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PI5USB1457*

USB Charger Controller supporting SDP, CDP, and DCP per BC1.2 spec

Features

→ USB charger controller that supports SDP, DCP and CDP modes

- □ DCP (Dedicated charger port) is used when enumeration is not available
- □ CDP (Charging downstream port) is used when enumeration is available, but FAST charging is requested
- □ SDP (Standard downstream port) is used for systems that can only support 500mA across Vbus

→ Single Power Supply, 5V ±10%

→ Integrated ESD protection up to +/- 4kV contact on pins 2 and 3 per IEC61000-4-2 spec

→ Detects and differentiates between mouse/keyboard (USB Low/Full Speed device) when in Sleep and Charge mode (USB1457 and USB1457A versions only)

→ Provides multiple modes of charging to ensure all of the following spec's can be met:

- □ USB Battery Charger 1.2 spec
- □ USB Battery Charger 1.1 spec
- □ USB Battery Charger 1.0 spec
- □ YD/T-1591 charger spec
- □ Certain modes available can also support devices using non-standard approaches to charging, such as Apple products and RIM/Blackberry products

→ Packaging (Pb-free & Green):

- □ 8-Contact TDFN, ZAE (2.0mm x 2.0mm x 0.75mm)
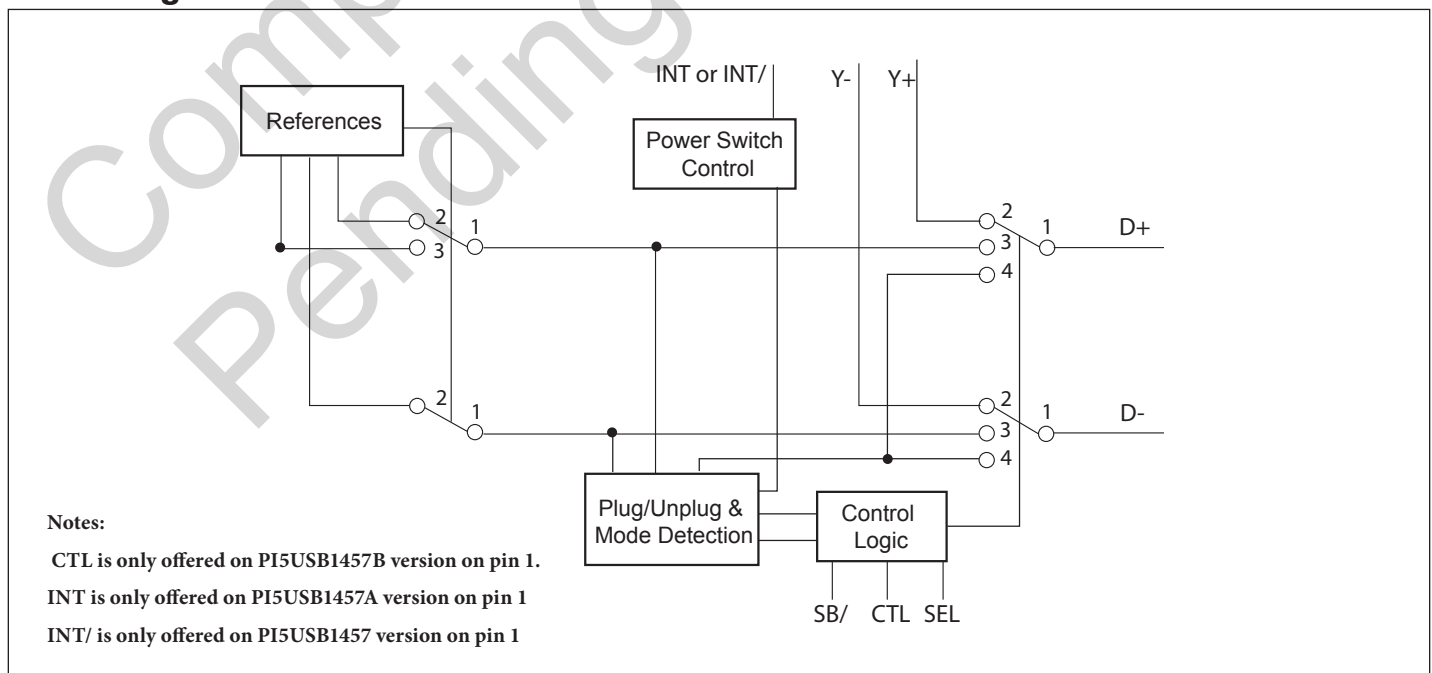
Description

