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November 2001
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74LCX32245

Low Voltage 32-Bit Bidirectional Transceiver with 5V Tolerant Inputs and Outputs

General Description

The LCX32245 contains thirty-two non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus oriented applications. The device is designed for low voltage (2.5V or 3.3V) V_{CC} applications with capability of interfacing to a 5V signal environment. The device is byte controlled. Each byte has separate control inputs which could be shorted together for full 32-bit operation. The T/\bar{R} inputs determine the direction of data flow through the device. The \overline{OE} inputs disable both the A and B ports by placing them in a high impedance state.

The LCX32245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

- 5V tolerant inputs and outputs
 - 2.3V–3.6V V_{CC} specifications provided
 - 4.5 ns t_{PD} max ($V_{CC} = 3.3V$), 20 μA I_{CC} max
 - Power down high impedance inputs and outputs
 - Supports live insertion/withdrawal (Note 1)
 - ± 24 mA output drive ($V_{CC} = 3.0V$)
 - Uses patented noise/EMI reduction circuitry
 - Latch-up performance exceeds 500 mA
 - ESD performance:
 - Human body model > 2000V
 - Machine model > 200V
 - Packaged in plastic Fine-Pitch Ball Grid Array (FBGA)
- Note 1:** To ensure the high-impedance state during power up or down, \overline{OE} should be tied to V_{CC} through a pull-up resistor; the minimum value or the resistor is determined by the current-sourcing capability of the driver.

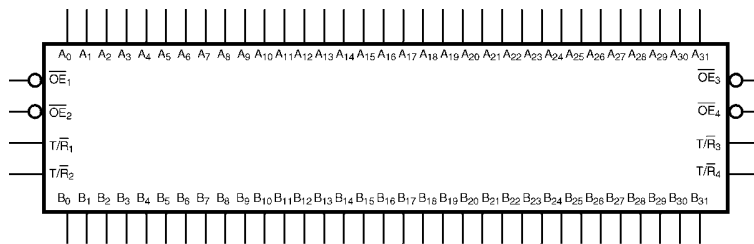
Ordering Code:

Order Number	Package Number	Package Description
74LCX32245G (Note 2)(Note 3)	BGA96A	96-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide

Note 2: Ordering code "G" indicates Trays.

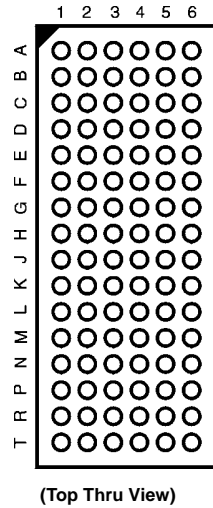
Note 3: Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Logic Symbol



74LCX32245

Connection Diagram



Pin Descriptions

Pin Names	Description
\overline{OE}_n	Output Enable Input (Active LOW)
T/\overline{R}_n	Transmit/Receive Input
A_0-A_{31}	Side A Inputs or 3-STATE Outputs
B_0-B_{31}	Side B Inputs or 3-STATE Outputs

FBGA Pin Assignments

	1	2	3	4	5	6
A	B ₁	B ₀	T/\overline{R}_1	\overline{OE}_1	A ₀	A ₁
B	B ₃	B ₂	GND	GND	A ₂	A ₃
C	B ₅	B ₄	V _{CC}	V _{CC}	A ₄	A ₅
D	B ₇	B ₆	GND	GND	A ₆	A ₇
E	B ₉	B ₈	GND	GND	A ₈	A ₉
F	B ₁₁	B ₁₀	V _{CC}	V _{CC}	A ₁₀	A ₁₁
G	B ₁₃	B ₁₂	GND	GND	A ₁₂	A ₁₃
H	B ₁₄	B ₁₅	T/\overline{R}_2	\overline{OE}_2	A ₁₅	A ₁₄
J	B ₁₇	B ₁₆	T/\overline{R}_3	\overline{OE}_3	A ₁₆	A ₁₇
K	B ₁₉	B ₁₈	GND	GND	A ₁₈	A ₁₉
L	B ₂₁	B ₂₀	V _{CC}	V _{CC}	A ₂₀	A ₂₁
M	B ₂₃	B ₂₂	GND	GND	A ₂₂	A ₂₃
N	B ₂₅	B ₂₄	GND	GND	A ₂₄	A ₂₅
P	B ₂₇	B ₂₆	V _{CC}	V _{CC}	A ₂₆	A ₂₇
R	B ₂₉	B ₂₈	GND	GND	A ₂₈	A ₂₉
T	B ₃₀	B ₃₁	T/\overline{R}_4	\overline{OE}_4	A ₃₁	A ₃₀

