

# 54LCX245

## Low Voltage Bidirectional Transceiver with 5V Tolerant Inputs and Outputs

### General Description

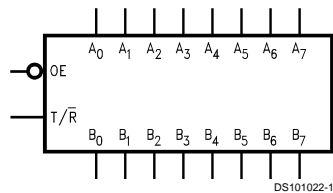
The LCX245 contains eight non-inverting bidirectional buffers with TRI-STATE™ outputs and is intended for bus-oriented applications. The device is designed for low voltage (3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment. The  $T/\bar{R}$  input determines the direction of data flow through the device. The  $\overline{OE}$  input disables both the A and B ports by placing them in a high impedance state.

The LCX245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

### Features

- 5V tolerant inputs and outputs
- 9ns  $t_{PD}$  max, 10 $\mu$ A  $I_{CCQ}$  max
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal
- 2.0V–3.6V  $V_{CC}$  supply operation
- $\pm 24$  mA output drive
- Implements patented noise/EMI reduction circuitry
- Functionally compatible with the 54 series 245
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V
- Standard Microcircuit Drawing (SMD) 5962-97543

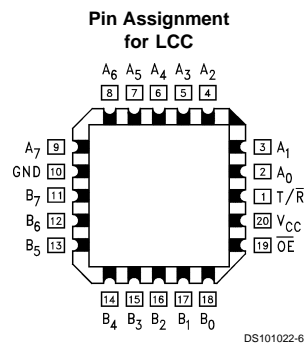
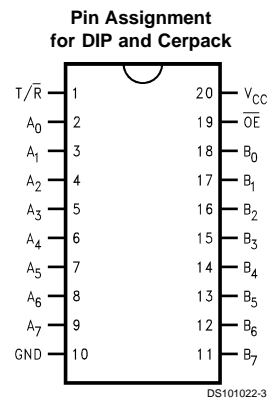
### Logic Symbols



### Pin Descriptions

Pin Names	Description
$\overline{OE}$	Output Enable Input
$T/\bar{R}$	Transmit/Receive Input
$A_0$ – $A_7$	Side A Inputs or 3-STATE Outputs
$B_0$ – $B_7$	Side B Inputs or 3-STATE Outputs

### Connection Diagram



TRI-STATE® is a registered trademark of National Semiconductor Corporation.

## Truth Table

Inputs		Outputs
OE	T/R	
L	L	Bus B <sub>0</sub> -B <sub>7</sub> Data to Bus A <sub>0</sub> -A <sub>7</sub>
L	H	Bus A <sub>0</sub> -A <sub>7</sub> Data to Bus B <sub>0</sub> -B <sub>7</sub>
H	X	HIGH Z State on A <sub>0</sub> -A <sub>7</sub> , B <sub>0</sub> -B <sub>7</sub> (Note 1)

H= High Voltage Level

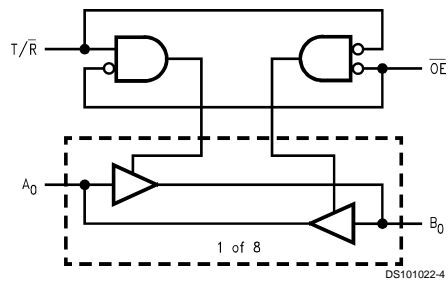
L= Low Voltage Level

X= Immaterial

Z= High Impedance

**Note 1:** Unused bus terminals during HIGH Z State must be held HIGH or LOW.

## Logic Diagram



## Absolute Maximum Ratings (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V
DC Input Voltage ( $V_I$ )	-0.5V to +7.0V
DC Input Diode Current ( $I_{IK}$ )	
$V_I < \text{GND}$	-50 mA
DC Output Diode Current ( $I_{OK}$ )	
$V_O < \text{GND}$	-50mA
$V_O \geq V_{CC}$	+50mA
DC Output Voltage ( $V_O$ )	
Output in High or Low State	-0.5V to $V_{CC} + 0.5V$
Output in TRI-STATE	-0.5V to 7.0V
DC Output Source or Sink Current ( $I_O$ )	$\pm 50\text{mA}$
DC $V_{CC}$ or Ground Current	$\pm 200\text{mA}$
Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C
Junction Temperature ( $T_J$ )	
CDIP	175°C

