

## Wide Bandwidth, 2-Channel, SPST USB 2.0 Switch w/ ESD and Overvoltage protection

### Features

- USB 2.0 compliant
- $R_{ON}$  is  $5.5\Omega$  typical
- Low bit-to-bit skew
- Low Crosstalk:  $-40\text{dB}$  @ 500 Mbps
- I/O pins have over voltage protection and can tolerate a short to Vbus
- Near-Zero propagation delay: 250ps
- Switching speed: 9ns
- Channel On Capacitance: 7pF
- $V_{DD}$  Operating Range: 2.7V to  $4.2\text{V} \pm 10\%$
- Data pin I/O ESD: 12kV HBM protection per the JESD22-A114D specification.
- -3dB Bandwidth: 1300 MHz (Typ)
- Packaging (Pb-free & Green): 10-contact TQFN (ZL10)

### Description

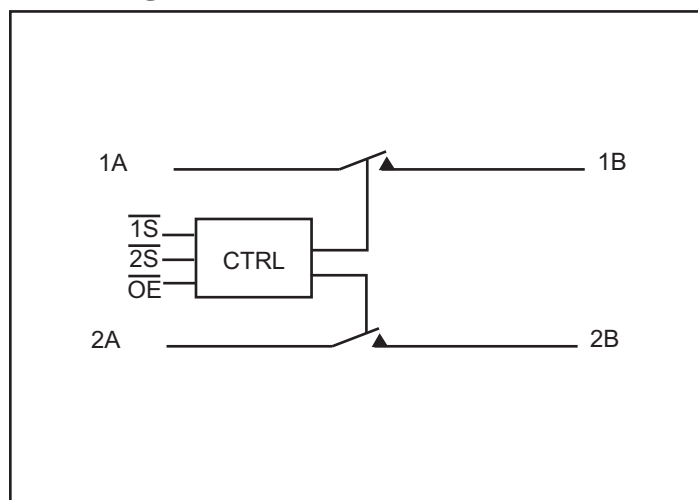
The PI3USB2117 is a single differential channel USB 2.0 Switch. Industry leading advantages include a propagation delay of less than 250ps, resulting from its low channel resistance and I/O capacitance. The switch is bidirectional and offers little or no attenuation of the high-speed signals at the outputs. It is designed for low bit-to-bit skew, high channel-to-channel noise isolation and is compatible with various standards, such as High Speed USB 2.0 (480 Mb/s).

In addition to isolating D+/D- pins from a USB connector, Pericom's PI3USB2117 solution provides Electrostatic Discharge (ESD) protection, up to 12kV per the JESD22-A114D specification. PI3USB2117 also offers overvoltage protection, per the USB 2.0 specification. With the chip powered on or off, all I/O pins can withstand a direct short to the Vbus pin on the USB connector. In order to enable the overvoltage protection feature, the user must add a 100ohm resistor between the power rail and Vdd pin on the chip, pin 9.

### Application

- Routes signals for USB 2.0
- Hand held devices

### Block Diagram



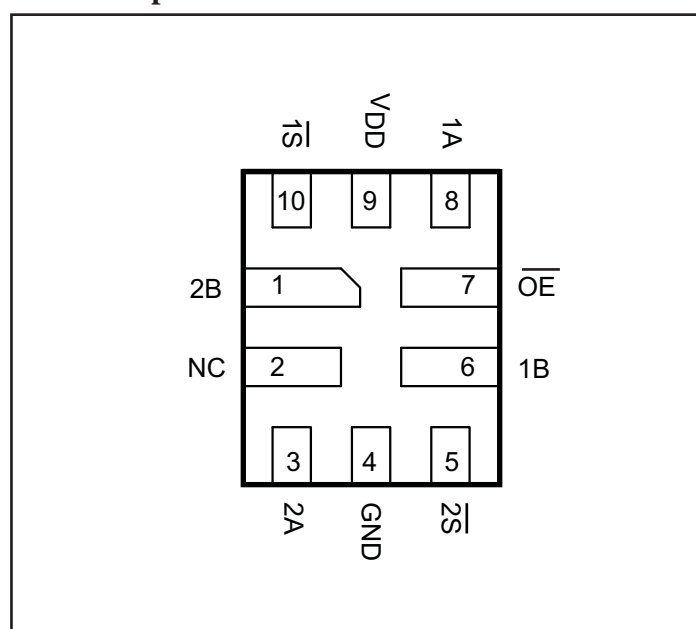
### Truth Table

$\overline{OE}$	$\overline{xS}$	Function
H	X	I/O's = Hi-Z
L	L	$xA = xB$
L	H	Disconnect

