

## 5.0 Gbps, 2-port, USB 3.0 ReDriver™ with Digital Configuration

### Features

- USB 3.0 compatible
- Four 5.0 Gbps differential signal pairs
- Adjustable Receiver Equalization
- 100Ω Differential CML I/O's
- Pin Configured Output Emphasis Control
- Input signal level detect and squelch for each channel
- Automatic Receiver Detect with digital enable/disable
- Low Power ~660mW
- Auto "Slumber" mode for adaptive power management
- Stand-by Mode – Power Down State
- Industrial Temp Support (-40°C to 85°C)
- Single Supply Voltage: 3.3V
- Packaging: 42-Pin TQFN (3.5x9mm)

### Pin Diagram (Top Side View)

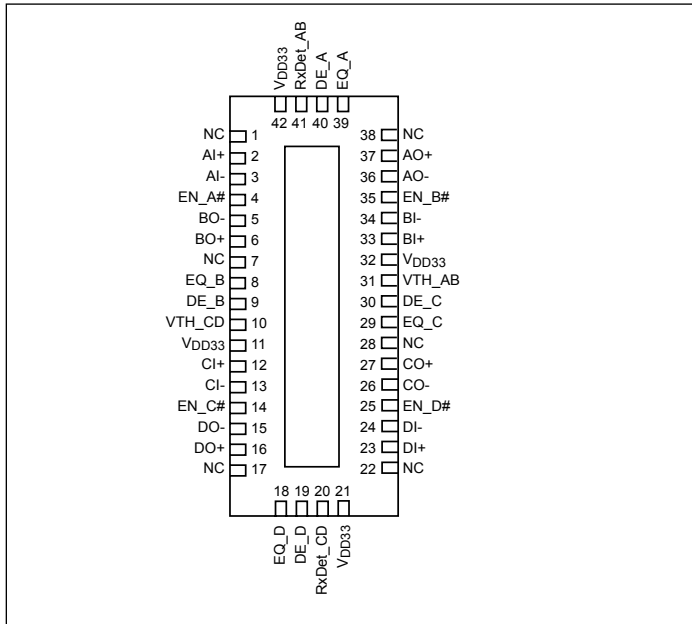
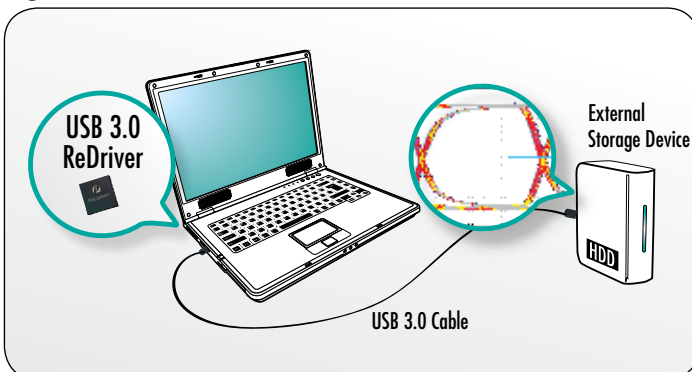


