SIM Card Interface Level Shifter

Features

- SIM Card Voltage Range 1.65V to 3.6V
- Host Voltage Range: 1.1V to 2.0V
- Automatic Level Translation
- Low Operating/Shutdown Current
- 8kV ESD HBM for SIM Card Pins
- 2kV ESD HBM for All Other Pins
- Meets EMV Fault Tolerance Requirements
- 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-Q100/101/104/200, 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 (Pb-free & Green):
  - 10-Contact, 1.4mmx1.8mm X1QFN (XEA)

Description

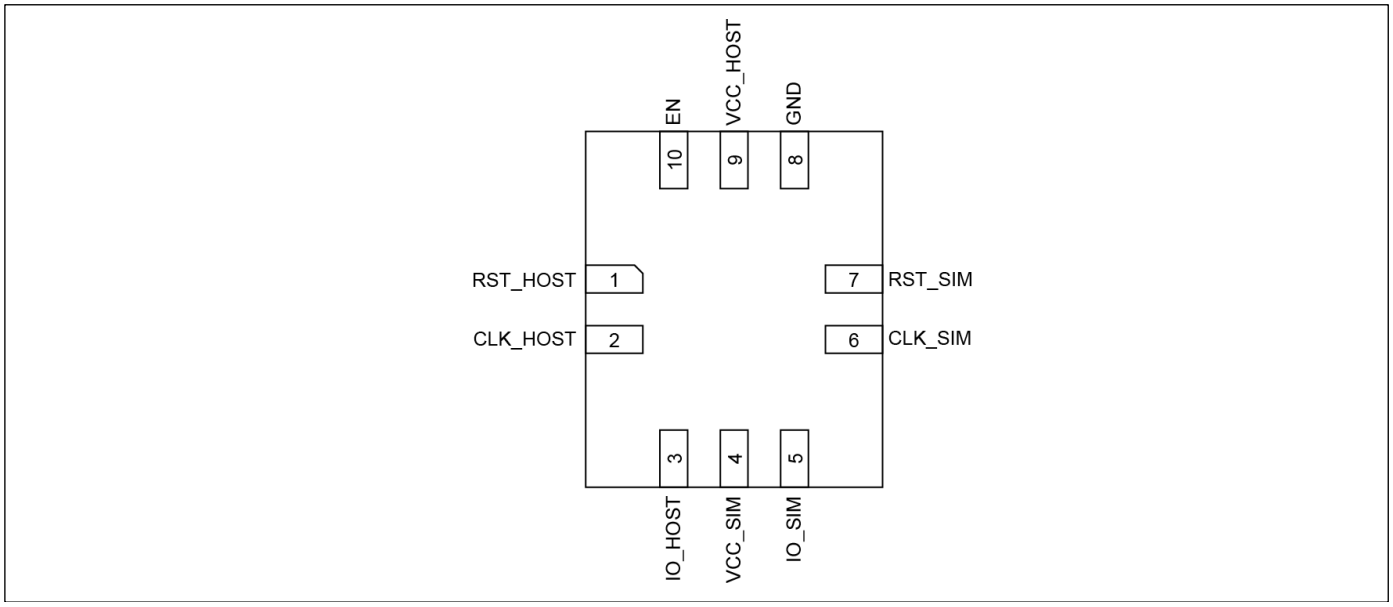
The DIODES™ PI4ULS3V4103 provides the power conversion and signal level translation needed for advanced cellular telephones to interface with 1.8V and 3V subscriber identity modules (SIMs). The device meets all requirements for 1.8V or 3V SIMs. Internal level translators allow controller operating with supplier as low as 1.2V to interface with 1.8V or 3V Smart Cards.

Applications

- GSM, TD-SCDMA
- Wireless Point-to-Sale Terminals
- Multiple SIM Card Interfaces

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.

Pin Configuration



Pin Description

Pin#	Name	Type	Description
9	VCC_HOST	P	Power Supply for Host side pins
4	VCC_SIM	P	Power Supply for SIM card side pins
10	EN	I	Host Controller driven Enable Inputs. EN=HIGH output active, EN=LOW shutdown the device.
1	RST_HOST	I	Reset input from host controller.
2	CLK_HOST	I	Clock input from host controller.
3	IO_HOST	I/O	Host controller bidirectional data input/output.
7	RST_SIM	O	Reset output pin for the SIM card.
6	CLK_SIM	O	Clock output pin for the SIM card.
5	IO_SIM	I/O	SIM Card bidirectional data input/output.
8	GND	P	Ground for the SIM card and host controller.

