and VO are used to denote specific conditions for VI/O.
5. II and IO are used to denote specific conditions for II/O.
6. The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions[1]

Symbol	Description	Parameter	Min	Max	Unit
V_{DD}	Supply voltage		2.3	3.6	V
V_{IH}	High-level control input voltage	V_{DD} = 2.3 V to 2.7 V	1.4	-	
		V_{DD} = 2.7 V to 3.6 V	1.3	-	
V_{IL}	Low-level control input voltage	V_{DD} = 2.3 V to 2.7 V		0.6	
		V_{DD} = 2.7 V to 3.6 V		0.6	
$V_{I/O}$	Data input/output voltage		0	5.5	
T_A	Operating free-air temperature		–40	85	°C

Note:

1. All unused control inputs of the device must be held at V_{DD} or GND to ensure proper device operation.

ELECTRICAL CHARACTERISTICS

Over operating free-air temperature range (unless otherwise noted)

Parameter		Testing Conditions		Min	Typ	Max	Unit
V_{IK}		V_{DD} = 3.6V, 2.7V, I_I = –18 mA				–1.8	V
I_{IN}	Control Inputs	V_{DD} = 3.6V, 2.7V, 0V, V_{IN} = 0V to 3.6V				±1	µA
I_{OZ}[3]		V_{DD} = 3.6V, 2.7V, V_{IN} = V_{DD} or GND, V_O = 0V to 3.6V, V_I = 0V, Switch OFF				±1	
$I_{(OFF)}$		V_{DD} = 0V	$V_{I/O}$ = 0V to 3.6V			±2	
			$V_{I/O}$ = 0 to 2.7V			±1	
I_{CC}		V_{DD} = 3.6V, 2.7V, V_{IN} = V_{DD} or GND, $I_{I/O}$ = 0 V, Switch ON or OFF				50	
I_{CC} (low power mode)		V_{DD} = 3.6V, 2.7V, V_{IN} = V_{DD} or GND, Switch disabled, ($\overline{OE}$ in high state)				2	
DI_{CC}[4]	Control Inputs		V_{DD} = 2.7V, S sweeps from 1.4V to 3.3V, OE/ = 0V			15	
			V_{DD} = 2.7V, OE/ sweeps from 1.4V to 3.3V, S = 0V			0.75	
C_{IN}	Control Inputs	V_{DD} = 3.3V, 2.5V, V_{IN} = 3.3V or 0V			1	2	pF
$C_{io(OFF)}$		V_{DD} = 3.3V, 2.5V, V_{IN} = 3.3V or 0V, Switch OFF			2	4	
$C_{io(ON)}$		V_{DD} = 3.3V, 2.5V, V_{IN} = 3.3V or 0V, Switch ON			5	6	
r_{ON}[5]		V_{DD} = 3V, 2.3V	V_I = 0V, I_O = 30 mA			6	Ω
			V_I = 2.4V, I_O = –15 mA			6	
Dr_{ON}		V_{DD} = 3V, 2.3V	V_I = 0V, I_O = 30 mA		0.2		
			V_I = 1.7V, I_O = –15 mA		0.2		
$r_{ON(flat)}$		V_{DD} = 3V, 2.3V	V_I = 0V, I_O = 30 mA		1		
			V_I = 1.7V, I_O = –15 mA		1		

Notes:

1. V_{IN} and I_{IN} refer to control inputs. VI, VO, II, and IO refer to data pins.
2. All typical values are at V_{DD} = 3.3 V (unless otherwise noted), T_A = 25°C.
3. For I/O ports, the parameter IOZ includes the input leakage current.
4. This is the increase in supply current for each input that is at the specified TTL voltage level, rather than V_{DD} or GND.
5. Measured by the voltage drop between the input and output terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two terminals.

DYNAMIC ELECTRICAL CHARACTERISTICS over operating range, T_A = –40°C to 85°C, V_{DD} = 3.3 V ± 10%, GND = 0V

Symbol	Parameter	Test Conditions	Typ[1]	Unit
X_{TALK}	Crosstalk	R_L = 50Ω, f = 250 MHz	–40	dB
O_{IRR}	OFF isolation	R_L = 50Ω, f = 250 MHz	–41	
BW	Bandwidth (–3 dB)	R_L = 50Ω	1.1	GHz

Note:

1. For Max or Min conditions, use the appropriate value specified under Electrical Characteristics for the applicable device type.