Figure 1



### Description

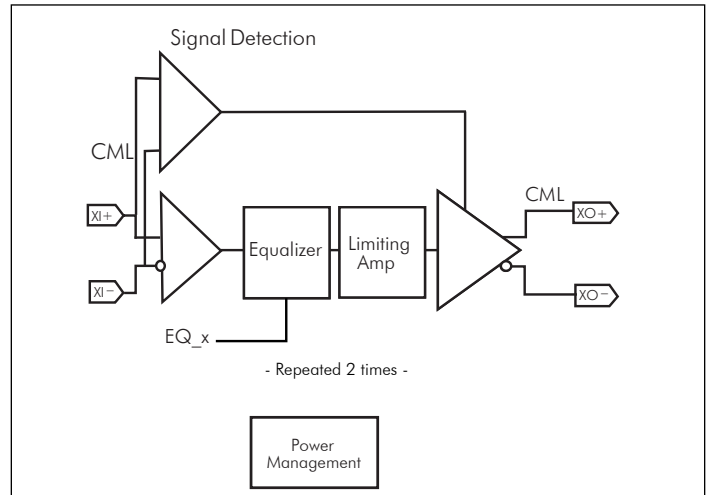
Pericom Semiconductor's PI3EQX7742AI is a low power, high performance 5.0 Gbps signal ReDriver™ designed specifically for the USB 3.0 protocol. The device provides programmable equalization, De-Emphasis, and input threshold controls to optimize performance over a variety of physical mediums by reducing Inter-Symbol Interference. PI3EQX7742AI supports four 100Ω Differential CML data I/O's between the Protocol ASIC to a switch fabric, over cable, or to extend the signals across other distant data pathways on the user's platform.

The integrated equalization circuitry provides flexibility with signal integrity of the signal before the ReDriver. A low-level input signal detection and output squelch function is provided for each channel.

Each channel operates fully independently. When the channels are enabled  $EN\_x\# = 0$  and operating, that channels' input signal level (on  $xI+/-$ ) determines whether the output is active.

If the input signal level of the channel falls below the active threshold level ( $V_{th-}$ ) then the outputs are driven to the common mode voltage. In addition to signal conditioning, when  $EN\_x\# = 1$ , the device enters a low power standby mode. The PI3EQX7742AI also includes a fully programmable receiver detect function. When the RxDet pin is pulled high, automatic receiver detection will be active. The device will then move to power down due to inactivity.

### Block Diagram



## Pin Description

Pin #	Pin Name	Type	Description
1, 7, 17, 22, 28, 38	NC	NC	No Connect
2, 3	AI+, AI-	Input	CML input channels. With Selectable input termination between 50Ω to internal V <sub>BIAS</sub> and Hi-Z.
5, 6	BO-, BO+	Output	Selectable output termination between 50Ω to internal V <sub>bias</sub> and 2kΩ to internal V <sub>bias</sub> , and Hi-Z.
12, 13	CI+, CI-	Input	CML input channels. With Selectable input termination between 50Ω to internal V <sub>BIAS</sub> and Hi-Z.
15, 16	DO-, DO+	Output	Selectable output termination between 50Ω to internal V <sub>bias</sub> and 2kΩ to internal V <sub>bias</sub> , and Hi-Z.
23, 24	DI+, DI-	Input	CML input channels. With Selectable input termination between 50Ω to internal V <sub>BIAS</sub> and Hi-Z.
26, 27	CO-, CO+	Output	Selectable output termination between 50Ω to internal V <sub>bias</sub> and 2kΩ to internal V <sub>bias</sub> , and Hi-Z.
33, 34	BI+, BI-	Input	CML input channels. With Selectable input termination between 50Ω to internal V <sub>BIAS</sub> and Hi-Z.
36, 37	AO-, AO+	Output	Selectable output termination between 50Ω to internal V <sub>bias</sub> and 2kΩ to internal V <sub>bias</sub> , and Hi-Z.
11, 21, 32, 42	VDD33	Power	3.3V Voltage Supply
39, 8, 18, 29	EQ_A, EQ_B, EQ_D, EQ_C	Input	Equalization Adjustment. Tri-level input pin. When set to "high", the pin becomes logic "1"; when set to "open", the pin becomes "open"; when set to "low", the pin becomes logic "0". Please refer to Mode Adjustment on page 3.
40, 9, 19, 30	DE_A, DE_B, DE_D, DE_C	Input	Set the de-emphasis of the output CML buffer. Tri-level input pin. When set to "high", the pin becomes logic "1"; when set to "open", the pin becomes "open"; when set to "low", the pin becomes logic "0". Please refer to Mode Adjustment on page 3.
10, 31	VTH_CD, VTH_AB	Input	Set the voltage threshold of two channels. "Low" means V <sub>TH</sub> at (50mV, 110mV); "High" means V <sub>TH</sub> at (80mV, 150mV)
4, 14, 25, 35	EN_A#, EN_C#, EN_D#, EN_B#	Input	Channel Enable. "Low" = Channel is in normal operation. "High" = Channel is in power down mode. With internal 200kΩ pull-down resistor.
20, 41	RXDET_CD, RXDET_AB	Input	Set the state of receiver detection of two channels. "Low" means no receiver detection and "high" means the receiver detection is active. With internal 200kΩ pull-up resistor.
Center Pad	GND	GND	Supply Ground.