Maximum Ratings

Storage Temperature	–55°C to +150°C
Ambient Temperature	–40°C to +85°C
Supply Voltage to Ground Potential	–0.5V to +4.6V
Host Side Input Voltage	–0.5V to +2.2V
Card Side Input Voltage	–0.5V to +4.6V
Power Dissipation Continuous	1000mW
I/O Latch-up Current	-100mA to +100mA
ESD, HBM for SIM card Pins	–8000V to +8000V
ESD, HBM for other Pins	–2000V to +2000V

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.
The device is guaranteed to meet performance specifications from 0°C to 85°C. Specification over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical controls.
I_{CC} based on long-term current density limitation.

DC Electrical Characteristics

(1.1V ≤ V_{CC_HOST} ≤ 2.0V, 1.65V ≤ V_{CC_SIM} ≤ 3.6V ,T_A = –40°C to 85°C, unless otherwise noted.)

Parameter	Description	Test Conditions	Min	Typ.	Max	Unit
Host Side Power Supply						
$V_{CC-HOST}$	Host side operating Voltage		1.1	-	2.0	V
$I_{CC-HOST}$	$V_{CC-HOST}$ Operating Current	EN=High,V_I = VCC, I_O = 0	-	-	10	µA
$I_{CCS-HOST}$	$V_{CC-HOST}$ Shutdown Current	EN=GND	-	-	60	
SIM Card Side Power Supply						
V_{CC-SIM}	SIM side operating Voltage		1.65	-	3.6	V
I_{CC-SIM}	V_{CC-SIM} Operating Current	EN=High,V_I = VCC, I_O = 0	-	-	10	µA
$I_{CCS-SIM}$	V_{CC-SIM} Shutdown Current	EN=GND	-	-	2	
EN pins						
V_{IL}	Low Level input Voltage		-	-	0.3x $V_{CC-HOST}$	V
V_{IH}	High Level input Voltage		0.7x $V_{CC-HOST}$	-	-	V
Host Side CLK, RST, IO pins						
V_{IL}	Low Level input Voltage		-	-	0.25 x $V_{CC-HOST}$	V
V_{IH}	High Level input Voltage		0.75x $V_{CC-HOST}$	-	-	V
V_{OL}	Low Level Output Voltage (IO_HOST pin)	I_{OL} = 1 mA	-	-	0.3	V
V_{OH}	High Level Output Voltage (IO_HOST pin)	I_{OH} = -10µA	0.7 x $V_{CC-HOST}$	-	-	V
SIM Card Side CLK, RST, IO pins						
V_{IL}	Low Level input Voltage (IO_SIM pin)		-	-	0.3 x V_{CC-SIM}	V
V_{IH}	High Level input Voltage (IO_SIM pin)		0.7x V_{CC-SIM}	-	-	V
V_{OL}	High Level Output Voltage (IO_SIM pin)	I_{OL} = 1 mA	-	-	0.3	V
	High Level Output Voltage (RST_SIM, CLK_SIM pin)	I_{OL} = 1 mA	-	-	0.2 x V_{CC-SIM}	V
V_{OH}	High Level Output Voltage (IO_SIM pin)	I_{OH} = -10µA	0.7x V_{CC-SIM}	-	-	V
	High Level Output Voltage (RST_SIM, CLK_SIM pins)	I_{OH} = -1mA	0.8x V_{CC-SIM}	-	-	V
Resistors and IO capacitance						
Rs	series resistance	IO_SIM, RST_SIM ,CLKSIM	-	44	-	Ω