SWITCHING CHARACTERISTICS over operating range, T_A = –40°C to 85°C, V_{DD} = 3.3 V ± 10%, GND = 0V

Symbol	Parameter		Min	Typ[1]	Max	Unit
t_{pd}	Propagation Delay[2,3]			0.25		ns
t_{ON}	Line enable time	S to D, nD			125	
		$\overline{OE}$ to D, nD			100	
t_{OFF}	Line disable time	S to D, nD			12	
		$\overline{OE}$ to D, nD			12	
$t_{SK(O)}$	Output skew between center port to any other port[2]			0.1	0.2	
$t_{SK(P)}$	Skew between opposite transitions of the same output (tPHL – tPLH)[2]			0.1	0.2	

Notes:
1. For Max or Min conditions, use the appropriate value specified under Electrical Characteristics for the applicable device type.
2. Specified by design
3. The switch contributes no propagational delay other than the RC delay of the on resistance of the switch and the load capacitance. The time constant for the switch alone is of the order of 0.25 ns for 10-pF load. Since this time constant is much smaller than the rise/fall times of typical driving signals, it adds very little propagational delay to the system. Propagational delay of the bus switch, when used in a system, is determined by the driving circuit on the driving side of the switch and its interactions with the load on the driven side.

Application Information

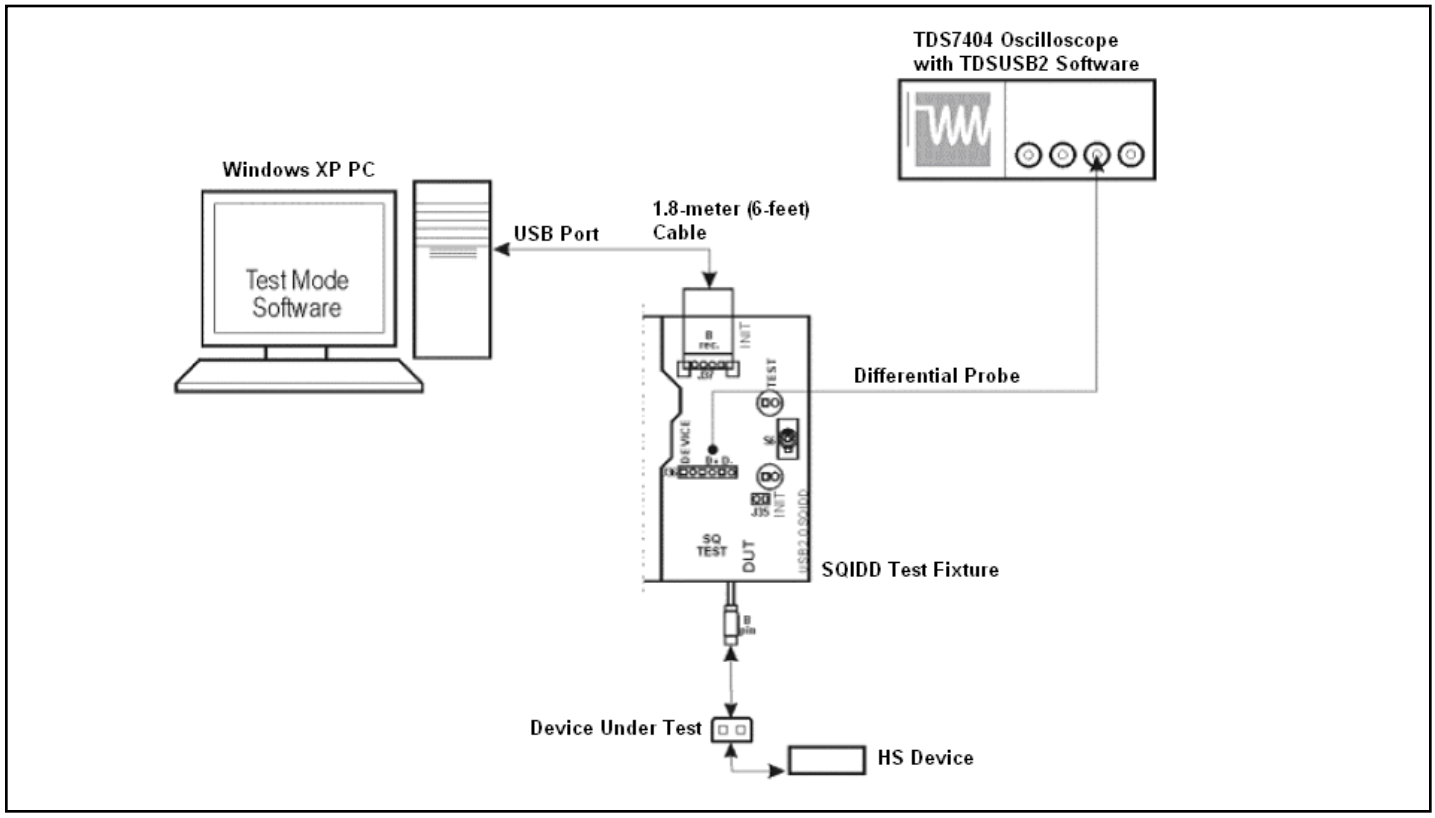
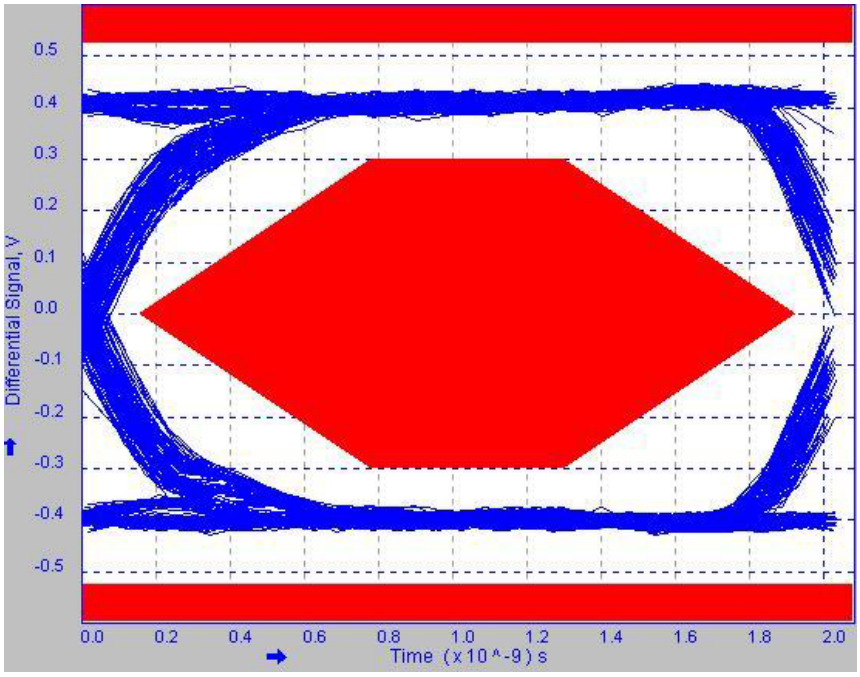


