DIODES
INCORPORATED

Lead-free Green

A product Line of
Diodes Incorporated | PERICOM®

PI2EQX510E

1.8V 5.0Gbps, 1-channel, USB3.0 ReDrive

Features

→ USB 3.0 compatible

→ Full compliancy to USB 3.0 Super Speed standard

→ One 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 function

→ Automatic Receiver Detect

→ Low Power : ~110mW (typ)

→ Auto "Slumber" mode for adaptive power management

→ Single Supply Voltage: 1.8V

→ Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)

→ Halogen and Antimony Free. "Green" Device (Note 3)

→ For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.

   https://www.diodes.com/quality/product-definitions/

→ Packaging: 10-Pin X2QFN 1.6 x 1.6 mm
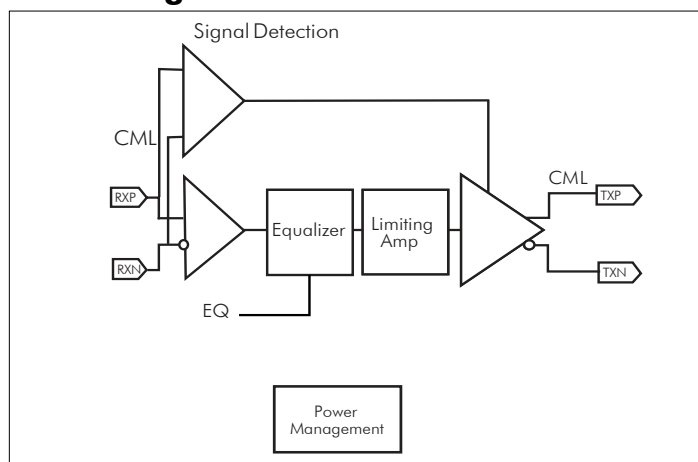
Description

Diodes' PI2EQX510E 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.

PI2EQX510E supports one 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. The channels' input signal level determines whether the output is active.

The PI2EQX510E also includes a 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.
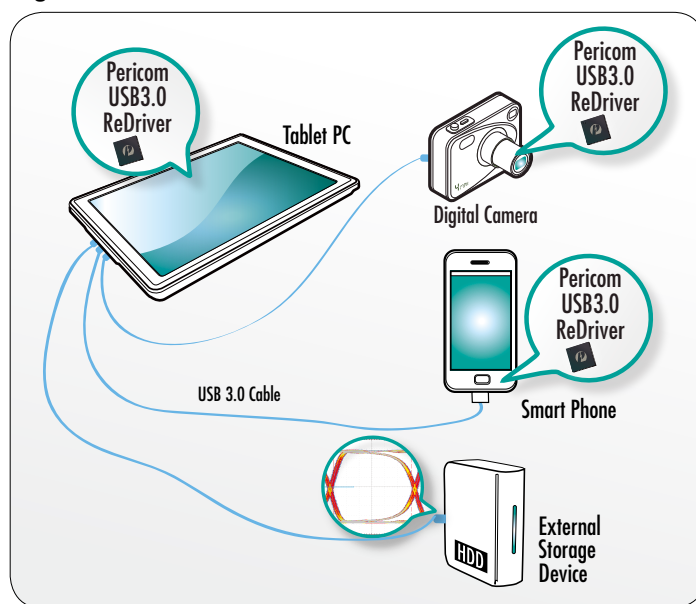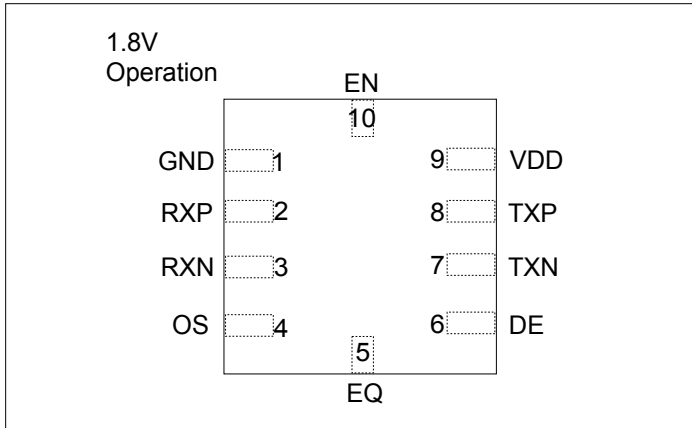
Block Diagram

Figure 1

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

ReDriver is a trademark of Diodes Incorporated.

