

# SN54LVT240, SN74LVT240 3.3-V ABT OCTAL BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS134F – SEPTEMBER 1992 – REVISED JULY 1995

- State-of-the-Art Advanced BICMOS Technology (ABT) Design for 3.3-V Operation and Low-Static Power Dissipation
- Support Mixed-Mode Signal Operation (5-V Input and Output Voltages With 3.3-V  $V_{CC}$ )
- Support Unregulated Battery Operation Down to 2.7 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $< 0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$
- ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model ( $C = 200$  pF,  $R = 0$ )
- Latch-Up Performance Exceeds 500 mA Per JEDEC Standard JESD-17
- Bus-Hold Data Inputs Eliminate the Need for External Pullup Resistors
- Support Live Insertion
- Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, Ceramic Chip Carriers (FK), and Ceramic (J) DIPs

## description

These octal buffers and line drivers are designed specifically for low-voltage (3.3-V)  $V_{CC}$  operation, but with the capability to provide a TTL interface to a 5-V system environment.

These devices are organized as two 4-bit buffer/line drivers with separate output-enable ( $\overline{OE}$ ) inputs. When  $\overline{OE}$  is low, the devices pass data from the A inputs to the Y outputs. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

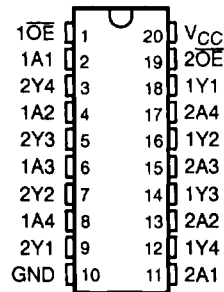
Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

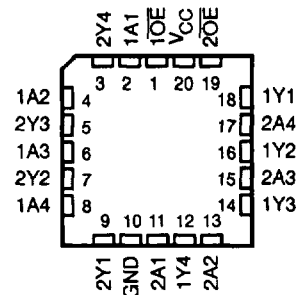
The SN74LVT240 is available in TI's shrink small-outline package (DB), which provides the same I/O pin count and functionality of standard small-outline packages in less than half the printed-circuit-board area.

The SN54LVT240 is characterized for operation over the full military temperature range of  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ . The SN74LVT240 is characterized for operation from  $-40^\circ\text{C}$  to  $85^\circ\text{C}$ .

SN54LVT240 . . . J PACKAGE  
SN74LVT240 . . . DB, DW, OR PW PACKAGE  
(TOP VIEW)



SN54LVT240 . . . FK PACKAGE  
(TOP VIEW)



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 **TEXAS  
INSTRUMENTS**

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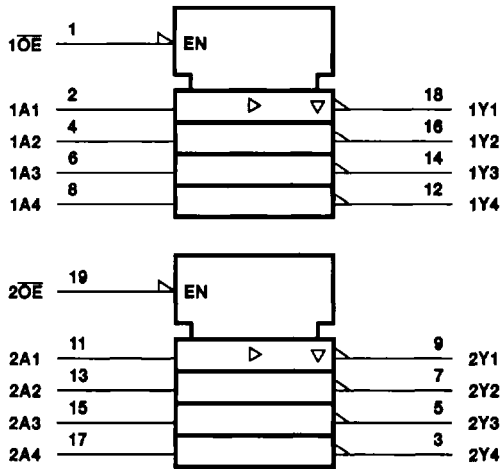
**SN54LVT240, SN74LVT240**  
**3.3-V ABT OCTAL BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

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**FUNCTION TABLE**  
 (each buffer)

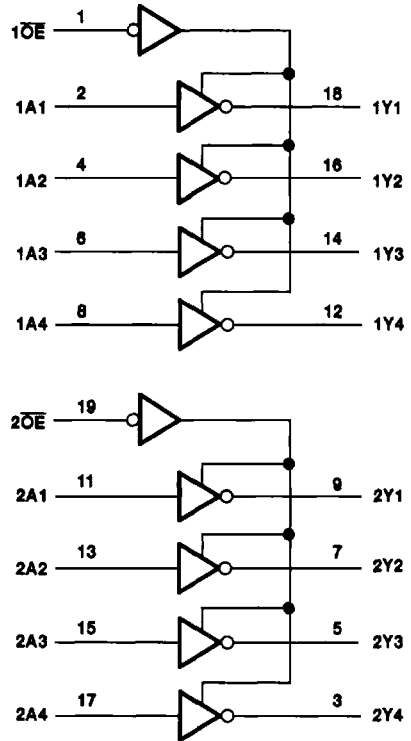
INPUTS		OUTPUT
$\overline{OE}$	A	Y
L	H	L
L	L	H
H	X	Z