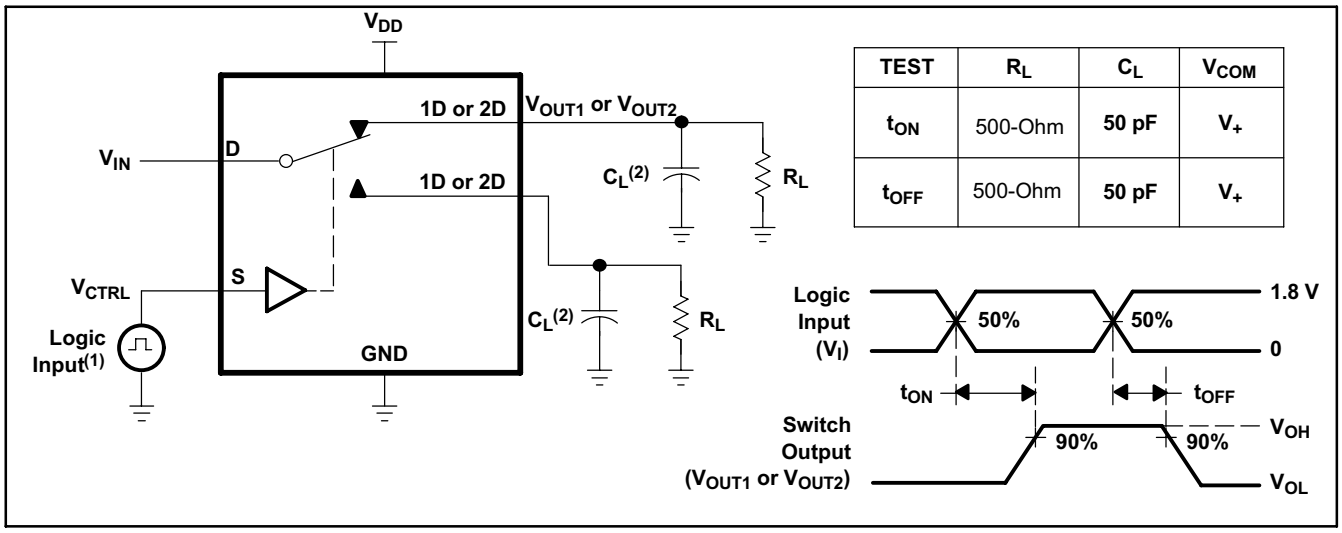
Figure 5: HS Eye Test Setup

Test Result



Test Result 1: High-speed, Up-stream, Near-end Eye of PI3USB221

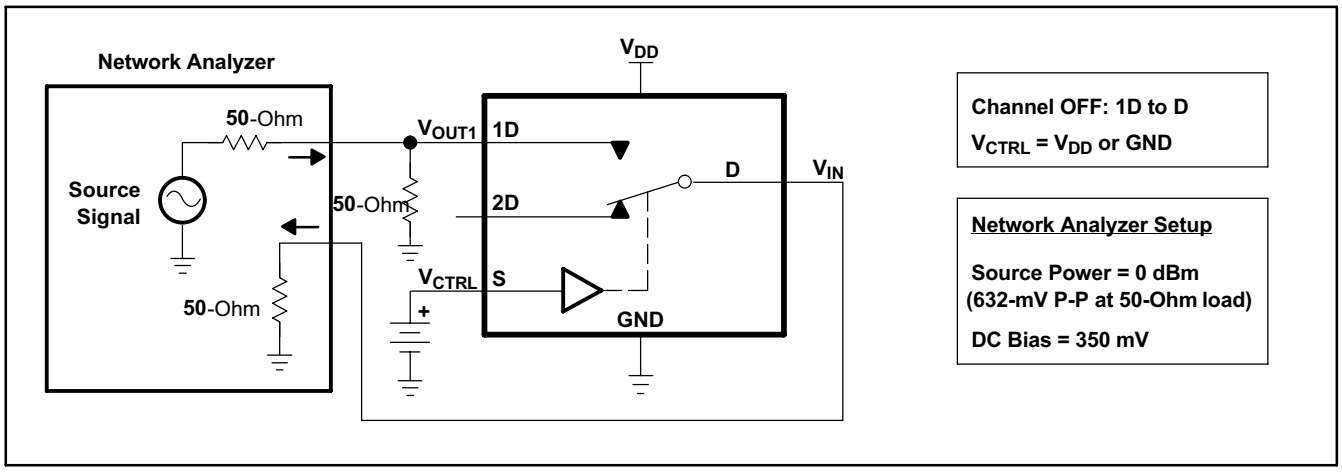
PARAMETER MEASUREMENT INFORMATION



TEST	R_L	C_L	V_{COM}
t_{ON}	500-Ohm	50 pF	V_+
t_{OFF}	500-Ohm	50 pF	V_+

(1) All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, Z_O = 50-Ohm, t_r < 5 ns, t_f < 5 ns.
(2) C_L includes probe and jig capacitance.

Turn-On (t_{ON}) and Turn-Off Time (t_{OFF})



OFF Isolation (O_{ISO})

PARAMETER MEASUREMENT INFORMATION (continued)

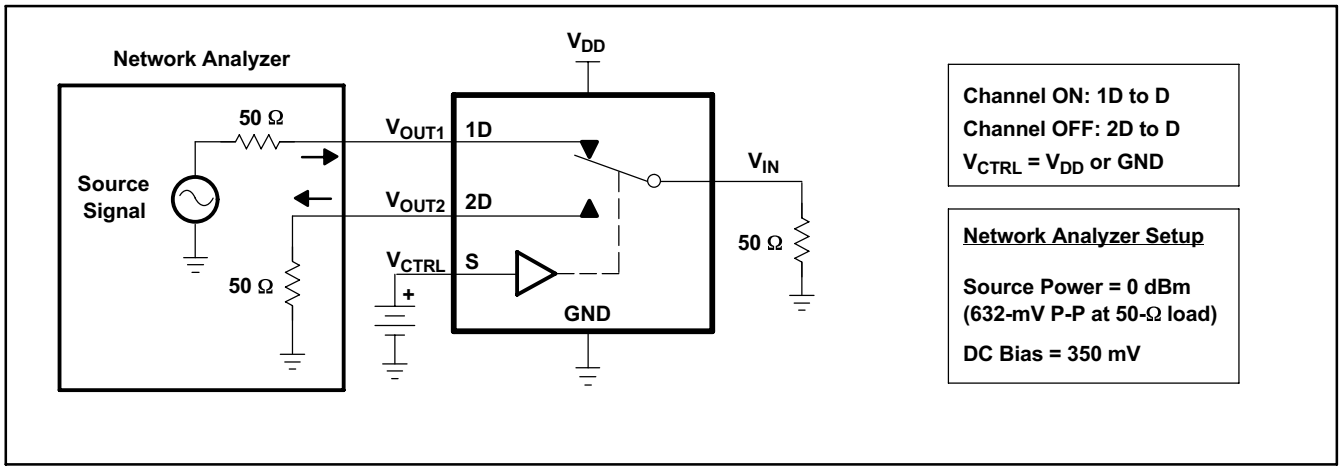


Figure 11. Crosstalk (X_{TALK})