### Notes:

1.  $x = 0, 1$

### Pin Description



### Maximum Ratings

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

Storage Temperature .....	-65°C to +150°C
Supply Voltage to Ground Potential .....	-0.5V to +4.6V
DC Input Voltage .....	-0.5V to $V_{DD} + 0.5V$
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 USB 2.0 Switching over Operating Range

( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{DD} = 3.0 - 4.4V$ )

Parameter	Description	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(2)</sup>	Max.	Units
$V_{IH}$	Input HIGH Voltage	Guaranteed HIGH level	$V_{DD} = 4.2V$	2.0		V
			$V_{DD} = 3.3V$	1.6		
$V_{IL}$	Input LOW Voltage	Guaranteed HIGH level			0.8	
$V_{IK}$	Clamp Diode Voltage	$V_{DD} = \text{Max.}, I_{IN} = -18\text{mA}$		-0.7	-1.2	
$I_{IH}$	Input HIGH Current	$V_{DD} = \text{Max.}, V_{IN} = V_{DD}$			$\pm 5$	$\mu\text{A}$
$I_{IL}$	Input LOW Current	$V_{DD} = \text{Max.}, V_{IN} = \text{GND}$			$\pm 5$	
$R_{ON}$	Switch On-Resistance <sup>(3)</sup>	$V_{DD} = \text{Min.}, -0.4V \leq V_{IN} \leq 1.0V,$ $I_{IN} = -40\text{mA}$		5.5	6.5	$\Omega$
$R_{FLAT(ON)}$	On-Resistance Flatness <sup>(3)</sup>	$V_{DD} = \text{Min.}, V_{IN} @ 1.5V$ and $V_{DD} I_{IN} = -40\text{mA}$		2.0		
$\Delta R_{ON}$	On-Resistance match from center ports to any other port <sup>(3)</sup>	$V_{DD} = \text{Min.}, -0.4V \leq V_{IN} \leq 1.0V,$ $I_{IN} = -40\text{mA}$		0.5		

**Notes:**

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- $V_{DD} = 3.0 - 4.4V$ ,  $T_A = 25^\circ\text{C}$  ambient and maximum loading.
- Measured by the voltage drop between Input and Output pins at indicated current through the Switch-On-Resistance is determined by the lower of the voltages on the two pins.

### Power Supply Characteristics ( $V_{DD} = 3.0 - 4.4V$ )

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ.	Max.	Units
$I_{CC}$	Quiescent Power Supply Current	$V_{DD} = \text{Max.}, V_{IN} = \text{GND or } V_{DD}$			1	$\mu\text{A}$

**Notes:**

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.

**Capacitance** ( $T_A = 25^\circ\text{C}$ ,  $f = 1\text{MHz}$ )

Parameters <sup>(3)</sup>	Description	Test Conditions <sup>(1)</sup>	Typ. <sup>(2)</sup>	Units
$C_{IN}$	Input Capacitance	$V_{IN} = 0\text{V}$	4.0	pF
$C_{OFF}$	Off Capacitance, Switch OFF		3.2	
$C_{ON}$	Switch Capacitance, Switch ON		7.0	

**Dynamic Electrical Characteristics Over the Operating Range**

Parameters	Description	Test Conditions	Min.	Typ. <sup>(2)</sup>	Units
$X_{TALK}$	Crosstalk	$R_L = 50\Omega$ , $f = 250\text{MHz}$		-40	dB
$O_{IRR}$	OFF Isolation			-31	
-3dB BW	Bandwidth -3dB	$R_L = 50\Omega$		1300	MHz
0.5dB BW	0.5dB Bandwidth	$R_L = 50\Omega$		270	MHz

**Notes:**

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{DD} = 3.3\text{V}$ ,  $T_A = 25^\circ\text{C}$  ambient and maximum loading.
- This parameter is determined by device characterization but is not production tested.

