

4-Bit Bidirectional Level Shifter with Automatic Sensing & Ultra Tiny Package

Features

- High-Speed with 24 Mb/s Data Rate for push-pull applications
- High-Speed with 2 Mb/s Data Rate for open-drain applications
- 1.65V to 3.6V on A Port and 2.3V to 5.5V on B Port
- V_{CCA} must be less than or equal to V_{CCB}
- No Direction-Control Signal Needed
- Low Bit-to-Bit Skew
- Non-preferential Power-up Sequencing
- ESD protection exceeds JESD22-A114
 - A Port: 2500V HBM
 - B Port: 2500V HBM
- Integrated 10 k Ω Pull-Up Resistors
- 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):
 - 14-Pin, TSSOP (L)
 - 14-Pin, 3.5mm x 3.5mm, TQFN (ZB)
 - 12-Pin, 1.7mm x 2.0mm, XQFN (ZMA)
 - 12-Pin, 1.87mm x 1.37mm, WLCSP (GAB)

Application(s)

- I2C, SMBus, MDIO
- Low Voltage ASIC Level Translation
- Mobile Phones, PDAs, Cameras

Description

The DIODES™ LXS0104 is a 4-bit configurable, dual-supply, bidirectional, auto-sensing translator that does not require a directional control pin. The A and B ports are designed to track two different power supply rails, V_{CCA} and V_{CCB} respectively. This allows bidirectional translation between lower and higher logic signal levels.

When the OE pin is low, all I/Os are configured to be in a high-impedance state.

Power-off protection is implemented to prevent current passing through the device when it is powered-down.

Block Diagram

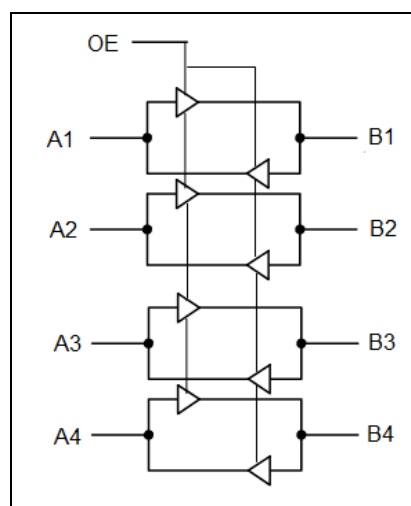
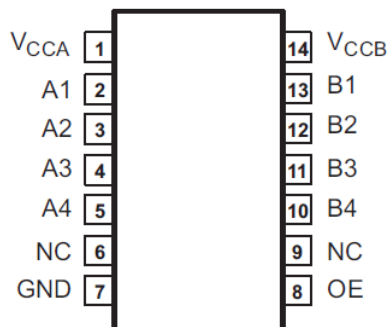


Figure 1: Block Diagram

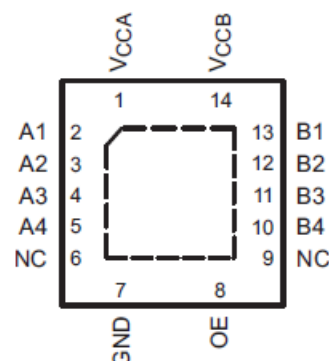
Notes:

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.

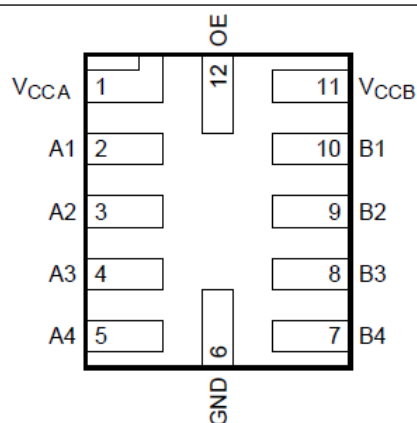
Pin Configuration



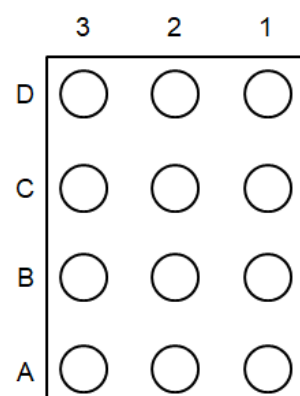
TSSOP-14 (TOP VIEW)



TQFN-14 (TOP VIEW)



XQFN-12 (TOP VIEW)



WLCSP (TOP VIEW)

Pin Description

Pin Name	TSSOP Pin#	TQFN Pin#	XQFN Pin#	WLCSP Pin#	Type	Description
V _{CCA}	1	1	1	B2	Power	A-port supply voltage. $1.65\text{ V} \leq V_{CCA} \leq 3.6\text{ V}$
V _{CCB}	14	14	11	A2	Power	B-port supply voltage. $2.3\text{ V} \leq V_{CCB} \leq 5.5\text{ V}$
A1	2	2	2	A3	I/O	Input/output A. Referenced to V _{CCA} .
A2	3	3	3	B3	I/O	Input/output A. Referenced to V _{CCA}
A3	4	4	4	C3	I/O	Input/output A. Referenced to V _{CCA}
A4	5	5	5	D3	I/O	Input/output A. Referenced to V _{CCA}
B1	13	13	10	A1	I/O	Input/output B. Referenced to V _{CCB}
B2	12	12	9	B1	I/O	Input/output B. Referenced to V _{CCB}
B3	11	11	8	C1	I/O	Input/output B. Referenced to V _{CCB}
B4	10	10	7	D1	I/O	Input/output B. Referenced to V _{CCB}
OE	8	8	12	C2	Input	Output enable (active High). Pull OE low to place all outputs in 3-state mode. Referenced to V _{CCA} .
GND	7	7	6	D2	GND	Ground.
NC	6,9	6,9	-	-	-	No Connection

