PERICOM®

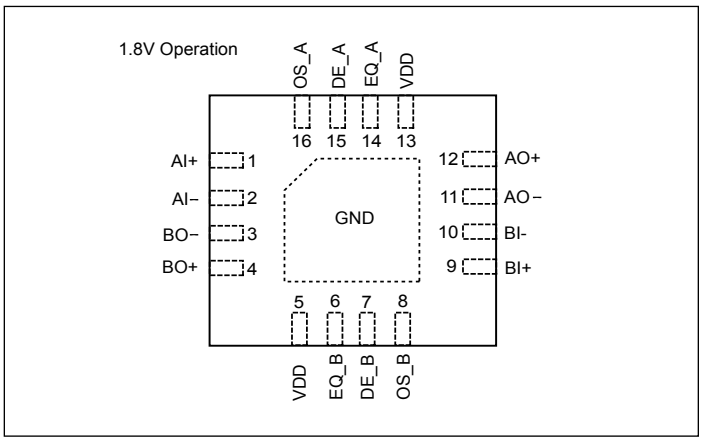
PI2EQX502E

1.8V 5.0Gbps, 1-port, USB 3.0 ReDriver™

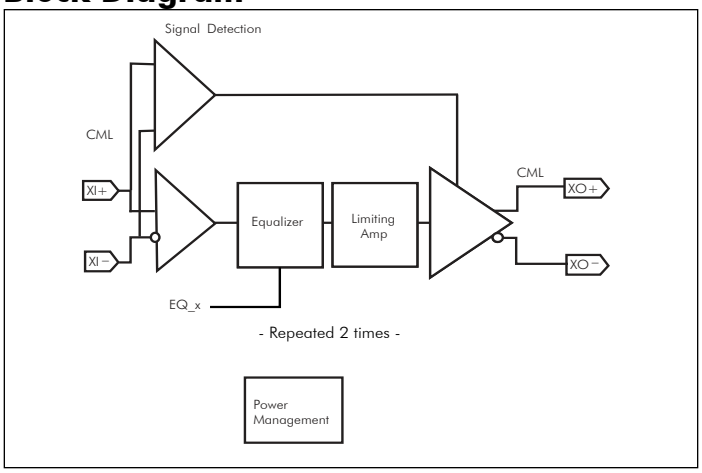
Features

- USB 3.0 compatible
- Full Compliancy to USB3.0 Super Speed Standard
- Two 5.0Gbps 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
- Low Power : ~205mW
- Auto "Slumber" mode for adaptive power management
- Single Supply Voltage: 1.8V
- Packaging: 16-Pin TQFN 3 x 3 mm

Pin Diagram (Top Side View)



Block Diagram



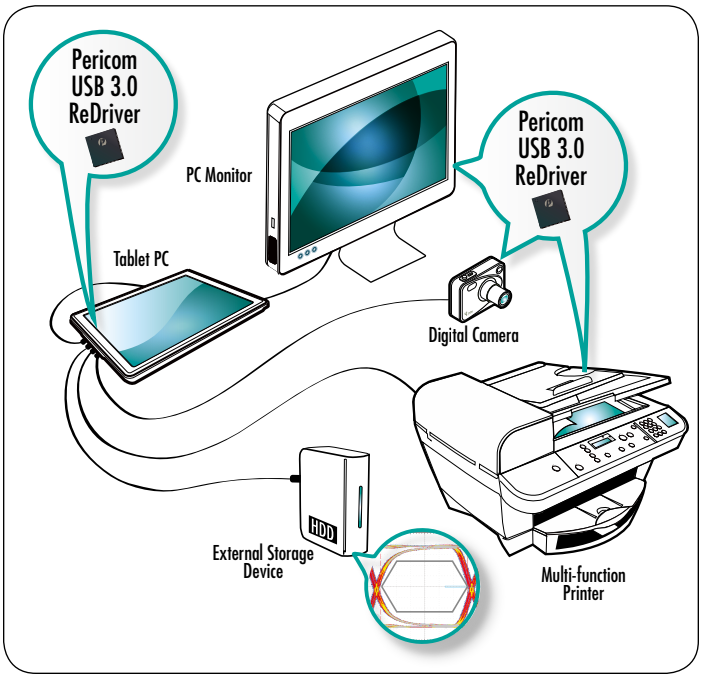
Description

Pericom Semiconductor's PI2EQX502E is a low power, high performance 5.0 Gbps signal ReDriver™ designed specifically for the USB 3.0 protocol. The device provides programmable equalization and De-Emphasis to optimize performance over a variety of physical mediums by reducing Inter-Symbol Interference. PI2EQX502E supports two 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. The channels' input signal level (on xI+/-) determines whether the output is active.

