



May 2002
Revised May 2002

74LCXH16245 Low Voltage 16-Bit Bidirectional Transceiver with Bushold

General Description

The LCXH16245 contains sixteen 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 16-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 LCXH16245 data inputs include active bushold circuitry, eliminating the need for external pull-up resistors to hold unused or floating data inputs at a valid logic level.

The LCXH16245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

- 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 outputs
- Bushold on inputs eliminates the need for external pull-up/pull-down resistors
- ± 24 mA output drive ($V_{CC} = 3.0V$)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance conforms to the requirements of JESD78
- ESD performance:
 - Human body model > 2000V
 - Machine model > 200V
- Also packaged in plastic Fine-Pitch Ball Grid Array (FBGA)

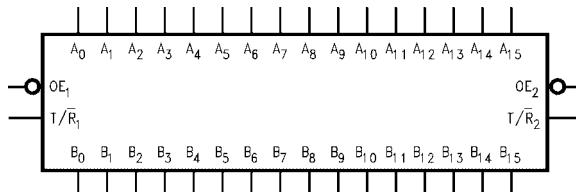
Ordering Code:

Order Number	Package Number	Package Description
74LCXH16245G (Note 1) (Note 2)	BGA54A	54-Ball Fine-Pitch Ball Grid Array (FBGA), JEDEC MO-205, 5.5mm Wide
74LCXH16245MTD (Note 2)	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

Note 1: Ordering Code "G" indicates Trays.

Note 2: Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

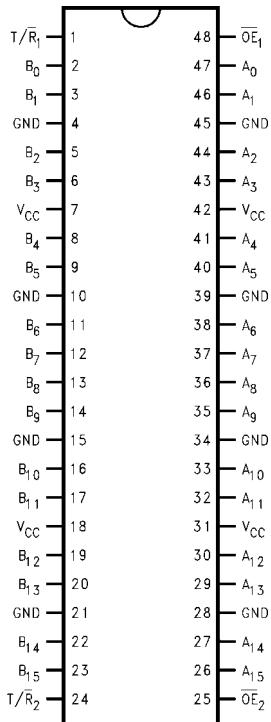
Logic Symbol



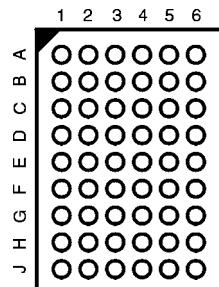
74LCXH16245

Connection Diagrams

Pin Assignment for SSOP and TSSOP



Pin Assignment for FBGA



(Top Thru View)

Pin Descriptions

Pin Names	Description
OE _n	Output Enable Input
T/R _n	Transmit/Receive Input
A ₀ -A ₁₅	Side A Inputs or 3-STATE Outputs (BUSHOLD)
B ₀ -B ₁₅	Side B Inputs or 3-STATE Outputs (BUSHOLD)

FBGA Pin Assignments

	1	2	3	4	5	6
A	B ₀	NC	T/R ₁	OE ₁	NC	A ₀
B	B ₂	B ₁	NC	NC	A ₁	A ₂
C	B ₄	B ₃	V _{CC}	V _{CC}	A ₃	A ₄
D	B ₆	B ₅	GND	GND	A ₅	A ₆
E	B ₈	B ₇	GND	GND	A ₇	A ₈
F	B ₁₀	B ₉	GND	GND	A ₉	A ₁₀
G	B ₁₂	B ₁₁	V _{CC}	V _{CC}	A ₁₁	A ₁₂
H	B ₁₄	B ₁₃	NC	NC	A ₁₃	A ₁₄
J	B ₁₅	NC	T/R ₂	OE ₂	NC	A ₁₅

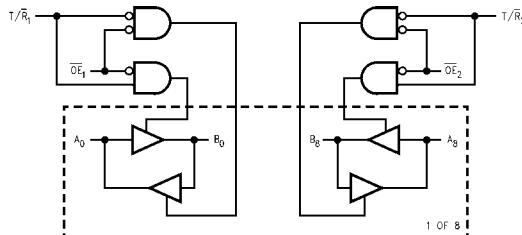
Truth Tables

Inputs		Outputs
OE ₁	T/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
OE ₂	T/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