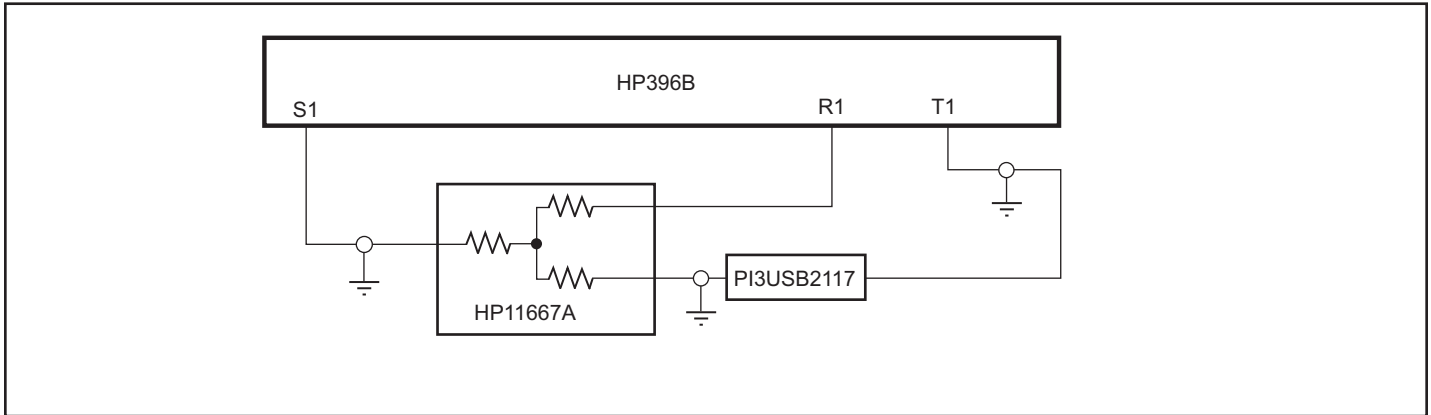
**Switching Characteristics**

Parameters	Description	Test Conditions <sup>(1)</sup>	Min.	Typ.	Max.	Units
$t_{PD}$	Propagation Delay <sup>(2,3)</sup>	See Test Circuit for Electrical Characteristics 1		0.25		ns
$t_{PZH}$ , $t_{PZL}$	Line Enable Time	See Test Circuit for Electrical Characteristics 2	0.5		15.0	
$t_{PHZ}$ , $t_{PLZ}$	Line Disable Time		0.5		9.0	
$t_{SKc-c}$	Output skew, channel-to-channel <sup>(2)</sup>				20	ps

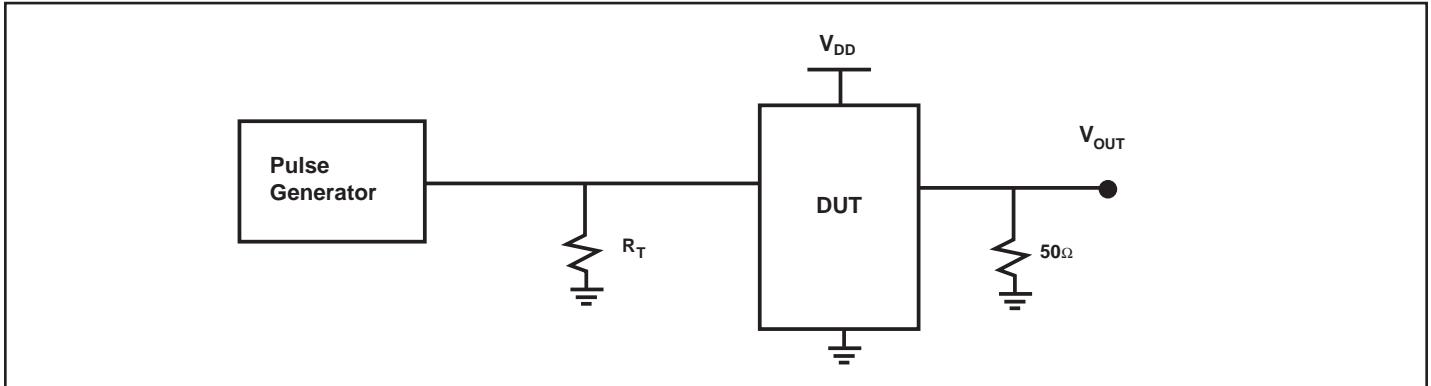
**Notes:**

- For max. or min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- 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 0.25ns for 10pF 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 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.

