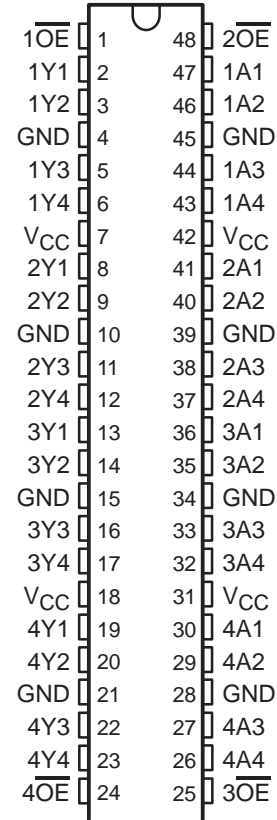


# SN54LVTH16240, SN74LVTH16240 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS684C – MARCH 1997 – REVISED APRIL 1999

- Members of the Texas Instruments *Widebus™* Family
- 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,  $T_A = 25^\circ\text{C}$
- $I_{off}$  and Power-Up 3-State Support Hot Insertion
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Distributed  $V_{CC}$  and GND Pin Configuration Minimizes High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Latch-Up Performance Exceeds 500 mA Per JESD 17
- ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ( $C = 200$  pF,  $R = 0$ )
- Package Options Include Plastic Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings

SN54LVTH16240 . . . WD PACKAGE  
SN74LVTH16240 . . . DGG OR DL PACKAGE  
(TOP VIEW)



## description

These 16-bit buffers/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.

The 'LVTH16240 devices are designed specifically to improve both the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters.

The devices can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. The devices provide inverting outputs and symmetrical active-low output-enable ( $\overline{OE}$ ) inputs.

When  $V_{CC}$  is between 0 and 1.5 V, the devices are in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V,  $\overline{OE}$  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.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

Widebus is a trademark of Texas Instruments Incorporated.

UNLESS OTHERWISE NOTED this document contains PRODUCTION DATA information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1999, Texas Instruments Incorporated

# SN54LVTH16240, SN74LVTH16240

## 3.3-V ABT 16-BIT BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

SCBS684C – MARCH 1997 – REVISED APRIL 1999

#### description (continued)

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

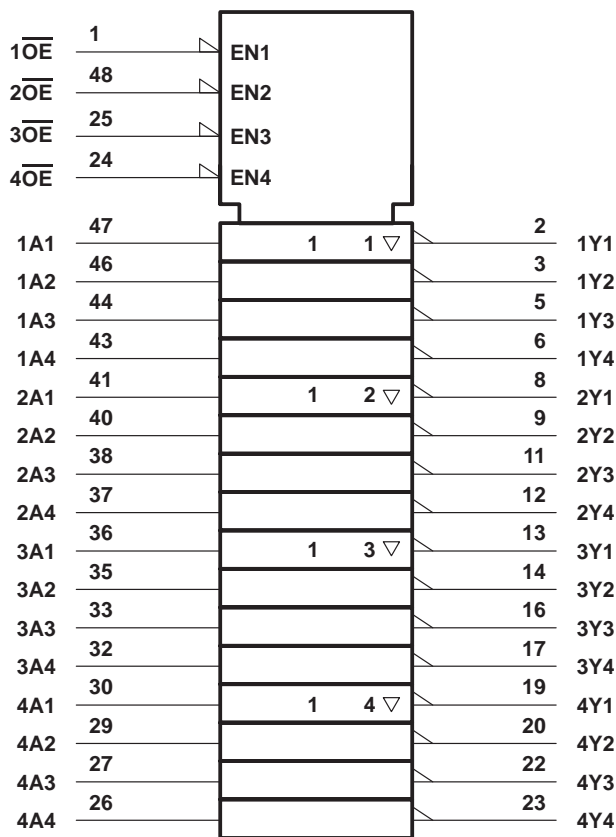
These devices are fully specified for hot-insertion applications using  $I_{off}$  and power-up 3-state. The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the devices when they are powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict.