Truth Tables

Inputs		Outputs
\overline{OE}_1	T/\overline{R}_1	
L	L	Bus B ₀ -B ₇ Data to Bus A ₀ -A ₇
L	H	Bus A ₀ -A ₇ Data to Bus B ₀ -B ₇
H	X	HIGH Z State on A ₀ -A ₇ , B ₀ -B ₇

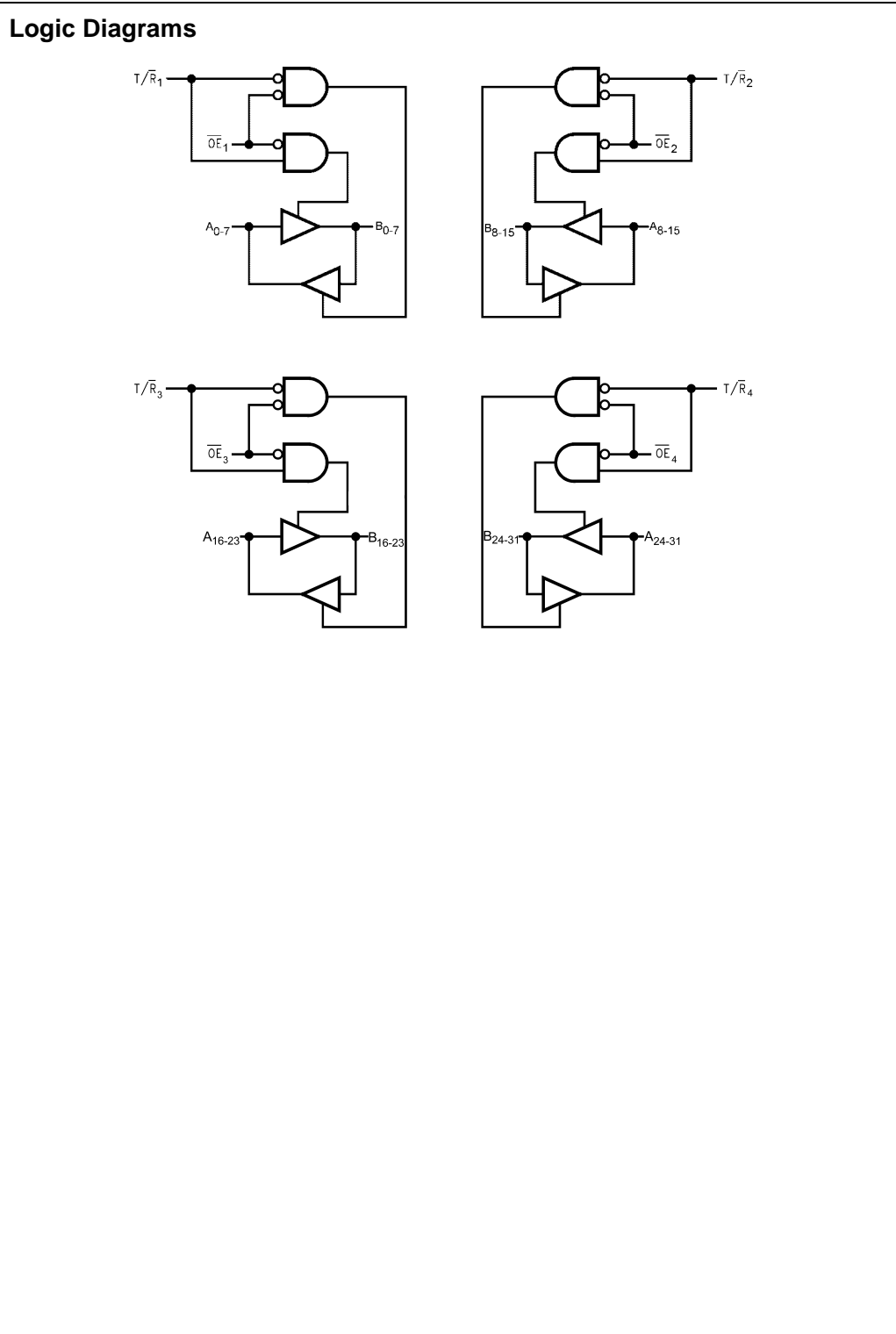
Inputs		Outputs
\overline{OE}_2	T/\overline{R}_2	
L	L	Bus B ₈ -B ₁₅ Data to Bus A ₈ -A ₁₅
L	H	Bus A ₈ -A ₁₅ Data to Bus B ₈ -B ₁₅
H	X	HIGH Z State on A ₈ -A ₁₅ , B ₈ -B ₁₅