## Adaptive Auto Power Down or "Slumber" Mode

Notebooks, netbooks, and other power sensitive consumer devices require judicious use of power in order to maximize battery life. In order to minimize the power consumption of our devices, Pericom has added an additional adaptive auto power down feature. When a signal detector is idle for longer than 5ms, the corresponding channel will move to low power mode ONLY. (It means both channels will move to low power mode individually).

In the low power mode, the signal detector will still be monitoring the input channel. If the channel is in low power mode and the input signal is detected, the corresponding channel will wake up.

The device can also be forced into power down mode through the use of the EN\_x# pins however this would require the use of GPIO pins to control.

### Configuration Table

EN_x#	R <sub>X</sub> Det_xx	Function	Input R	Output R
1	X	Channel disable if EN_A#, EN_B#, EN_C#, and EN_D# are high, Chip Power Down	Hi-Z	Hi-Z
0	1	Chip and channel enabled, receiver detect is active	50Ω / Hi-Z*	50Ω / Hi-Z*
0	0	Chip and channel enabled, receiver detect is not active	50Ω	50Ω

\* Refer to pin 20 & 41 description

### Mode Adjustment

#### Equalization Setting:

EQ\_A/B/C/D are the selection pins for the equalization selection for each direction.

Equalizer setting	
EQ_A/B/C/D	@ 2.5GHz
0	3 dB
open	6dB (Default)
1	9dB

#### De-emphasis Setting:

DE\_A/B/C/D are the selection pins for the de-emphasis selection for each direction.

Output de-emphasis setting	
DE_A/B/C/D	De-emphasis
0	0 dB
open	-3.5 dB
1	-6 dB

## 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 SIG Voltage.....	-0.5V to V <sub>DD</sub> +0.5V
Current Output .....	-25mA to +25mA
Power Dissipation Continuous.....	1.0W
Operating Temperature.....	-40°C to +85°C
ESD, Human Body Model.....	-7kv to +7kV
ESD, Machine Model.....	-200V to +200V

**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	Parameter	Conditions	Min.	Typ.	Max.	Units
<b>DEVICE PARAMETERS</b>						
maximum data rate					5	Gbps
t <sub>ENB</sub>	Device enable time	sleep mode exit time ENA/B# H->L with Rx termination present		100		ns
t <sub>DIS</sub>	Device disable time	sleep mode entry time ENA/B# L->H		7		ns
<b>CONTROL LOGIC</b>						
I <sub>IH</sub>	Input High Current				50	uA
I <sub>IL</sub>	Input LOW Current		-50			
<b>Tri-level Control Pins (Pins: 39, 8, 18, 29, 40, 9, 19, 30)</b>						
V <sub>IH</sub>	Input High Voltage		0.8V <sub>pp</sub>			V
V <sub>IL</sub>	Input Low Voltage				0.2V <sub>pp</sub>	

