

SN54AHC16540, SN74AHC16540 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCLS331B – MARCH 1996 – REVISED JUNE 1997

- Members of the Texas Instruments **Widebus™** Family
- Operating Range 2-V to 5.5-V V_{CC}
- **EPIC™** (Enhanced-Performance Implanted CMOS) Process
- Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Package Options Include 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

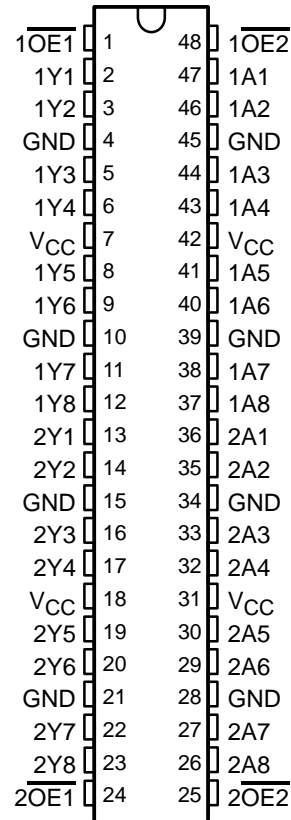
description

These 16-bit buffers and bus drivers provide a high-performance bus interface for wide data paths.

The 3-state control gate is a 2-input AND gate with active-low inputs so that if either output-enable ($\overline{OE1}$ or $\overline{OE2}$) input is high, all corresponding outputs are in the high-impedance state.

The SN54AHC16540 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74AHC16540 is characterized for operation from -40°C to 85°C .

SN54AHC16540 . . . WD PACKAGE
SN74AHC16540 . . . DGG OR DL PACKAGE
(TOP VIEW)



FUNCTION TABLE
(each 8-bit section)

INPUTS			OUTPUT Y
$\overline{OE1}$	$\overline{OE2}$	A	
L	L	L	H
L	L	H	L
H	X	X	Z
X	H	X	Z



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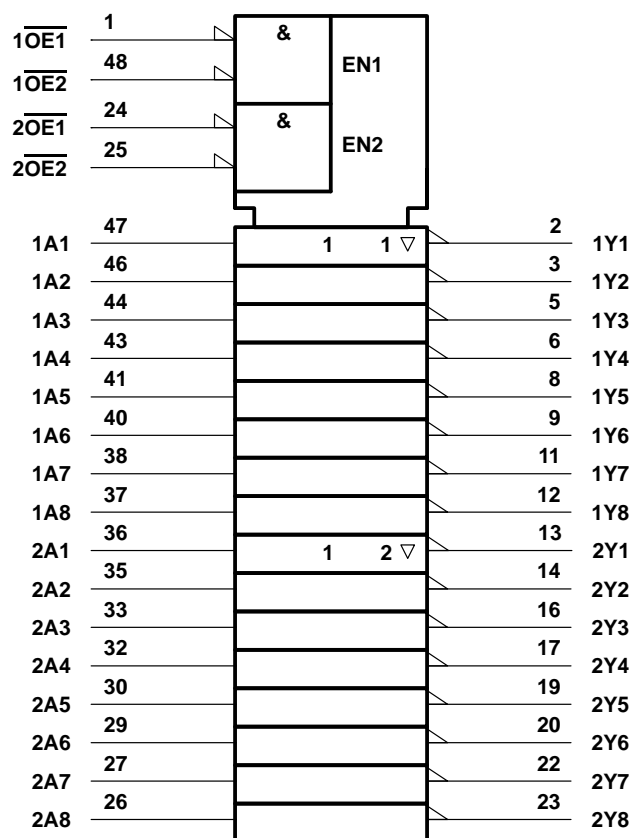


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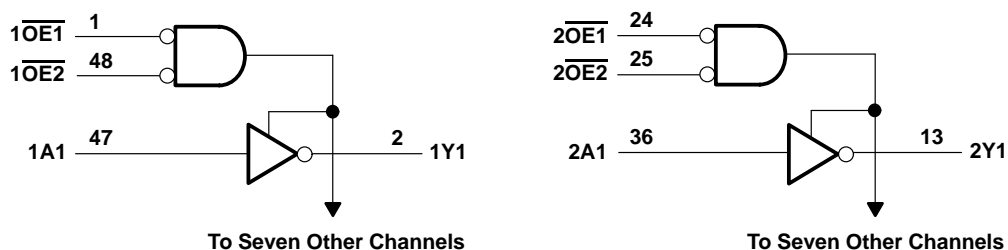
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logic diagram (positive logic)