Pin Diagram (Top Side View)

1.8V Operation

EN 10	
GND 1	9 VDD
RXP 2	8 TXP
RXN 3	7 TXN
OS 4	6 DE
5 EQ	

Pin Description

Pin #	Pin Name	Type	Description
9	VDD	Power	1.8V power supply
2, 3	RXP, RXN	Input	CML input channels. With Selectable input termination between 50Ω to internal $V_{BIAS}R_X$ or 60kΩ to GND. The RXP and RXN are pin polarity reversible as long as output pins are reversed at the same time.
5	EQ	Input	Set the equalization of channel. 4-level input pin. With internal 60kΩ pull-up resistor and 120kΩ pull-down resistor.
8, 7	TXP, TXN	Output	Selectable output termination between 50Ω to internal V_{BIAS}, 2kΩ to internal V_{BIAS} or HI-Z. The TXP and TXN are pin reversible as long as input pins are reversed at the same time.
10	EN	Intput	Channel Enable. High = channel Enable, Low = channel disable. With internal 180kΩ pull-up resistor
4	OS	Input	Set output swing of output CML buffer. 3-level input pin. With internal 90kΩ pull-up resistor and 90kΩ pull-down resistor.
6	DE	Input	Set de-emphasis of output CML buffer. 3-level input pin. With internal 90kΩ pull-up resistor and 90kΩ pull-down resistor.
1	GND	GND	Supply Ground.

Power Management

Notebooks, netbooks, tablets 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, Diodes has added an additional adaptive power management feature. When a signal detector is idle for longer than 1.3ms, the channel will move to low power mode.

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, it 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 $V_{BIAS}R_X$	2kΩ to V_{BIAS}
Active mode	50Ω to $V_{BIAS}R_X$	50Ω to V_{BIAS}
PD Mode	60kΩ to GND	HIZ

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 40kΩ 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 +2.5V
DC SIG Voltage...–0.5V to V_{DD} +0.5V
Current Output ....–25mA to +25mA
Power Dissipation Continuous 1.0W
Operating Temperature.. 0°C to +70°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

VDD = 1.8V $\pm$ 0.2V, T_A = 0 to 70°C

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
Device Parameters						
maximum data rate					5	Gbps
$T_{power-on-rst}$	Power-On Reset Time	Reset time is required after EN pin goes from Low to High			50	ms
t_{DIS}	Device disable time	Disable time is required after EN pin goes from High to Low		7		ns
2-Level Control Pins (10)						
V_{IH}	DC input logic high		Vdd*0.65			V
V_{IL}	DC input logic low				Vdd*0.35	V
I_{IH}	Input High Current				20	uA
I_{IL}	Input LOW Current		-20			uA
3-Level Control Pins (4, 6)						
V_{IH}	DC input logic "High"		0.92*Vdd	Vdd		V
V_{IF}	DC input logic "Float"		0.25*Vdd	0.5*Vdd	0.75*Vdd	V
V_{IL}	DC input logic "Low"			0	0.08* Vdd	V
I_{IH}	Input High Current				40	uA
I_{IL}	Input LOW Current		-40			uA
4-Level Control Pins (5)						
V_{IH}	DC input logic "High"		0.92*Vdd	Vdd		V
V_{IF}	DC input logic "Float"		0.59*Vdd	0.67*Vdd	0.75*Vdd	V
V_{IR}	DC input logic "With Rext to GND"		0.25*Vdd	0.33*Vdd	0.41*Vdd	V
V_{IL}	DC input logic "Low"			0	0.08*Vdd	V
I_{IH}	Input High Current				30	uA
I_{IL}	Input LOW Current		-60			uA
Rext	External resistor connects to GND		38K	40K	42K	Ω