Notebook PCs are used around the world to charge battery-powered handheld devices such as cell phones and MP3/MP4 players. Hand-held devices require communication with the notebook PC before they start to draw current. This ensures that the hand-held device will obtain sufficient current when it wants to charge. The issue is that the notebook PC does not have a way to provide this acknowledge signal to the handheld device when the notebook is in "Sleep" mode.
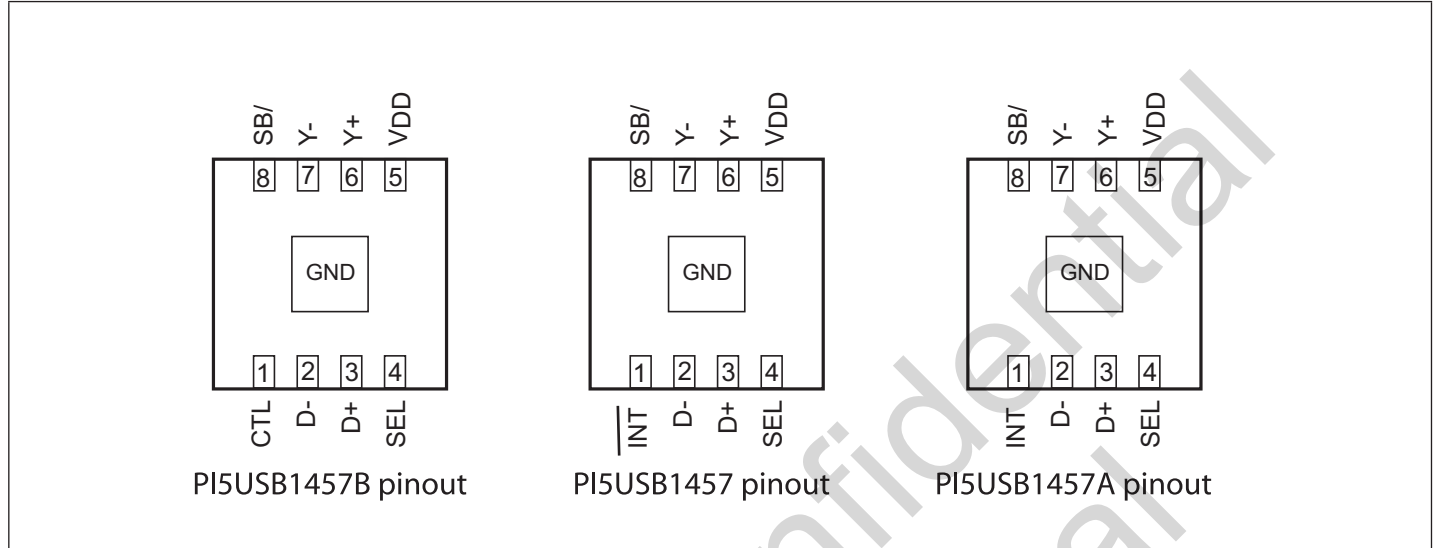
Pericom's PI5USB1457(*/A/B) solves this issue by setting the D+/D- pins in the notebook PC to the required signal levels during "sleep" mode. When the handheld device sees these required signal levels, it will then start to draw the current required to charge itself.

Cell phones within today's market use different communication schemes, so the switch will need to configure itself in different modes. PI5USB1457 (*/A/B) can alternate between modes automatically, once device type is correctly detected.

D+, D- and Vbus pins are protected with Pericom's ESD protection circuits supporting ESD damage as high as +/-4kV contact per IEC61000-4-2 specification.

Block Diagram

Notes:

CTL is only offered on PI5USB1457B version on pin 1.