The SN54LVTH16240 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74LVTH16240 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

**FUNCTION TABLE**  
(each 4-bit buffer)

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

#### logic symbol†

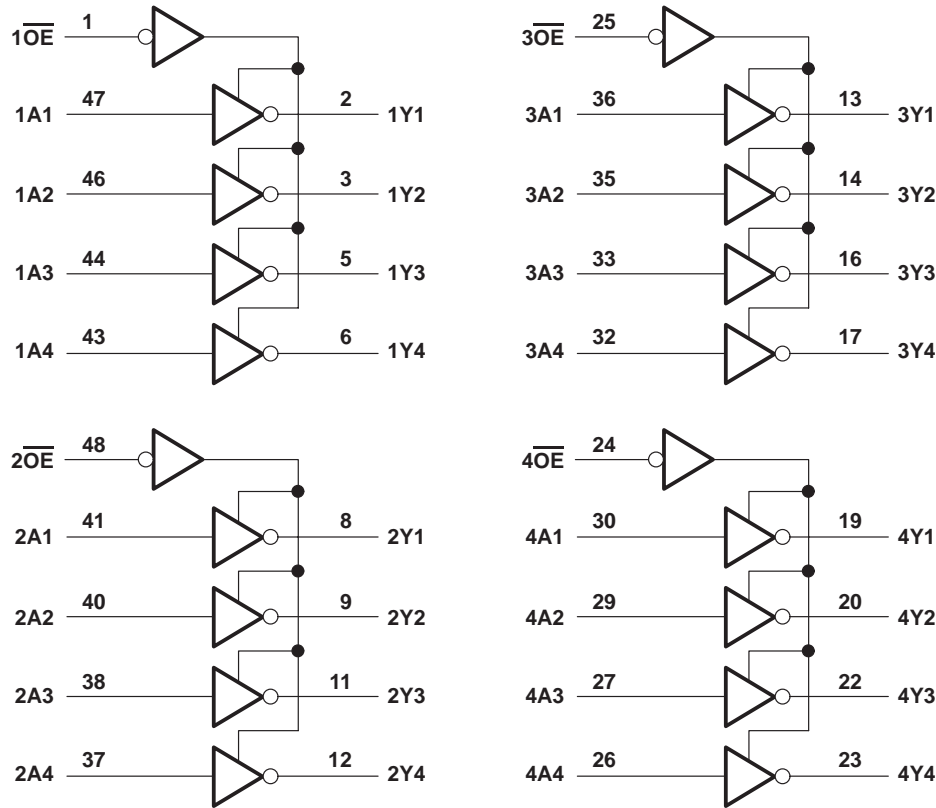


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

**SN54LVTH16240, SN74LVTH16240**  
**3.3-V ABT 16-BIT BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

SCBS684C – MARCH 1997 – REVISED APRIL 1999

**logic diagram (positive logic)**



**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-impedance or power-off state, $V_O$ (see Note 1) .....	-0.5 V to 7 V
Voltage range applied to any output in the high state, $V_O$ (see Note 1) .....	-0.5 V to $V_{CC} + 0.5$ V
Current into any output in the low state, $I_{OL}$ : SN54LVTH16240 .....	96 mA
SN74LVTH16240 .....	128 mA
Current into any output in the high state, $I_{OH}$ (see Note 2): SN54LVTH16240 .....	48 mA
SN74LVTH16240 .....	64 mA
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	-50 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	-50 mA
Package thermal impedance, $\theta_{JA}$ (see Note 3): DGG package .....	89°C/W
DL package .....	94°C/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 package thermal impedance is calculated in accordance with JESD 51.



**SN54LVTH16240, SN74LVTH16240**  
**3.3-V ABT 16-BIT BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

SCBS684C – MARCH 1997 – REVISED APRIL 1999

**recommended operating conditions (see Note 4)**

		SN54LVTH16240		SN74LVTH16240		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		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	10	ns/V
$\Delta t/\Delta V_{CC}$	Power-up ramp rate	200		200		$\mu$ s/V
$T_A$	Operating free-air temperature	-55	125	-40	85	$^{\circ}$ C

NOTE 4: All unused control inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