## AC/DC Electrical Characteristics

<b>3.3V Power Supply Characteristics</b>						
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V <sub>DD33</sub>	Power Supply Voltage		3.0		3.6	V
P <sub>STANDBY33</sub>	Supply Power Standby	EN_[A:B:C:D]# = 1		0.3	3.6	mW
P <sub>SLUMBER33</sub>	Supply Power Slumber	EN_[A:B:C:D]# = 0, No Input Signal		92	130	
P <sub>DEVICE_UNPLUG</sub>	Supply Power Device Unplug	EN_[A:B:C:D]# = 0, Output unterminated		14		
P <sub>ACTIVE33</sub>	Supply Power Active	EN_[A:B:C:D]# = 0, V <sub>RX-DIFF-P</sub> ≥ V <sub>TH-SD</sub>		656	900	
I <sub>DD-STANDBY33</sub>	Supply Current Standby	EN_[A:B:C:D]# = 1			1	mA
I <sub>DD-SLUMBER33</sub>	Supply Current Slumber	EN_[A:B:C:D]# = 0, No Input Signal			36	mA
I <sub>DD-DEVICE_UNPLUG</sub>	Supply Current Device Unplug	EN_[A:B:C:D]# = 0, Output unterminated		4.3		mA
I <sub>DD-ACTIVE33</sub>	Supply Current Active	EN_[A:B:C:D] x# = 0, V <sub>RX-DIFF-P</sub> ≥ V <sub>TH-SD</sub>			250	

**AC/DC Electrical Characteristics (Continued..)**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
<b>Receiver AC/DC</b>						
V <sub>RX-DIFFP-P</sub>	Differential Peak-to-Peak Input Voltage	AC coupled differential RX peak to peak signal	100		1200	mVpp
V <sub>RX-C</sub>	Common Mode Voltage			1		V
V <sub>cm_ac</sub>	RX AC Common Mode Voltage	Measured at Rx pins with termination enabled			150	mVP
Z <sub>DC_RX</sub>	DC common mode impedance		18	26	30	Ω
Z <sub>diff_RX</sub>	DC differential input impedance		72	80	120	
Z <sub>RX_HIGH_IMP+</sub>	DC Input high impedance	Device in sleep mode RX termination not powered measured with respect to GND over 500mV max		67		kΩ
RL <sub>RX-DIFF</sub>	Differential return loss	50 MHz-1.25GHz		23		dB
		1.25 GHz-2.5 GHz		13		
RL <sub>RX-CM</sub>	Common mode return loss	50 MHz-2.5 GHz		8		dB
TH-SD	Signal detect Threshold	EN_A/B/C/D# = 0	65		175	mVppd
<b>Transmitter Output AC/DC (100Ω differential)<sup>1</sup></b>						
V <sub>TX-DIFFP-P</sub>	Differential Peak-to-peak Output Voltage	$V_{TX-DIFFP-P} = 2 *  V_{TX-D+} - V_{TX-D-} $	400		1200	mV
V <sub>TX-LFPS</sub>	LFPS Differential Peak-to-peak Output Voltage		800			
V <sub>TX-C</sub>	Common-Mode Voltage	$ V_{TX-D+} + V_{TX-D-} /2$	0.5		1.2	V
V <sub>cm_ac</sub>	TX AC common mode voltage				100	mVpp
DE		DE A/B/C/D = 0		0		dB
		DE A/B/C/D = NC	-3.0	-3.5	-4.0	
		DE A/B/C/D = 1		-6.0		
Z <sub>diff_TX</sub>	DC differential impedance		72	90	120	Ω
Z <sub>CM_TX</sub>	DC common mode impedance	Measured w.r.t to AC ground over 0-500mV	18	23	30	
RL <sub>diff_TX</sub>	Differential return loss	f= 50MHz-1.25 GHz		12		dB
		f= 1.25 GHz-2.5 GHz		8		
RL <sub>CM_TX</sub>	Common mode return loss	f= 50 MHz-2.5GHz		10		dB
I <sub>TX_SC</sub>	TX short circuit current	TX± shorted to GND		26		mA
V	Transmitter DC common-mode voltage V			1		V
V <sub>TX_CM_AC_Active</sub>	TX AC common mode voltage active			30	100	mVpp