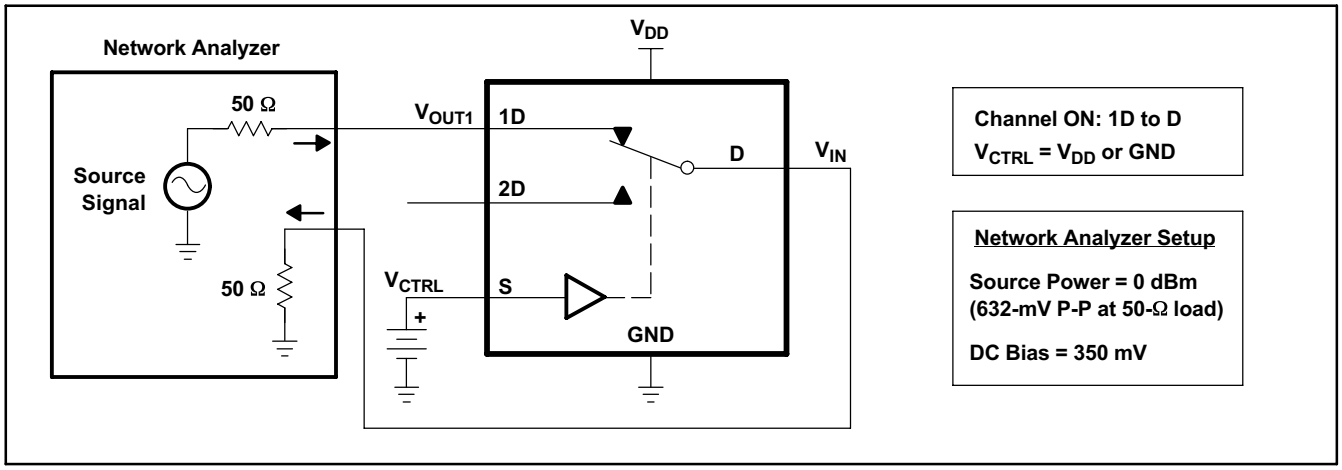


Figure 12. Bandwidth (BW)

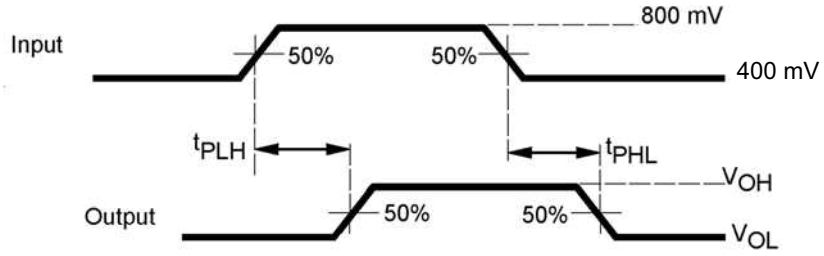
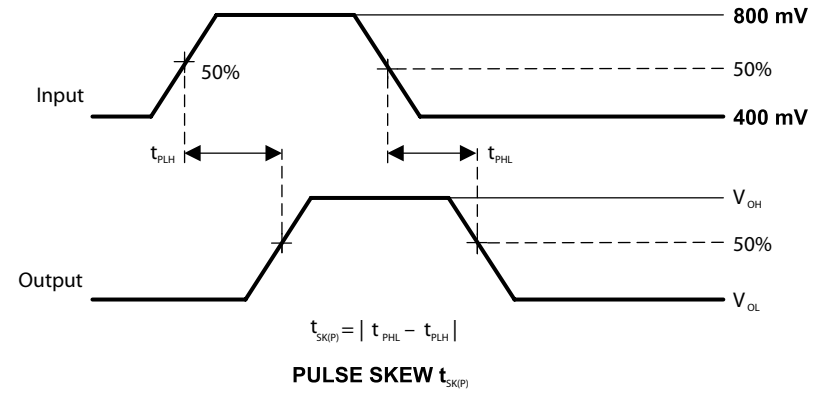
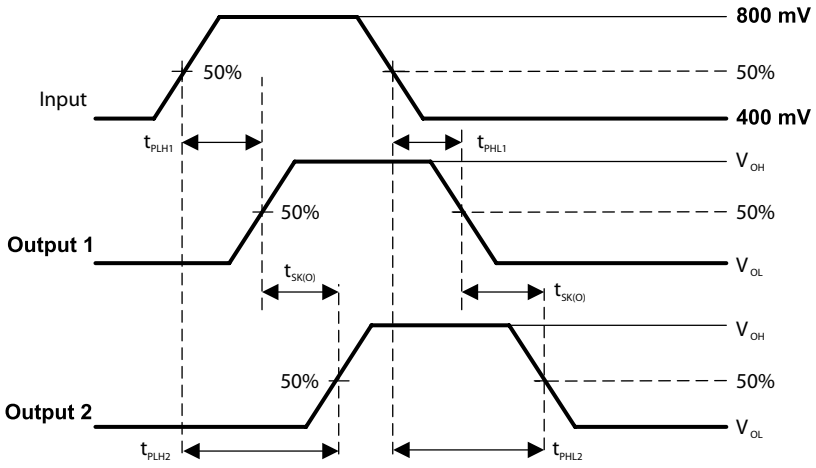


Figure 13. Propagation Delay

PARAMETER MEASUREMENT INFORMATION (continued)



