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March 2008

## 74LCXR2245

# Low Voltage Bidirectional Transceiver with 5V Tolerant Inputs and Outputs and 26 $\Omega$ Series Resistors on Both A and B Ports

#### **Features**

- 5V tolerant inputs and outputs
- 2.3V–3.6V V<sub>CC</sub> specifications provided
- 8.0ns  $t_{PD}$  max. ( $V_{CC} = 3.3V$ ),  $10\mu A I_{CC}$  max.
- Power down high impedance inputs and outputs
- Supports live insertion/withdrawal<sup>(1)</sup>
- ±12mA output drive (V<sub>CC</sub> = 3.0V)
- Implements proprietary noise/EMI reduction circuitry
- Latch-up performance exceeds 500mA
- $\blacksquare$  Equivalent 26 $\Omega$  series resistor on all outputs
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V

#### Note:

 To ensure the high-impedance state during power up or down, OE should be tied to V<sub>CC</sub> through a pull-up resistor: the minimum value or the resistor is determined by the current-sourcing capability of the driver.

#### **General Description**

The LCXR2245 contains eight non-inverting bidirectional buffers with 3-STATE outputs and is intended for bus oriented applications. The device is designed for low voltage (2.5V and 3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment. The  $T/\overline{R}$  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  $26\Omega$  series resistor helps reduce output overshoot and undershoot.

The LCXR2245 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

#### **Ordering Information**

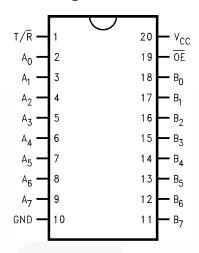
Order Number	Package Number	Package Description
74LCXR2245WM	M20B	20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
74LCXR2245SJ	M20D	20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74LCXR2245MSA	MSA20	20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide
74LCXR2245MTC	MTC20	20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering number.



All packages are lead free per JEDEC: J-STD-020B standard.

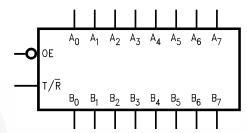
## **Connection Diagram**



#### **Pin Description**

Pin Names	Description
ŌĒ	Output Enable Input
T/R	Transmit/Receive Input
A <sub>0</sub> -A <sub>7</sub>	Side A Inputs or 3-STATE Outputs
B <sub>0</sub> –B <sub>7</sub>	Side B Inputs or 3-STATE Outputs

# **Logic Symbol**



#### **Truth Table**

Inputs			
ŌĒ	T/R	Outputs	
L	L	Bus B <sub>0</sub> – B <sub>7</sub> Data to Bus A <sub>0</sub> – A <sub>7</sub>	
L	Н	Bus $A_0 - A_7$ Data to Bus $B_0 - B_7$	
Н	Х	HIGH Z State on $A_0 - A_7$ , $B_0 - B_7^{(2)}$	

H = HIGH Voltage Level

L = LOW Voltage Level

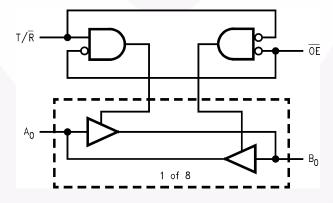
X = Immaterial

Z = High Impedance

#### Note:

2. Unused bus terminals during HIGH Z State must be held HIGH or LOW.

# **Logic Diagram**



#### **Absolute Maximum Ratings**

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating		
V <sub>CC</sub>	Supply Voltage	-0.5V to +7.0V		
V <sub>I</sub>	DC Input Voltage	-0.5V to +7.0V		
Vo	DC Output Voltage			
	Output in 3-STATE	-0.5V to +7.0V		
	Output in HIGH or LOW State <sup>(3)</sup>	-0.5V to V <sub>CC</sub> + 0.5V		
I <sub>IK</sub>	DC Input Diode Current, V <sub>I</sub> < GND —5			
I <sub>OK</sub>	DC Output Diode Current			
	V <sub>O</sub> < GND	–50mA		
	$V_O > V_{CC}$	+50mA		
Io	DC Output Source/Sink Current	±50mA		
I <sub>CC</sub>	DC Supply Current per Supply Pin ±100			
I <sub>GND</sub>	DC Ground Current per Ground Pin ±100m			
T <sub>STG</sub>	Storage Temperature	−65°C to +150°C		