**AC/DC Electrical Characteristics (Continued..)**

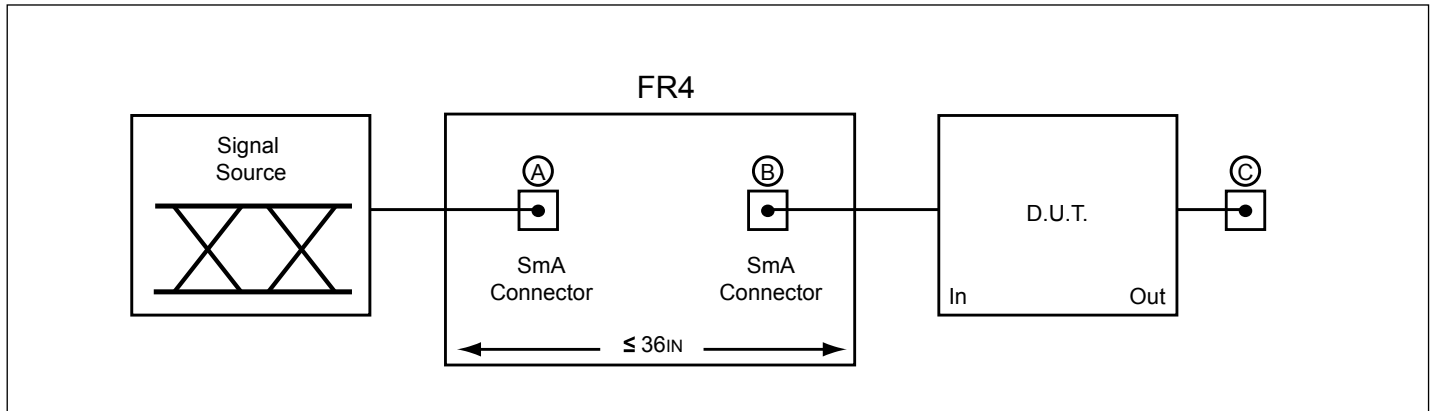
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V <sub>detect</sub>	Voltage change to allow receiver	Positive voltage to sense receiver termination			600	mV
t <sub>R,tF</sub>	Output rise/fall time	20%-80% of differential voltage measured 1" from the output pin		90		ps
T <sub>diff_LH</sub> , T <sub>diff_HL</sub>	Differential propagation delay	Propagation delay between 50% level at input and output		305	370	ps