PULSE SKEW $t_{SK(P)}$



OUTPUT SKEW $t_{SK(P)}$

Figure 14. Skew Test

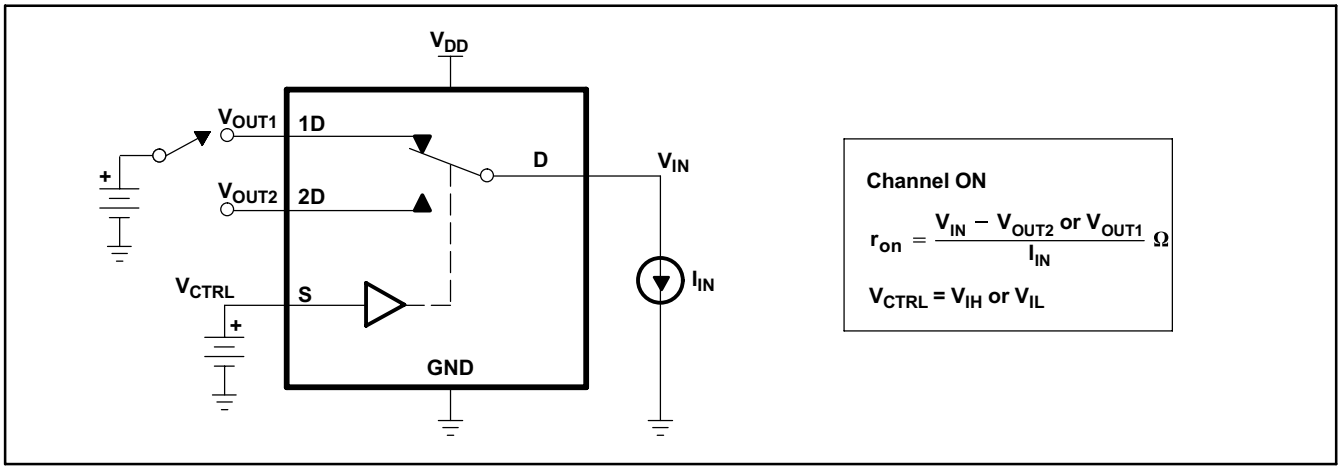


Figure 15. ON-State Resistance (r_{on})

PARAMETER MEASUREMENT INFORMATION (continued)