Maximum Ratings

Storage Temperature	-65 °C to +150 °C
DC Supply Voltage port B.....	-0.5 V to +6.5 V
DC Supply Voltage port A	-0.5 V to +4.6 V
Vi (A) referenced DC Input Voltage.....	-0.5 V to +4.6 V
Vi (B) referenced DC Input Voltage.....	-0.5 V to +6.5 V
Enable Control Pin DC Input Voltage	-0.5 V to +4.6 V
Continuous output current, I/O	45 mA

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 Operation Conditions

Symbol	Parameter	Min	Typ	Max	Unit
V _{CCA}	V _{CCA} Positive DC Supply Voltage	1.65	-	3.6	V
V _{CCB}	V _{CCB} Positive DC Supply Voltage	2.3	-	5.5	V
V _{OE}	Enable Control Pin Voltage	GND	-	3.6	V
V _{IO}	I/O Pin Voltage (A1, A2, A3, A4)	GND	-	V _{CCA}	V
	I/O Pin Voltage (B1, B2, B3, B4)	GND	-	V _{CCB}	V
$\Delta t / \Delta v$	Input transition rise or fall time	-	-	-	-
	A or B port Push-Pull Driving, (V _{CCA} = 1.65 V to 3.6 V, V _{CCB} = 2.3 V to 5.5 V)	-	-	10	ns/V
	OE (V _{CCA} = 1.65 V to 3.6 V, V _{CCB} = 2.3 V to 5.5 V)	-	-	10	ns/V
T _A	Operating Temperature Range	-40	-	+85	°C

DC Electrical Characteristics

V_{CCI} is the supply voltage associated with the input port. V_{CCO} is the supply voltage associated with the output port.

Symbol	Parameter	Test Conditions	V_{CCA}	V_{CCB}	Temp.	Min	Typ	Max	Unit
V_{IHB}	B port Input HIGH Voltage	$I_{OHA} = -20 \mu A$ $V_{IA} = V_{CCA} \times 0.67$	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	$V_{CCI} - 0.4$	-	-	V
V_{ILB}	B port Input LOW Voltage	$I_{OLB} = 1 \text{ mA}$ $V_{IA} = 0.4 \text{ V}$	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	-	-	0.15	V
V_{IHA}	A port Input HIGH Voltage	$I_{OHB} = -20 \mu A$ $V_{IB} = V_{CCB} \times 0.67$	1.65 V to 1.95 V	2.3 V to 5.5 V	-40 to 85 °C	$V_{CCI} - 0.2$	-	-	V
			1.65 V to 3.6 V	2.3 V to 5.5 V		$V_{CCI} - 0.4$			
V_{ILA}	A port Input LOW Voltage	$I_{OLB} = 1 \text{ mA}$ $V_{IB} = 0.4 \text{ V}$	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	-	-	0.15	V
V_{IH}	Control Pin Input HIGH Voltage	-	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	$V_{CCA} \times 0.65$	-	-	V
V_{IL}	Control Pin Input LOW Voltage	-	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	-	-	$V_{CCA} \times 0.35$	V
V_{OHB}	B port Output HIGH Voltage	$I_{OHB} = -20 \mu A$ $V_{IA} \geq V_{CCA} - 0.4 \text{ V}$	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	$0.8 \times V_{CCB}$	-	-	V
V_{OLB}	B port Output LOW Voltage	$I_{OLB} = 1 \text{ mA}$ $V_{IA} \leq 0.15 \text{ V}$	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	-	-	0.4	V
V_{OHA}	A port Output HIGH Voltage	$I_{OHA} = -20 \mu A$ $V_{IB} \geq V_{CCB} - 0.4 \text{ V}$	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	$0.8 \times V_{CCA}$	-	-	V
V_{OLA}	A port Output LOW Voltage	$I_{OLA} = 1 \text{ mA}$ $V_{IB} \leq 0.15 \text{ V}$	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	-	-	0.4	V
I_I	Input leakage current	OE, $V_I = V_{CCI}$ or GND	1.65 V to 3.6 V	2.3 V to 5.5 V	25 °C	-	-	± 1	μA
					-40 to 85 °C	-	-	± 2	
I_{OFF}	Partial power down current	A port	0 V	0 V to 5.5 V	25 °C	-	-	± 1	μA
					-40 to 85 °C	-	-	± 2	
		B port	0 V to 3.6 V	0 V	25 °C	-	-	± 1	
					-40 to 85 °C	-	-	± 2	
I_{OZ}	Off-state Leakage current	A or B port, OE = V_{IL}	1.65 V to 3.6 V	2.3 V to 5.5 V	25 °C	-	-	± 1	μA
					-40 to 85 °C	-	-	± 2	
I_{QVCCA}	V_{CCA} Supply Current	$V_I = V_O = \text{open}, I_O = 0$	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	-	-	2.8	μA
			3.6 V	0 V	-40 to 85 °C	-	-	2.2	
			0 V	5.5 V	-40 to 85 °C	-	-	-1	

DC Electrical Characteristics Cont.

