

SN54LVT16244A, SN74LVT16244A 3.3-V ABT 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCBS142E - MAY 1992 - REVISED JANUARY 1996

- State-of-the-Art Advanced BICMOS Technology (ABT) Design for 3.3-V Operation and Low-Static Power Dissipation
- Members of the Texas Instruments *Widebus™* Family
- 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
- Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Packaged in Plastic 300-mil 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

SN54LVT16244A . . . WD PACKAGE
SN74LVT16244A . . . DGG OR DL PACKAGE
(TOP VIEW)

1 \overline{OE}	1	48	2 \overline{OE}
1Y1	2	47	1A1
1Y2	3	46	1A2
GND	4	45	GND
1Y3	5	44	1A3
1Y4	6	43	1A4
V_{CC}	7	42	V_{CC}
2Y1	8	41	2A1
2Y2	9	40	2A2
GND	10	39	GND
2Y3	11	38	2A3
2Y4	12	37	2A4
3Y1	13	36	3A1
3Y2	14	35	3A2
GND	15	34	GND
3Y3	16	33	3A3
3Y4	17	32	3A4
V_{CC}	18	31	V_{CC}
4Y1	19	30	4A1
4Y2	20	29	4A2
GND	21	28	GND
4Y3	22	27	4A3
4Y4	23	26	4A4
4 \overline{OE}	24	25	3 \overline{OE}

description

The 'LVT16244A are 16-bit buffers and line drivers designed 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 can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. These devices provide true outputs and symmetrical active-low output-enable (\overline{OE}) inputs.

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 SN74LVT16244A is available in TI's shrink small-outline (DL) and thin shrink small-outline (DGG) packages, which provide twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

Widebus is a trademark of Texas Instruments Incorporated.

PRODUCTION DATA information is 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.



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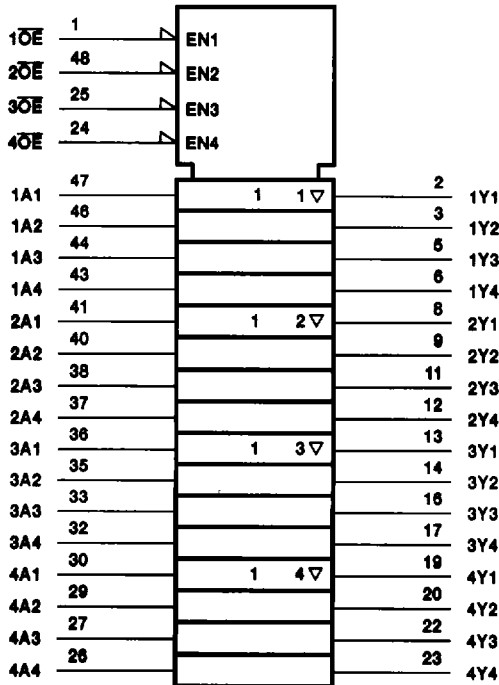
description (continued)

The SN54LVT16244A is characterized for operation over the full military temperature range of -55°C to 125°C. The SN74LVT16244A is characterized for operation from -40°C to 85°C.

FUNCTION TABLE
(each buffer)

INPUTS		OUTPUT
OE	A	Y
L	H	H
L	L	L
H	X	Z

logic symbol



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

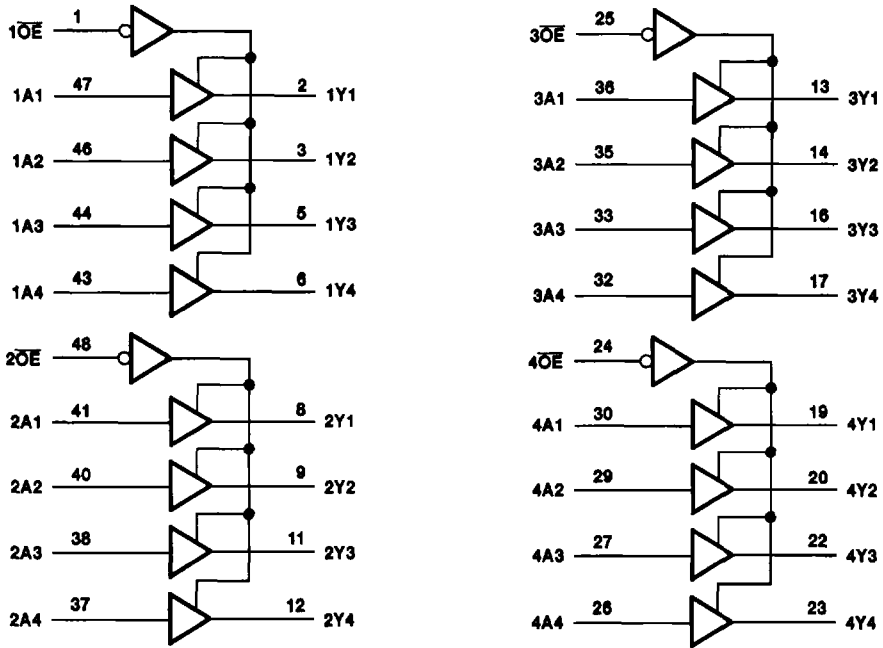


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logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature (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 : SN54LVT16244A	96 mA
SN74LVT16244A	128 mA
Current into any output in the high state, I_O (see Note 2): SN54LVT16244A	48 mA
SN74LVT16244A	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): DGG package	0.85 W
DL package	1.2 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.



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recommended operating conditions (see Note 4)

		SN54LVT16244A		SN74LVT16244A		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
Δt/Δv	Input transition rise or fall rate	Outputs enabled		10	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.