Inputs		Outputs
\overline{OE}_3	T/\overline{R}_3	
L	L	Bus B ₁₆ -B ₂₃ Data to Bus A ₁₆ -A ₂₃
L	H	Bus A ₁₆ -A ₂₃ Data to Bus B ₁₆ -B ₂₃
H	X	HIGH Z State on A ₁₆ -A ₂₃ , B ₁₆ -B ₂₃

Inputs		Outputs
\overline{OE}_4	T/\overline{R}_4	
L	L	Bus B ₂₄ -B ₃₁ Data to Bus A ₂₄ -A ₃₁
L	H	Bus A ₂₄ -A ₃₁ Data to Bus B ₂₄ -B ₃₁
H	X	HIGH Z State on A ₂₄ -A ₃₁ , B ₂₄ -B ₃₁

H = HIGH Voltage Level
L = LOW Voltage Level

X = Immaterial (HIGH or LOW, inputs and I/O's may not float)
Z = High Impedance



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Absolute Maximum Ratings (Note 4)							
Symbol	Parameter	Value	Conditions	Units			
V _{CC}	Supply Voltage	-0.5 to +7.0		V			
V _I	DC Input Voltage	-0.5 to +7.0		V			
V _O	DC Output Voltage	-0.5 to +7.0	Output in 3-STATE	V			
		-0.5 to V _{CC} + 0.5	Output in HIGH or LOW State (Note 5)				
I _{IK}	DC Input Diode Current	-50	V _I < GND	mA			
I _{OK}	DC Output Diode Current	-50	V _O < GND	mA			
		+50	V _O > V _{CC}				
I _O	DC Output Source/Sink Current	±50		mA			
I _{CC}	DC Supply Current per Supply Pin	±100		mA			
I _{GND}	DC Ground Current per Ground Pin	±100		mA			
T _{STG}	Storage Temperature	-65 to +150		°C			
Recommended Operating Conditions (Note 6)							
Symbol	Parameter	Min	Max	Units			
V _{CC}	Supply Voltage	Operating	2.0	3.6	V		
		Data Retention	1.5	3.6			
V _I	Input Voltage	0	5.5	V			
V _O	Output Voltage	HIGH or LOW State	0	V _{CC}	V		
		3-STATE	0	5.5			
I _{OH} /I _{OL}	Output Current				mA		
		V _{CC} = 3.0V - 3.6V		±24			
		V _{CC} = 2.7V - 3.0V		±12			
		V _{CC} = 2.3V - 2.7V		±8			
T _A	Free-Air Operating Temperature	-40	85	°C			
Δt/ΔV	Input Edge Rate, V _{IN} = 0.8V-2.0V, V _{CC} = 3.0V	0	10	ns/V			
<p>Note 4: The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.</p> <p>Note 5: I_O Absolute Maximum Rating must be observed.</p> <p>Note 6: Unused inputs or I/O's must be held HIGH or LOW. They may not float.</p>							
DC Electrical Characteristics							
Symbol	Parameter	Conditions	V _{CC} (V)	T _A = -40°C to +85°C		Units	
				Min	Max		
V _{IH}	HIGH Level Input Voltage		2.3 - 2.7	1.7		V	
			2.7 - 3.6	2.0			
V _{IL}	LOW Level Input Voltage		2.3 - 2.7		0.7	V	
			2.7 - 3.6		0.8		
V _{OH}	HIGH Level Output Voltage	I _{OH} = -100 μA	2.3 - 3.6	V _{CC} - 0.2		V	
					2.3		1.8
					2.7		2.2
					3.0		2.4
					3.0		2.2
V _{OL}	LOW Level Output Voltage	I _{OL} = 100 μA	2.3 - 3.6		0.2	V	
					2.3		0.6
					2.7		0.4
					3.0		0.4
					3.0		0.55
I _I	Input Leakage Current	0 ≤ V _I ≤ 5.5V	2.3 - 3.6		±5.0	μA	
I _{OZ}	3-STATE I/O Leakage	0 ≤ V _O ≤ 5.5V V _I = V _{IH} or V _{IL}	2.3 - 3.6		±5.0	μA	
I _{OFF}	Power-Off Leakage Current	V _I or V _O = 5.5V	0		10	μA	