Symbol	Parameter	Test Conditions	V _{CCA}	V _{CCB}	Temp.	Min	Typ	Max	Unit
I _{QVCCB}	V _{CCB} Supply Current	V _I = V _O = open, I _O = 0	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	-	-	12	-
			3.6 V	0 V	-40 to 85 °C	-	-	-1	μA
			0 V	5.5 V	-40 to 85 °C	-	-	1	-
I _{QVCCA} + I _{QVCCB}	Total Supply current	V _I = V _O = open, I _O = 0	1.65 V to 3.6 V	2.3 V to 5.5 V	-40 to 85 °C	-	-	14.4	μA
C _I	Input Capacitance	OE	3.3 V	3.3 V	25 °C	-	2.5	-	pF
					-40 to 85 °C	-	-	4.8	
C _{IO}	Input-to-output Capacitance	A or B port	3.3 V	3.3 V	25 °C	-	12	-	pF
					-40 to 85 °C	-	-	15	
		A port	0 V	0 V	25 °C	-	5	6.5	
					-40 to 85 °C	-	-	7.5	
		B port	0 V	0 V	25 °C	-	6	7.5	
					-40 to 85 °C	-	-	8.5	

AC Electrical Characteristics

(Unless otherwise specified, -40 °C ≤ T_A ≤ 85 °C)

I/O test circuits of Figures 2, 3, 4 & 5, C_{LOAD} = 15 pF, R_{LOAD} = 1 MΩ, input pulse generator having the following characteristics: Z_O = 50 Ω, PRR ≤ 10 MHz, dv/dt ≥ 1 V / ns

V_{CCA} = 1.8 V ± 0.15 V

Symbol	Parameter	Test Conditions	V _{CCB} = 2.5 V ± 0.2 V		V _{CCB} = 3.3 V ± 0.3 V		V _{CCB} = 5.0 V ± 0.5 V		Unit
			Min	Max	Min	Max	Min	Max	
t _{PHL-A-B}	High to Low propagation delay	Push-pull driving	-	5.3	-	5.4	-	6.8	ns
		Open-Drain driving	-	8.8	-	9.6	-	10	
t _{PLH-A-B}	Low to High propagation delay	Push-pull driving	-	6.8	-	7.1	-	7.5	ns
		Open-Drain driving	-	260	-	208	-	198	
t _{PHL-B-A}	High to Low propagation delay	Push-pull driving	-	4.4	-	4.5	-	4.7	ns
		Open-Drain driving	-	5.3	-	4.4	-	4	
t _{PLH-B-A}	Low to High propagation delay	Push-pull driving	-	5.3	-	4.5	-	0.5	ns
		Open-Drain driving	-	175	-	140	-	102	
t _{en}	Enable Time	OE to A or B	-	200	-	200	-	200	ns
t _{dis}	Disable Time	OE to A or B	-	230	-	230	-	230	ns
t _{RA}	A port Rise Time	Push-pull driving	3.2	9.5	2.3	9.3	2.7	7.6	ns
		Open-Drain driving	32.8	165	27.9	132	20.5	95	
t _{RB}	B port Rise Time	Push-pull driving	2.8	10.8	2.7	9.1	2.1	7.6	ns
		Open-Drain driving	30	145	23	106	10	58	
t _{FA}	A port Fall Time	Push-pull driving	2	5.9	1.9	6	1.7	13.3	ns
		Open-Drain driving	3	6.9	3	6.4	3.1	6.1	
t _{FB}	B port Fall Time	Push-pull driving	2.9	13.8	2.8	16.2	2.8	16.2	ns
		Open-Drain driving	3.1	13.8	3.2	16.2	3.9	16.2	
t _{PPSKEW}	Channel-to-Channel Skew	-	-	0.7	-	0.7	-	0.7	ns
f _{DATA}	Maximum Data Rate	Push-pull driving	21	-	22	-	24	-	Mbps
		Open-Drain driving	2	-	2	-	2	-	

$V_{CCA} = 2.5\text{ V} \pm 0.2\text{ V}$

Symbol	Parameter	Test Conditions	$V_{CCB} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CCB} = 5.0\text{ V} \pm 0.5\text{ V}$		Unit
			Min	Max	Min	Max	Min	Max	
$t_{PHL-A-B}$	High to Low propagation delay	Push-pull driving	-	3.2	-	3.7	-	3.8	ns
		Open-Drain driving	-	6.3	-	6	-	5.8	
$t_{PLH-A-B}$	Low to High propagation delay	Push-pull driving	-	3.5	-	4.1	-	4.4	ns
		Open-Drain driving	-	250	-	206	-	190	
$t_{PHL-B-A}$	High to Low propagation delay	Push-pull driving	-	3	-	3.6	-	4.3	ns
		Open-Drain driving	-	4.7	-	4.2	-	4	
$t_{PLH-B-A}$	Low to High propagation delay	Push-pull driving	-	3.4	-	1.6	-	1	ns
		Open-Drain driving	-	170	-	140	-	103	
t_{en}	Enable Time	OE to A or B	-	200	-	200	-	200	ns
t_{dis}	Disable Time	OE to A or B	-	50	-	40	-	35	ns
t_{RA}	A port Rise Time	Push-pull driving	2.8	7.4	2.6	6.6	1.8	5.6	ns
		Open-Drain driving	24.9	149	22.8	121	18.4	89	
t_{RB}	B port Rise Time	Push-pull driving	2.7	8.3	2.4	7.2	2	6.1	ns
		Open-Drain driving	25.5	151	20.5	112	12	64	
t_{FA}	A port Fall Time	Push-pull driving	1.9	5.7	1.9	5.5	1.8	5.3	ns
		Open-Drain driving	2.9	6.9	2.9	6.2	2.9	5.8	
t_{FB}	B port Fall Time	Push-pull driving	2.2	7.8	2.4	6.7	2.6	6.6	ns
		Open-Drain driving	3	8.8	2.9	9.4	3.1	10.4	
t_{PPSKEW}	Channel-to-Channel Skew	-	-	0.7	-	0.7	-	0.7	ns
f_{DATA}	Maximum Data Rate	Push-pull driving	20	-	22	-	24	-	Mbps
		Open-Drain driving	2	-	2	-	2	-	