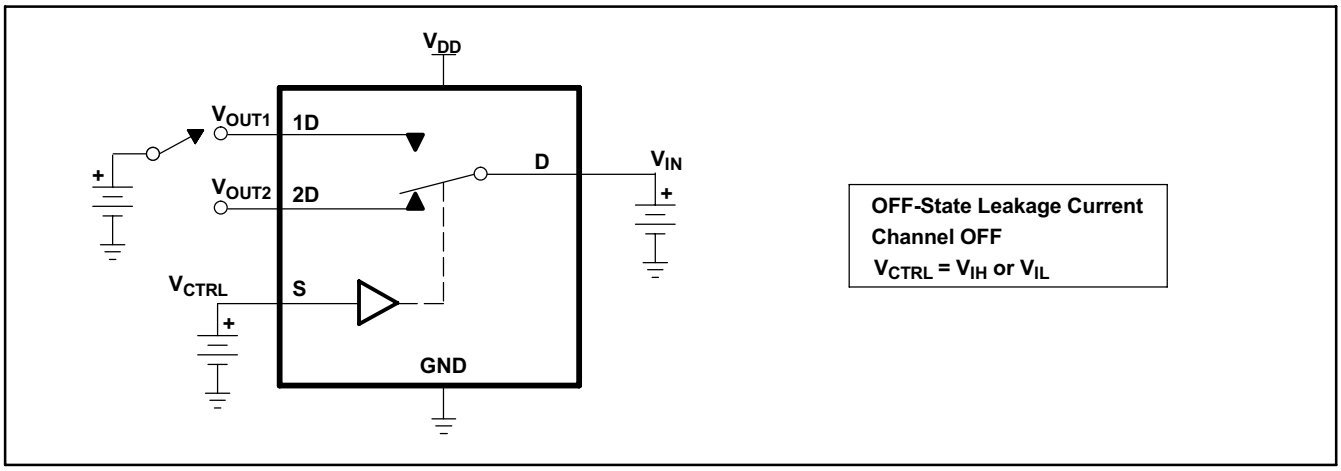


Figure 16. OFF-State Leakage Current

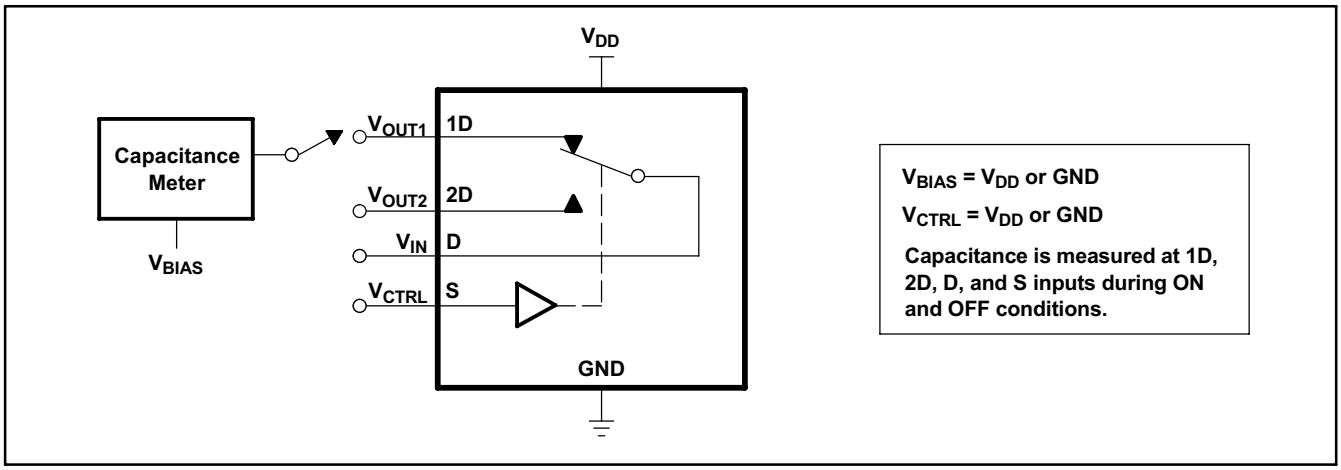
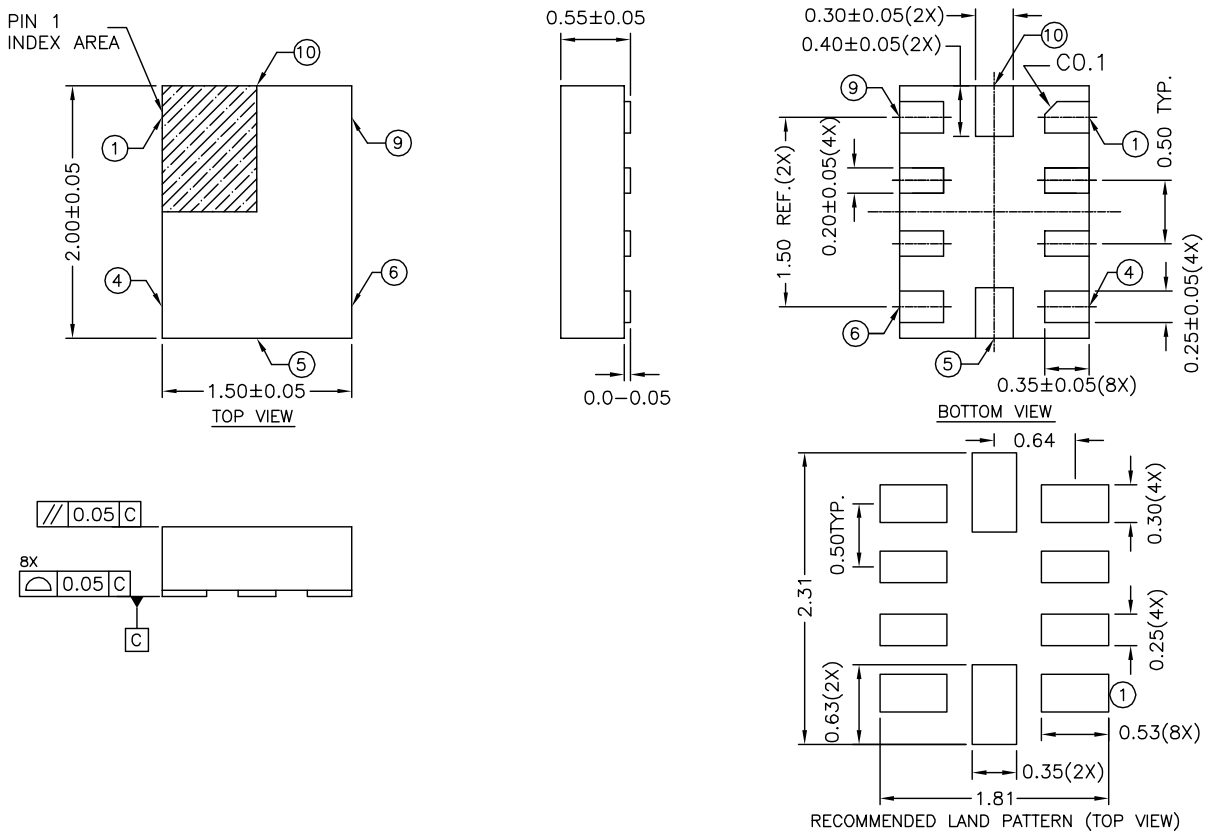


Figure 17. Capacitance



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–288
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.