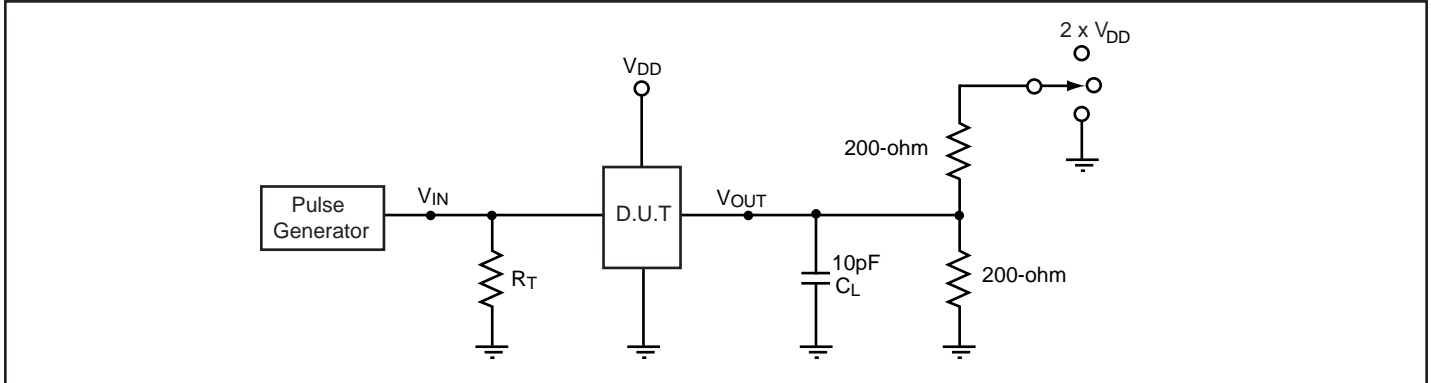
**Test Circuit for Dynamic Electrical Characteristics**



**Test Circuit for Electrical Characteristics 1**



**Test Circuit for Electrical Characteristics 2**



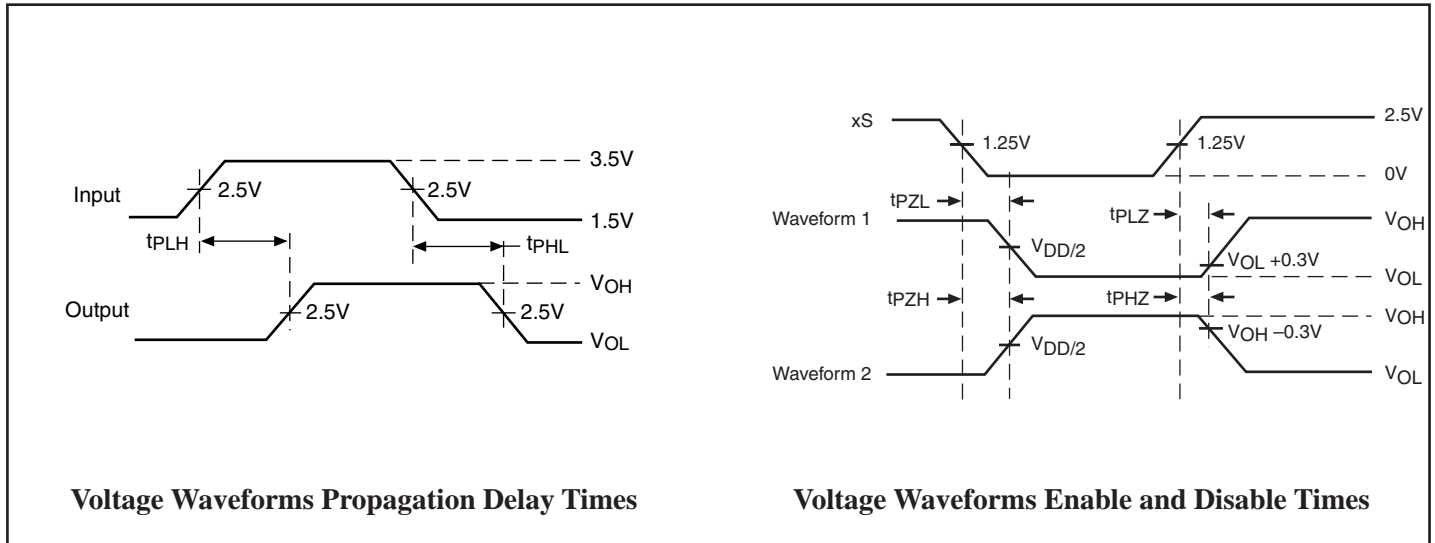
**Notes:**

- $C_L$  = Load capacitance: includes jig and probe capacitance.
- $R_T$  = Termination resistance: should be equal to  $Z_{OUT}$  of the Pulse Generator
- 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.
- All input impulses are supplied by generators having the following characteristics:  $PRR \leq \text{MHz}$ ,  $Z_O = 50\Omega$ ,  $t_R \leq 2.5\text{ns}$ ,  $t_F \leq 2.5\text{ns}$ .
- The outputs are measured one at a time with on transition per measurement.

