

# 74LCXH162244

## Low Voltage 16-Bit Buffer/Line Driver with Bushold and 26Ω Series Resistors in Outputs

### General Description

The LCXH162244 contains sixteen non-inverting buffers with 3-STATE outputs designed to be employed as a memory and address driver, clock driver, or bus oriented transmitter/receiver. The device is nibble controlled. Each nibble has separate 3-STATE control inputs which can be shorted together for full 16-bit operation.

The LCXH162244 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.

In addition, the outputs include equivalent 26Ω (nominal) series resistors to reduce overshoot and undershoot and are designed to sink/source up to 12 mA at  $V_{CC} = 3.0V$ .

The LCXH162244 is designed for low voltage (2.5V or 3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment.

The LCXH162244 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

### Features

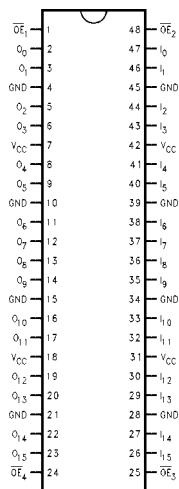
- 5V tolerant control inputs and outputs
- 2.3V–3.6V  $V_{CC}$  specifications provided
- Outputs include equivalent series resistance of 26Ω to make external termination resistors unnecessary and reduce overshoot and undershoot
- Bushold on data inputs eliminates the need for external pull-up/pull-down resistors
- 5.3 ns  $t_{PD}$  max ( $V_{CC} = 3.0V$ ), 20 μA  $I_{CC}$  max
- Power down high impedance inputs and outputs
- ±12 mA output drive ( $V_{CC} = 3.0V$ )
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds 500 mA
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V

### Ordering Code:

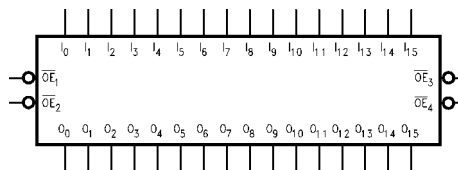
Order Number	Package Number	Package Description
74LCXH162244MEA	MS48A	48-Lead Small Shrink Outline Package (SSOP), JEDEC MO-118, 0.300 Wide
74LCXH162244MTD	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide

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

### Connection Diagram



### Logic Symbol



### Pin Descriptions

Pin Names	Description
$\overline{OE}_n$	Output Enable Input (Active LOW)
$I_0$ – $I_{15}$	Bushold Inputs
$O_0$ – $O_{15}$	Outputs

74LCXH162244 Low Voltage 16-Bit Buffer/Line Driver with Bushold and 26Ω Series Resistors in Outputs

## Truth Tables

Inputs		Outputs
$\overline{OE}_1$	I <sub>0</sub> -I <sub>3</sub>	O <sub>0</sub> -O <sub>3</sub>
L	L	L
L	H	H
H	X	Z

Inputs		Outputs
$\overline{OE}_3$	I <sub>8</sub> -I <sub>11</sub>	O <sub>8</sub> -O <sub>11</sub>
L	L	L
L	H	H
H	X	Z

Inputs		Outputs
$\overline{OE}_2$	I <sub>4</sub> -I <sub>7</sub>	O <sub>4</sub> -O <sub>7</sub>
L	L	L
L	H	H
H	X	Z

Inputs		Outputs
$\overline{OE}_4$	I <sub>12</sub> -I <sub>15</sub>	O <sub>12</sub> -O <sub>15</sub>
L	L	L
L	H	H
H	X	Z

H = HIGH Voltage Level  
L = LOW Voltage Level

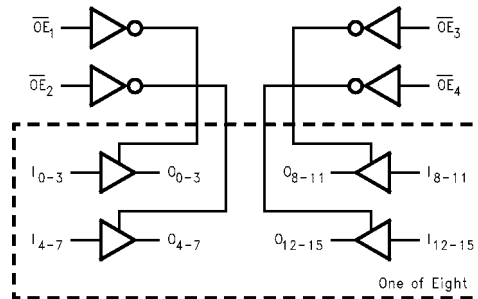
X = Immaterial  
Z = High Impedance

## Functional Description

The LCXH162244 contains sixteen non-inverting buffers with 3-STATE standard outputs. The LCXH162244 data inputs include active bushold circuitry eliminating the need for pull-up resistors to hold unused or floating data inputs at a valid logic level. The device is also designed with 26Ω series resistors in the outputs. This design reduces line noise in applications such as memory address drivers, clock drivers and bus transceiver/transmitters. The device is nibble (4 bits) controlled with each nibble functioning

identically, but independent of the other. The control pins can be shorted together to obtain full 16-bit operation. The 3-STATE outputs are controlled by an Output Enable ( $\overline{OE}_n$ ) input for each nibble. When  $\overline{OE}_n$  is LOW, the outputs are in 2-state mode. When  $\overline{OE}_n$  is HIGH, the outputs are in the high impedance mode, but this does not interfere with entering new data into the inputs.

