

## 74VCX16240

# Low Voltage 16-Bit Inverting Buffer/Line Driver with 3.6V Tolerant Inputs and Outputs

### General Description

The VCX16240 contains sixteen inverting buffers with 3-STATE outputs to be employed as a memory and address driver, clock driver, or bus oriented transmitter/receiver. The device is nibble (4-bit) controlled. Each nibble has separate 3-STATE control inputs which can be shorted together for full 16-bit operation.

The 74VCX16240 is designed for low voltage (1.4V to 3.6V)  $V_{CC}$  applications with I/O capability up to 3.6V.

The 74VCX16240 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

### Features

- 1.4V to 3.6V  $V_{CC}$  supply operation
- 3.6V tolerant inputs and outputs
- $t_{PD}$   
2.5 ns max for 3.0V to 3.6V  $V_{CC}$
- Power-off high impedance inputs and outputs
- Supports live insertion and withdrawal (Note 1)
- Static Drive ( $I_{OH}/I_{OL}$ )  
±24 mA @ 3.0V  $V_{CC}$
- Uses patented noise/EMI reduction circuitry
- Latch-up performance exceeds 300 mA
- ESD performance:  
Human body model > 2000V  
Machine model > 200V

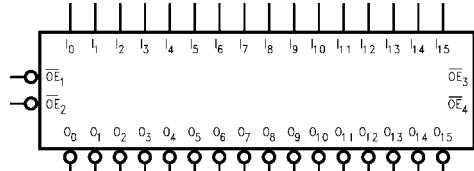
**Note 1:** To ensure the high-impedance state during power up or power down, OE should be tied to  $V_{CC}$  through a pull-up resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

### Ordering Code:

Order Number	Package Number	Package Descriptions
74VCX16240MTD	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.

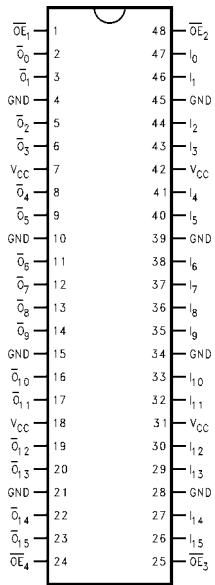
### Logic Symbol



### Pin Descriptions

Pin Names	Description
$\overline{OE}_n$	Output Enable Input (Active LOW)
$I_0-I_{15}$	Inputs
$\overline{O}_0-\overline{O}_{15}$	Outputs

### Connection Diagram



### Truth Tables

Inputs		Outputs
$\overline{OE}_1$	$I_0-I_3$	$\overline{O}_0-\overline{O}_3$
L	L	H
L	H	L
H	X	Z

Inputs		Outputs
$\overline{OE}_2$	$I_4-I_7$	$\overline{O}_4-\overline{O}_7$
L	L	H
L	H	L
H	X	Z

Inputs		Outputs
$\overline{OE}_3$	$I_8-I_{11}$	$\overline{O}_8-\overline{O}_{11}$
L	L	H
L	H	L
H	X	Z

Inputs		Outputs
$\overline{OE}_4$	$I_{12}-I_{15}$	$\overline{O}_{12}-\overline{O}_{15}$
L	L	H
L	H	L
H	X	Z

H = HIGH Voltage Level

L = LOW Voltage Level

X = Immaterial (HIGH or LOW, inputs may not float)

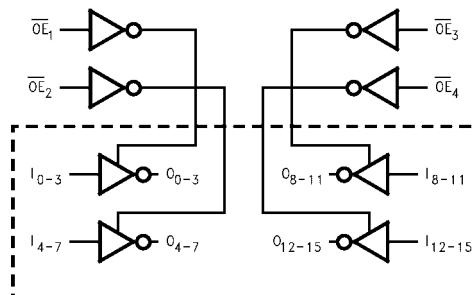
Z = High Impedance

### Functional Description

The 74VCX16240 contains sixteen inverting buffers with 3-STATE outputs. The device is nibble (4 bits) controlled with each nibble functioning identically, but independent of each other. The control pins may be shorted together to obtain full 16-bit operation. The 3-STATE outputs are con-

trolled by an Output Enable ( $\overline{OE}_n$ ) input. When  $\overline{OE}_n$  is LOW, the outputs are in the 2-state mode. When  $\overline{OE}_n$  is HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the inputs.