AC/DC Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
1.8V Power Supply Characteristics						
V_{DD}	Power Supply Voltage	Voltage Supply	1.6	1.8	2.0	V
$P_{SLUMBER}$	Supply Power Slumber	Device Plugged, No Input Signal		15	26	mW
P_{DEVICE_UNPLUG}	Supply Power Device Unplug	Device Unplugged, No Input Signal		2.2		mW
P_{ACTIVE}	Supply Power Active	$V_{RX-DIFF-P} \geq V_{TH-SD}$, DE=1, Device Plugged, OS = Float		112		mW
$P_{DISABLE}$	Supply Power Disable	Device disabled, EN=Low		25		μW
$I_{DD-SLUMBER}$	Supply Current Slumber	Device Plugged, No Input Signal		8		mA
$I_{DD-DEVICE\_UNPLUG}$	Supply Current Device Unplug	Device Unplugged, No Input Signal		1.2		mA
$I_{DD-ACTIVE}$	Supply Current Active	$V_{RX-DIFF-P} \geq V_{TH-SD}$, DE=1, Device Plugged, OS = Float		62		mA
$I_{DD-DISABLE}$	Supply Current Disable	Device disabled, EN=Low		12		μA
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		120	ohm
Z_{DC_RX}	DC Common Mode impedance		18		30	Ω
$Z_{RX\_HIGH\_IMP+}$	DC Input high impedance	Device in unplug mode RX termination measured with respect to AC GND over 500mV max		67		kΩ
$RL_{RX-DIFF}$	Differential return loss	50 MHz-1.25GHz		23		db
		1.25 GH-2.5 GHz		13		db
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)						
$V_{TX-DIFFP-P}$	Differential Peak-to-peak Output Voltage	$V_{TX-DIFFP-P} = 2 * \mid V_{TX-D+} - V_{TX-D-} \mid$	400		1200	mVppd
$V_{TX-LFPS}$	LFPS Differential Peak-to-peak Output Voltage		800		1200	mVppd
V_{TX-C}	Common-Mode Voltage	$\mid V_{TX-D+} + V_{TX-D-} \mid/2$	0.5		1.2	V
V_{cm_ac}	TX AC common mode voltage				100	mVpp
DE		DE = 0		0		dB
		DE = NC	-3.0	-3.5	-4.0	dB
		DE = 1		-6.0		dB