The PI2EQX502E also includes an automatic receiver detect function. The receiver detection loop will be active again if the corresponding channel's signal detector is idle for longer than 7.3mS. The channel will then move to Unplug Mode if load not detected, or it will return to Low Power Mode (Slumber Mode) due to inactivity.

Figure1



Pin Description

Pin #	Pin Name	Type	Description
5, 13	VDD	Power	1.8V power supply
16 8	OS_A OS_B	Input	Set output swing of output CML buffer. 3-level input pin, with internal 108kΩ pull-up resistor and 108KΩ pull-down resistor
14 6	EQ_A EQ_B	Input	Set the equalization of two channels. 4-level input pin. With internal 72kΩ pull-up resistor and 144KΩ pull-down resistor.
15 7	DE_A DE_B	Input	Set de-emphasis of output CML buffers. Tri-level input pin. With internal 108kΩ pull-up resistor and 108kΩ pull-down resistor.
1, 2 9, 10	AI+, AI- BI+, BI-	Input	CML input channels. With Selectable input termination between 50Ω to internal Vbias or 60kOhm to GND.
12, 11 4, 3	AO+, AO- BO+, BO-	Output	Selectable output termination between 50Ω to internal Vbias or 2kΩ to internal Vbias.
Center Pad	GND	GND	Supply Ground.

Power Management

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 power management feature. When a signal detector is idle for longer than 1.3ms, 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 a channel is in low power mode and the input signal is detected, the corresponding channel will wake-up immediately. If a channel is in low power mode and the signal detector is idle longer than 6ms, the receiver detection loop will be active again. If load is not detected, then the Channel will move to Device Unplug Mode and monitor the load continuously. If load is detected, it will return to Low Power Mode and receiver detection will be active again per 6ms.

Configuration Table

Mode	Input R	Output R
Unplug mode	60kΩ to GND	2kΩ to V_{BIAS}
Slumber mode	50Ω to V_{BIAS}	2kΩ to V_{BIAS}
Active mode	50Ω to V_{BIAS}	50Ω to V_{BIAS}

Mode Adjustment

Equalization Setting:

EQ is the selection pin for the equalization.

Equalizer setting	
EQ	@ 2.5GHz
0 (Tie 0Ω to GND)	3 dB
Open (Leave open)	6dB (Default)
1 (Tie 0Ω to Vdd)	9dB
R (Tie 48kΩ to GND)	12dB

De-emphasis Setting:

DE is the selection pin for the de-emphasis.

Output de-emphasis setting	
DE	De-emphasis
0	0 dB
Open	-3.5 dB (default)
1	-6 dB

Output Swing Setting:

OS is the selection pin for the output swing.

Output swing setting	
OS	Output swing
0	700 mVppd
Open	1000 mVppd (default)
1	1200 mVppd

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 +2V
DC SIG Voltage	–0.5V to V_{DD} +0.5V
Current Output	–25mA to +25mA
Power Dissipation Continuous	1.0W
Operating Temperature	-40°C to +85°C
ESD, Human Body Model	–8kv to +8kV

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
DEVICE PARAMETERS						
maximum date rate					5	Gbps
t_{ENB}	Slumber mode exit time	LFPS signal		20		ns
t_{DIS}	Slumber mode entry time	Electrical idle		1.3		ms
CONTROL LOGIC						
I_{IH}	Input High Current				50	uA
I_{IL}	Input LOW Current		-50			
Tri-level Control Pins (Pins: 7, 8, 15, 16)						
V_{IH}	Input High Voltage		0.8Vdd			V
V_{IL}	Input Low Voltage				0.2Vdd	