### Logic Diagram



Absolute Maximum Ratings (Note 2)		Recommended Operating Conditions (Note 4)	
Supply Voltage ( $V_{CC}$ )	-0.5V to +4.6V	Power Supply	
DC Input Voltage ( $V_I$ )	-0.5V to +4.6V	Operating Input Voltage	1.4V to 3.6V
Output Voltage ( $V_O$ )		Output Voltage ( $V_O$ )	-0.3V to +3.6V
Outputs 3-STATED	-0.5V to +4.6V	Output in Active States	0V to $V_{CC}$
Outputs Active (Note 3)	-0.5V to $V_{CC}$ +0.5V	Output in 3-State	0.0V to 3.6V
DC Input Diode Current ( $I_{IK}$ ) $V_I < 0V$	-50 mA	Output Current in $I_{OH}/I_{OL}$	
DC Output Diode Current ( $I_{OK}$ )		$V_{CC} = 3.0V$ to 3.6V	±24 mA
$V_O < 0V$	-50 mA	$V_{CC} = 2.3V$ to 2.7V	±18 mA
$V_O > V_{CC}$	+50 mA	$V_{CC} = 1.65V$ to 2.3V	±6 mA
DC Output Source/Sink Current ( $I_{OH}/I_{OL}$ )	±50 mA	$V_{CC} = 1.4V$ to 1.6V	±2 mA
DC $V_{CC}$ or GND Current per Supply Pin ( $I_{CC}$ or GND)	±100 mA	Free Air Operating Temperature ( $T_A$ )	-40°C to +85°C
Storage Temperature Range ( $T_{STG}$ )	-65°C to +150°C	Minimum Input Edge Rate ( $\Delta t/\Delta V$ )	
		$V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$	10 ns/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.			
Note 4: Floating or unused inputs must be held HIGH or LOW.			
DC Electrical Characteristics			
Symbol	Parameter	Conditions	$V_{CC}$ (V)
$V_{IH}$	HIGH Level Input Voltage	$I_{OH} = -100 \mu A$	2.7 - 3.6
		$I_{OH} = -12 mA$	2.0
		$I_{OH} = -18 mA$	1.6
		$I_{OH} = -24 mA$	$0.65 \times V_{CC}$
$V_{IL}$	LOW Level Input Voltage	$I_{OL} = -100 \mu A$	2.7 - 3.6
		$I_{OL} = -6 mA$	2.3 - 2.7
		$I_{OL} = -12 mA$	1.65 - 2.3
		$I_{OL} = -18 mA$	1.4 - 1.6
$V_{OH}$	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$	2.7 - 3.6
		$I_{OH} = -12 mA$	$V_{CC} - 0.2$
		$I_{OH} = -18 mA$	2.2
		$I_{OH} = -24 mA$	3.0
		$I_{OH} = -100 \mu A$	3.0
		$I_{OH} = -6 mA$	2.2
		$I_{OH} = -12 mA$	$V_{CC} - 0.2$
		$I_{OH} = -18 mA$	2.3
$I_{OL}$	LOW Level Output Voltage	$I_{OL} = -100 \mu A$	2.3 - 2.7
		$I_{OL} = -6 mA$	2.0
		$I_{OL} = -12 mA$	1.8
		$I_{OL} = -18 mA$	1.7
$V_{OL}$	LOW Level Output Voltage	$I_{OL} = -100 \mu A$	1.65 - 2.3
		$I_{OL} = -6 mA$	$V_{CC} - 0.2$
		$I_{OL} = -12 mA$	1.65
		$I_{OL} = -18 mA$	1.25
$I_{OL}$	LOW Level Output Voltage	$I_{OL} = -100 \mu A$	1.4 - 1.6
		$I_{OL} = -6 mA$	$V_{CC} - 0.2$
		$I_{OL} = -12 mA$	1.4
		$I_{OL} = -18 mA$	1.05