**logic symbol†**



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

**logic diagram (positive logic)**



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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, $V_{CC}$ .....	-0.5 V to 4.6 V
Input voltage range, $V_I$ (see Note 1) .....	-0.5 V to 7 V
Voltage range applied to any output in the high state or power-off state, $V_O$ (see Note 1) .....	-0.5 V to 7 V
Current into any output in the low state, $I_O$ : SN54LVT240 .....	96 mA
SN74LVT240 .....	128 mA
Current into any output in the high state, $I_O$ (see Note 2): SN54LVT240 .....	48 mA
SN74LVT240 .....	64 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	-50 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	-50 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): DB package .....	0.6 W
DW package .....	1.6 W
PW package .....	0.7 W
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.  
 2. This current flows only when the output is in the high state and  $V_O > V_{CC}$ .  
 3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

## recommended operating conditions (see Note 4)

		SN54LVT240		SN74LVT240		UNIT
		MIN	MAX	MIN	MAX	
$V_{CC}$	Supply voltage	2.7	3.6	2.7	3.6	V
$V_{IH}$	High-level input voltage	2		2		V
$V_{IL}$	Low-level input voltage				0.8	V
$V_I$	Input voltage		5.5		5.5	V
$I_{OH}$	High-level output current		-24		-32	mA
$I_{OL}$	Low-level output current		48		64	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	Outputs enabled			10	ns/V
$T_A$	Operating free-air temperature	-55	125	-40	85	°C

NOTE 4: Unused control inputs must be held high or low to prevent them from floating.

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**SN54LVT240, SN74LVT240**  
**3.3-V ABT OCTAL BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		SN54LVT240		SN74LVT240		UNIT	
			MIN	TYP†	MAX	MIN		TYP†
$V_{IK}$	$V_{CC} = 2.7\text{ V}$ , $I_I = -18\text{ mA}$				-1.2		V	
$V_{OH}$	$V_{CC} = \text{MIN to MAX}^\ddagger$ , $I_{OH} = -100\ \mu\text{A}$		$V_{CC} - 0.2$		$V_{CC} - 0.2$		V	
	$V_{CC} = 2.7\text{ V}$ , $I_{OH} = -8\text{ mA}$		2.4		2.4			
	$V_{CC} = 3\text{ V}$		2		2			
$V_{OL}$	$V_{CC} = 2.7\text{ V}$	$I_{OL} = 100\ \mu\text{A}$			0.2		V	
		$I_{OL} = 24\text{ mA}$			0.5			
	$V_{CC} = 3\text{ V}$	$I_{OL} = 16\text{ mA}$			0.4			
		$I_{OL} = 32\text{ mA}$			0.5			
		$I_{OL} = 48\text{ mA}$			0.55			
		$I_{OL} = 64\text{ mA}$			0.55			
$I_I$	$V_{CC} = 0\text{ or MAX}^\ddagger$ , $V_I = 5.5\text{ V}$				10		$\mu\text{A}$	
	$V_{CC} = 3.6\text{ V}$	$V_I = V_{CC}\text{ or GND}$	Control inputs			$\pm 1$		
		$V_I = V_{CC}$	Data inputs			1		
$V_I = 0$					-5			
$I_{off}$	$V_{CC} = 0$ , $V_I\text{ or }V_O = 0\text{ to }4.5\text{ V}$						$\mu\text{A}$	
$I_I(\text{hold})$	$V_{CC} = 3\text{ V}$		$V_I = 0.8\text{ V}$	Data Inputs	75		$\mu\text{A}$	
			$V_I = 2\text{ V}$		-75			
$I_{OZH}$	$V_{CC} = 3.6\text{ V}$ , $V_O = 3\text{ V}$				5		$\mu\text{A}$	
$I_{OZL}$	$V_{CC} = 3.6\text{ V}$ , $V_O = 0.5\text{ V}$				-5		$\mu\text{A}$	
$I_{CC}$	$V_{CC} = 3.6\text{ V}$ , $V_I = V_{CC}\text{ or GND}$ , $I_O = 0$		Outputs high		0.12 0.19		mA	
			Outputs low		8.6 12			
			Outputs disabled		0.12 0.19			
$\Delta I_{CC}^\S$	$V_{CC} = 3\text{ V to }3.6\text{ V}$ , One input at $V_{CC} - 0.6\text{ V}$ , Other inputs at $V_{CC}\text{ or GND}$				0.2		mA	
$C_I$	$V_I = 3\text{ V or }0$				4		pF	
$C_O$	$V_O = 3\text{ V or }0$				8		pF	

† All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

‡ For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

§ This is the increase in supply current for each input that is at the specified TTL voltage level rather than  $V_{CC}$  or GND.