AC/DC Electrical Characteristics

1.8V Power Supply Characteristics						
Symbol	**Parameter**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
V_{DD18}	Power Supply Voltage		1.7		1.9	V
$P_{SLUMBER18}$	Supply Power Slumber	Device Plugged, No Input Signal		27		mW
P_{DEVICE_UNPLUG}	Supply Power Device Unplug	Device Unplugged, No Input Signal		4		
$P_{ACTIVE18}$	Supply Power Active	$V_{RX\text{-}DIFF\text{-}P} \geq V_{TH\text{-}SD}$, Device Plugged and DE=1 for both channels		225		
$I_{DD\text{-}SLUMBER18}$	Supply Current Slumber	Device Plugged, No Input Signal		15		mA
$I_{DD\text{-}DEVICE\_UNPLUG}$	Supply Current Device Unplug	Device Unplugged, No Input Signal		2		mA
$I_{DD\text{-}ACTIVE18}$	Supply Current Active	$V_{RX\text{-}DIFF\text{-}P} \geq V_{TH\text{-}SD}$, Device Plugged and DE=1 for both channels		125		

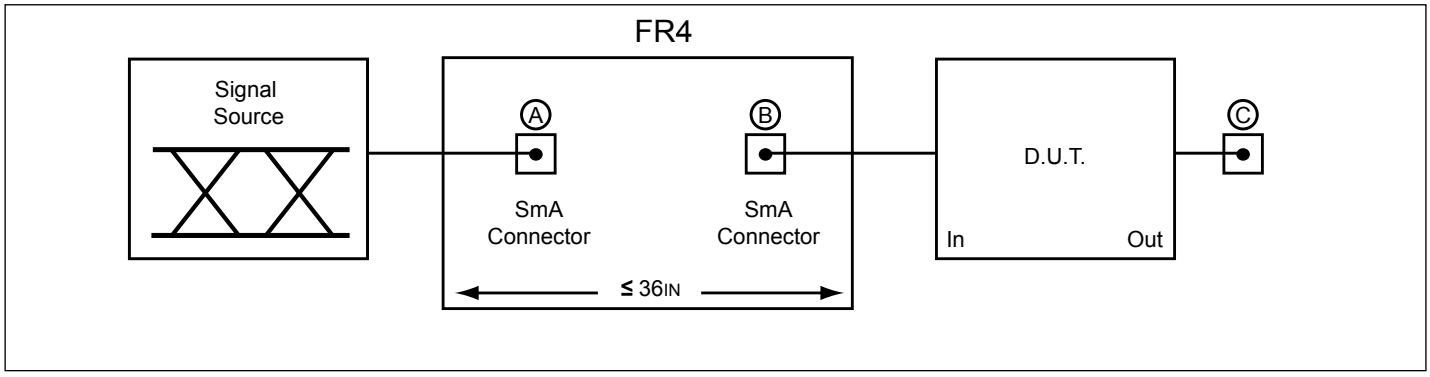
AC/DC Electrical Characteristics (Continued..)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
Receiver AC/DC						
$V_{RX-DIFFP-P}$	Differential Peak-to-Peak Input Voltage	AC coupled differential RX peak to peak signal	175		1200	mVppd
V_{RX-C}	Common Mode Voltage			1		V
V_{cm_ac}	RX AC Common Mode Voltage	Measured at Rx pins with termination enabled			150	mV
Z_{diff_RX}	DC differential input impedance		72	80	120	
$Z_{RX\_HIGH\_IMP+}$	DC Input high impedance	Device in unplug mode RX termination measured with respect to AC GND 200mV max		67		kΩ
$RL_{RX-DIFF}$	Differential return loss	50 MHz-1.25GHz		23		db
		1.25 GH-2.5 GHz		13		
RL_{RX-CM}	Common mode return loss	50 MHz-2.5 GHz		8		db
TH-SD	Signal detect Threshold		65		175	mVppd
Transmitter Output AC/DC (100Ω differential)[1]						
$V_{TX-DIFFP-P}$	Differential Peak-to-peak Output Voltage	$V_{TX-DIFFP-P} = 2 * \lvert V_{TX-D+} - V_{TX-D-} \rvert$	400		1200	mVppd
$V_{TX-LFPS}$	LFPS Differential Peak-to-peak Output Voltage		800			
V_{TX-C}	Common-Mode Voltage	$\lvert V_{TX-D+} + V_{TX-D-} \rvert /2$	0.5		1.2	V
V_{cm_ac}	TX AC common mode voltage				100	mVppd
DE		DEA/B = 0		0		dB
		DEA/B = NC	-3.0	-3.5	-4.0	
		DEA/B = 1		-6.0		
Z_{diff_TX}	DC differential impedance		72	90	120	Ω
RL_{diff_TX}	Differential return loss	f= 50MHz-1.25 GHz		12		dB
		f= 1.25 GHz-2.5 GHz		8		
RL_{CM_TX}	Common mode return loss	f= 50 MHz-2.5GHz		10		dB
I_{TX_SC}	TX short circuit current	TX± shorted to GND		26		mA
$V_{TX\_CM\_AC\_Active}$	TX AC common mode voltage active			30	100	mVpp