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance

Logic Diagram



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Absolute Maximum Ratings (Note 3)				
Symbol	Parameter	Value	Conditions	Units
V_{CC}	Supply Voltage	-0.5 to +7.0		V
V_I	DC Input Voltage	-0.5 to $V_{CC} + 0.5$		V
V_O	DC Output Voltage	-0.5 to +7.0 -0.5 to $V_{CC} + 0.5$	Output in 3-STATE Output in HIGH or LOW State (Note 4)	V
I_{IK}	DC Input Diode Current	-50	$V_I < GND$	mA
I_{OK}	DC Output Diode Current	-50 +50	$V_O < GND$ $V_O > V_{CC}$	mA
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		$^{\circ}C$

Recommended Operating Conditions (Note 5)

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	V_{CC}	V_{CC}	V
		HIGH or LOW State	0	V_{CC}	
V_O	Output Voltage	3-STATE	0	V_{CC}	V
		$V_{CC} = 3.0V - 3.6V$		± 24	
		$V_{CC} = 2.7V - 3.0V$		± 12	
I_{OH}/I_{OL}	Output Current	$V_{CC} = 2.3V - 2.7V$		± 8	mA
		$V_{CC} = 3.0V - 3.6V$		± 24	
		$V_{CC} = 2.7V - 3.0V$		± 12	
T_A	Free-Air Operating Temperature		-40	85	$^{\circ}C$
$\Delta t/\Delta V$	Input Edge Rate, $V_{IN} = 0.8V - 2.0V$, $V_{CC} = 3.0V$		0	10	ns/V

Note 3: 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.

Note 4: I_O Absolute Maximum Rating must be observed.

Note 5: Floating or unused control inputs must be HIGH or LOW.

DC Electrical Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = -40^{\circ}C$ to $+85^{\circ}C$		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	$I_{OH} = -100 \mu A$	2.3 – 3.6	$V_{CC} - 0.2$		V
		$I_{OH} = -8 mA$	2.3	1.8		
		$I_{OH} = -12 mA$	2.7	2.2		
		$I_{OH} = -18 mA$	3.0	2.4		
		$I_{OH} = -24 mA$	3.0	2.2		
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$	2.3 – 3.6		0.2	V
		$I_{OL} = 8mA$	2.3		0.6	
		$I_{OL} = 12 mA$	2.7		0.4	
		$I_{OL} = 16 mA$	3.0		0.4	
		$I_{OL} = 24 mA$	3.0		0.55	
I_I	Input Leakage Current	Data	$V_I = V_{CC}$ or GND	2.3 – 3.6	± 5.0	μA
		Control	$0 \leq V_I \leq 5.5$	2.3 – 3.6	± 5.0	

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DC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V _{CC} (V)	T _A = -40°C to +85°C		Units
				Min	Max	
I _{H(HOLD)}	Bushold Input Minimum Drive Hold Current	V _{IN} = 0.7V	2.3	45		μA
		V _{IN} = 1.7V		-45		
		V _{IN} = 0.8V	3.0	75		
		V _{IN} = 2.0V		-75		
I _{I(OD)}	Bushold Input Over-Drive Current to Change State	(Note 6)	2.7	300		μA
		(Note 7)		-300		
		(Note 6)	3.6	450		
		(Note 7)		-450		
I _{OZ}	3-STATE I/O Leakage	V _O = V _{CC} or GND	2.3 – 3.6		±5.0	μA
I _{OFF}	Power-Off Leakage Current	V _I or V _O = 5.5V	0		10	μA
I _{CC}	Quiescent Supply Current	V _I = V _{CC} or GND	2.3–3.6		20	μA
ΔI _{CC}	Increase in I _{CC} per Input	V _{IH} = V _{CC} – 0.6V	2.3–3.6		500	μA

Note 6: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 7: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

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 A _n to B _n or B _n to A _n	1.0	4.5	1.0	5.2	1.0	5.4	ns	
t _{PLH}		1.0	4.5	1.0	5.2	1.0	5.4		
t _{PZL}	Output Enable Time	1.0	6.5	1.0	7.2	1.0	8.5	ns	
t _{PZH}		1.0	6.5	1.0	7.2	1.0	8.5		
t _{PLZ}	Output Disable Time	1.0	6.4	1.0	6.9	1.0	7.7	ns	
t _{PHZ}		1.0	6.4	1.0	6.9	1.0	7.7		
t _{OSHL}	Output to Output Skew (Note 8)			1.0				ns	
t _{OSLH}				1.0					

Note 8: Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t_{OSHL}) or LOW-to-HIGH (t_{OSLH}). Parameter guaranteed by design.