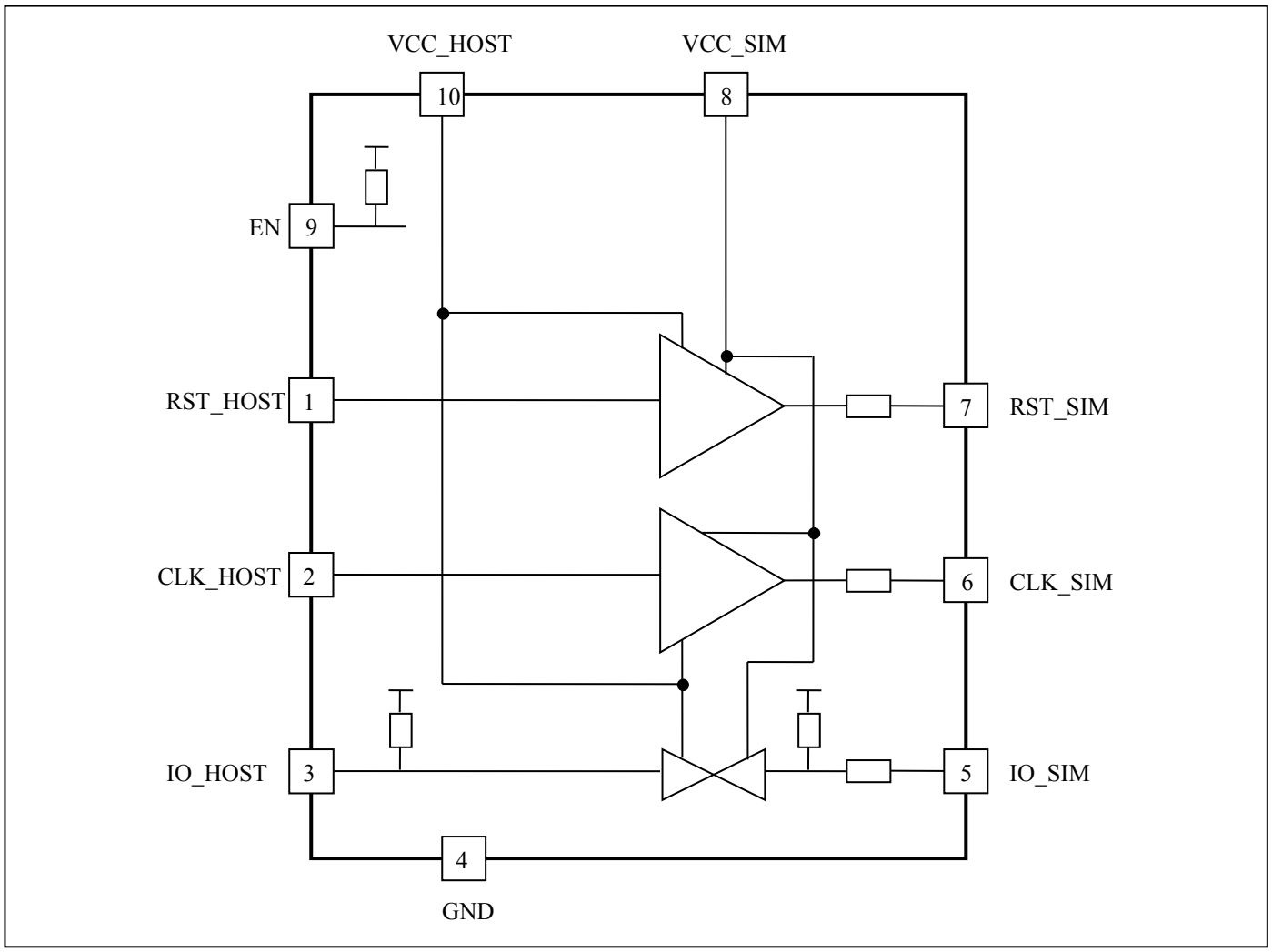
Parameter	Description	Test Conditions	Min	Typ.	Max	Unit
R_{PU}	Pull-up resistors	IO_HOST	-	20	-	kΩ
		IO_SIM	-	15	-	kΩ
		EN	-	50	-	kΩ
C_{IO}	input/output capacitance	Host side pins	-	7	-	pF
		Card Side pins	-	15	-	pF
		EN pin	-	7	-	pF

Dynamic Characteristics

($1.1V \leq V_{CC\_HOST} \leq 2.0V$, $1.65V \leq V_{CC\_SIM} \leq 3.6V$, $T_A = -40°C$ to $85°C$, unless otherwise noted.)

Parameter	Description	Test Conditions	Min	Typ.	Max	Unit
VCC_HOST = 1.8 V; VCC_SIM = 2.95 V; SIM card $C_L \leq 30$ pF; host $C_L \leq 10$ pF						
t_{PD}	propagation delay	SIM card side to Host side	-	8	15	ns
		Host side to SIM card side	-	8	15	ns
t_R	Rising time		-	-	10	ns
t_F	Falling time		-	-	10	ns
tsk(o)	output skew time	between channels; IO_SIM and CLK_SIM	-	-	2	ns
fclk	clock frequency	Clk_SIM			25	MHz
VCC_HOST = 1.2 V; VCC_SIM = 1.8 V; SIM card $C_L \leq 30$ pF; host $C_L \leq 10$ pF						
t_{PD}	propagation delay	SIM card side to Host side	-	8	15	ns
		Host side to SIM card side	-	8	15	ns
t_R	Rising time		-	-	10	ns
t_F	Falling time		-	-	10	ns
tsk(o)	output skew time	between channels; IO_SIM and CLK_SIM	-	-	2	ns
fclk	clock frequency	Clk_SIM			25	MHz