**Equalization**

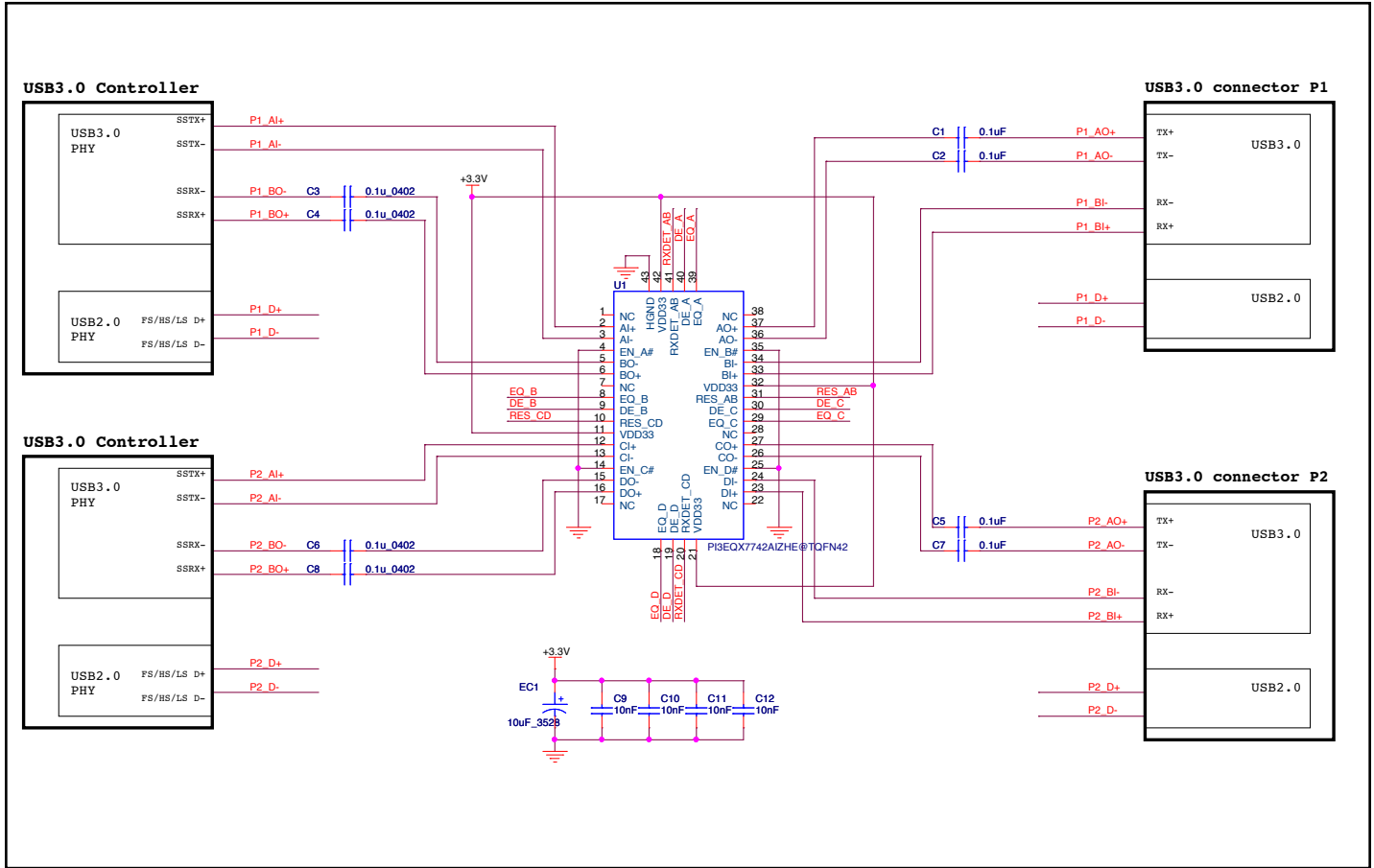
T <sub>TX-EYE</sub> <sup>(1)(2)</sup>	Total jitter(Tj)	with 36 inch of inputFR4 trace		0.2	0.5	UI <sup>(3)</sup> Pp
DJ <sub>TX</sub> <sup>(2)</sup>	Deterministic jitter(Dj)			0.1	0.3	
RJ <sub>TX</sub> <sup>(2)(4)</sup>	Random jitter(Rj)			0.09	0.2	

**Note:**

1. Includes RJ at 10<sup>-12</sup> BER
2. Deterministic jitter measured with PRBS31 pattern, Random jitter measured with 1010 pattern VID=1000mVpp, 5Gbps,
3. UI = 200ps
4. Rj calculated as 14.069 times the RMS random jitter for 10<sup>-12</sup> BER