## DC Electrical Characteristics (Continued)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	Min	Max	Units
V <sub>OL</sub>	LOW Level Output Voltage	I <sub>OL</sub> = 100 $\mu$ A	2.7–3.6		0.2	V
		I <sub>OL</sub> = 12 mA	2.7		0.4	
		I <sub>OL</sub> = 18 mA	3.0		0.4	
		I <sub>OL</sub> = 24 mA	3.0		0.55	
	I <sub>OL</sub> = 100 $\mu$ A	I <sub>OL</sub> = 100 $\mu$ A	2.3–2.7		0.2	
		I <sub>OL</sub> = 12 mA	2.3		0.4	
		I <sub>OL</sub> = 18 mA	2.3		0.6	
	I <sub>OL</sub> = 100 $\mu$ A	I <sub>OL</sub> = 100 $\mu$ A	1.65–2.3		0.2	
		I <sub>OL</sub> = 6 mA	1.65		0.3	
	I <sub>OL</sub> = 100 $\mu$ A	I <sub>OL</sub> = 100 $\mu$ A	1.4 - 1.6		0.2	
		I <sub>OL</sub> = 2 mA	1.4		0.35	
I <sub>I</sub>	Input Leakage Current	0 $\leq$ V <sub>I</sub> $\leq$ 3.6V	1.4–3.6		$\pm$ 5.0	$\mu$ A
I <sub>OZ</sub>	3-STATE Output Leakage	0 $\leq$ V <sub>O</sub> $\leq$ 3.6V V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	1.4–3.6		$\pm$ 10	$\mu$ A
I <sub>OFF</sub>	Power-OFF Leakage Current	0 $\leq$ (V <sub>I</sub> , V <sub>O</sub> ) $\leq$ 3.6V	0		10	$\mu$ A
I <sub>CC</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CC</sub> or GND V <sub>CC</sub> $\leq$ (V <sub>I</sub> , V <sub>O</sub> ) $\leq$ 3.6V (Note 5)	1.4–3.6 1.4–3.6		20 $\pm$ 20	$\mu$ A
$\Delta$ I <sub>CC</sub>	Increase in I <sub>CC</sub> per Input	V <sub>IH</sub> = V <sub>CC</sub> – 0.6V	2.7–3.6		750	$\mu$ A

Note 5: Outputs disabled or 3-STATE only.

### AC Electrical Characteristics (Note 6)

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = -40°C to +85°C		Units	Figure Number
				Min	Max		
t <sub>PHL</sub> t <sub>PLH</sub>	Propagation Delay	C <sub>L</sub> = 30 pF, R <sub>L</sub> = 500Ω	3.3 ± 0.3	0.8	2.5	ns	Figures 1, 2
			2.5 ± 0.2	1.0	3.0		
			1.8 ± 0.15	1.5	6.0		
	Output Enable Time	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 2kΩ	1.5 ± 0.1	1.0	12.0	ns	Figures 5, 6
			3.3 ± 0.3	0.8	3.5		Figures 1, 3, 4
			2.5 ± 0.2	1.0	4.1		
t <sub>PZL</sub> t <sub>PZH</sub>	Output Disable Time	C <sub>L</sub> = 30 pF, R <sub>L</sub> = 500Ω	1.8 ± 0.15	1.5	8.2	ns	Figures 5, 7, 8
			1.5 ± 0.1	1.0	16.4		
			3.3 ± 0.3	0.8	3.5		Figures 1, 3, 4
	Output to Output Skew (Note 7)	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 2kΩ	2.5 ± 0.2	1.0	3.8	ns	
			1.8 ± 0.15	1.5	6.8		Figures 5, 7, 8
			1.5 ± 0.1	1.0	13.6		
t <sub>OSHL</sub> t <sub>OSLH</sub>	t <sub>OSHL</sub> t <sub>OSLH</sub>	C <sub>L</sub> = 30 pF, R <sub>L</sub> = 500Ω	3.3 ± 0.3		0.5	ns	
			2.5 ± 0.2		0.5		
			1.8 ± 0.15		0.75		
		C <sub>L</sub> = 15 pF, R <sub>L</sub> = 2kΩ	1.5 ± 0.1		1.5		

**Note 6:** For C<sub>L</sub> = 50 pF, add approximately 300 ps to the AC maximum specification.

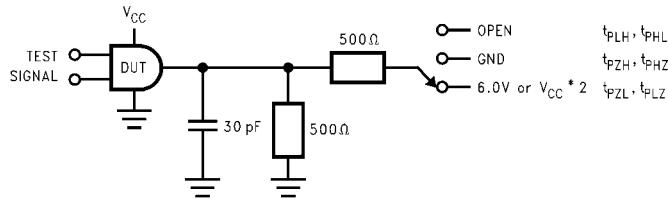
**Note 7:** Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>).