## Logic Diagram



Absolute Maximum Ratings <sup>(Note 1)</sup>						
Symbol	Parameter	Value	Conditions	Units		
V <sub>CC</sub>	Supply Voltage	-0.5 to +7.0		V		
V <sub>I</sub>	DC Input Voltage	$\overline{OE}$	-0.5 to +7.0	V		
		I <sub>0</sub> - I <sub>15</sub>	-0.5 to V <sub>CC</sub> + 0.5			
V <sub>O</sub>	DC Output Voltage	-0.5 to +7.0	Output in 3-STATE	V		
		-0.5 to V <sub>CC</sub> + 0.5	Output in HIGH or LOW State (Note 2)			
I <sub>IK</sub>	DC Input Diode Current	-50	V <sub>I</sub> < GND	mA		
I <sub>OK</sub>	DC Output Diode Current	-50	V <sub>O</sub> < GND	mA		
		+50	V <sub>O</sub> > V <sub>CC</sub>			
I <sub>O</sub>	DC Output Source/Sink Current	±50		mA		
I <sub>CC</sub>	DC Supply Current per Supply Pin	±100		mA		
I <sub>GND</sub>	DC Ground Current per Ground Pin	±100		mA		
T <sub>STG</sub>	Storage Temperature	-65 to +150		°C		
Recommended Operating Conditions <sup>(Note 3)</sup>						
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	V <sub>CC</sub>	V		
V <sub>O</sub>	Output Voltage	HIGH or LOW State	0	V <sub>CC</sub>	V	
		3-STATE	0	5.5		
I <sub>OH</sub> /I <sub>OL</sub>	Output Current	V <sub>CC</sub> = 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		
<p><b>Note 1:</b> 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><b>Note 2:</b> I<sub>O</sub> Absolute Maximum Rating must be observed.</p> <p><b>Note 3:</b> Unused control inputs must be held HIGH or LOW. They may not float.</p>						
DC Electrical Characteristics						
Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C		Units
				Min	Max	
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	I <sub>OH</sub> = -100 μA	2.3 - 3.6	V <sub>CC</sub> - 0.2		V
		I <sub>OH</sub> = -4 mA	2.3	1.8		
		I <sub>OH</sub> = -4 mA	2.7	2.2		
		I <sub>OH</sub> = -6 mA	3.0	2.4		
		I <sub>OH</sub> = -8 mA	2.7	2.0		
		I <sub>OH</sub> = -12 mA	3.0	2.0		
V <sub>OL</sub>	LOW Level Output Voltage	I <sub>OL</sub> = 100 μA	2.3 - 3.6		0.2	V
		I <sub>OL</sub> = 4 mA	2.3		0.6	
		I <sub>OL</sub> = 4 mA	2.7		0.4	
		I <sub>OL</sub> = 6 mA	3.0		0.55	
		I <sub>OL</sub> = 8 mA	2.7		0.6	
		I <sub>OL</sub> = 12 mA	3.0		0.8	

## DC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C		Units
				Min	Max	
I <sub>I</sub>	Input Leakage Current	Data	V <sub>I</sub> = V <sub>CC</sub> or GND	2.3 – 3.6		μA
		Control	0 ≤ V <sub>I</sub> ≤ 5.5	2.3 – 3.6		
I <sub>I(HOLD)</sub>	Bushold Input Minimum Drive Hold Current	V <sub>IN</sub> = 0.7V	2.3	45		μA
		V <sub>IN</sub> = 1.7V		-45		
		V <sub>IN</sub> = 0.8V	3.0	75		
		V <sub>IN</sub> = 2.0V		-75		
I <sub>I(OD)</sub>	Bushold Input Over-Drive Current to Change State	(Note 4)	2.7	300		μA
		(Note 5)		-300		
		(Note 4)	3.6	450		
		(Note 5)		-450		
I <sub>OZ</sub>	3-STATE Output Leakage	0 ≤ V <sub>O</sub> ≤ 5.5V V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	2.3 – 3.6		±5.0	μA
I <sub>OFF</sub>	Power-Off Leakage Current	V <sub>O</sub> = 5.5V	0		10	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CC</sub> or GND	2.3 – 3.6		20	μA
ΔI <sub>CC</sub>	Increase in I <sub>CC</sub> per Input	V <sub>IH</sub> = V <sub>CC</sub> - 0.6V	2.3 – 3.6		500	μA