AC/DC Electrical Characteristics Cont.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
Z_{diff_TX}	DC differential impedance		72		120	Ω
Z_{CM_TX}	DC Common Mode impedance		18		30	
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-1.25GHz		10		dB
		f = 1.25GHz-2.5GHz		4.5		
I_{TX_SC}	TX short circuit current	TX± shorted to GND		26		mA
V	Transmitter DC common-mode voltage V			0.85		V
$V_{TX\_CM\_AC\_Active}$	TX AC common mode voltage active			30	100	mVpp
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 input FR4 trace		0.2	0.5	UI[3]
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. Deterministic jitter measured with PRBS7 pattern, Random jitter measured with 1010 pattern $V_{RX-DIFFP-P}$=1000mVpp, 5Gbps,
3. UI = 200ps
4. Rj calculated as 14.069 times the RMS random jitter for 10^{-12} BER
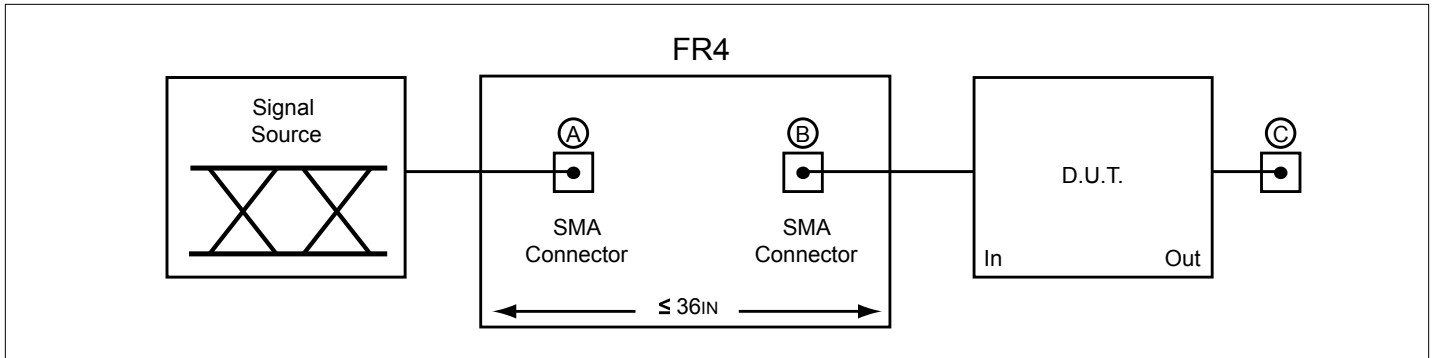
Test Condition Referenced in the Electrical Characteristic Table
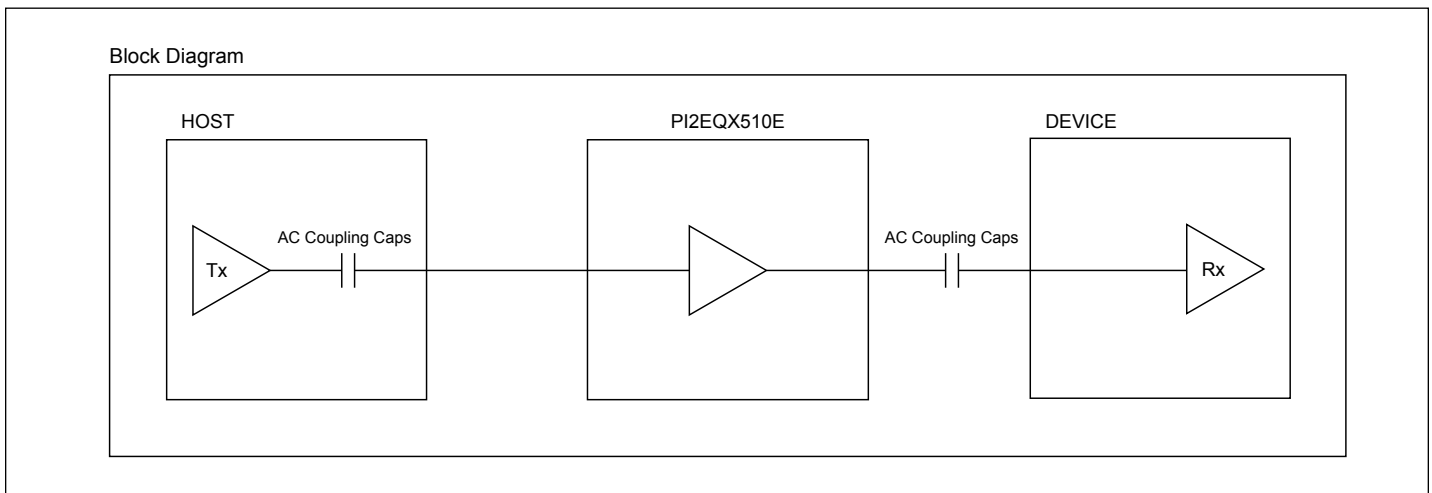
PI2EQX510E Application Schematics

Packaging Mechanical: 10-X2QFN (XUA)

SYMBOLS	MIN.	NOM.	MAX.
A	0.30	0.35	0.40
A1	0.00	0.02	0.05
A3		0.127 REF.	
b	0.15	0.20	0.25
D	1.55	1.60	1.65
E	1.55	1.60	1.65
e		0.40 BSC	
L	0.35	0.40	0.45
L1	0.45	0.50	0.55