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

PARAMETER	TEST CONDITIONS		SN54LVT16244A		SN74LVT16244A		UNIT
			MIN	MAX	MIN	TYP†	
V _{IK}	V _{CC} = 2.7 V, I _I = -18 mA		-1.2		-1.2		V
V _{OH}	V _{CC} = MIN to MAX‡, I _{OH} = -100 μA		V _{CC} -0.2		V _{CC} -0.2		V
	V _{CC} = 2.7 V,	I _{OH} = -8 mA	2.4		2.4		
	V _{CC} = 3 V	I _{OH} = -24 mA I _{OH} = -32 mA	2		2		
V _{OL}	V _{CC} = 2.7 V	I _{OL} = 100 μA	0.2		0.2		V
		I _{OL} = 24 mA	0.5		0.5		
	V _{CC} = 3 V	I _{OL} = 16 mA	0.4		0.4		
		I _{OL} = 32 mA	0.5		0.5		
		I _{OL} = 48 mA I _{OL} = 64 mA	0.55		0.55		
I _I	V _{CC} = 0 or MAX‡, V _I = 5.5 V		50		10		μA
	V _{CC} = 3.6 V	V _I = V _{CC} or GND	Control inputs		±1		
		V _I = V _{CC} V _I = 0	Data inputs		1 -5		
I _{off}	V _{CC} = 0, V _I or V _O = 0 to 4.5 V				±100		μA
I _I (hold)	V _{CC} = 3 V	V _I = 0.8 V	A inputs		75		μA
		V _I = 2 V			-75		
I _{OZH}	V _{CC} = 3.6 V, V _O = 3 V		5		5		μA
I _{OZL}	V _{CC} = 3.6 V, V _O = 0.5 V		-5		-5		μA
I _{CC}	V _{CC} = 3.6 V, V _I = V _{CC} or GND, I _O = 0,		Outputs high		0.19		mA
			Outputs low		5		
			Outputs disabled		0.19		
ΔI _{CC} §	V _{CC} = 3 V to 3.6 V, One input at V _{CC} - 0.6 V, Other inputs at V _{CC} or GND		0.2		0.2		mA
C _I	V _I = 3 V or 0				4		pF
C _O	V _O = 3 V or 0				10		pF

† All typical values are at V_{CC} = 3.3 V, T_A = 25°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 operating free-air temperature range, $C_L = 50$ pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	SN54LVT16244A				SN74LVT16244A				UNIT
			$V_{CC} = 3.3$ V ± 0.3 V		$V_{CC} = 2.7$ V		$V_{CC} = 3.3$ V ± 0.3 V			$V_{CC} = 2.7$ V	
			MIN	MAX	MIN	MAX	MIN	TYP†	MAX	MIN	
t_{PLH}	A	Y	1	4.4	5.1		1	2.3	4.1	5	ns
t_{PHL}			1	4.5	5.3		1	2.3	4.1	5.2	
t_{PZH}	\overline{OE}	Y	1	5.3	6.4		1	2.6	5.2	6.3	ns
t_{PZL}			1	5.3	6.8		1	2.6	5.2	6.7	
t_{PHZ}	\overline{OE}	Y	2.1	7	7.7		2.2	3.9	5.7	6.3	ns
t_{PLZ}			1.9	5.9	5.9		2	3.7	5.1	5.6	

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

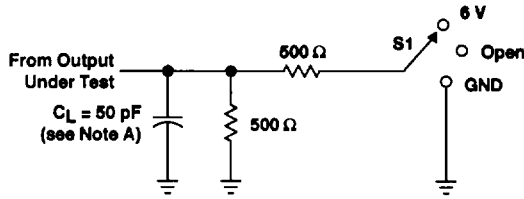


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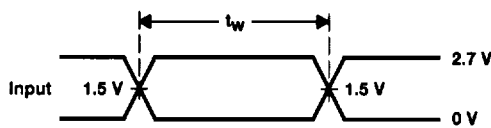
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PARAMETER MEASUREMENT INFORMATION

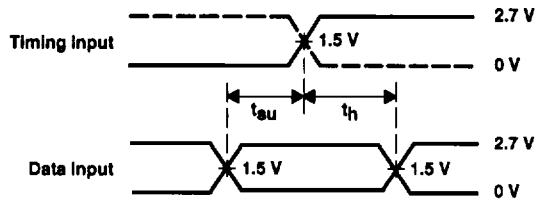


TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND

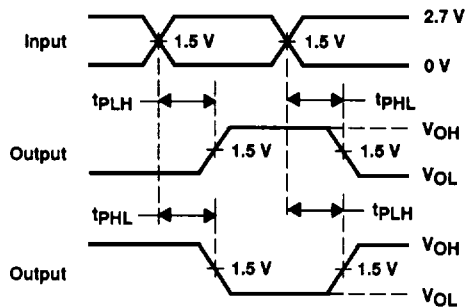
LOAD CIRCUIT FOR OUTPUTS



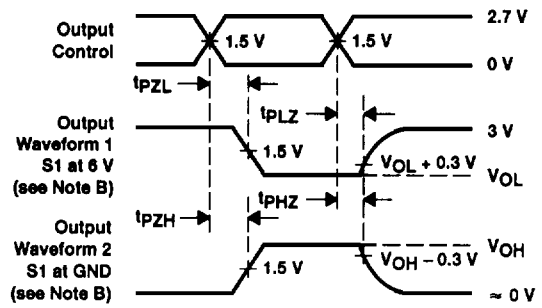
VOLTAGE WAVEFORMS
PULSE DURATION



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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