INT is only offered on PI5USB1457A version on pin 1

INT/ is only offered on PI5USB1457 version on pin 1

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Pin Configuration 8-Pin TDFN (ZAE)

PI5USB1457B pinout   PI5USB1457 pinout   PI5USB1457A pinout

Pinout Table

PI5USB1457	PI5USB1457A	PI5USB1457B	Pin Name	I/O Type	Description
1	*	*	INT/	O	p-mosfet open source output. When SB/ observes a logic change (from H to L or from L to H). INT/ is high for ~ 2.1 seconds, otherwise INT/ is hi-z. External pull-down is required.
*	1	*	INT	O	n-mosfet open drain output. When SB/ observes a logic change (from H to L or from L to H). INT is LOW for ~ 2.1 seconds, otherwise, INT is hi-z. External pull-up is required.
*	*	1	CTL	I	Input control logic (See truth table)
2	2	2	D-	I/O	USB Connector, D- connection
3	3	3	D+	I/O	USB Connector, D+ connection
4	4	4	SEL	I	Input control logic (See truth table)
5	5	5	V_{DD}	Power	5V power supply
6	6	6	Y+	I/O	Host USB transceiver (if existent) D+ connection
7	7	7	Y-	I/O	Host USB transceiver (if existent) D- connection
8	8	8	SB/	I	Control input to switch between S0 charging or sleep and charge
9	9	9	EP	Ground	Exposed Pad. Connect EP to ground.

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PI5USB1457
USB Charger Controller IC

Truth Tables

PI5USB1457 and PI5USB1457A

SB/ (pin 8)	SEL(pin 4)	Feature	pin 1 role (INT or INT/)
0	0	Auto S & C without mouse/keyboard pass through	INT or INT/
0	1	Auto S & C with mouse/keyboard pass through	INT or INT/
1	0	S0 charging with SDP only	INT or INT/
1	1	S0 charging with CDP or SDP only (depending on external device)	INT or INT/
0	M= $(1/2)*V_{DD}$	Test Mode, M = $V_{DD/2}$ = $(1/2)*V_{DD}$	

PI5USB1457B

SB/ (pin 8)	CTL (pin 1)	Feature	pin 4 role (SEL)
0	0	Auto S & C	0: without mouse/keyboard pass through
0	0	Auto S & C	1: Not Allowed
0	1	S & C with manual mode	0: BC1.1 only
0	1	S & C with manual mode	1: Apple only
1	0	S0 charging enabled	0: SDP only
1	0	S0 charging enabled	1: SDP/CDP depending on external device
1	1	S0 charging enabled	0: SDP only
1	1	power down	1: IC power off with all I/Os hi-z
0	x	test mode	M = $(1/2)*V_{DD}$

Detailed Feature Description

Sleep and Charge Mode enabled

When the PI5USB1457 (*/A/B) is configured into auto mode with sleep and charge enabled (see truth table to understand how to configure into auto mode), the charger controller will manage all communication with external devices to enable charging to occur. First, Pericom's IC will use load sensing techniques to detect when a device has been plugged in.

Once a device is properly detected, the Pericom IC will automatically switch to the appropriate charging mode required for the specific external USB device that was detected.

Mouse/Keyboard pass through mode Explanation

Since USB1.1 devices do not integrate charging protocols, there is no special charging mode required to support charging the device. Therefore, if a USB Low-Speed external device is detected, then Pericom's solution will simply connect D+/- from the USB connector directly to the USB host controller.

System wake-up via external mouse or keyboard

Today's systems are enabled to wake up from S3 mode if a pre-enumerated mouse/keyboard has activity (movement or key-pressed). In order for the system to continue supporting this feature, the USB host controller must be able to communicate with the external device in S3 mode. Therefore, if a mouse/keyboard is detected (via the USB low speed pass through feature), Pericom's PI5USB1457 family will enable the communication between device and controller. Our device will automatically pass the signals through with minimal degradation.

CDP mode description

When the PI5USB1457 family is configured into CDP mode (see truth table to understand how to configure into CDP mode), D+/- is connected to Y+/-, allowing communication/enumeration to occur between USB host controller and USB device. The Pericom device will continue to monitor D+ for contact detection and to start CDP charging.

Once contact detection has been observed, then CDP enumeration will occur. The external device must initiate the charge-set up, and once the Pericom device correctly observes the required command, the PI5USB1457 family will respond to complete the charge-set up.