Note
1. Controlling dimentions in millimeters. Angles in degrees.
2. Ref: JEDEC MO-288
3. Recommended land pattern is for reference only.
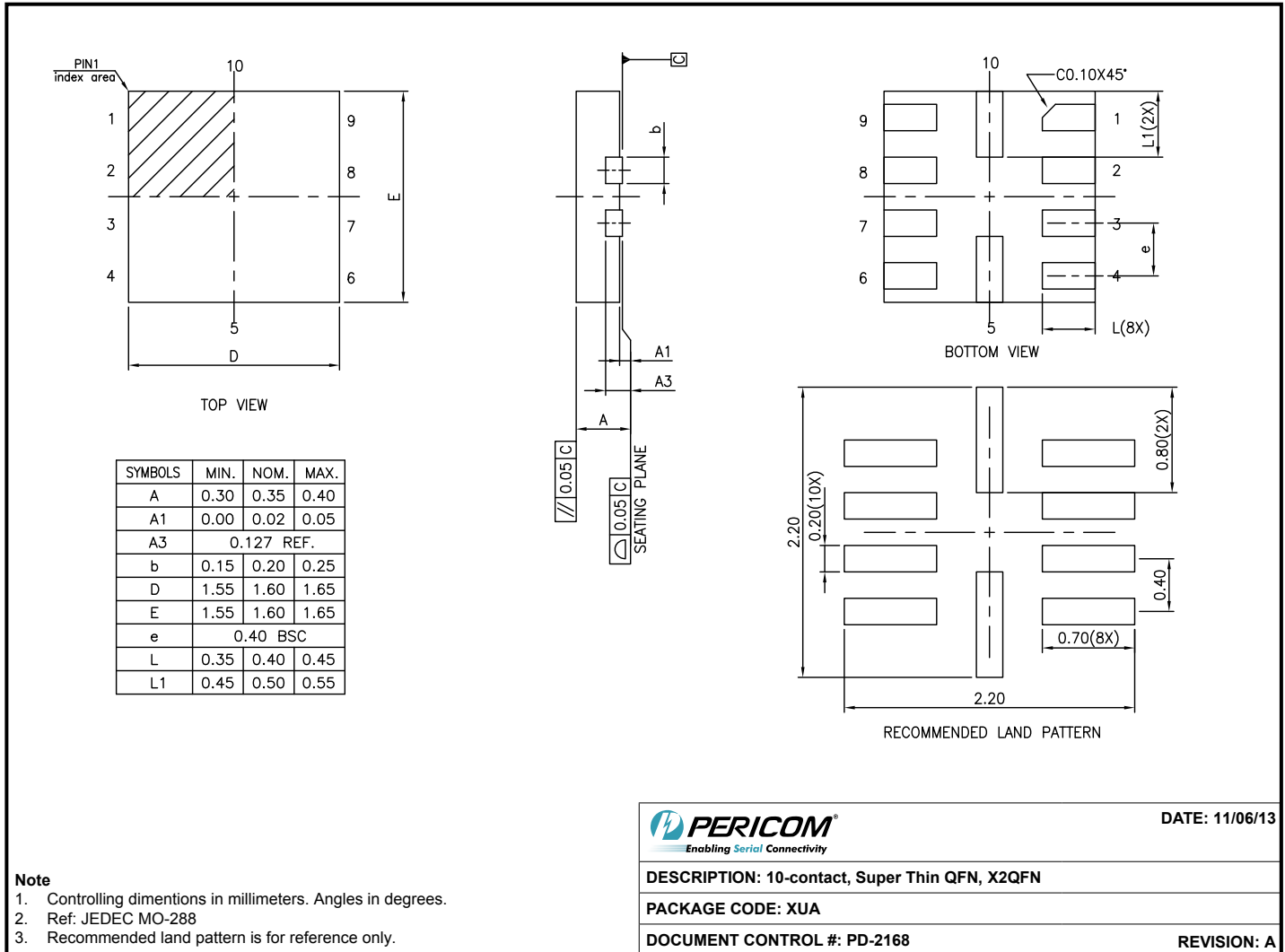
13-0218

PERICOM
Enabling *Serial* Connectivity

DATE: 11/06/13

DESCRIPTION: 10-contact, Super Thin QFN, X2QFN

PACKAGE CODE: XUA

DOCUMENT CONTROL #: PD-2168

REVISION: A

For latest package info.

please check: http://www.diodes.com/design/support/packaging/pericom-packaging/packaging-mechanicals-and-thermal-characteristics/

Ordering Information

Ordering Number	Package Code	Package Description
PI2EQX510EXUAEX	XUA	10-contact, Super Thin QFN, X2QFN

Notes:

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3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. E = Pb-free and Green
5. X suffix = Tape/Reel

IMPORTANT NOTICE

LIFE SUPPORT