

April 1999

## 54LCX16244

### Low Voltage 16-Bit Buffer/Line Driver with 5V Tolerant Inputs and Outputs

#### General Description

The LCX16244 contains sixteen non-inverting buffers with TRI-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 TRI-STATE control inputs which can be shorted together for full 16-bit operation.

The LCX16244 is designed for low voltage (3.3V)  $V_{CC}$  applications with capability of interfacing to a 5V signal environment.

The LCX16244 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

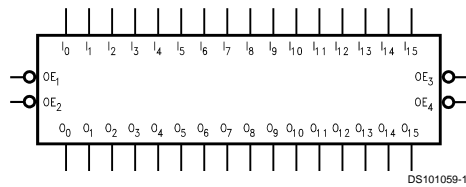
#### Features

- 5V tolerant inputs and outputs
- 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 54 series 16244
- ESD performance:
  - Human body model > 2000V
  - Machine model > 200V
- Standard Microcircuit Drawing (SMD) 5962-9950501

#### Ordering Code

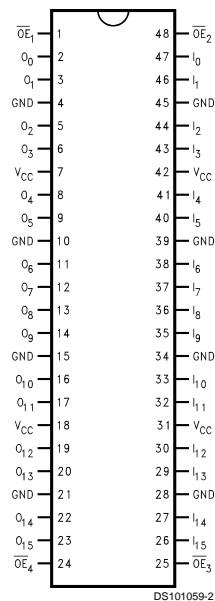
Order Number	Package Number	Package Description
54LCX16244W-QML	WA48A	48-Lead Cerpack Package

#### Logic Symbol



#### Connection Diagram

Pin Assignment for Cerpack



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

## Pin Descriptions

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

## Functional Description

The LCX16244 contains sixteen non-inverting buffers with TRI-STATE standard outputs. 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 TRI-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 bi-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.

## Truth Tables

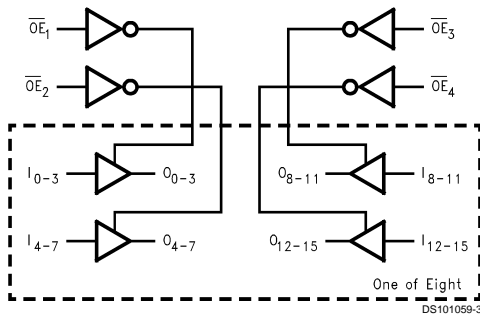
Inputs		Outputs	Inputs		Outputs
$\overline{OE}_1$	$I_0-I_3$	$O_0-O_3$	$\overline{OE}_2$	$I_4-I_7$	$O_4-O_7$
L	L	L	L	L	L
L	H	H	L	H	H
H	X	Z	H	X	Z

Inputs		Outputs	Inputs		Outputs
$\overline{OE}_3$	$I_8-I_{11}$	$O_8-O_{11}$	$\overline{OE}_4$	$I_{12}-I_{15}$	$O_{12}-O_{15}$
L	L	L	L	L	L
L	H	H	L	H	H
H	X	Z	H	X	Z

H = High Voltage Level  
 L = Low Voltage Level  
 X = Immaterial  
 Z = High Impedance

## Logic Diagram



## Absolute Maximum Ratings (Note 1)

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 ( $V_O$ ) (Note 2)	
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	$\pm 400\text{mA}$
Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C
Power Dissipation	750mW
Junction Temperature ( $T_J$ )	175°C

## Recommended Operating Conditions (Note 2)

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 ( $T_A$ )	-55°C to +125°C
Minimum Input Edge Rate ( $\Delta t/\Delta V$ )	
$V_{IN}$ from 0.8V to 2.0V, $V_{CC} = 3.0V$	0ns/V to 10ns/V