## Recommended Operating Conditions (Note 3)

Supply Voltage ( $V_{CC}$ )	
Operating	2.0V to 3.6V
Data Retention	1.5V to 3.6V
Input Voltage ( $V_I$ )	0V to 5.5V
Output Voltage ( $V_O$ )	
High or Low State	0V to $V_{CC}$
TRI-STATE	0V to 5.5V
Operating Temperature ( $T_A$ )	
54LCX	-55°C to +125°C
Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
$V_{IN}$ from 0.8V to 2.0V, $V_{CC} = 3.0V$	0ns/V to 10ns/V

**Note 2:** 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 3:**  $I_O$  Absolute Maximum Rating must be observed.

## DC Electrical Characteristics

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = -55^\circ\text{C to } +125^\circ\text{C}$		Units
				Min	Max	
$V_{IH}$	HIGH Level Input Voltage		2.7-3.6	2.0		V
$V_{IL}$	LOW Level Input Voltage		2.7-3.6		0.8	V
$V_{OH}$	HIGH Level Output Voltage	$I_{OH} = -100 \mu\text{A}$	2.7-3.6	$V_{CC} - 0.2$		V
		$I_{OH} = -12 \text{ mA}$	2.7	2.2		V
		$I_{OH} = -12 \text{ mA}$	3.0	2.4		V
		$I_{OH} = -24 \text{ mA}$	3.0	2.2		V
$V_{OL}$	LOW Level Output Voltage	$I_{OL} = 100 \mu\text{A}$	2.7-3.6		0.2	V
		$I_{OL} = 12 \text{ mA}$	2.7		0.4	V
		$I_{OL} = 24 \text{ mA}$	3.0		0.55	V
$I_I$	Input Leakage Current	$0 \leq V_I \leq 5.5V$	2.7-3.6		$\pm 5.0$	$\mu\text{A}$
$V_{IKL}$	Clamp Diode Voltage	$I_M = -18\text{mA}$	3.0		-1.2	V
$I_{OZ}$	TRI-STATE I/O Leakage	$0 \leq V_O \leq 5.5V$ $V_I = V_{IH}$ or $V_{IL}$	2.7-3.6		$\pm 5.0$	$\mu\text{A}$
$I_{CCZ}$	Supply Current Outputs TRI-STATE	$V_I = 5.5V$ or GND	2.7-3.6		10	$\mu\text{A}$
$I_{OFF}$	Power-Off Leakage Current	$V_{CC} = 0V$ , $V_I = 0V$ , $V_M = 5.5V$	0		100	$\mu\text{A}$
$I_{CC}$	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.7-3.6		10	$\mu\text{A}$
$\Delta I_{CC}$	Increase in $I_{CC}$ per Input	$V_{IH} = V_{CC} - 0.6V$	2.7-3.6		0.5	mA

## AC Electrical Characteristics

Symbol	Parameter	$T_A = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ , $C_L = 50\text{pF}$ , $R_L = 500\Omega$				Units
		$V_{CC} = 3.3\text{V} \pm 0.3\text{V}$		$V_{CC} = 2.7\text{V}$		
		Min	Max	Min	Max	
$t_{PHL}$	Propagation Delay	1.5	8.0	1.5	9.0	ns
$t_{PLH}$	$A_n$ to $B_n$ or $B_n$ to $A_n$	1.5	8.0	1.5	9.0	
$t_{PZL}$	Output Enable Time	1.5	10.0	1.5	11.0	ns
$t_{PZH}$		1.5	10.0	1.5	11.0	
$t_{PLZ}$	Output Disable Time	1.5	8.0	1.5	9.0	ns
$t_{PHZ}$		1.5	8.0	1.5	9.0	
$t_{OSHL}$	Output to Output Skew (Notes 4, 5)		1.0		1.0	ns
$t_{OSLH}$			1.0		1.0	