DC Electrical Characteristics (Continued)								
Symbol	Parameter	Conditions	V _{CC} (V)	T _A = -40°C to +85°C		Units		
				Min	Max			
I _{CC}	Quiescent Supply Current	V _I = V _{CC} or GND	2.3-3.6		20	μA		
		3.6V ≤ V _I , V _O ≤ 5.5V (Note 7)	2.3-3.6		±20			
ΔI _{CC}	Increase in I _{CC} per Input	V _{IH} = V _{CC} - 0.6V	2.3-3.6		500	μA		
Note 7: Outputs disabled or 3-STATE only.								
AC Electrical Characteristics								
Symbol	Parameter	T _A = -40°C to +85°C, R _L = 500Ω						Units
		V _{CC} = 3.3V ± 0.3V		V _{CC} = 2.7V		V _{CC} = 2.5V ± 0.2V		
		C _L = 50 pF		C _L = 50 pF		C _L = 30 pF		
		Min	Max	Min	Max	Min	Max	
t _{PHL}	Propagation Delay	1.5	4.5	1.5	5.2	1.5	5.4	ns
t _{PLH}	A _n to B _n or B _n to A _n	1.5	4.5	1.5	5.2	1.5	5.4	
t _{PZL}	Output Enable Time	1.5	6.5	1.5	7.2	1.5	8.5	ns
t _{PZH}		1.5	6.5	1.5	7.2	1.5	8.5	
t _{PLZ}	Output Disable Time	1.5	6.4	1.5	6.9	1.5	7.7	ns
t _{PHZ}		1.5	6.4	1.5	6.9	1.5	7.7	
Dynamic Switching Characteristics								
Symbol	Parameter	Conditions	V _{CC} (V)	T _A = 25°C		Units		
				Typical				
V _{OLP}	Quiet Output Dynamic Peak V _{OL}	C _L = 50 pF, V _{IH} = 3.3V, V _{IL} = 0V	3.3	0.8		V		
		C _L = 30 pF, V _{IH} = 2.5V, V _{IL} = 0V	2.5	0.6				
V _{OLV}	Quiet Output Dynamic Valley V _{OL}	C _L = 50 pF, V _{IH} = 3.3V, V _{IL} = 0V	3.3	-0.8		V		
		C _L = 30 pF, V _{IH} = 2.5V, V _{IL} = 0V	2.5	-0.6				
Capacitance								
Symbol	Parameter	Conditions	Typical	Units				
C _{IN}	Input Capacitance	V _{CC} = Open, V _I = 0V or V _{CC}	7	pF				
C _{I/O}	Input/Output Capacitance	V _{CC} = 3.3V, V _I = 0V or V _{CC}	8	pF				
C _{PD}	Power Dissipation Capacitance	V _{CC} = 3.3V, V _I = 0V or V _{CC} , f = 10 MHz	20	pF				