$V_{CCA} = 3.3\text{ V} \pm 0.3\text{ V}$

Symbol	Parameter	Test Conditions	$V_{CCB} = 3.3\text{ V} \pm 0.3\text{ V}$		$V_{CCB} = 5.0\text{ V} \pm 0.5\text{ V}$		Unit
			Min	Max	Min	Max	
$t_{PHL-A-B}$	High to Low propagation delay	Push-pull driving	-	2.4	-	3.1	ns
		Open-Drain driving	-	4.2	-	4.6	
$t_{PLH-A-B}$	Low to High propagation delay	Push-pull driving	-	4.2	-	4.4	ns
		Open-Drain driving	-	204	-	165	
$t_{PHL-B-A}$	High to Low propagation delay	Push-pull driving	-	2.5	-	3.3	ns
		Open-Drain driving	-	124	-	97	
$t_{PLH-B-A}$	Low to High propagation delay	Push-pull driving	-	2.5	-	2.6	ns
		Open-Drain driving	-	139	-	105	
t_{en}	Enable Time	OE to A or B	-	200	-	200	ns
t_{dis}	Disable Time	OE to A or B	-	230	-	230	ns
t_{RA}	A port Rise Time	Push-pull driving	2.3	5.6	1.9	4.8	ns
		Open-Drain driving	17.4	116	15.4	85	
t_{RB}	B port Rise Time	Push-pull driving	2.5	6.4	2.1	7.4	ns
		Open-Drain driving	17.7	116	11.8	72	
t_{FA}	A port Fall Time	Push-pull driving	2	5.4	1.9	5	ns
		Open-Drain driving	2.8	6.1	2.8	5.7	
t_{FB}	B port Fall Time	Push-pull driving	2.3	7.4	2.4	7.6	ns
		Open-Drain driving	2.8	7.6	2.9	8.3	
t_{PPSKEW}	Channel-to-Channel Skew	-	-	0.7	-	0.7	ns
f_{DATA}	Maximum Data Rate	Push-pull driving	23	-	24	-	Mbps
		Open-Drain driving	2	-	2	-	

Test Circuits

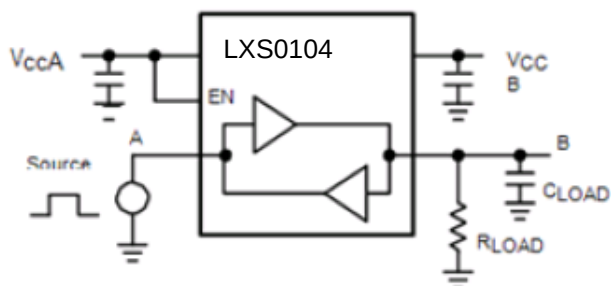


Figure 2: Rail-to-Rail Driving A

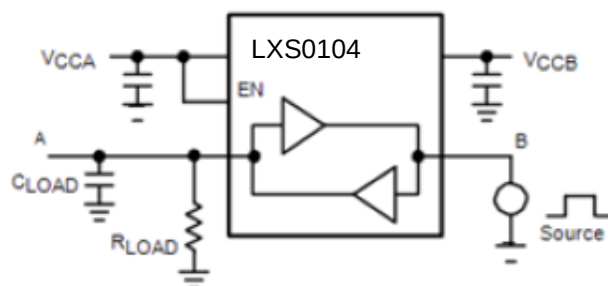


Figure 3: Rail-to-Rail Driving B

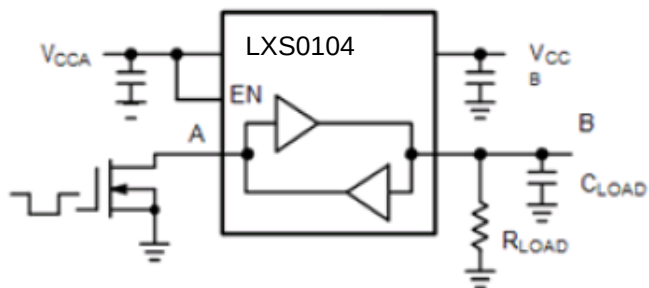


Figure 4: Open-Drain Driving A

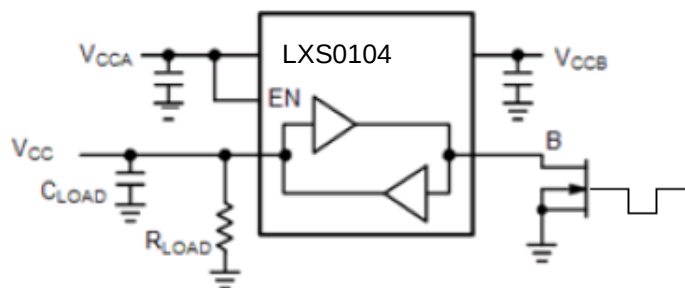
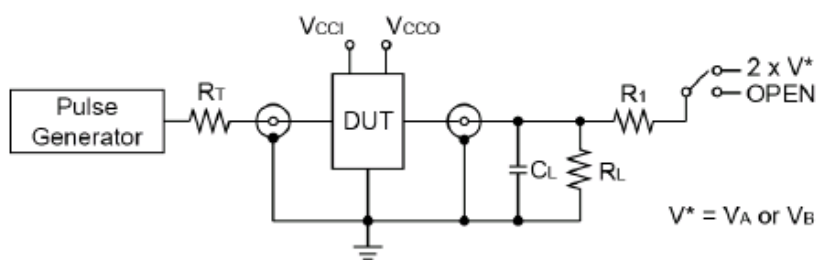


Figure 5: Open-Drain Driving B



Test	Switch
t_{pZH}, t_{pHZ}	Open
t_{pZL}, t_{pLZ}	$2 \times V^*$

$C_L = 15\text{pF}$

$R_L = R_1 = 50\text{k}\Omega$

$R_T = Z_{OUT}$ of pulse generator (Typically 50Ω)

$V^* = V_A$ or V_B for A or B measurements, respectively.