**Note 4:** 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 ( $t_{OSLH}$ ).

**Note 5:** Guaranteed but not tested (design characterization data).

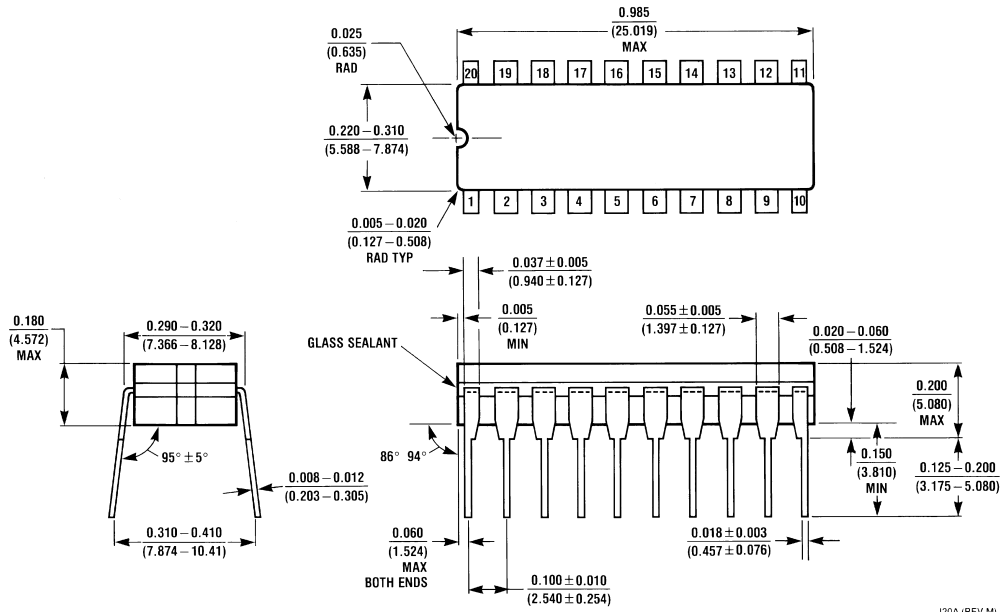
## Dynamic Switching Characteristics

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = 25^{\circ}\text{C}$	Units
				Max	
$V_{OLP}$	Quiet Output Dynamic Peak $V_{OL}$	$C_L = 50\text{ pF}$ , $V_{IH} = 3.0\text{V}$ , $V_{IL} = 0\text{V}$	3.0	1.0	V
$V_{OLV}$	Quiet Output Dynamic Valley $V_{OL}$	$C_L = 50\text{ pF}$ , $V_{IH} = 3.0\text{V}$ , $V_{IL} = 0\text{V}$	3.0	-0.8	V