PERICOM Enabling Serial Connectivity

DATE: 01/26/09

DESCRIPTION: 10-Lead, Thin Leadframe Land Grid Array (TLLGA)

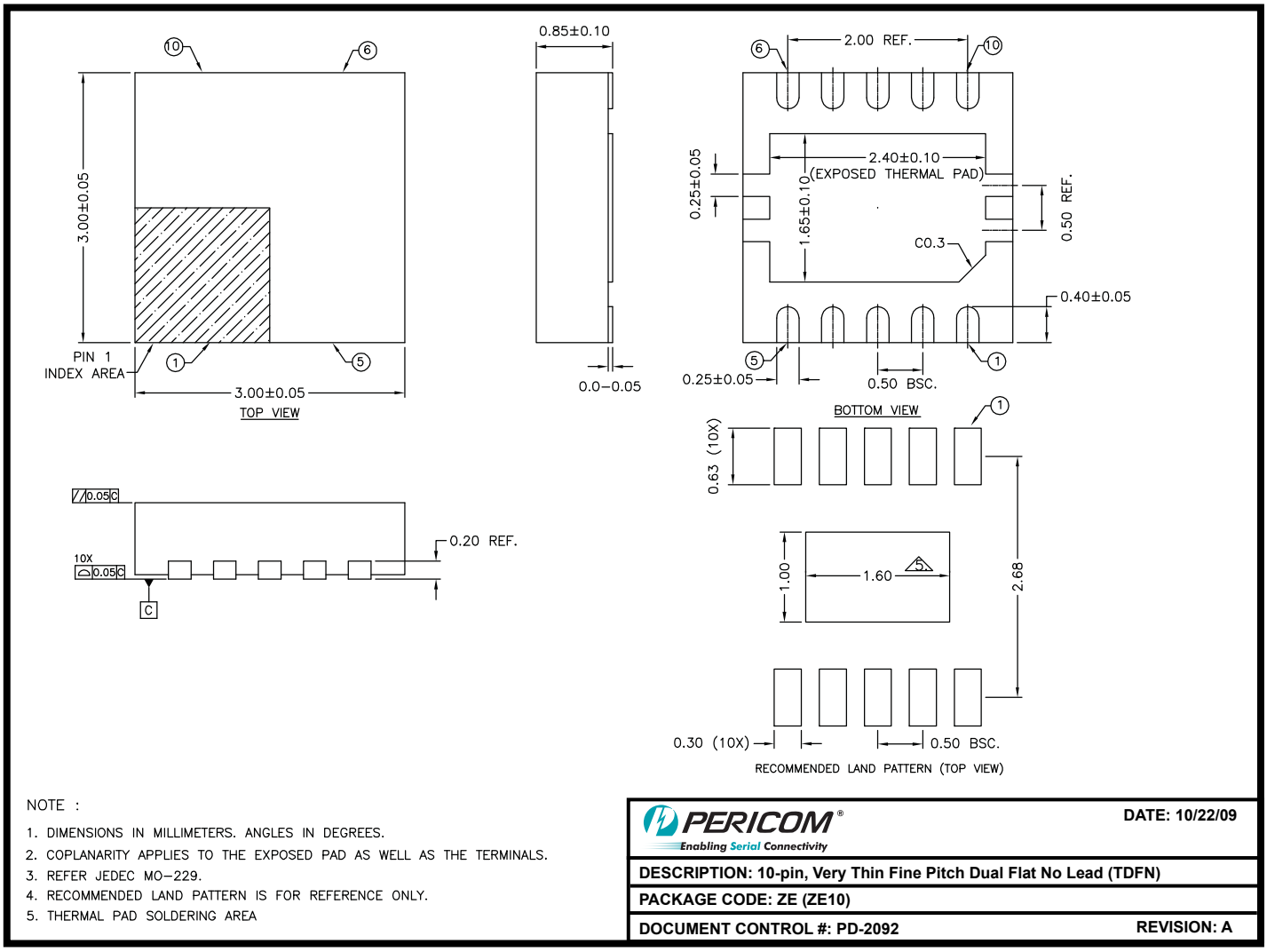
PACKAGE CODE: XA10

DOCUMENT CONTROL #: PD-2095 **REVISION: --**

09-0064

Note:

- For latest package info, please check: http://www.pericom.com/products/packaging/mechanicals.php



NOTE :

1. DIMENSIONS IN MILLIMETERS. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
3. REFER JEDEC MO–229.
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.
5. THERMAL PAD SOLDERING AREA

PERICOM Enabling Serial Connectivity

DATE: 10/22/09

DESCRIPTION: 10-pin, Very Thin Fine Pitch Dual Flat No Lead (TDFN)

PACKAGE CODE: ZE (ZE10)

DOCUMENT CONTROL #: PD-2092 REVISION: A

09-0138

Note:

- For latest package info, please check: http://www.pericom.com/products/packaging/mechanicals.php

Ordering Information(1-3)

Ordering Code	Package Code	Package Description
PI3USB221XAE	XA	10-Contact , Pb-free and Green (TLLGA)
PI3USB221ZEE	ZE	10-Contact, Pb-free and Green (TDFN)

Notes:

1. Thermal characteristics can be found on the company web site at www.pericom.com/packaging/
2. E = Pb-free and Green
3. Adding an X suffix = Tape/Reel