Function Block Diagram



Function Description

VCC_HOST (Pin 10): Power. Supply voltage of HOST controller side signal.
VCC_SIM (Pin 8): Power. Supply voltage of SIM card side signal.
RST_HOST (Pin 1): Input. Supply the reset signal to the card through RST. It is level shifted and transmitted directly to the RST pin of the selected card.

CLK_HOST (Pin 2): Input. Supply the clock signal to the card through CLK. It is level shifted and transmitted directly to the CLK pin of the card.
IO_HOST (Pin 3): Input / Output. Connect this pin to microcontroller side I/O pin. The DATA pin provides the bidirectional communication path to card. The pin possesses a weak pull-up, allowing the controller to use an open drain output with capable of sinking greater than 1mA and maintain a HIGH state during shutdown, as long as V_{DD} is powered.

RST_SIM (Pin 7): Reset output to the card socket RST pin and the reset signal is derived from the RSTIN pin with level shift function. The RST pin is shut down until V_{CC} attain its correct value. This pin is pulled to ground during shutdown.
CLK_SIM (Pin 6): Clock output to the card socket CLK pin and the clock signal is derived from the CLKIN pin with level shift functions. The CLK pin is gated off until V_{CC} attain its correct value. This pin is pulled to ground during shutdown. Fast rising and falling edges necessitate careful board layout for the CLK node.
IO_SIM (Pin 5): Data output/input to the card socket I/O pin, transmit /receive data to/from the DATA pin with level shift

function. The I/O pin is gated off until V_{CC} attain its correct value. The SIM card output must be on an open-drain driver capable of sourcing>1mA.
EN (Pin 9): Input. EN pin enable and disable V_{CC}. RST, CLK, I/O pins are shut down until V_{CC} attain its correct value.
GND (Pin 4): Chip Ground. This pad must be soldered directly to a PCB ground plane.

Power Off State and Sequence

In application, there could be a condition when VCC_HOST is powered while VCC_SIM is powered off.

The SIM card side pins (CLK_SIM, RST_SIM, IO_SIM) would be turned off in this conditions, but there're ESD diodes connected to VCC_SIM, like in bellow figure 1. If there are voltages on these pins while the VCC_SIM is not powered, it will have leakage current pass through the diodes.