### Dynamic Switching Characteristics

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> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0V	1.8	0.25	V	
			2.5	0.6		
			3.3	0.8		
V <sub>OLV</sub>	Quiet Output Dynamic Valley V <sub>OL</sub>	C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0V	1.8	-0.25	V	
			2.5	-0.6		
			3.3	-0.8		
V <sub>OHV</sub>	Quiet Output Dynamic Valley V <sub>OH</sub>	C <sub>L</sub> = 30 pF, V <sub>IH</sub> = V <sub>CC</sub> , V <sub>IL</sub> = 0V	1.8	1.5	V	
			2.5	1.9		
			3.3	2.2		

### Capacitance

Symbol	Parameter	Conditions	T <sub>A</sub> = +25°C		Units
			Typical		
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = 1.8, 2.5V or 3.3V, V <sub>I</sub> = 0V or V <sub>CC</sub>	6		pF
C <sub>OUT</sub>	Output Capacitance	V <sub>I</sub> = 0V or V <sub>CC</sub> , V <sub>CC</sub> = 1.8V, 2.5V or 3.3V	7		pF
C <sub>PD</sub>	Power Dissipation Capacitance	V <sub>I</sub> = 0V or V <sub>CC</sub> , f = 10 MHz, V <sub>CC</sub> = 1.8V, 2.5V or 3.3V	20		pF

AC Loading and Waveforms ( $V_{CC} 3.3V \pm 0.3V$  to  $1.8V \pm 0.15V$ )

TEST	SWITCH
$t_{PLH}, t_{PHL}$	Open
$t_{PZL}, t_{PLZ}$	6V at $V_{CC} = 3.3 \pm 0.3V$ ; $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V; 1.8V \pm 0.15V$
$t_{PZH}, t_{PHZ}$	GND

FIGURE 1. AC Test Circuit

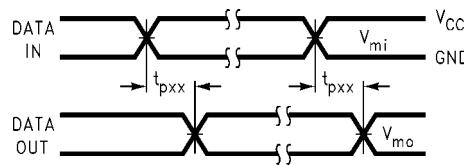


FIGURE 2. Waveform for Inverting and Non-Inverting Functions

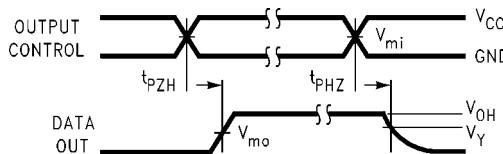


FIGURE 3. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

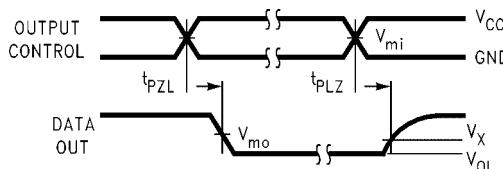
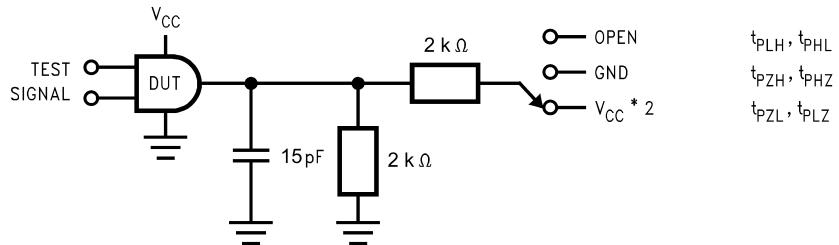


FIGURE 4. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

Symbol	$V_{CC}$		
	$3.3V \pm 0.3V$	$2.5V \pm 0.2V$	$1.8V \pm 0.15V$
$V_{mi}$	1.5V	$V_{CC}/2$	$V_{CC}/2$
$V_{mo}$	1.5V	$V_{CC}/2$	$V_{CC}/2$
$V_X$	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$	$V_{OL} + 0.15V$
$V_Y$	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$	$V_{OH} - 0.15V$

### AC Loading and Waveforms ( $V_{CC} 1.5V \pm 0.1V$ )



TEST	SWITCH
$t_{PLH}, t_{PHL}$	Open
$t_{PZL}, t_{PLZ}$	$V_{CC} \times 2$ at $V_{CC} = 1.5 \pm 0.1V$
$t_{PZH}, t_{PHZ}$	GND