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AC LOADING and WAVEFORMS Generic for LCX Family

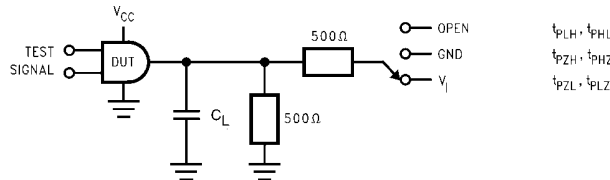
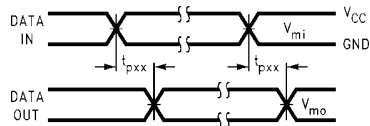
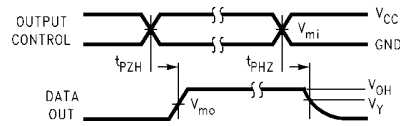


FIGURE 1. AC Test Circuit (C_L includes probe and jig capacitance)

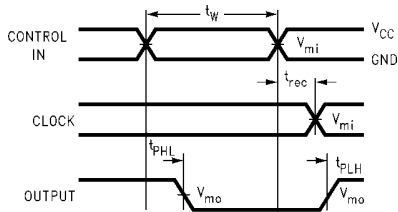
Test	Switch
t_{PLH} , t_{PHL}	Open
t_{PZL} , t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V$, and 2.7V $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
t_{PZH} , t_{PHZ}	GND



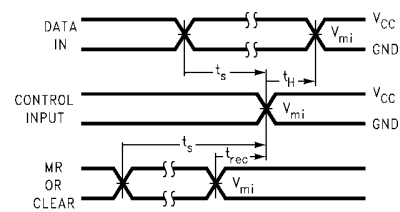
Waveform for Inverting and Non-Inverting Functions



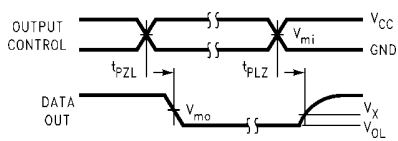
3-STATE Output High Enable and Disable Times for Logic