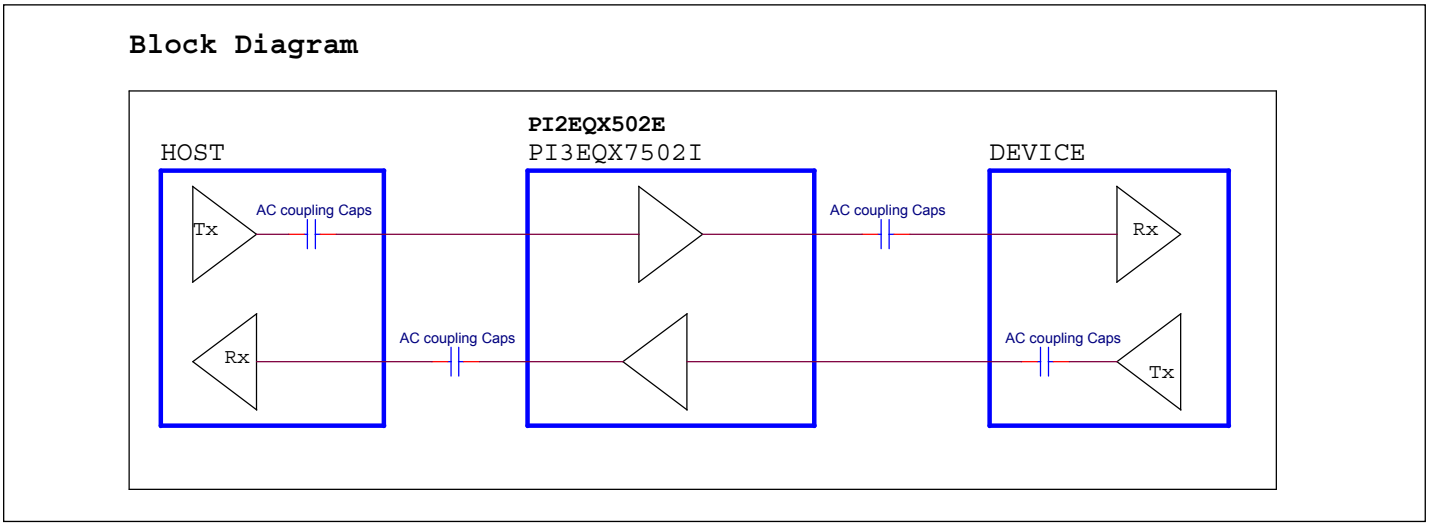
AC/DC Electrical Characteristics (Continued..)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{detect}	Voltage change to allow receiver detect	Positive voltage to sense receiver termination			600	mV
t_R,t_F	Output rise/fall time	20%-80% of differential voltage measured 1" from the output pin		90		ps
T_{diff_LH}, T_{diff_HL}	Differential propagation delay	Propagation delay between 50% level at input and output		305		ps
Jitter Profile						
T_{TX-EYE}(1)(2)	Total jitter(Tj)	with 36 inch of inputFR4 trace		0.2	0.5	UI(3) p-p
DJ_{TX}(2)	Deterministic jitter(Dj)			0.1	0.3	
RJ_{TX}(2)(4)	Random jitter(Rj)			0.09	0.2	