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

AC LOADING and WAVEFORMS Generic for LCX Family

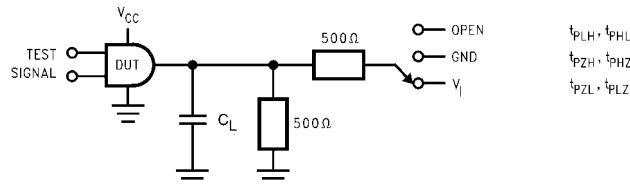
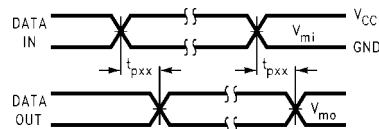
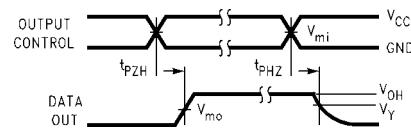


FIGURE 1. AC Test Circuit (C_L includes probe and jig capacitance)

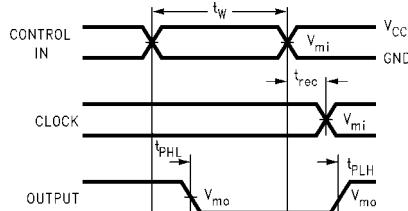
Test	Switch
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V, 2.7V$ and $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
t_{PZH}, t_{PHZ}	GND



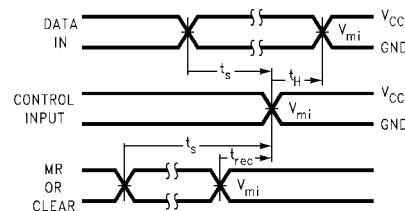
Waveform for Inverting and Non-Inverting Functions



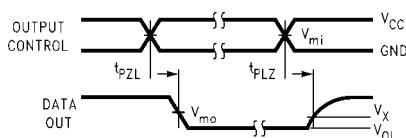
3-STATE Output High Enable and Disable Times for Logic