Propagation Delay, Pulse Width and t_{rec} Waveforms



Setup Time, Hold Time and Recovery Time for Logic



3-STATE Output Low Enable and Disable Times for Logic

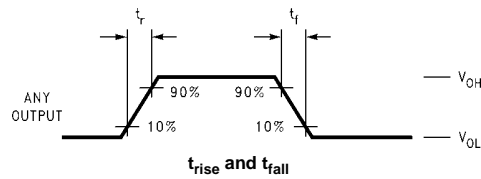
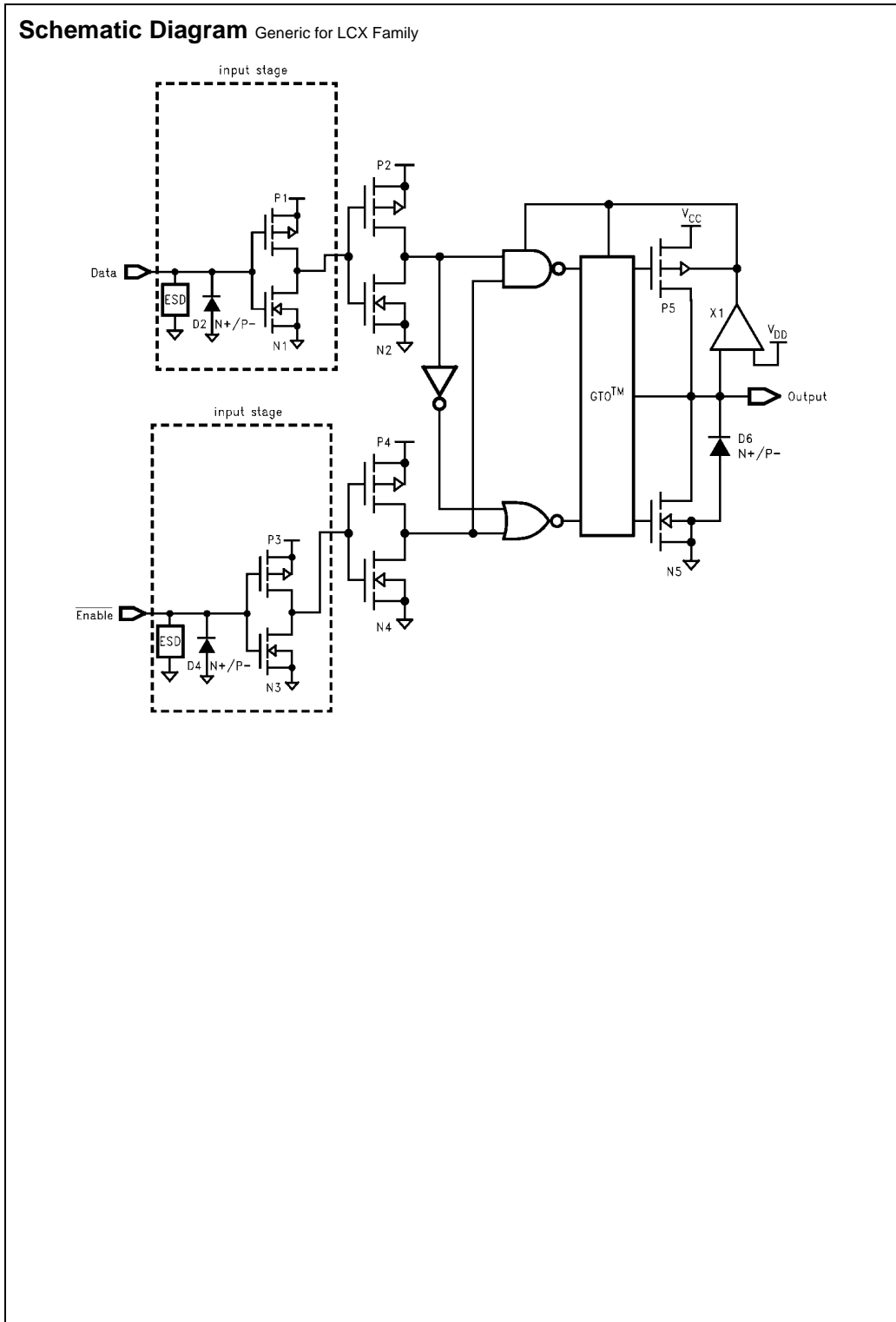


FIGURE 2. Waveforms
(Input Characteristics; $f = 1MHz$, $t_r = t_f = 3ns$)

Symbol	V_{CC}		
	$3.3V \pm 0.3V$	2.7V	$2.5V \pm 0.2V$
V_{mi}	1.5V	1.5V	$V_{CC}/2$
V_{mo}	1.5V	1.5V	$V_{CC}/2$
V_x	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
V_y	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$



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74LCX32245 Low Voltage 32-Bit Bidirectional Transceiver with 5V Tolerant Inputs and Outputs

Physical Dimensions inches (millimeters) unless otherwise noted

Top View

Bottom View

Notes:

- A. THIS PACKAGE CONFORMS TO JEDEC MO-205
- B. ALL DIMENSIONS IN MILLIMETERS
- C. LAND PATTERN RECOMMENDATION: NSMD (Non Solder Mask Defined)
.35MM DIA PADS WITH A SOLDERMASK OPENING OF .45MM CONCENTRIC TO PADS
- D. DRAWING CONFORMS TO ASME Y14.5M-1994

BGA96ArevE

96-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide
Package Number BGA96A

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