#### Note:

3. I<sub>O</sub> Absolute Maximum Rating must be observed.

# Recommended Operating Conditions<sup>(4)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Min.	Max.	Units
V <sub>CC</sub>	Supply Voltage			
	Operating	2.0	3.6	V
	Data Retention	1.5	3.6	
V <sub>I</sub>	Input Voltage	0	5.5	V
Vo	Output Voltage			
	HIGH or LOW State	0	V <sub>CC</sub>	V
	3-STATE		5.5	
I <sub>OH</sub> / I <sub>OL</sub>	Output Current		<i>y</i>	
	$V_{CC} = 3.0V - 3.6V$		±12	mA
	V <sub>CC</sub> = 2.7V–3.0V		±8	
	V <sub>CC</sub> = 2.3V–2.7V		±4	
T <sub>A</sub>	Free-Air Operating Temperature	-40	85	°C
Δt / ΔV	Input Edge Rate, V <sub>IN</sub> = 0.8V–2.0V, V <sub>CC</sub> = 3.0V	0	10	ns/V

#### Note

4. Unused inputs must be held HIGH or LOW. They may not float.

#### **DC Electrical Characteristics**

				$T_A = -40^{\circ}C$	to +85°C	
Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	Min	Max	Units
V <sub>IH</sub>	HIGH Level Input Voltage	2.3–2.7		1.7		V
		2.7–3.6		2.0		
V <sub>IL</sub>	LOW Level Input Voltage	2.3–2.7			0.7	V
		2.7–3.6			0.8	
V <sub>OH</sub>	HIGH Level Output Voltage	2.3–3.6	$I_{OH} = -100 \mu A$	V <sub>CC</sub> – 0.2		V
		2.3	$I_{OH} = -4mA$	1.8		
		2.7	$I_{OH} = -4mA$	2.2		
		3.0	$I_{OH} = -6mA$	2.4		
		2.7	$I_{OH} = -8mA$	2.0		
		3.0	$I_{OH} = -12mA$	2.0		
V <sub>OL</sub>	LOW Level Output Voltage	2.3–3.6	$I_{OL} = 100 \mu A$		0.2	V
		2.3	$I_{OL} = 4mA$		0.6	
		2.7	$I_{OL} = 4mA$		0.4	
		3.0	$I_{OL} = 6mA$		0.55	
		2.7	$I_{OL} = 8mA$		0.6	
		3.0	$I_{OL} = 12mA$		0.8	
I <sub>I</sub>	Input Leakage Current	2.3–3.6	$0 \le V_I \le 5.5V$		±5.0	μA
I <sub>OZ</sub>	3-STATE I/O Leakage	2.3–3.6	$\begin{aligned} 0 &\leq V_O \leq 5.5V, \\ V_I &= V_{IH} \text{ or } V_{IL} \end{aligned}$		±5.0	μA
I <sub>OFF</sub>	Power-Off Leakage Current	0	$V_I$ or $V_O = 5.5V$		10	μA
I <sub>CC</sub>	Quiescent Supply Current	2.3–3.6	$V_I = V_{CC}$ or GND		10	μA
		2.3–3.6	$3.6V \le V_I, V_O \le 5.5V^{(5)}$		±10	
$\Delta I_{CC}$	Increase in I <sub>CC</sub> per Input	2.3-3.6	$V_{IH} = V_{CC} - 0.6V$		500	μΑ