Figure 6: Test Circuit for Enable/Disable Time Measurement

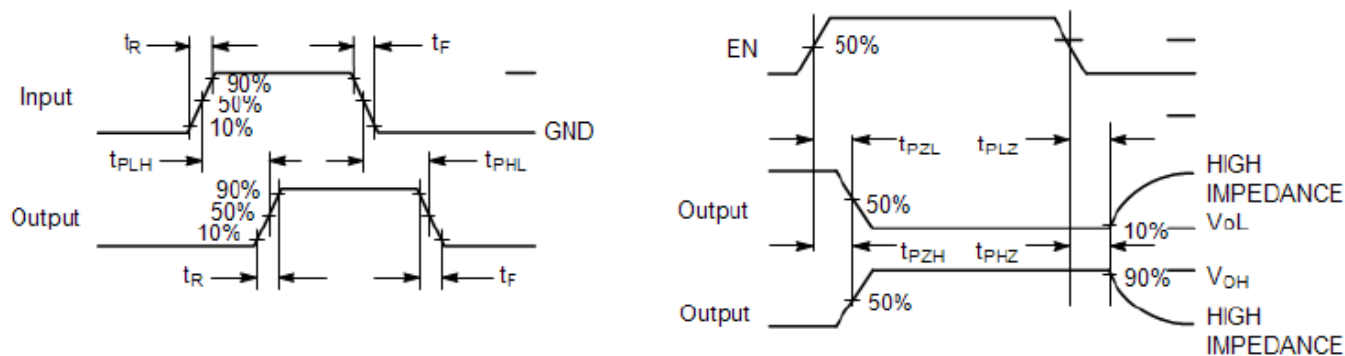


Figure 7: Timing Definitions for Propagation Delays and Enable/Disable Measurement

Functional Description

Level Translator Architecture

The LXS0104 is a 4-bit configurable, dual-supply, bidirectional, auto-sensing translator that does not require a directional control pin. The A port operating voltage range is from 1.65 V to 3.6 V, and the B port operating voltage range is from 2.3 V to 5.5 V.

The translator has integrated a 10 k Ω pull-up resistor on each I/O line. The integrated pull-up resistors are used to pull-the I/O lines to either V_{CCA} or V_{CCB} . When OE goes low, the pull-up resistors are disabled. There is an nmos transistor that connects the A-port and B-port. In addition, each output has integrated an one-shot rising edge detector to turn on the pmos transistor within a short duration to improve the low-to-high transition.

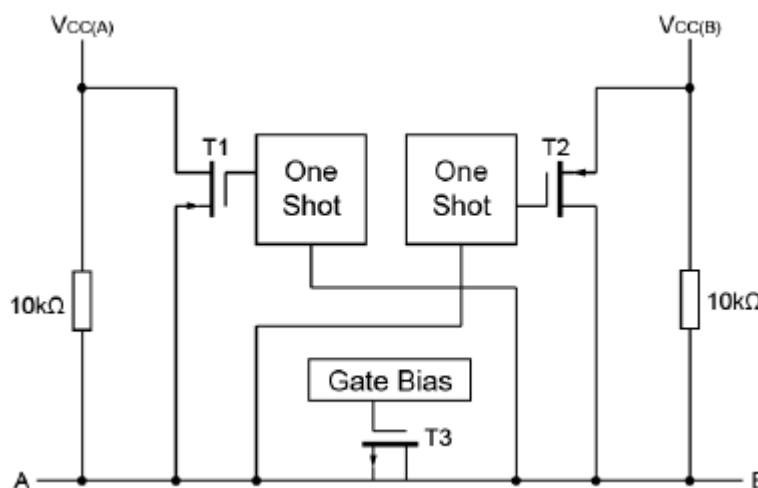


Figure 8: Architecture of LXS0104 I/O cell (one channel)

Input Driver Requirements

The rise (t_R) and fall (t_F) timing parameters of the open drain outputs depend on the magnitude of the pull-up resistors. In addition, the propagation times (t_{PD}), and maximum data rate depend on the impedance of the device that is connected to the translator. The timing parameters listed in the data sheet assume that the output impedance of the drivers connected to the translator is less than 50 Ω .

Output Enable and Disable (OE)

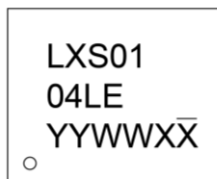
The LXS0104 has an Output Enable pin (OE) that enables the device by setting HIGH. Driving the Output Enable pin to a low logic level minimizes the power consumption of the device and set all I/Os in high-impedance OFF state. Normal translation operation occurs when the OE pin is equal to a logic high signal. The OE pin is referenced to the V_{CCA} supply.

Power Supply Guidelines

During normal operation, supply voltage V_{CCA} must be less than or equal to V_{CCB} . The sequencing of the power supplies will not damage the device during the power up operation. For optimal performance, 0.01 μ F to 0.1 μ F decoupling capacitors should be used on the V_{CCA} and V_{CCB} power supply pins. Ceramic capacitors are a good design choice to filter and bypass any noise signals on the voltage lines to the ground plane of the PCB. The noise immunity will be maximized by placing the capacitors as close as possible to the supply and ground pins, along with minimizing the PCB connection traces.