**Note 1:** 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 2:**  $I_O$  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
$V_{IC}$	Negative Input Clamp Voltage	$I_{IN} = -18\text{mA}$	3.0		-1.2	V
$I_I$	Input Leakage Current	$0 \leq V_I \leq 5.5V$	2.7-3.6		$\pm 5.0$	$\mu\text{A}$
$I_{OZ}$	3-STATE Output Leakage	$0 \leq V_O \leq 5.5V$ $V_I = V_{IH}$ or $V_{IL}$	2.7-3.6		$\pm 5.0$	$\mu\text{A}$
$I_{OFF}$	Power-Off Leakage Current	$V_I$ or $V_O = 5.5V$	0		10	$\mu\text{A}$
$I_{CC}$	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.7-3.6		20	$\mu\text{A}$
		$3.6V \leq V_I, V_O \leq 5.5V$	2.7-3.6		$\pm 20$	$\mu\text{A}$
$\Delta I_{CC}$	Increase in $I_{CC}$ per Input	$V_{IH} = V_{CC} - 0.6V$	2.7-3.6		500	$\mu\text{A}$

## 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	0.5	5.5	1.0	6.0	ns
$t_{PLH}$	Data to Output	0.5	5.5	1.0	6.0	ns
$t_{PZL}$	Output Enable Time	0.5	6.5	1.0	7.0	ns
$t_{PZH}$	Output Disable Time	0.5	6.5	1.0	7.0	ns
$t_{PLZ}$	Output Disable Time	1.0	6.0	1.0	6.0	ns
$t_{PHZ}$	Output Disable Time	1.0	6.0	1.0	6.0	ns
$t_{OSHL}$	Output to Output Skew (Note 3)		1.0		1.0	ns
$t_{OSLH}$						

**Note 3:** 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.

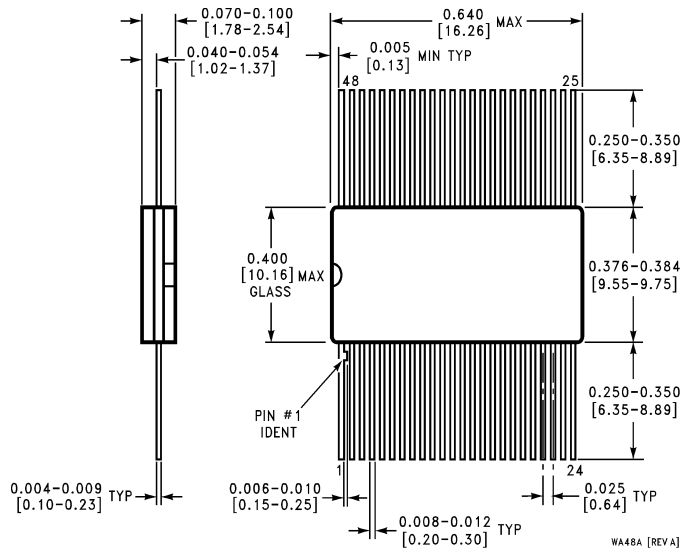
## Dynamic Switching Characteristics

Symbol	Parameter	Conditions	$V_{CC}$ (V)	$T_A = 25^\circ\text{C}$	Units
				Max	
$V_{OLP}$	Quiet Output Dynamic Peak $V_{OL}$	$C_L = 50\ \text{pF}, V_{IH} = 3.3\text{V}, V_{IL} = 0\text{V}$	3.3	1.2	V
$V_{OLV}$	Quiet Output Dynamic Valley $V_{OL}$	$C_L = 50\ \text{pF}, V_{IH} = 3.3\text{V}, V_{IL} = 0\text{V}$	3.3	-1.1	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
$C_{OUT}$	Output Capacitance	$V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}$	12	pF
$C_{PD}$	Power Dissipation Capacitance	$V_{CC} = 3.3\text{V}, V_I = 0\text{V or } V_{CC}, f = 10\ \text{MHz}$	40	pF

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



**48-Lead Cerpack  
Package Number WA48A**

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