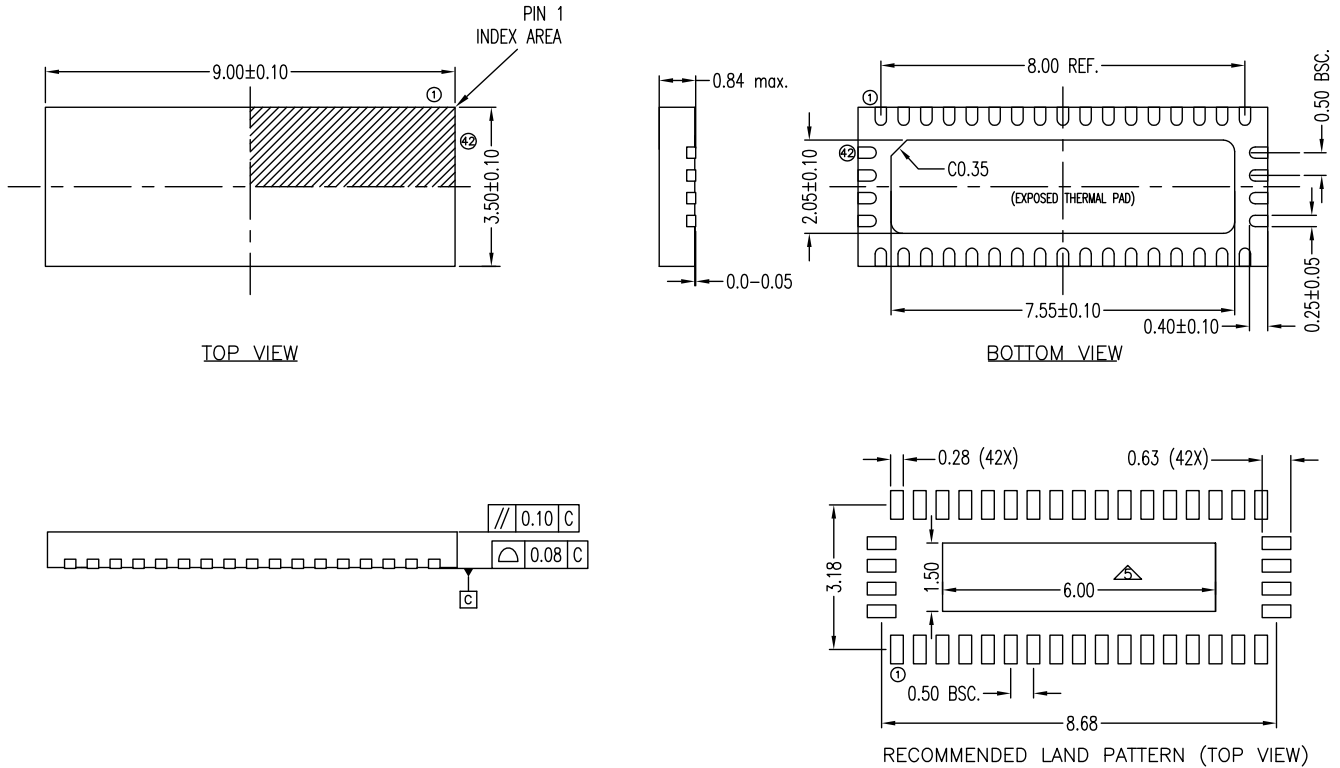


**Test Condition Referenced in the Electrical Characteristic Table**



**PI3EQX7742AI Application Schematic**

**Packaging Mechanical: 42-Contact TQFN (ZH)**



- Notes:**
1. All dimensions are in millimeters. Angles in degrees.
  2. Coplanarity applies to the exposed pad as well as the terminals.
  3. Refer JEDEC MO-220.
  4. Recommended land pattern is for reference only.
  5. Thermal pad soldering area

<b>PERICOM</b> Enabling Serial Connectivity	DATE: 11/14/12
<b>DESCRIPTION: 42-contact Thin Fine Pitch Quad Flat No-Lead (TQFN)</b>	
<b>PACKAGE CODE: ZH42</b>	
<b>DOCUMENT CONTROL #: PD-2035</b>	<b>REVISION:D</b>

12-0529 **Note: For latest package info, please check: <http://www.pericom.com/products/packaging/mechanicals.php>**

**Ordering Information**

Ordering Number	Package Code	Package Description
PI3EQX7742AIZHE	ZH	Pb-Free and Green 42-pin TQFN (3.5 x 9mm)

- 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



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