Part Marking

L Package



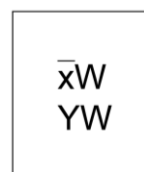
YY: Date Code (Year)
WW: Date Code (Workweek)
1st X: Assembly Code
2nd X: Fab Code
Bar above 2nd "X" means Cu wire

ZB Package



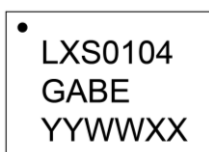
YY: Date Code (Year)
WW: Date Code (Workweek)
1st X: Assembly Site Code
2nd X: Fab Site Code
Bar above 2nd "X" means Cu wire

ZMA Package



xW: LXS0104ZMAE
Y: Date Code (Year)
W: Date Code (Workweek)

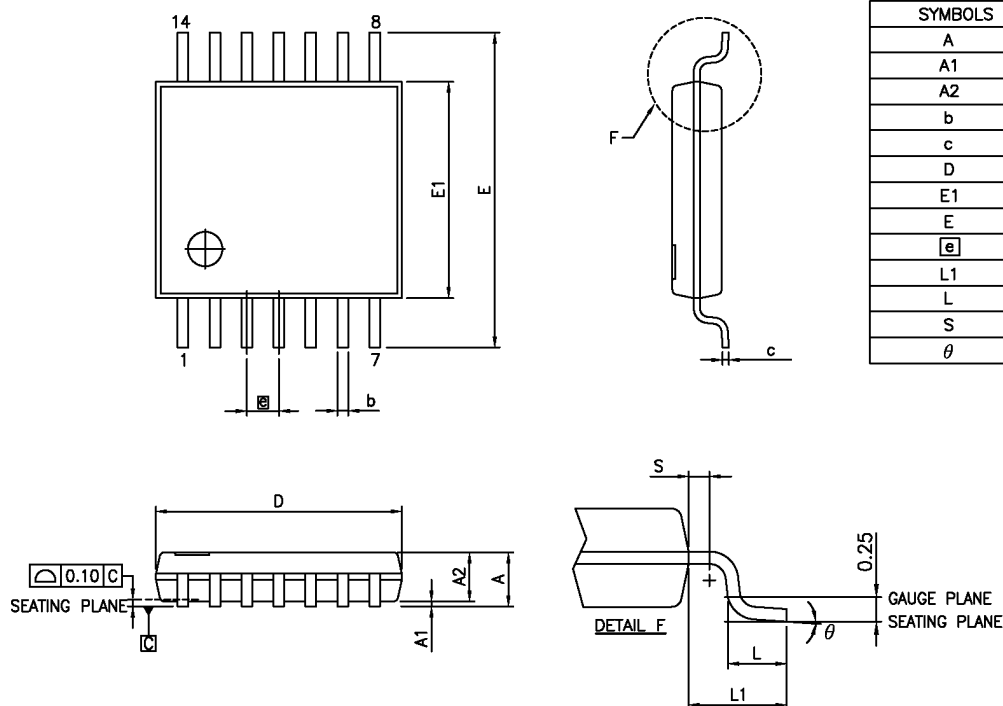
GAB Package



YY: Date Code (Year)
WW: Date Code (Workweek)
1st X: Assembly Site Code
2nd X: Fab Site Code

Packaging Mechanical

TSSOP-14 (L)



SYMBOLS	MIN.	NOM.	MAX.
A	—	—	1.20
A1	0.05	—	0.15
A2	0.80	1.00	1.05
b	0.19	—	0.30
c	0.09	—	0.20
D	4.90	5.00	5.10
E1	4.30	4.40	4.50
E	6.20	6.40	6.60
e	0.65 BSC		
L1	1.00 REF		
L	0.45	0.60	0.75
S	0.20	—	—
θ	0°	—	8°

NOTES:

1. ALL DIMENSIONS IN MILLIMETERS. ANGLES IN DEGREES.
2. JEDEC MO-153F
3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.



DATE: 03/24/16

DESCRIPTION: 14-Pin, 173mil Wide TSSOP

PACKAGE CODE: L (L14)

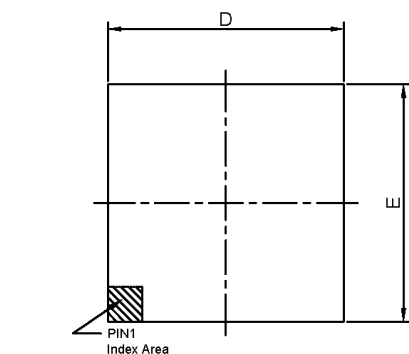
DOCUMENT CONTROL #: PD-1309

REVISION: E

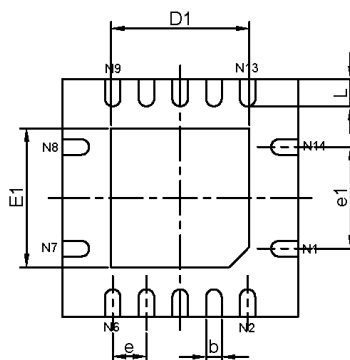
16-0060

LXS0104

TQFN-14 (ZB)

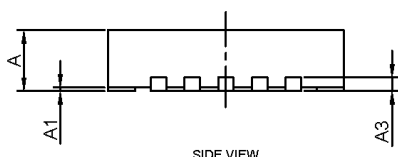


TOP VIEW

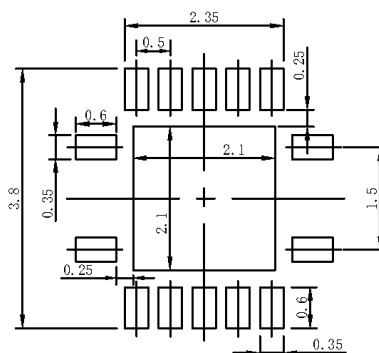


BOTTOM VIEW

PKG. DIMENSIONS(MM)		
SYMBOL	Min	Max
A	0.80	0.90
A1	0.00	0.05
A3	0.20 REF	
D	3.42	3.58
E	3.42	3.58
D1	1.95	2.15
E1	1.95	2.15
b	0.20	0.30
e	0.50 TYP	
e1	1.50 TYP	
L	0.32	0.48



SIDE VIEW



RECOMMENDED LAND PATTERN(unit:mm)

Notes:

1. Controlling dimensions in millimeters.
2. Ref: JEDEC MO-220
3. LAND PATTERN REFERENCE DIODES V-DFN3535-14 PACKAGE INFORMATION



DATE: 03/11/21

DESCRIPTION: 14-Pin, TQFN, 3.5*3.5

PACKAGE CODE: ZB (ZB14)