**Note 4:** An external driver must source at least the specified current to switch from LOW-to-HIGH.

**Note 5:** An external driver must sink at least the specified current to switch from HIGH-to-LOW.

## AC Electrical Characteristics

Symbol	Parameter	T <sub>A</sub> = -40°C to +85°C, R <sub>L</sub> = 500 Ω						Units
		V <sub>CC</sub> = 3.3V ± 0.3V		V <sub>CC</sub> = 2.7V		V <sub>CC</sub> = 2.5V ± 0.2V		
		C <sub>L</sub> = 50 pF		C <sub>L</sub> = 50 pF		C <sub>L</sub> = 30 pF		
		Min	Max	Min	Max	Min	Max	
t <sub>PHL</sub>	Propagation Delay	1.0	5.3	1.0	6.0	1.0	6.4	ns
t <sub>PLH</sub>	Data to Output	1.0	5.3	1.0	6.0	1.0	6.4	
t <sub>PZL</sub>	Output Enable Time	1.0	6.3	1.0	7.1	1.0	8.2	ns
t <sub>PZH</sub>	Output Disable Time	1.0	6.3	1.0	7.1	1.0	8.2	
t <sub>PLZ</sub>	Output Disable Time	1.0	5.4	1.0	5.7	1.0	6.5	ns
t <sub>PHZ</sub>	Output Enable Time	1.0	5.4	1.0	5.7	1.0	6.5	
t <sub>OSSL</sub>	Output to Output Skew (Note 6)		1.0					ns
t <sub>OSLH</sub>	Output to Output Skew (Note 6)		1.0					

**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>OSSL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>). Parameter guaranteed by design.

## Dynamic Switching Characteristics

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C	Units
				Typical	
V <sub>OLP</sub>	Quiet Output Dynamic Peak V <sub>OL</sub>	C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3V, V <sub>IL</sub> = 0V	3.3	0.35	V
		C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5V, V <sub>IL</sub> = 0V	2.5	0.25	
V <sub>OLV</sub>	Quiet Output Dynamic Valley V <sub>OL</sub>	C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3V, V <sub>IL</sub> = 0V	3.3	-0.35	V
		C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5V, V <sub>IL</sub> = 0V	2.5	-0.25	

## Capacitance

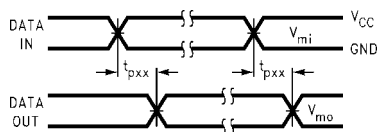
Symbol	Parameter	Conditions	Typical	Units
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = Open, V <sub>I</sub> = 0V or V <sub>CC</sub>	7	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub>	8	pF
C <sub>PD</sub>	Power Dissipation Capacitance	V <sub>CC</sub> = 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub> , f = 10 MHz	20	pF

**AC LOADING and WAVEFORMS** Generic for LCX Family

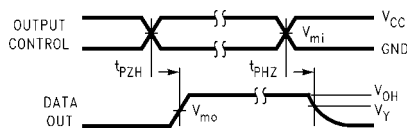


**FIGURE 1. AC Test Circuit ( $C_L$  includes probe and jig capacitance)**

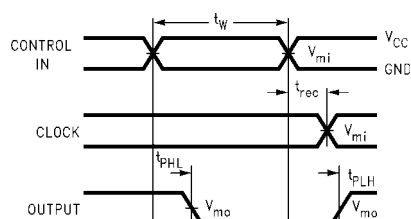
$V_I$	$C_L$
6V for $V_{CC} = 3.3V, 2.7V$	50 pF
$V_{CC} * 2$ for $V_{CC} = 2.5V$	30 pF



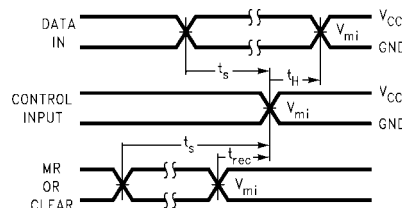
**Waveform for Inverting and Non-Inverting Functions**



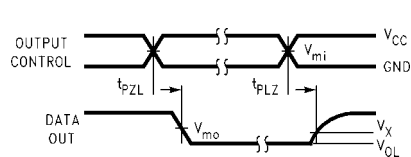
**3-STATE Output High Enable and Disable Times for Logic**



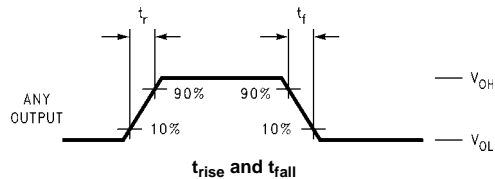
**Propagation Delay, Pulse Width and  $t_{rec}$  Waveforms**