#### Note:

5. Outputs disabled or 3-STATE only.

#### **AC Electrical Characteristics**

	T <sub>A</sub> =			40°C to +85°C, $R_L = 500\Omega$				
			3V ± 0.3V, 50pF		2.7V, 50pF	V <sub>CC</sub> = 2.5 C <sub>L</sub> =	5V ± 0.2V, 30pF	
Symbol	Parameter	Min.	Max.	Min.	Max.	Min.	Max.	Units
t <sub>PHL</sub> , t <sub>PLH</sub>	Propagation Delay, A <sub>n</sub> to B <sub>n</sub> or B <sub>n</sub> to A <sub>n</sub>	1.5	8.0	1.5	9.0	1.5	9.6	ns
t <sub>PZL</sub> , t <sub>PZH</sub>	Output Enable Time	1.5	9.5	1.5	10.5	1.5	11.0	ns
$t_{PLZ},t_{PHZ}$	Output Disable Time	1.5	7.5	1.5	8.5	1.5	9.0	ns
t <sub>OSHL</sub> , t <sub>OSLH</sub>	Output to Output Skew <sup>(6)</sup>		1.0					ns

#### Note:

6. 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<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>).

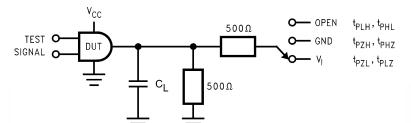
# **Dynamic Switching Characteristics**

				$T_A = 25^{\circ}C$	
Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	Typical	Unit
V <sub>OLP</sub>	Quiet Output Dynamic Peak V <sub>OL</sub>	3.3	$C_L = 50pF, V_{IH} = 3.3V, V_{IL} = 0V$	0.5	V
		2.5	$C_L = 30pF, V_{IH} = 2.5V, V_{IL} = 0V$	0.4	
V <sub>OLV</sub>	Quiet Output Dynamic Valley V <sub>OL</sub>	3.3	$C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V$	0.5	V
		2.5	$C_L = 30pF, V_{IH} = 2.5V, V_{IL} = 0V$	0.4	

# Capacitance

Symbol	Parameter	Conditions	Typical	Units
C <sub>IN</sub>	Input Capacitance	$V_{CC} = Open, V_I = 0V \text{ or } V_{CC}$	7	pF
C <sub>OUT</sub>	Output Capacitance	$V_{CC} = 3.3V$ , $V_I = 0V$ or $V_{CC}$	8	pF
C <sub>PD</sub>	Power Dissipation Capacitance	$V_{CC} = 3.3V$ , $V_I = 0V$ or $V_{CC}$ , $f = 10MHz$	25	pF

# AC Loading and Waveforms (Generic for LCX Family)

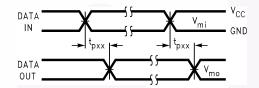


Test	Switch
t <sub>PLH</sub> , t <sub>PHL</sub>	Open
$t_{PZL}, t_{PLZ}$	6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$
$t_{PZH},t_{PHZ}$	GND

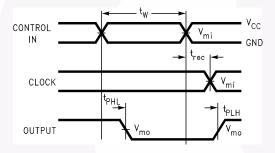
 $V_{CC}$ 

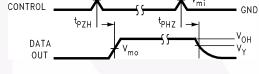
Figure 1. AC Test Circuit (C<sub>L</sub> includes probe and jig capacitance)