FIGURE 5. AC Test Circuit

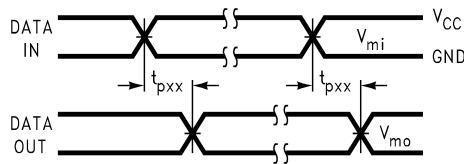


FIGURE 6. Waveform for Inverting and Non-Inverting Functions

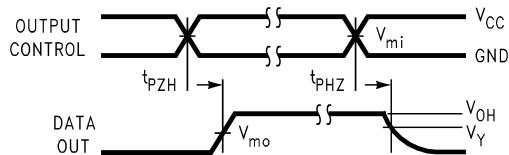


FIGURE 7. 3-STATE Output High Enable and Disable Times for Low Voltage Logic

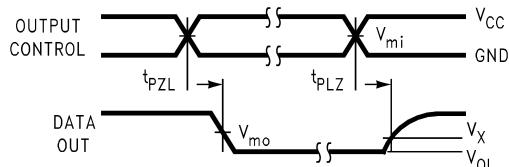
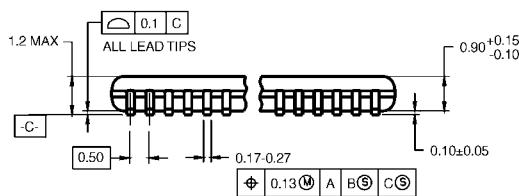
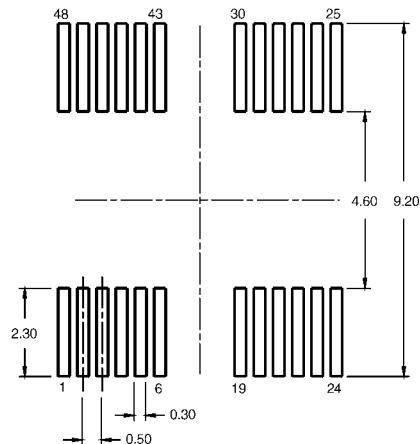
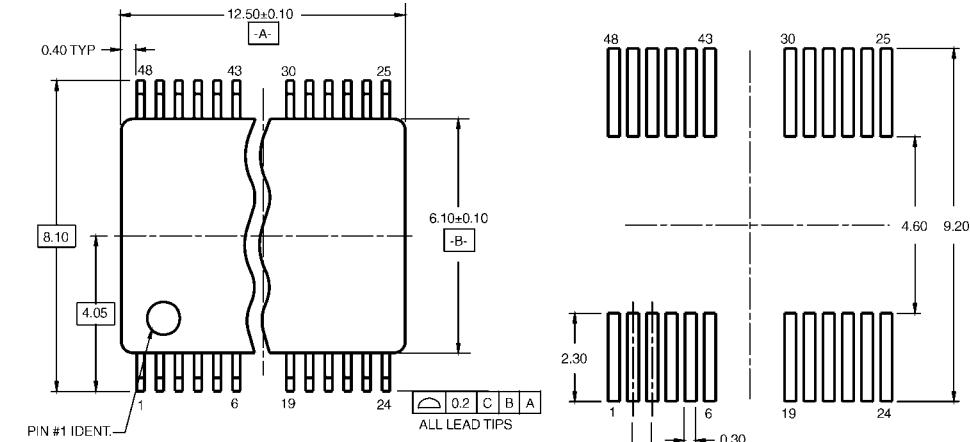


FIGURE 8. 3-STATE Output Low Enable and Disable Times for Low Voltage Logic

Symbol	$V_{CC}$
	$1.5V \pm 0.1V$
$V_{mi}$	$V_{CC}/2$
$V_{mo}$	$V_{CC}/2$
$V_X$	$V_{OL} + 0.1V$
$V_Y$	$V_{OH} - 0.1V$

## 74VCX16240 Low Voltage 16-Bit Inverting Buffer/Line Driver with 3.6V Tolerant Inputs and Outputs

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

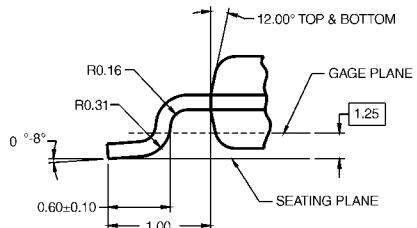


DIMENSIONS ARE IN MILLIMETERS

#### 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



DETAIL A

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

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