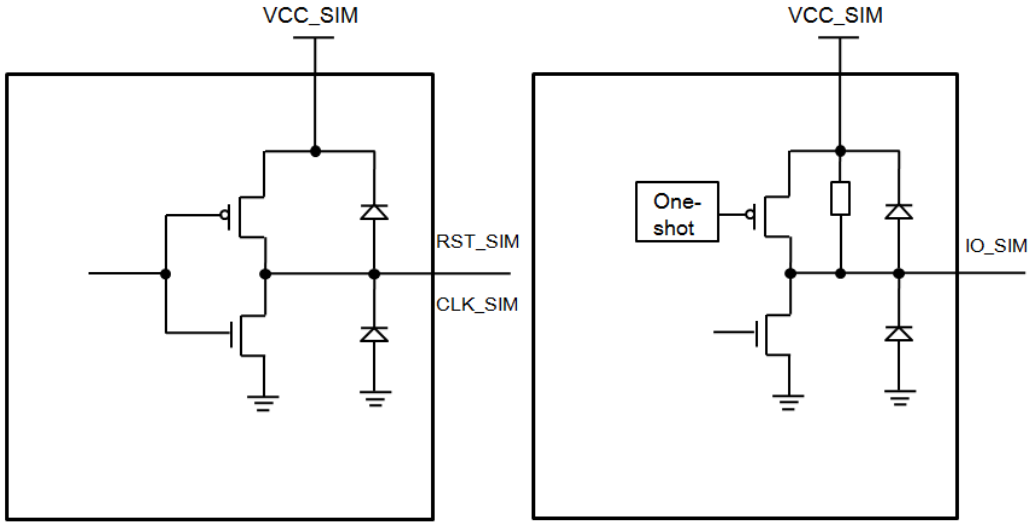
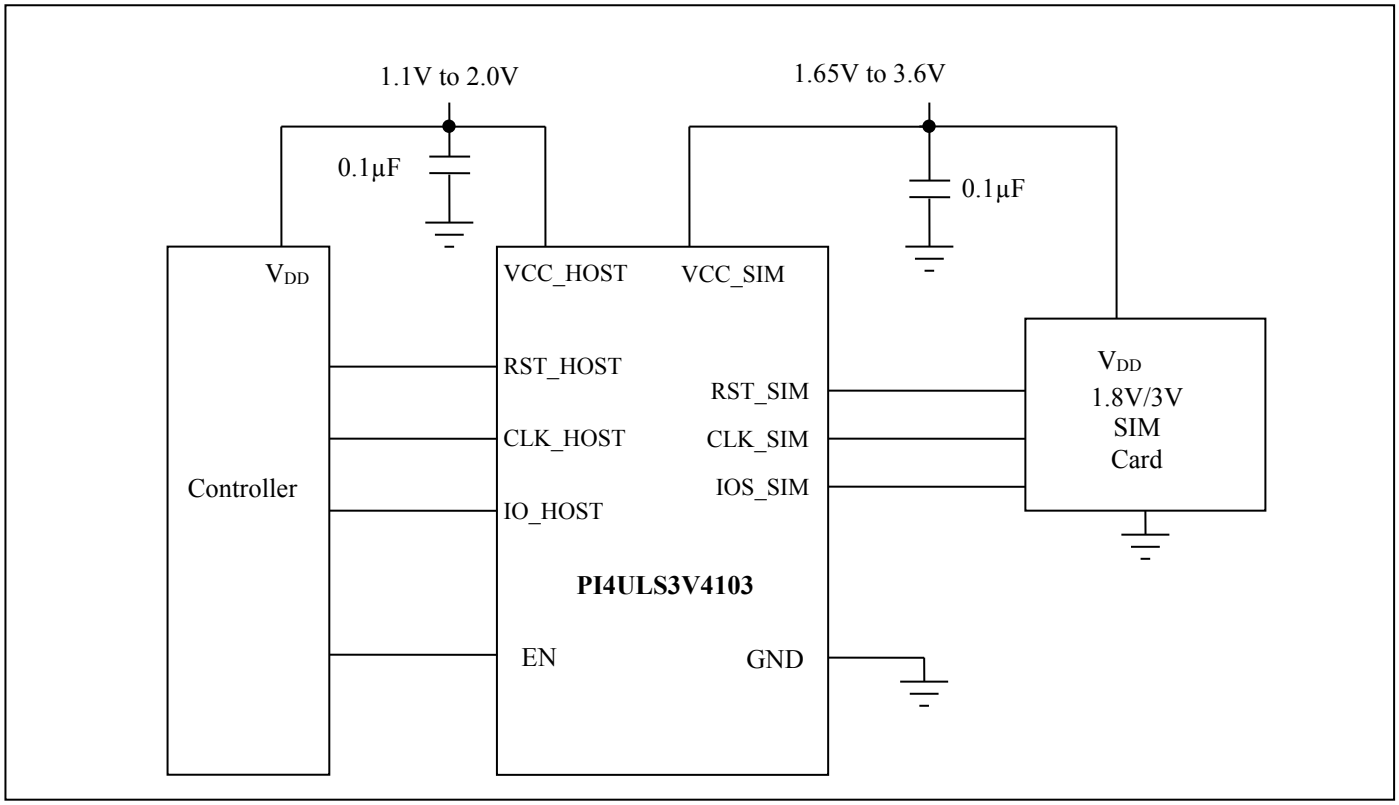


Figure 1: Structure of SIM Card side Pins

Application Circuit

The application circuit for PI4ULS3V4103 which shows the typical interface with a SIM card, is shown in below Figure.