Note:
1. Includes RJ at 10^{-12} BER
2. Determininstic 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^{-12} BER

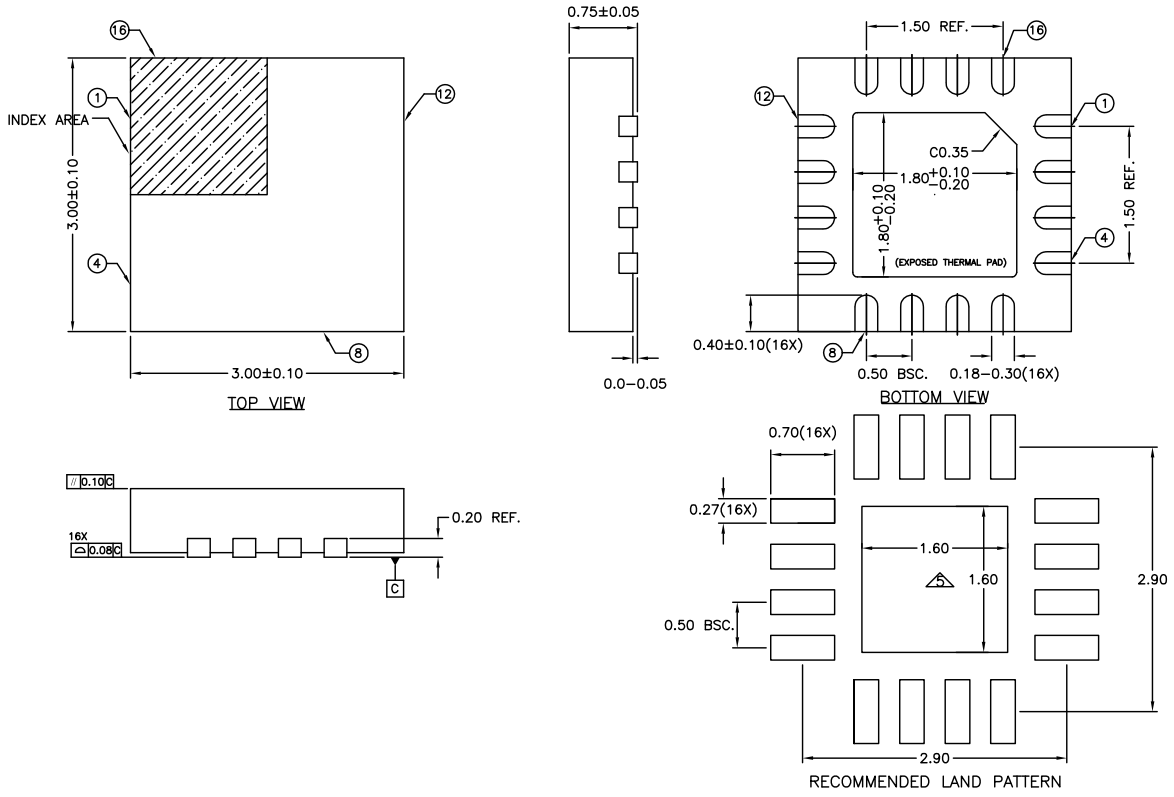


Test Condition Referenced in the Electrical Characteristic Table



PI2EQX502E Application Schematics

Packaging Mechanical: 16 pin TQFN (ZH)



NOTE :
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. COPLANARITY APPLIES TO THE EXPOSED THERMAL PAD AS WELL AS THE TERMINALS.
3. REFER JEDEC MO–220
4. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.
5. THERMAL PAD SOLDERING AREA (MESH STENCIL IS RECOMMENDED).

PERICOM Semiconductor Corporation — DATE:12/26/13

DESCRIPTION: 16-Contact, Thin Fine Pitch Quad Flat No-Lead (TQFN)

PACKAGE CODE: ZH (ZH16)

DOCUMENT CONTROL #: PD-2047 REVISION: E

14-0244

Ordering Information

Ordering Number	Package Code	Package Description
PI2EQX502EZHE	ZH	16-Contact, Thin Fine Pitch Quad Flat No-Lead (TQFN)

Notes:

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