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

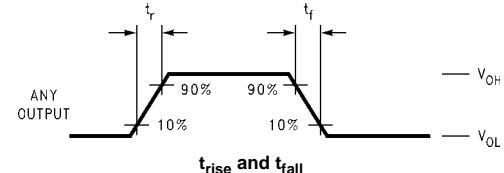


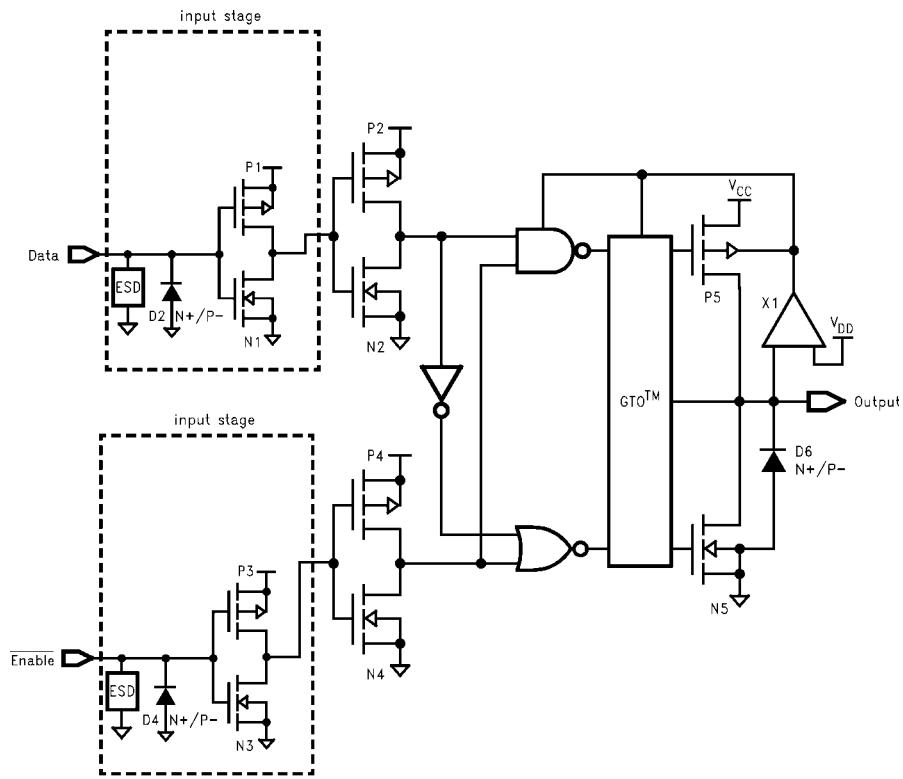
FIGURE 2. Waveforms
(Input Characteristics; $f = 1MHz$, $t_r = t_f = 3ns$)

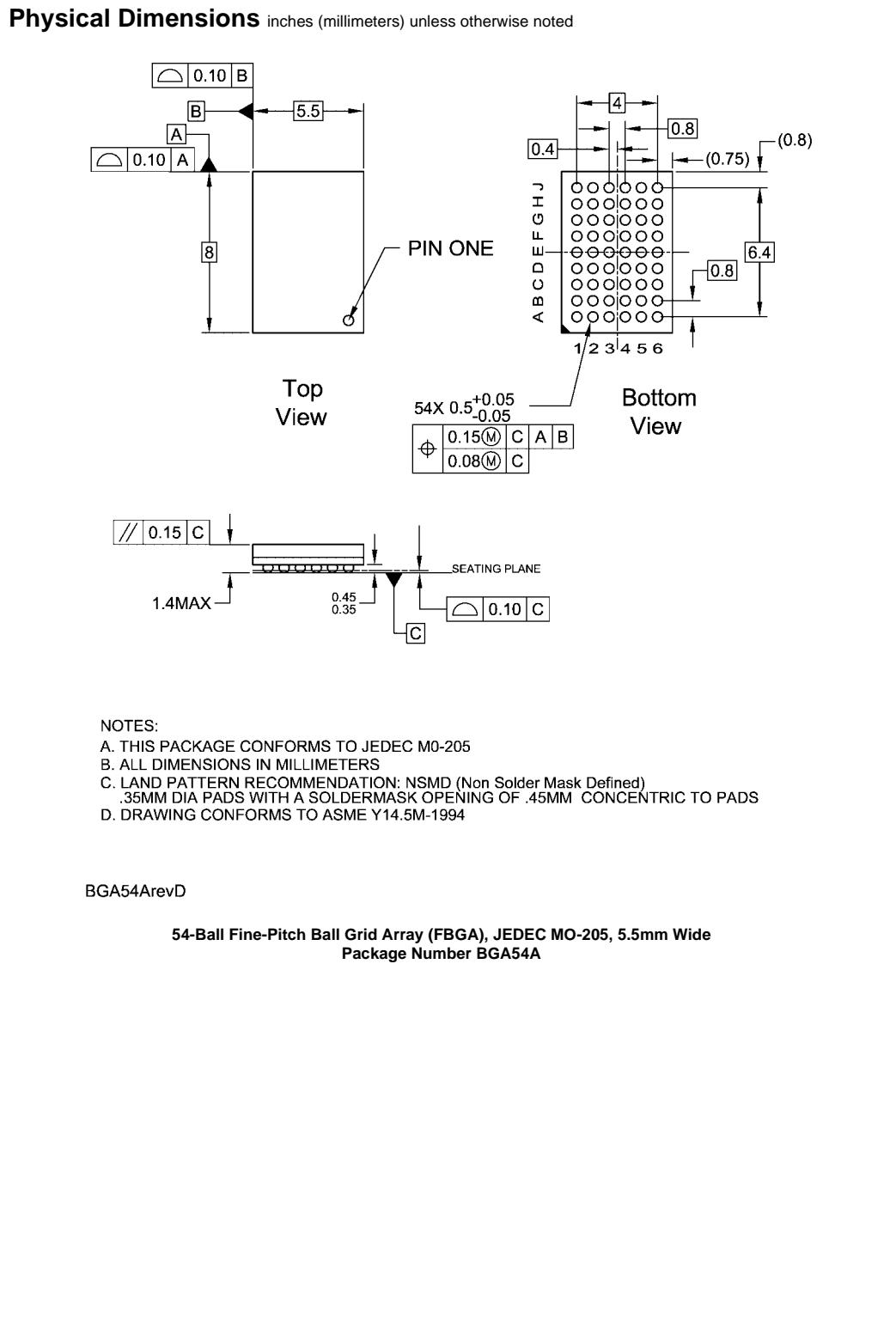
Symbol	V_{CC}		
	$3.3V \pm 0.3V$	$2.7V$	$2.5V \pm 0.2V$
V_{mi}	1.5V	1.5V	$V_{CC}/2$
V_{mo}	1.5V	1.5V	$V_{CC}/2$
V_x	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
V_y	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$