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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 7 V
Input voltage range, V_I (see Note 1)	–0.5 V to 7 V
Output voltage range, V_O (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±20 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±25 mA
Continuous current through each V_{CC} or GND	±75 mA
Package thermal impedance, θ_{JA} (see Note 2): 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 voltage ratings may be exceeded if the input and output current ratings are observed.
2. The package thermal impedance is calculated in accordance with JEDEC 51.

recommended operating conditions (see Note 3)

			SN54AHC16540		SN74AHC16540		UNIT
			MIN	MAX	MIN	MAX	
V_{CC}	Supply voltage		2	5.5	2	5.5	V
V_{IH}	High-level input voltage	$V_{CC} = 2$ V	1.5		1.5		V
		$V_{CC} = 3$ V	2.1		2.1		
		$V_{CC} = 5.5$ V	3.85		3.85		
V_{IL}	Low-level input voltage	$V_{CC} = 2$ V		0.5		0.5	V
		$V_{CC} = 3$ V		0.9		0.9	
		$V_{CC} = 5.5$ V		1.65		1.65	
V_I	Input voltage		0	5.5	0	5.5	V
V_O	Output voltage		0	V_{CC}	0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 2$ V		–50		–50	µA
		$V_{CC} = 3.3$ V ± 0.3 V		–4		–4	mA
		$V_{CC} = 5$ V ± 0.5 V		–8		–8	
I_{OL}	Low-level output current	$V_{CC} = 2$ V		50		50	µA
		$V_{CC} = 3.3$ V ± 0.3 V		4		4	mA
		$V_{CC} = 5$ V ± 0.5 V		8		8	
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 3.3$ V ± 0.3 V		100		100	ns/V
		$V_{CC} = 5$ V ± 0.5 V		20		20	
T_A	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

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

PARAMETER		TEST CONDITIONS	V _{CC}	T _A = 25°C			SN54AHC16540		SN74AHC16540		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V _{OH}		I _{OH} = –50 µA	2 V	1.9	2		1.9		1.9		V
			3 V	2.9	3		2.9		2.9		
			4.5 V	4.4	4.5		4.4		4.4		
		I _{OH} = –4 mA	3 V	2.58			2.48		2.48		
		I _{OH} = –8 mA	4.5 V	3.94			3.8		3.8		
V _{OL}		I _{OL} = 50 µA	2 V			0.1		0.1		0.1	V
			3 V			0.1		0.1		0.1	
			4.5 V			0.1		0.1		0.1	
		I _{OL} = 4 mA	3 V			0.36		0.5		0.44	
		I _{OL} = 8 mA	4.5 V			0.36		0.5		0.44	
I _I	Data inputs	V _I = V _{CC} or GND	5.5 V			±0.1		±1		±1	µA
	Control inputs					±0.1		±1		±1	
I _{OZ}		V _O = V _{CC} or GND, V _I ($\overline{\text{OE}}$) = V _{IL} or V _{IH}	5.5 V			±0.25		±2.5		±2.5	µA
I _{CC}		V _I = V _{CC} or GND, I _O = 0	5.5 V			4		40		40	µA
C _i		V _I = V _{CC} or GND	5 V		2	10				10	pF
C _O		V _O = V _{CC} or GND	5 V		4						pF

switching characteristics over recommended operating free-air temperature range, V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T _A = 25°C			SN54AHC16540		SN74AHC16540		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t _{PLH} *	A	Y	C _L = 15 pF		4.8	7	1	8.5	1	8.5	ns
t _{PHL} *					4.8	7	1	8.5	1	8.5	
t _{PZH} *	$\overline{\text{OE}}$	Y	C _L = 15 pF		6.8	10.5	1	12.5	1	12.5	ns
t _{PZL} *					6.8	10.5	1	12.5	1	12.5	
t _{PHZ} *	$\overline{\text{OE}}$	Y	C _L = 15 pF		6.8	10.5	1	12.5	1	12.5	ns
t _{PLZ} *					6.8	10.5	1	12.5	1	12.5	
t _{PLH}	A	Y	C _L = 50 pF		7.3	10.5	1	12	1	12	ns
t _{PHL}					7.3	10.5	1	12	1	12	
t _{PZH}	$\overline{\text{OE}}$	Y	C _L = 50 pF		8	14	1	16	1	16	ns
t _{PZL}					8	14	1	16	1	16	
t _{PHZ}	$\overline{\text{OE}}$	Y	C _L = 50 pF		8	15.4	1	17.5	1	17.5	ns
t _{PLZ}					8	15.4	1	17.5	1	17.5	