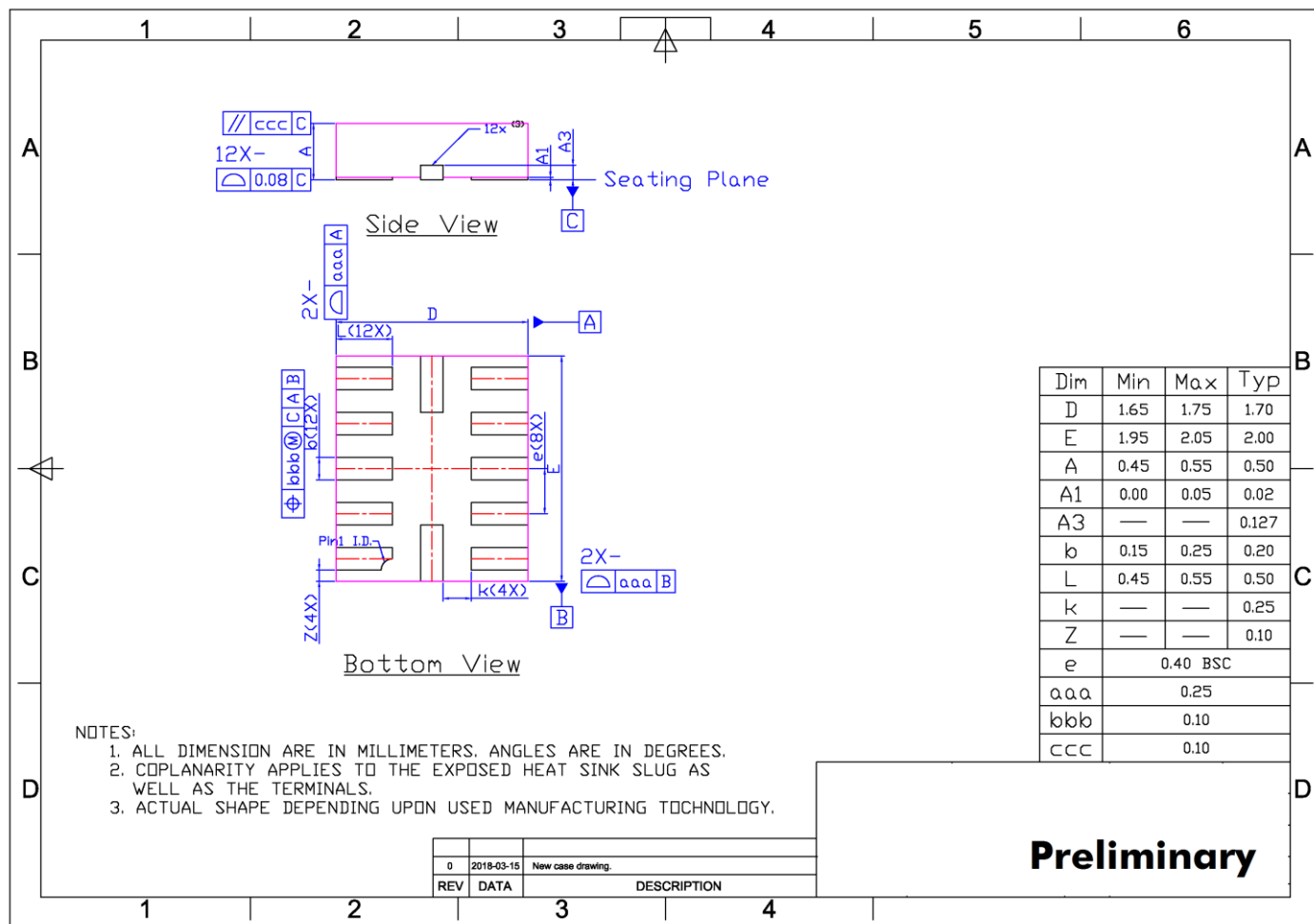
DOCUMENT CONTROL#: PD-2154

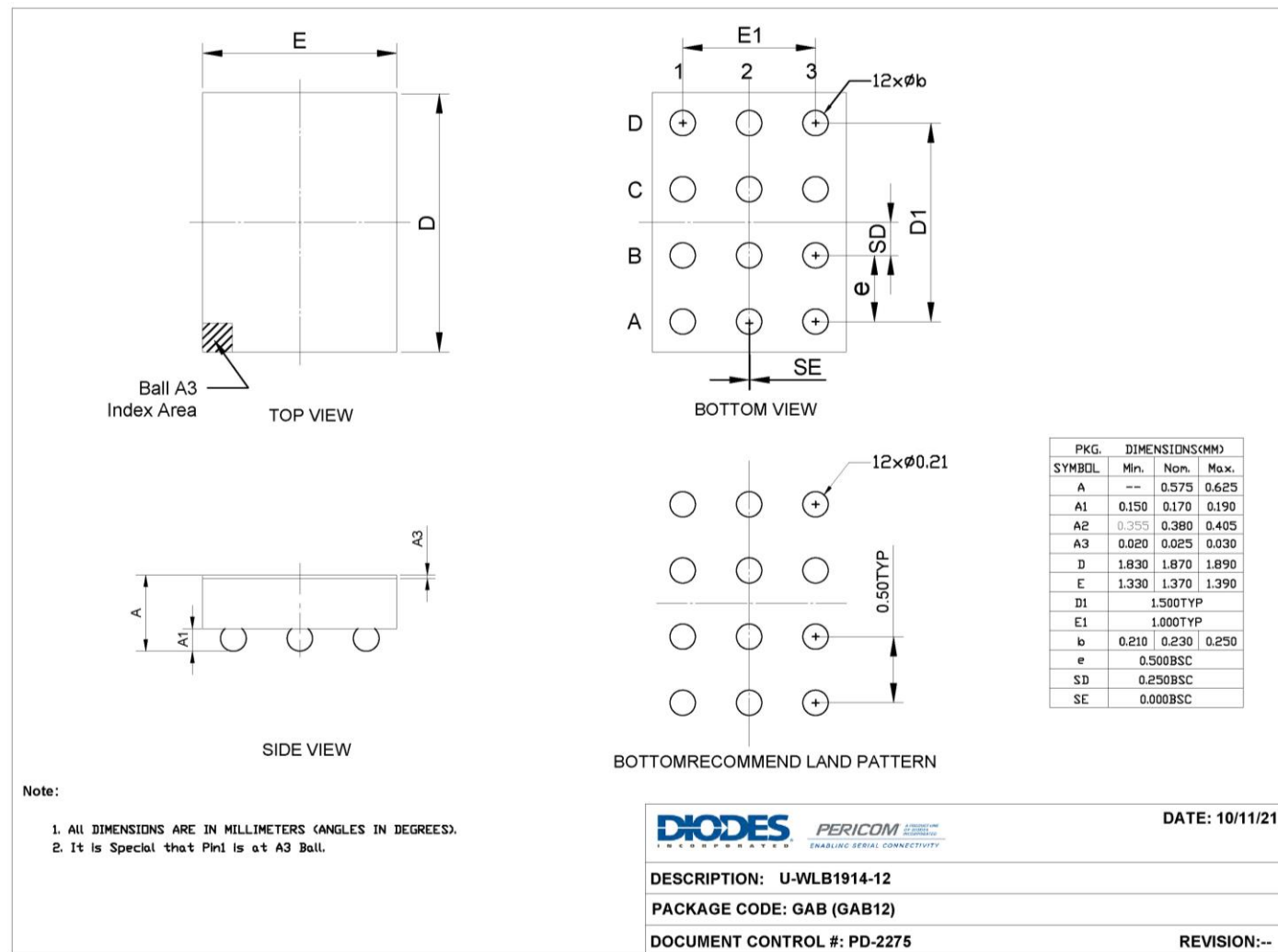
REVISION: A

21-1377

LXS0104

XQFN-12



WLCSP-12


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
LXS0104LEX	L	14-pin, TSSOP
LXS0104ZBEX	ZB	14-pin, TQFN 3.5mm x 3.5mm
LXS0104ZMAEX	ZMA	12-pin, XQFN 1.7mm x 2.0mm
LXS0104GABEX	GAB	12-ball, WLCSP

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.
4. E = Pb-free and Green
5. X suffix = Tape/Reel

IMPORTANT NOTICE

1. DIODES INCORPORATED (Diodes) AND ITS SUBSIDIARIES MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO ANY INFORMATION CONTAINED IN THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).
2. The Information contained herein is for informational purpose only and is provided only to illustrate the operation of Diodes' products described herein and application examples. Diodes does not assume any liability arising out of the application or use of this document or any product described herein. This document is intended for skilled and technically trained engineering customers and users who design with Diodes' products. Diodes' products may be used to facilitate safety-related applications; however, in all instances customers and users are responsible for (a) selecting the appropriate Diodes products for their applications, (b) evaluating the suitability of Diodes' products for their intended applications, (c) ensuring their applications, which incorporate Diodes' products, comply the applicable legal and regulatory requirements as well as safety and functional-safety related standards, and (d) ensuring they design with appropriate safeguards (including testing, validation, quality control techniques, redundancy, malfunction prevention, and appropriate treatment for aging degradation) to minimize the risks associated with their applications.
3. Diodes assumes no liability for any application-related information, support, assistance or feedback that may be provided by Diodes from time to time. Any customer or user of this document or products described herein will assume all risks and liabilities associated with such use, and will hold Diodes and all companies whose products are represented herein or on Diodes' websites, harmless against all damages and liabilities.
4. Products described herein may be covered by one or more United States, international or foreign patents and pending patent applications. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks and trademark applications. Diodes does not convey any license under any of its intellectual property rights or the rights of any third parties (including third parties whose products and services may be described in this document or on Diodes' website) under this document.