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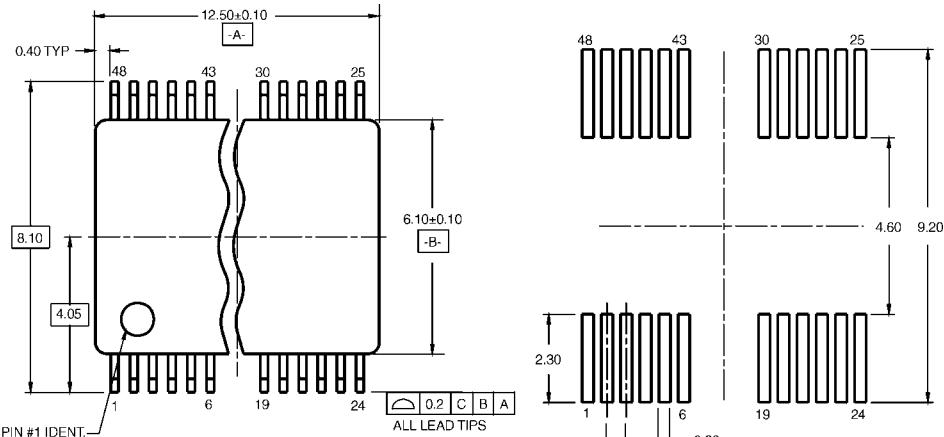
Schematic Diagram Generic for LCX Family



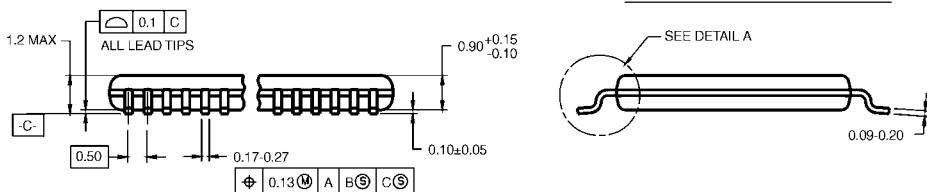


74LCXH16245 Low Voltage 16-Bit Bidirectional Transceiver with Bushold

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



LAND PATTERN RECOMMENDATION



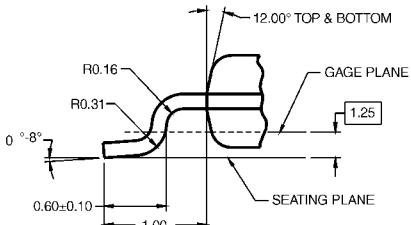
DIMENSIONS ARE IN MILLIMETERS

NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6, DATE 7/93.
 - B. DIMENSIONS ARE IN MILLIMETERS.
 - C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
 - D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTD48RevB1

**48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide
Package Number MTD48**



DETAIL A

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