**Setup Time, Hold Time and Recovery Time for Logic**



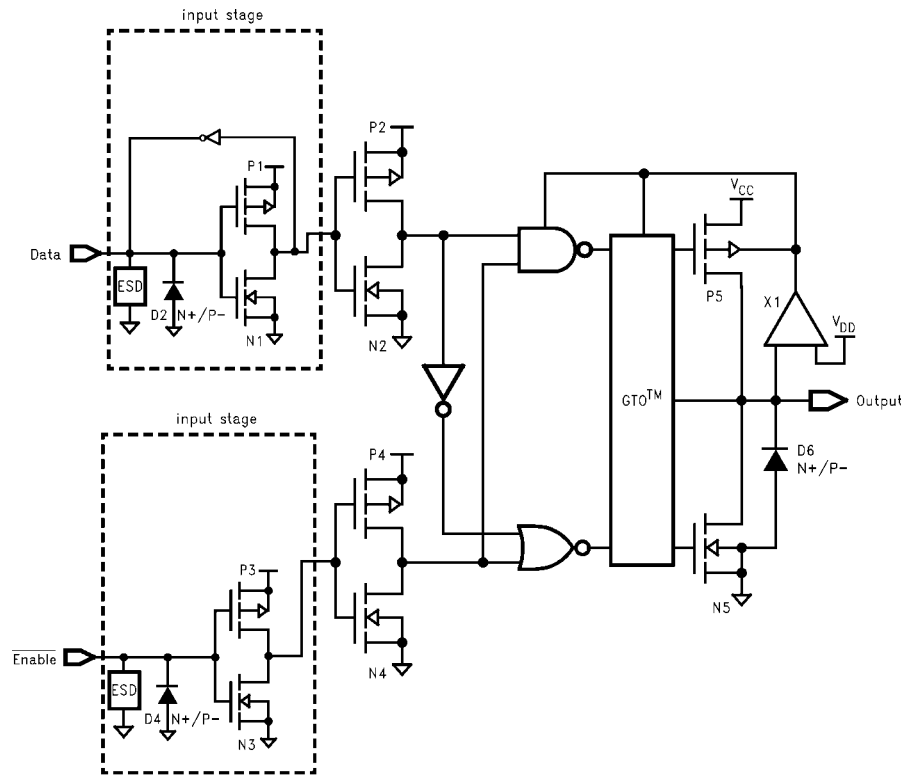
**3-STATE Output Low Enable and Disable Times for Logic**



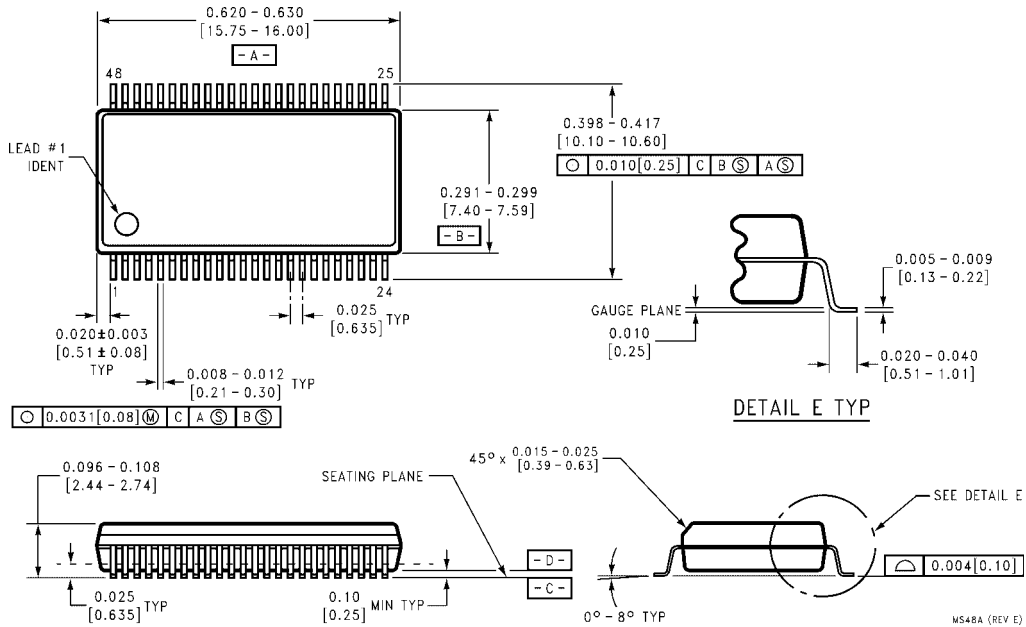
**FIGURE 2. Waveforms (Input Characteristics;  $f = 1MHz, t_R = t_F = 3ns$ )**

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	$V_{CC}/2$
$V_X$	$V_{OL} + 0.3V$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$
$V_Y$	$V_{OH} - 0.3V$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$

**Schematic Diagram** Generic for LCXH Family



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



**48-Lead Small Shrink Outline Package (SSOP), JEDEC MO-118, 0.300 Wide Package Number MS48A**

MS48A (REV E)

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

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**

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