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switching characteristics over recommended ranges of supply voltage and operating free-air temperature,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVT240				SN74LVT240				UNIT
			$V_{CC} = 3.3$ V $\pm 0.3$ V		$V_{CC} = 2.7$ V		$V_{CC} = 3.3$ V $\pm 0.3$ V			$V_{CC} = 2.7$ V	
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN	
$t_{PLH}$	A	Y	1	4.2		5.2	1	2.9	4.1	5.2	ns
$t_{PHL}$			1.3	3.7		4.1	1.3	2.5	3.5	4	
$t_{PZH}$	$\overline{OE}$	Y	1.2	4.7		5.7	1.2	3.2	4.6	5.6	ns
$t_{PZL}$			1.5	4.6		5.9	1.4	3.5	4.7	5.8	
$t_{PHZ}$	$\overline{OE}$	Y	2	3.3		5.7	2	3.6	5.2	5.5	ns
$t_{PLZ}$			1.9	4.6		4.6	1.9	3.2	4.4	4.4	

† All typical values are at  $V_{CC} = 3.3$  V,  $T_A = 25^\circ\text{C}$ .

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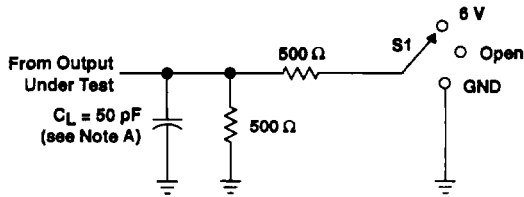


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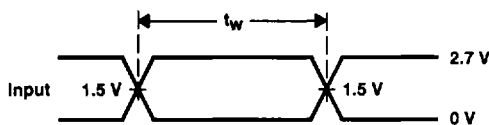
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**PARAMETER MEASUREMENT INFORMATION**

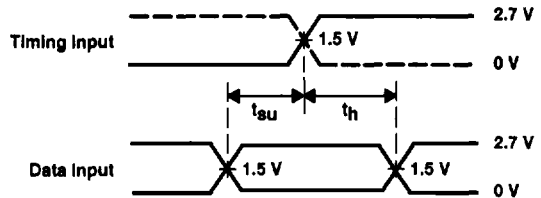


TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	6 V
$t_{PHZ}/t_{PZH}$	GND

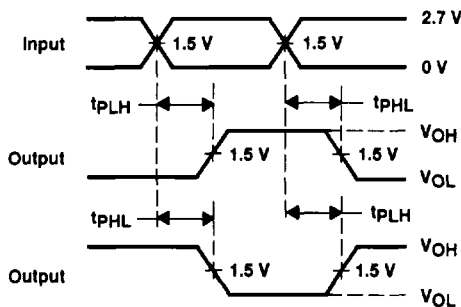
**LOAD CIRCUIT FOR OUTPUTS**



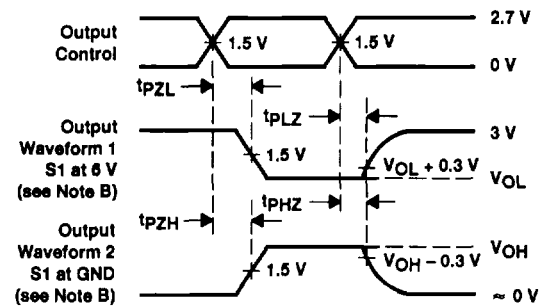
**VOLTAGE WAVEFORMS**  
**PULSE DURATION**



**VOLTAGE WAVEFORMS**  
**SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS**  
**PROPAGATION DELAY TIMES**  
**INVERTING AND NONINVERTING OUTPUTS**



**VOLTAGE WAVEFORMS**  
**ENABLE AND DISABLE TIMES**  
**LOW- AND HIGH-LEVEL ENABLING**

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.  
 C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq$  10 MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns.  
 D. The outputs are measured one at a time with one transition per measurement.

**Figure 1. Load Circuit and Voltage Waveforms**



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