**SN54LVTH16240, SN74LVTH16240**  
**3.3-V ABT 16-BIT BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

SCBS684C – MARCH 1997 – REVISED APRIL 1999

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

PARAMETER		TEST CONDITIONS		SN54LVTH16240		SN74LVTH16240		UNIT
				MIN	TYP†	MAX	MIN	
V <sub>IK</sub>		V <sub>CC</sub> = 2.7 V, I <sub>I</sub> = -18 mA		-1.2		-1.2		V
V <sub>OH</sub>		V <sub>CC</sub> = 2.7 V to 3.6 V, I <sub>OH</sub> = -100 μA		V <sub>CC</sub> -0.2		V <sub>CC</sub> -0.2		V
		V <sub>CC</sub> = 2.7 V, I <sub>OH</sub> = -8 mA		2.4		2.4		
		V <sub>CC</sub> = 3 V		2		2		
V <sub>OL</sub>		V <sub>CC</sub> = 2.7 V		I <sub>OL</sub> = 100 μA		0.2		V
				I <sub>OL</sub> = 24 mA		0.5		
		V <sub>CC</sub> = 3 V		I <sub>OL</sub> = 16 mA		0.4		
				I <sub>OL</sub> = 32 mA		0.5		
				I <sub>OL</sub> = 48 mA		0.55		
				I <sub>OL</sub> = 64 mA		0.55		
I <sub>I</sub>		V <sub>CC</sub> = 0 or 3.6 V, V <sub>I</sub> = 5.5 V		10		10		μA
		Control inputs V <sub>CC</sub> = 3.6 V, V <sub>I</sub> = V <sub>CC</sub> or GND		±1		±1		
		Data inputs V <sub>CC</sub> = 3.6 V		V <sub>I</sub> = V <sub>CC</sub>		1		
		V <sub>I</sub> = 0		-5		-5		
I <sub>off</sub>		V <sub>CC</sub> = 0, V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5 V				±100		μA
I <sub>I</sub> (hold)		V <sub>CC</sub> = 3 V		V <sub>I</sub> = 0.8 V		75		μA
				V <sub>I</sub> = 2 V		-75		
		V <sub>CC</sub> = 3.6 V‡, V <sub>I</sub> = 0 to 3.6 V				500		
I <sub>OZH</sub>		V <sub>CC</sub> = 3.6 V, V <sub>O</sub> = 3 V		5		5		μA
I <sub>OZL</sub>		V <sub>CC</sub> = 3.6 V, V <sub>O</sub> = 0.5 V		-5		-5		μA
I <sub>OZPU</sub>		V <sub>CC</sub> = 0 to 1.5 V, V <sub>O</sub> = 0.5 V to 3 V, OE = don't care		±100*		±100		μA
I <sub>OZPD</sub>		V <sub>CC</sub> = 1.5 V to 0, V <sub>O</sub> = 0.5 V to 3 V, OE = don't care		±100*		±100		μA
I <sub>CC</sub>		V <sub>CC</sub> = 3.6 V, I <sub>O</sub> = 0, V <sub>I</sub> = V <sub>CC</sub> or GND		Outputs high		0.19		mA
				Outputs low		5		
				Outputs disabled		0.19		
ΔI <sub>CC</sub> §		V <sub>CC</sub> = 3 V to 3.6 V, One input at V <sub>CC</sub> - 0.6 V, Other inputs at V <sub>CC</sub> or GND		0.2		0.2		mA
C <sub>i</sub>		V <sub>I</sub> = 3 V or 0		4		4		pF
C <sub>o</sub>		V <sub>O</sub> = 3 V or 0		9		9		pF

\* On products compliant to MIL-PRF-38535, this parameter is not production tested.

† All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

‡ This is the bus-hold maximum dynamic current. It is the minimum overdrive current required to switch the input from one state to another.

§ This is the increase in supply current for each input that is at the specified TTL voltage level rather than V<sub>CC</sub> or GND.

PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

**SN54LVTH16240, SN74LVTH16240**  
**3.3-V ABT 16-BIT BUFFERS/DRIVERS**  
**WITH 3-STATE OUTPUTS**

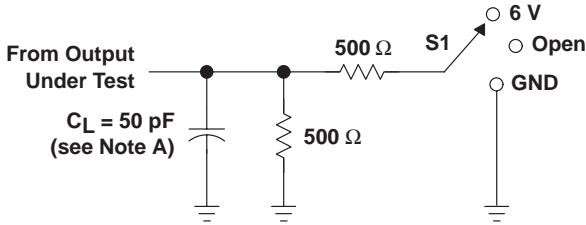
SCBS684C – MARCH 1997 – REVISED APRIL 1999

switching characteristics over recommended operating free-air temperature range,  $C_L = 50 \text{ pF}$   
(unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVTH16240				SN74LVTH16240				UNIT	
			$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		$V_{CC} = 2.7 \text{ V}$		$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$			$V_{CC} = 2.7 \text{ V}$		
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN		MAX
$t_{PLH}$	A	Y	1	3.6		4.1	1	2.2	3.5		4	ns
$t_{PHL}$			1	3.6		4.1	1	2.7	3.5		4	
$t_{PZH}$	$\overline{OE}$	Y	1	4.2		5.1	1	2.6	4		4.9	ns
$t_{PZL}$			1.1	4.6		4.8	1.2	2.6	4.4		4.6	
$t_{PHZ}$	$\overline{OE}$	Y	1.9	4.7		5.2	2	3.4	4.5		5	ns
$t_{PLZ}$			1.9	4.4		4.5	2	3.2	4.2		4.2	
$t_{sk(o)}$								0.5		0.5	ns	

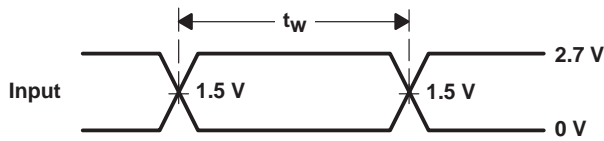
† All typical values are at  $V_{CC} = 3.3 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

PARAMETER MEASUREMENT INFORMATION

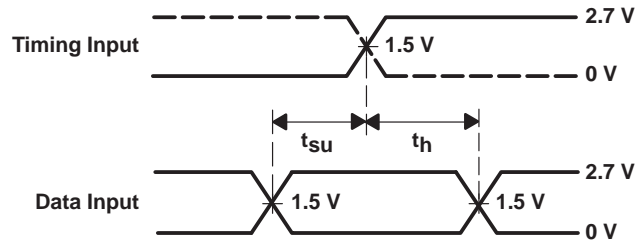


LOAD CIRCUIT

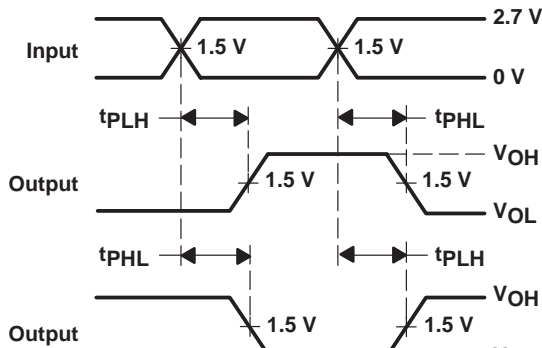
TEST	S1
$t_{PHL}/t_{PLH}$	Open
$t_{PLZ}/t_{PZL}$	6 V
$t_{PHZ}/t_{PZH}$	GND



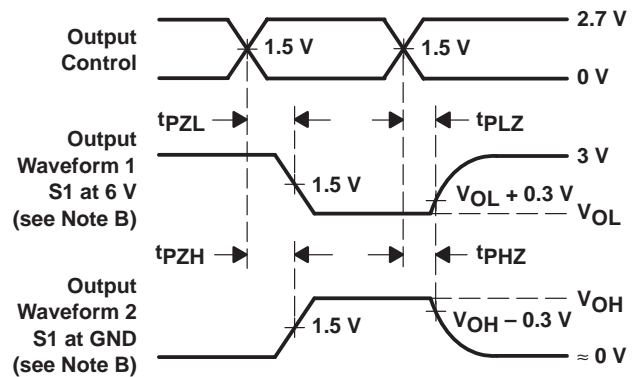
VOLTAGE WAVEFORMS  
PULSE DURATION



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:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .  
D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

## **IMPORTANT NOTICE**

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

**CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.**

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.