OUTPUT

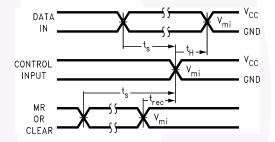


#### **Waveform for Inverting and Non-Inverting Functions**



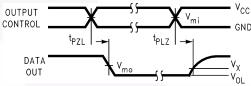


3-STATE Output High Enable and Disable Times for Logic

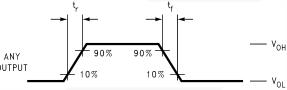


## Propagation Delay. Pulse Width and $t_{\text{rec}}$ Waveforms

Setup Time, Hold Time and Recovery Time for Logic





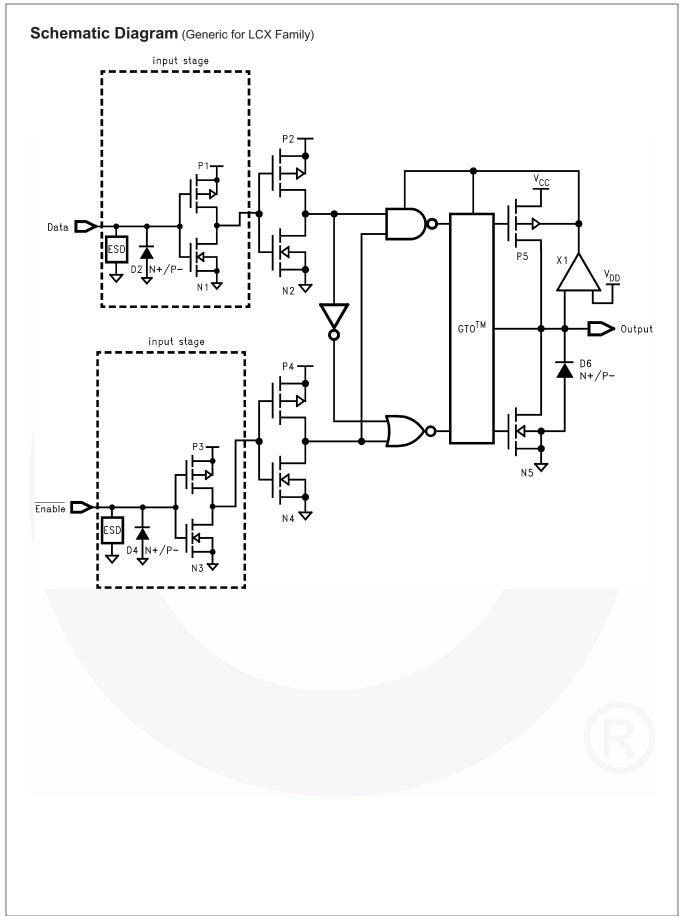


3-STATE Output Low Enable and Disable Times for Logic

t<sub>rise</sub> and t<sub>fall</sub>

	V <sub>CC</sub>			
Symbol	3.3V ± 0.3V	2.7V	2.5V ± 0.2V	
$V_{mi}$	1.5V	1.5V	V <sub>CC</sub> /2	
$V_{mo}$	1.5V	1.5V	V <sub>CC</sub> /2	
$V_{x}$	V <sub>OL</sub> + 0.3V	V <sub>OL</sub> + 0.3V	V <sub>OL</sub> + 0.15V	
V <sub>y</sub>	V <sub>OH</sub> – 0.3V	V <sub>OH</sub> – 0.3V	V <sub>OH</sub> – 0.15V	

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



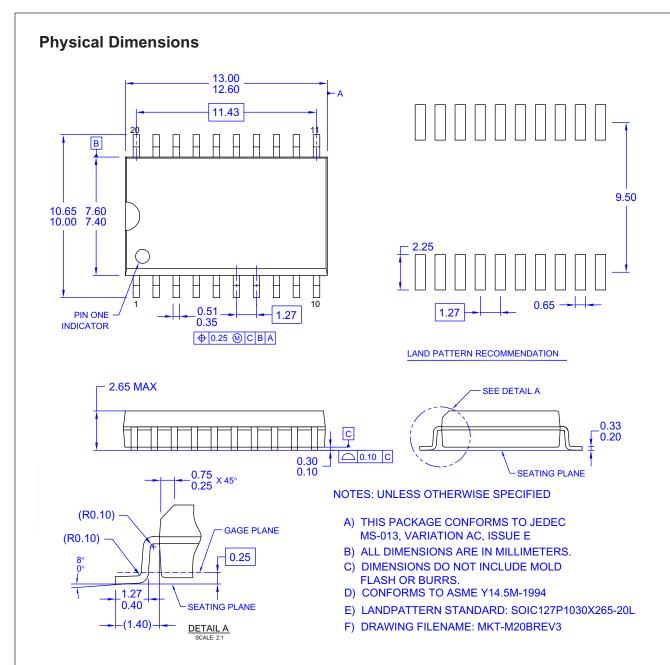
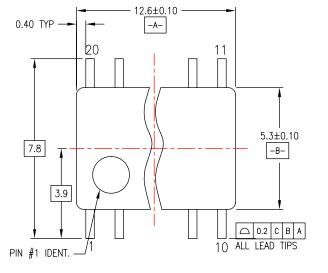