Electrical Parameters/Characteristics Recommended Operation Conditions

Parameter	Min.	Typ.	Max.	Unit
Ambient Operating Temperature	-40		+85	°C
V_{DD} Power Supply Voltage (measured in respect to GND)	+4.5		+5.5	V

DC Electrical Characteristics (V_{DD} = 5.0V +/- 10%, Ambient Temperature -40 to +85°C)

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{DD}	Operating Voltage			4.5		5.5	V
I_{DD}	Supply Current	V_{DD} = 5.25V	SB/ = Low, SEL = Low CTL (*B only) = don't care		250	300	µA
			SB/ = Low, SEL = High CTL (*B only) = don't care		250	300	
			SB/ = High, SEL = Low CTL (*B only) = don't care		50	75	
			SB/ = High, SEL = High CTL (*B only) = don't care		115	165	
I_{DDQ}	Quiescent Supply Current	Power Down Mode enabled (only available on *B version SEL = SB/ = CTL = HIGH, V_{DD} = 5.25V			16	25	
V_{IH} for SB+CTL	Input High Voltage	SB/, CTL		1.4			V
V_{IL} for SB+CTL	Input Low Voltage	SB/, CTL				0.4	
V_{IH} for SEL	Input High Voltage	For SEL pin		3.5			
V_{IL} for SEL	Input Low Voltage	For SEL pin				0.8	
V_{OH} for INT/	Output high voltage	For INT/ pin	PI5USB1457ZAE only	2.4			V
V_{OL} for INT	Output high voltage	For INT pin	PI5USB1457AZAE only			0.55	V

DC Electrical Characteristics (V$_{DD}$ = 5.0V +/- 10%, Ambient Temperature -40 to +85°C) Cont..

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
R$_{ON}$	Switch On-Resistance for USB 2.0 HS signal (From D± to Y±)	V$_{DD}$ = 4.5V, -0.4V < V$_{INPUT}$ < +0.4V, I$_{INPUT}$ = +30mA, SB/ = High		3	5	Ω
R$_{ON}$	Switch On-Resistance for USB 2.0 FS signal (From D± to Y±)	V$_{DD}$ = 5.0V, 0V < V$_{INPUT}$ < 3.3V I$_{INPUT}$ = -15mA , SB/ = High			7	
I$_{OZ}$	I/O leakage on signal pins (D±, Y±) current when port is off	V$_{DD}$ = 5.5V, V$_{INPUT}$ from 0V to 3.6V			+/-10	µA
I$_{OFF}$	Signal leakage on signal pins (D±, Y±) when chip is off	V$_{DD}$ = 0V, V$_{INPUT}$ from 0V to 5.5V			+/-10	µA

Capacitance (For typical spec T$_A$ = 25°C, for max spec T$_A$ = -40 to +85°C, f = 1MHz)

Parameter	Description	Test Condition	Typ.	Max.	Unit
C$_{IN}$	Control Logic Capacitance		2.7	3.5	pF
C$_{OFF}$ - USB path only	Switch Capacitance at D± or Y± when switch is OFF	SB/ = low	3.1	3.5	
CON - USB path only	Switch Capacitance between D+/- to Y+/- when switch is ON	SB/ = high	6.0	6.5	

Dynamic Electrical Characteristics Over the Operating Range

Parameter	Description	Test Condition	Min.	Typ.	Max.	Units
XTALK	Crosstalk	R$_L$ = 50Ω, freq = 240MHz		-30		dB
OIRR	Off-Isolation	R$_L$ = 50Ω, freq = 240MHz		-30		
-3dB BW	-3dB Bandwidth (along D+/- path)	R$_L$ = 50Ω		1,350		MHz
-0.5dB BW	-0.5dB Bandwidth (along D+/- path)	R$_L$ = 50Ω		350		
IN$_{LOSS}$	Insertion loss (along D+/- path)	freq = 240MHz		0.57		dB

CDP Mode

Symbol	Parameter	Test Condition	Min	Max	Units
V_D-_SRC	Voltage source on D- for CDP detect	$V_{D-} = 0.6V$	0.5	0.7	V
V_D+_SINK	D+_IN sink current	$0.4V <= V_{D-} < 0.8V$	50	150	uA

Parameter	Description	Test Condition(1)	Min	Typ	Max	Units
T_{pd}	Propagation delay			0.3		ns
Intra-Pair Skew	Output skew, bit to bit (Between + and - of same pair)	See Test Circuit for Electrical Characteristics		10		ps
T_{ON}	Turn on time for USB path	$C_L = 35pF$, $R_L = 300\Omega$			0.5	μs
T_{OFF}	Turn off time for USB path	$C_L = 35pF$, $R_L = 300\Omega$			0.25	