**Switch Positions**

Test	Switch
$t_{PLZ}$ , $t_{PZL}$	$2 \times V_{DD}$
$t_{PHZ}$ , $t_{PZH}$	GND
Prop Delay	Open

### Switching Waveforms



### Applications Information

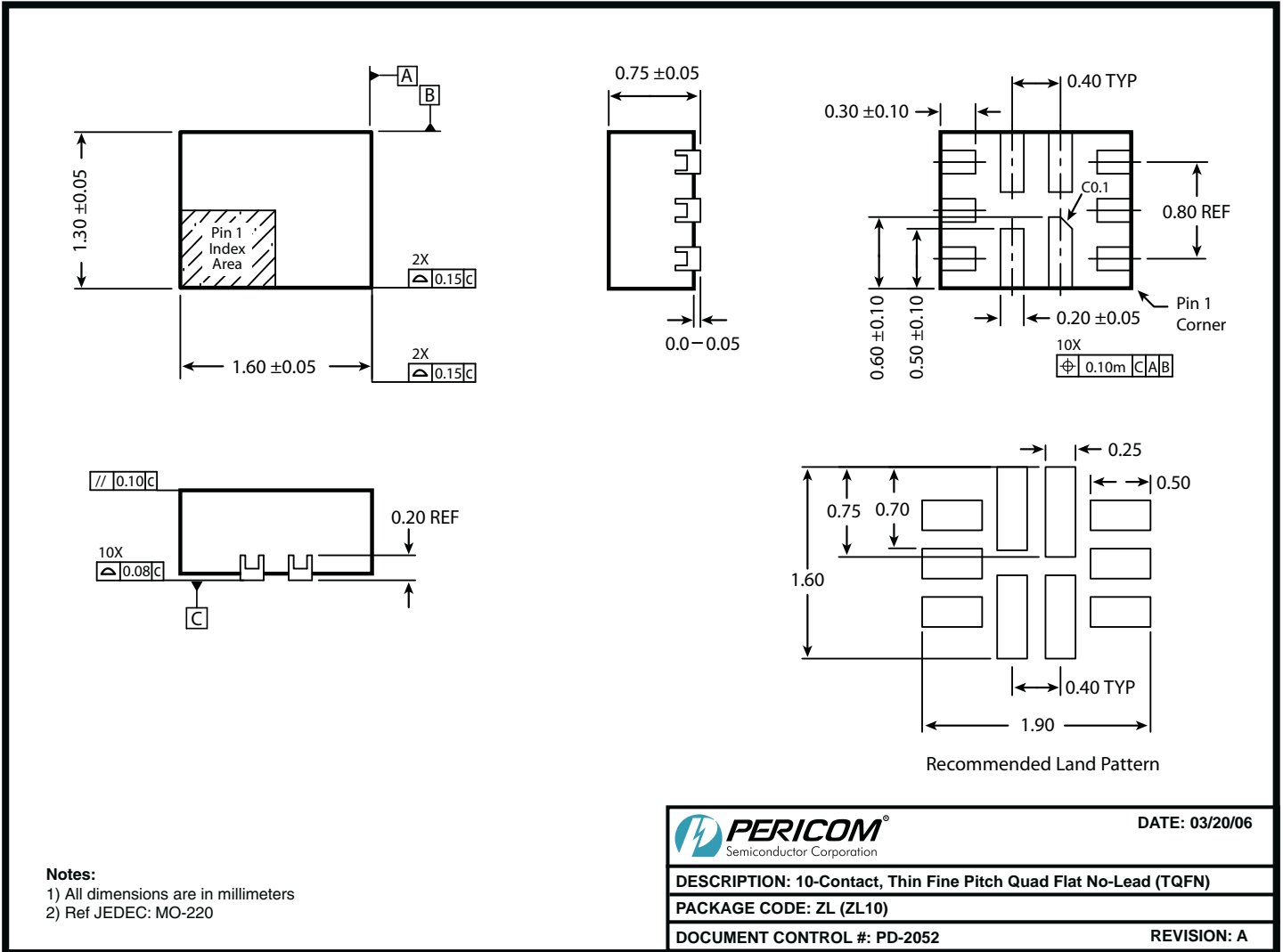
#### Logic Inputs

The logic control inputs can be driven up to +3.6V regardless of the supply voltage. For example, given a +3.3V supply, the output enables or select pins may be driven low to 0V and high to 3.6V. Driving IN Rail-to-Rail® minimizes power consumption.

#### Power Supply Sequencing

Proper power supply sequencing is recommended for all CMOS devices. Always apply VDD and GND before applying signals to input/output or control pins.

*Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd*



**Ordering Information**

Ordering Code	Package Code	Package Description	Top Mark
PI3USB2117ZLEX	ZL	Pb-free & Green, 10-contact TQFN	U7

**Notes:**

- Thermal characteristics can be found on the company web site at [www.pericom.com/packaging/](http://www.pericom.com/packaging/)
- E = Pb-free and Green
- X suffix = Tape/Reel