5. Diodes' products are provided subject to Diodes' Standard Terms and Conditions of Sale (<https://www.diodes.com/about/company/terms-and-conditions/terms-and-conditions-of-sales/>) or other applicable terms. This document does not alter or expand the applicable warranties provided by Diodes. Diodes does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel.
6. Diodes' products and technology may not be used for or incorporated into any products or systems whose manufacture, use or sale is prohibited under any applicable laws and regulations. Should customers or users use Diodes' products in contravention of any applicable laws or regulations, or for any unintended or unauthorized application, customers and users will (a) be solely responsible for any damages, losses or penalties arising in connection therewith or as a result thereof, and (b) indemnify and hold Diodes and its representatives and agents harmless against any and all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim relating to any noncompliance with the applicable laws and regulations, as well as any unintended or unauthorized application.
7. While efforts have been made to ensure the information contained in this document is accurate, complete and current, it may contain technical inaccuracies, omissions and typographical errors. Diodes does not warrant that information contained in this document is error-free and Diodes is under no obligation to update or otherwise correct this information. Notwithstanding the foregoing, Diodes reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. This document is written in English but may be translated into multiple languages for reference. Only the English version of this document is the final and determinative format released by Diodes.
8. Any unauthorized copying, modification, distribution, transmission, display or other use of this document (or any portion hereof) is prohibited. Diodes assumes no responsibility for any losses incurred by the customers or users or any third parties arising from any such unauthorized use.
9. This Notice may be periodically updated with the most recent version available at <https://www.diodes.com/about/company/terms-and-conditions/important-notice>

DIODES is a trademark of Diodes Incorporated in the United States and other countries.
The Diodes logo is a registered trademark of Diodes Incorporated in the United States and other countries.
© 2022 Diodes Incorporated. All Rights Reserved.

www.diodes.com