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

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switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54AHC16540		SN74AHC16540		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{PLH}^*	A	Y	$C_L = 15\text{ pF}$		3.7	5	1	6	1	6	ns
t_{PHL}^*					3.7	5	1	6	1	6	
t_{PZH}^*	\overline{OE}	Y	$C_L = 15\text{ pF}$		4.7	7.2	1	8.5	1	8.5	ns
t_{PZL}^*					4.7	7.2	1	8.5	1	8.5	
t_{PHZ}^*	\overline{OE}	Y	$C_L = 15\text{ pF}$		4.5	6.8	1	8	1	8	ns
t_{PLZ}^*					4.5	6.8	1	8	1	8	
t_{PLH}	A	Y	$C_L = 50\text{ pF}$		5.2	7	1	8	1	8	ns
t_{PHL}					5.2	7	1	8	1	8	
t_{PZH}	\overline{OE}	Y	$C_L = 50\text{ pF}$		6.2	9.2	1	10.5	1	10.5	ns
t_{PZL}					6.2	9.2	1	10.5	1	10.5	
t_{PHZ}	\overline{OE}	Y	$C_L = 50\text{ pF}$		6	8.8	1	10	1	10	ns
t_{PLZ}					6	8.8	1	10	1	10	

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

output-skew characteristics, $C_L = 50\text{ pF}$ (see Note 4)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC}	SN74AHC16540				UNIT
				T _A = 25°C		MIN	MAX	
				MIN	MAX			
t _{sk(o)}	A	Y	3.3 V ± 0.3 V	1.5		1.5		ns
			5 V ± 0.5 V	1		1		

NOTE 4: Characteristics are determined during product characterization and ensured by design.

noise characteristics, $V_{CC} = 5\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$ (see Note 5)

PARAMETER		SN74AHC16540			UNIT
		MIN	TYP	MAX	
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}			0.8	V
$V_{OL(V)}$	Quiet output, minimum dynamic V_{OL}			-0.8	V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}	4.7			V
$V_{IH(D)}$	High-level dynamic input voltage	3.5			V
$V_{IL(D)}$	Low-level dynamic input voltage			1.5	V

NOTE 5: Characteristics are determined during product characterization and ensured by design for surface-mount packages only.

operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

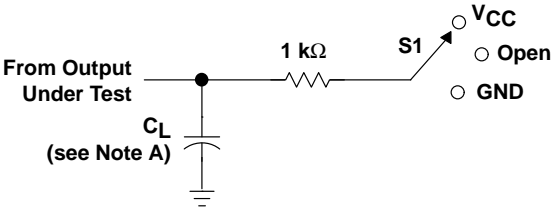
PARAMETER		TEST CONDITIONS		TYP	UNIT
C_{pd}	Power dissipation capacitance	No load,	$f = 1\text{ MHz}$	12	pF

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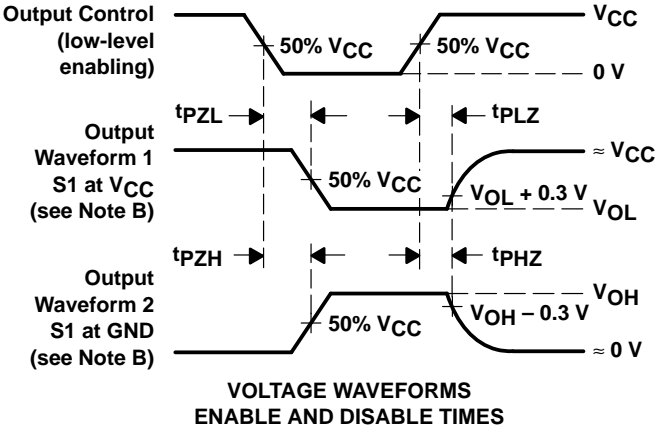
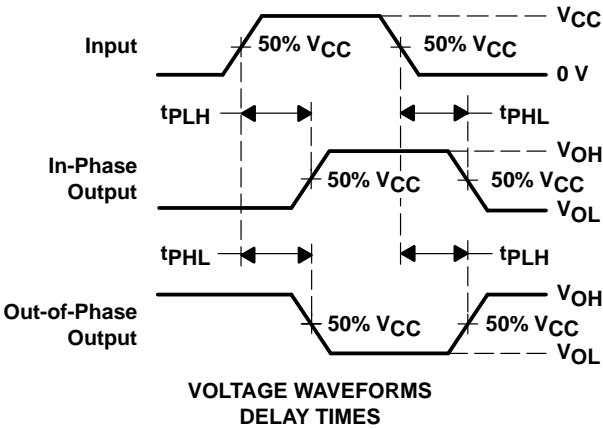
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PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND



- 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: $PRR \leq 1 \text{ MHz}$, $Z_O = 50 \Omega$, $t_r = 3 \text{ ns}$, $t_f = 3 \text{ ns}$.
D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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