Figure 1: Test Circuit for Electrical Characteristics

C_L INCLUDES FIXTURE AND STRAY CAPACITANCE
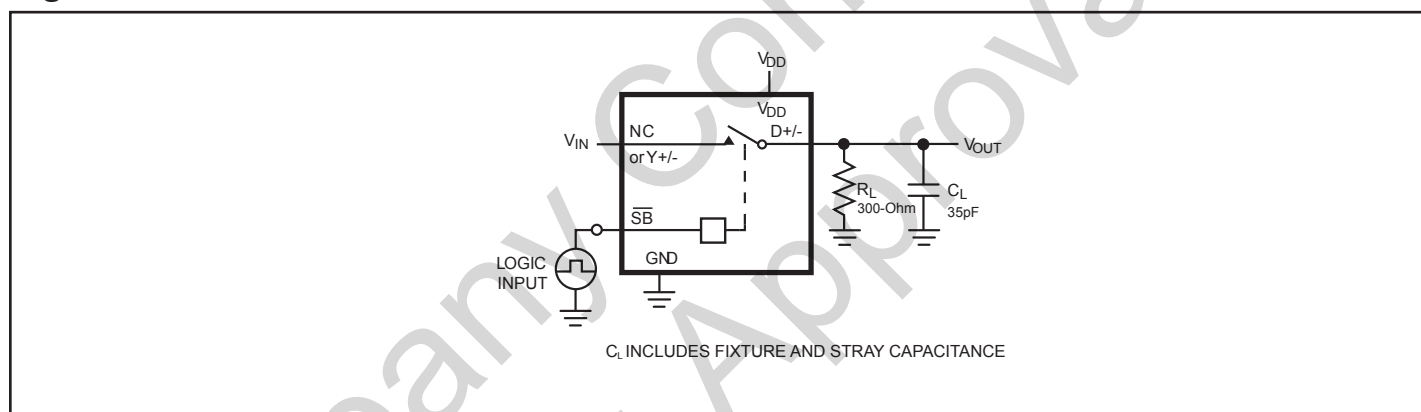
Notes:

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. All input impulses are supplied by generators having the following characteristics: PRR ≤ MHz, $Z_O = 50\Omega$, $t_R \leq 2.5ns$, $t_F \leq 2.5ns$.