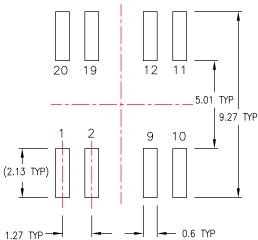
Figure 3. 20-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide

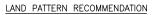
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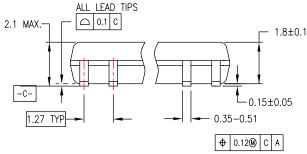
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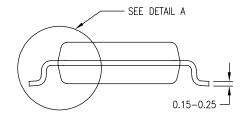
# Physical Dimensions (Continued)







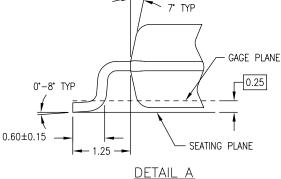




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M20DREVC

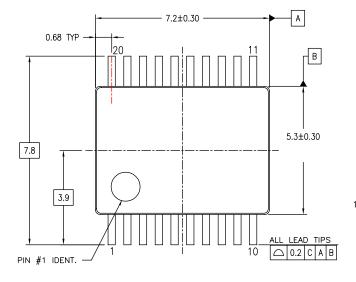
Figure 4. 20-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide

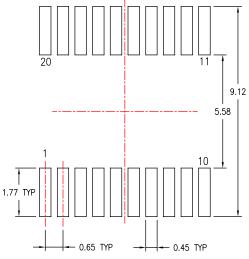
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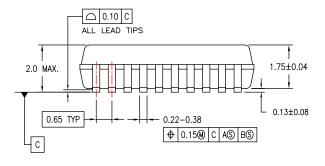
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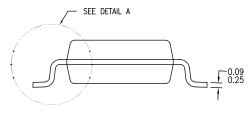
#### Physical Dimensions (Continued)





LAND PATTERN RECOMMENDATIONS

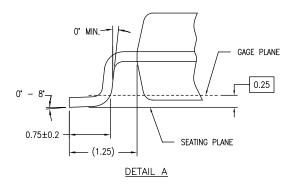




#### DIMENSIONS ARE IN MILLIMETERS

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- D. DIMENSIONS AND TOLERANCES PER ASME Y14.5M 1994.



#### MSA20REVB

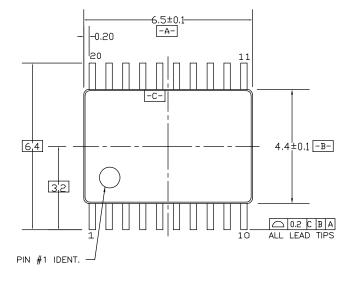
Figure 5. 20-Lead Shrink Small Outline Package (SSOP), JEDEC MO-150, 5.3mm Wide

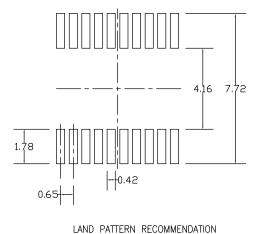
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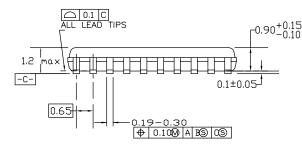
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#### Physical Dimensions (Continued)









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- D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

# 0.09-0.20J R0.09min GAGE PLANE 0 - 8°7 -0.6±0.1 R0.09min

SEE DETAIL A

DETAIL A

#### MTC20REVD1

#### Figure 6. 20-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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