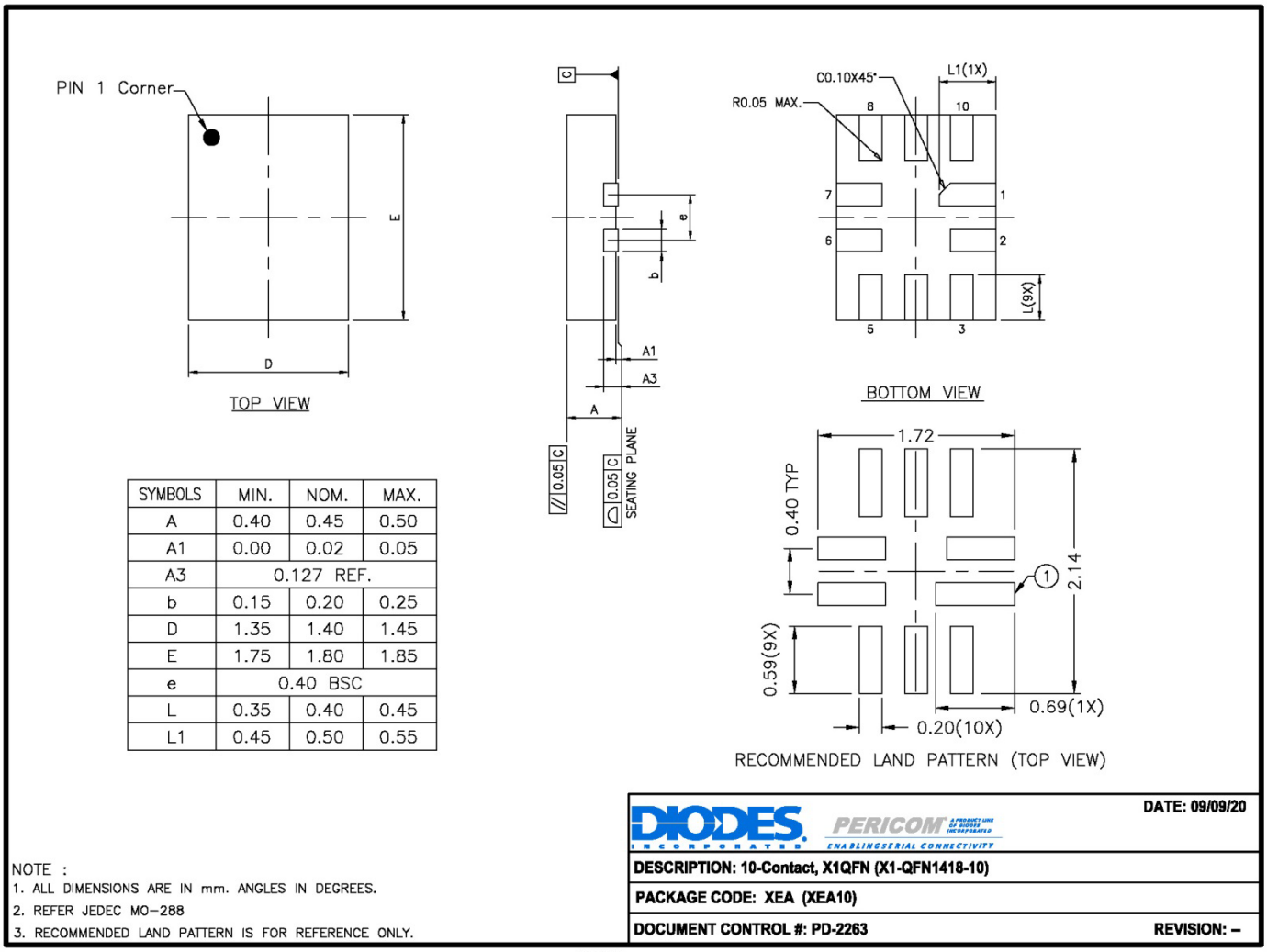


Part Marking

EZ: PI4ULS3V4103XEAE
Z: Die Rev
Y: One Chatacter Shorted Date Code
Bar Above First Character Denotes Pin 1 Indicator

Packaging Mechanical

10-X1QFN (XEA)



SYMBOLS	MIN.	NOM.	MAX.
A	0.40	0.45	0.50
A1	0.00	0.02	0.05
A3		0.127 REF.	
b	0.15	0.20	0.25
D	1.35	1.40	1.45
E	1.75	1.80	1.85
e		0.40 BSC	
L	0.35	0.40	0.45
L1	0.45	0.50	0.55

NOTE :
1. ALL DIMENSIONS ARE IN mm. ANGLES IN DEGREES.
2. REFER JEDEC MO-288
3. RECOMMENDED LAND PATTERN IS FOR REFERENCE ONLY.

DATE: 09/09/20
DESCRIPTION: 10-Contact, X1QFN (X1-QFN1418-10)
PACKAGE CODE: XEA (XEA10)
DOCUMENT CONTROL #: PD-2263 REVISION: –

20-0521

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

Ordering Information

Part Number	Package Code	Package Description
PI4ULS3V4103XEAEX	XEA	10-contact, X1QFN (X1-QFN1418-10)

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
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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

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