Test Circuit for Dynamic Electrical Characteristics
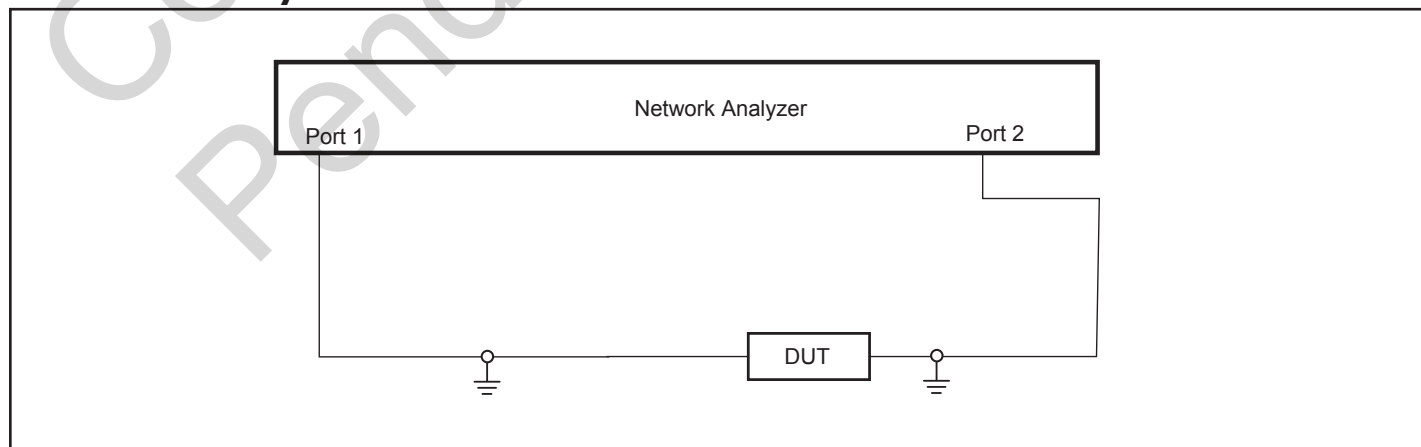
Packaging Mechanical: 8-Pin TDFN (ZAE)
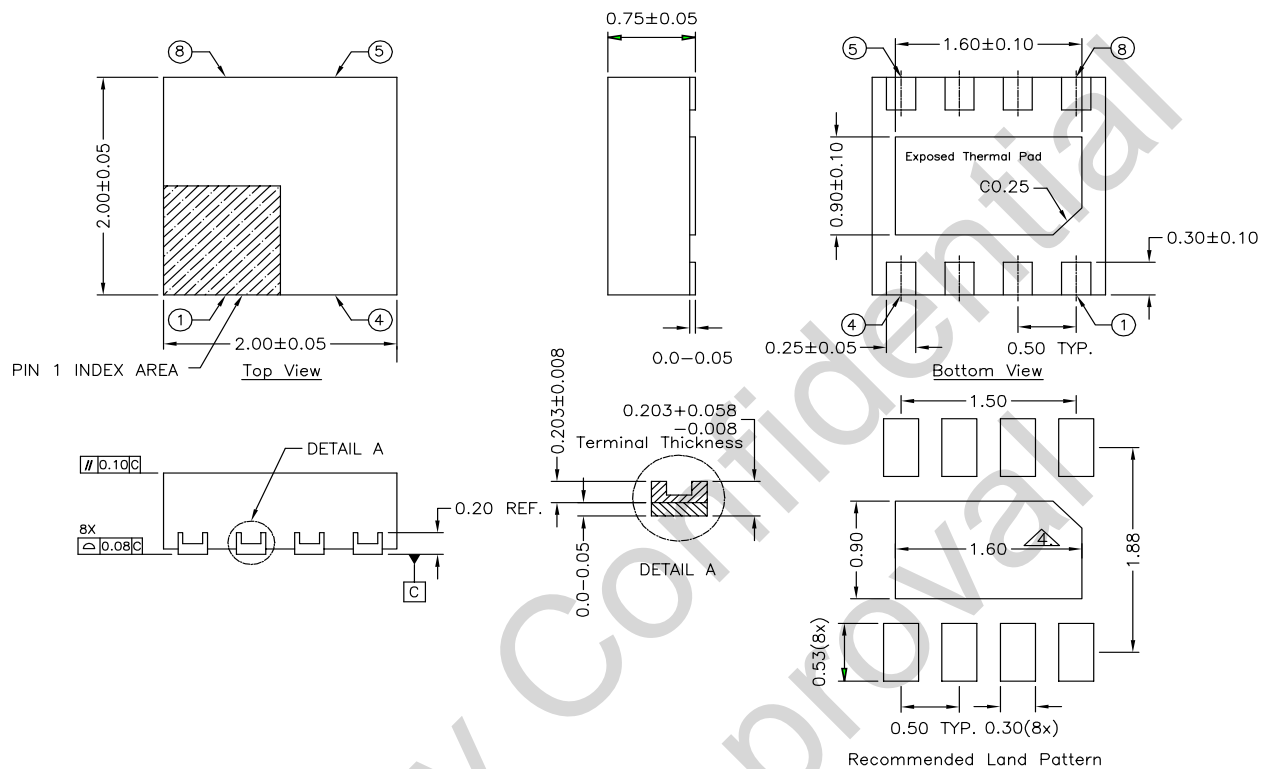
Notes:
1. All dimensions are in mm. Angles in degrees.
2. Coplanarity applies to the exposed pad as well as the terminals.
3. Refer JEDEC MO-229
4. Thermal pad soldering area (mesh stencile design is recommended)

PERICOM Enabling Serial Connectivity	**DATE: 09/20/10**
DESCRIPTION: 8-contact, Thin Dual-in-Line Flat Package (TDFN)	
PACKAGE CODE: ZA8	
DOCUMENT CONTROL #: PD-2068	**REVISION: B**

10-0528

Ordering Information

Ordering Code	Package Code	Package Description
PI5USB1457ZAE	ZAE	Pb-free & Green, 8-pin TDFN
PI5USB1457AZAE	ZAE	Pb-free & Green, 8-pin TDFN
PI5USB1457BZAE	ZAE	Pb-free & Green, 8-pin TDFN

1. Thermal characteristics can be found on the company web site at www.pericom.com/packaging/