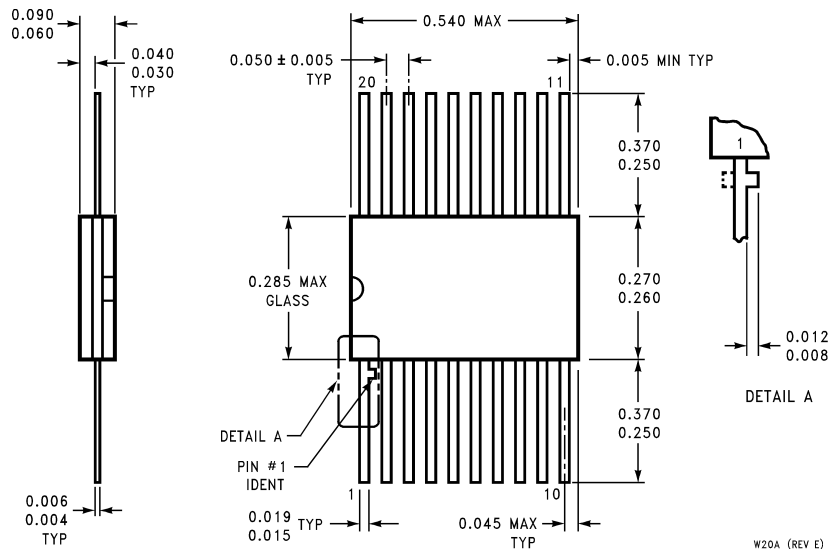
## Capacitance

Symbol	Parameter	Conditions	Max	Units
$C_{IN}$	Input Capacitance	$V_{CC} = \text{Open}$ , $V_I = 0\text{V}$ or $V_{CC}$	10	pF
$C_{IO}$	Input/Output Capacitance	$V_{CC} = 3.3\text{V}$ , $V_I = 0\text{V}$ or $V_{CC}$	12	pF
$C_{PD}$	Power Dissipation Capacitance	$V_{CC} = 3.3\text{V}$ , $V_I = 0\text{V}$ or $V_{CC}$ , $f = 10\text{ MHz}$	30	pF

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

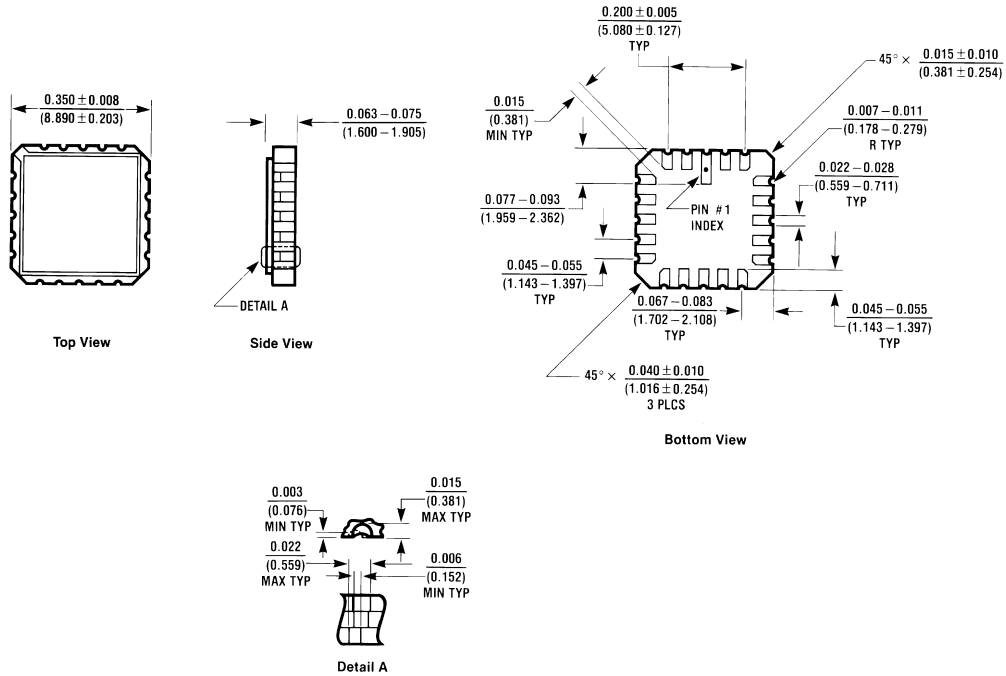


**20-Lead Ceramic Dual-in-line  
Package Number J20A**



**20-Lead Cerpack  
Package Number W20A**

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



**20-Lead Leadless Chip Carrier  
Package Number E20A**

E20A (REV D)

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