

SN54AHC541, SN74AHC541 OCTAL BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCLS261F – DECEMBER 1995 – REVISED JUNE 1996

- Operating Range 2-V to 5.5-V V_{CC}
- **EPIC™** (Enhanced-Performance Implanted CMOS) Process
- High Latch-Up Immunity Exceeds 250 mA Per JEDEC Standard JESD-17
- Package Options Include Plastic Small-Outline (DW), Shrink Small-Outline (DB), Thin Shrink Small-Outline (PW), and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

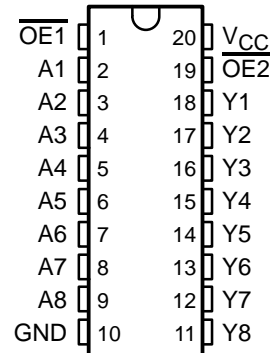
description

The 'AHC541 octal buffers/drivers are ideal for driving bus lines or buffer memory address registers. These devices feature inputs and outputs on opposite sides of the package to facilitate printed-circuit-board layout.

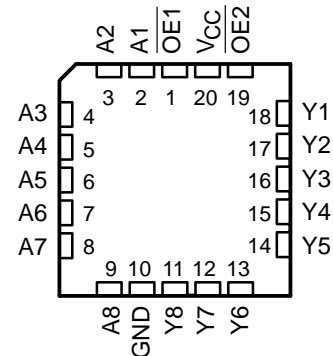
The 3-state control gate is a two-input AND gate with active-low inputs so that if either output-enable ($\overline{OE1}$ or $\overline{OE2}$) input is high, all corresponding outputs are in the high-impedance state. The outputs provide noninverted data when they are not in the high-impedance state.

The SN54AHC541 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74AHC541 is characterized for operation from -40°C to 85°C .

SN54AHC541 . . . J OR W PACKAGE
SN74AHC541 . . . DB, DW, N, OR PW PACKAGE
(TOP VIEW)



SN54AHC541 . . . FK PACKAGE
(TOP VIEW)



FUNCTION TABLE
(each buffer/driver)

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



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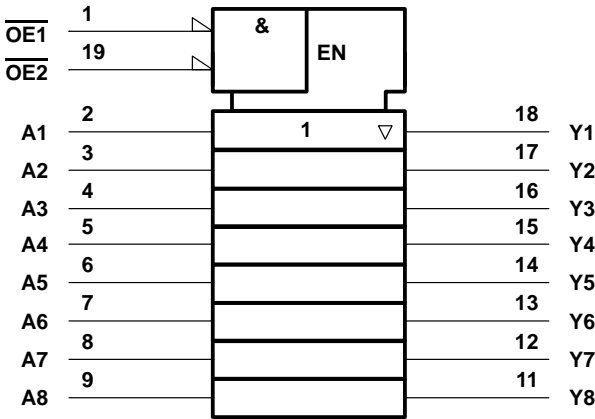
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS
INSTRUMENTS**

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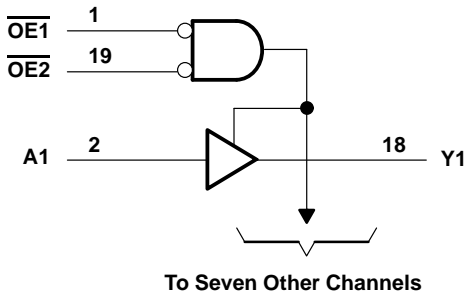
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logic symbol†



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

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 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} ($V_I < 0$ or $V_I > V_{CC}$)	−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 V_{CC} or GND	±75 mA
Maximum power dissipation at $T_A = 55^{\circ}\text{C}$ (in still air) (see Note 2):	
DB package	0.6 W
DW package	1.6 W
N package	1.3 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 voltage ratings may be exceeded if the input and output current ratings are observed.
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils, except for the N package, which has a trace length of zero.

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recommended operating conditions (see Note 3)

			SN54AHC541		SN74AHC541		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 ± 0.3 V		–4		–4	mA
		V _{CC} = 5 ± 0.5 V		–8		–8	
I _{OL}	Low-level output current	V _{CC} = 2 V		50		50	μA
		V _{CC} = 3.3 ± 0.3 V		4		4	mA
		V _{CC} = 5 ± 0.5 V		8		8	
Δt/Δv	Input transition rise or fall rate	V _{CC} = 3.3 ± 0.3 V		100		100	ns/V
		V _{CC} = 5 ± 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.

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

PARAMETER		TEST CONDITIONS	V _{CC}	T _A = 25°C			SN54AHC541		SN74AHC541		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 (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

[†] For input and output, I_{OZ} includes the input leakage current.



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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	SN54AHC541				UNIT
				$T_A = 25^\circ\text{C}$			MIN	MAX
				MIN	TYP	MAX		
t_{PLH}^*	A	Y	$C_L = 15 \text{ pF}$	5	7	1	8.5	ns
t_{PHL}^*				5	7	1	8.5	
t_{PZH}^*	\overline{OE}	Y	$C_L = 15 \text{ pF}$	6	10.5	1	11	ns
t_{PZL}^*				6	10.5	1	11	
t_{PHZ}^*	\overline{OE}	Y	$C_L = 15 \text{ pF}$	7	11	1	12	ns
t_{PLZ}^*				7	11	1	12	
t_{PLH}	A	Y	$C_L = 50 \text{ pF}$	7.5	10.5	1	12	ns
t_{PHL}				7.5	10.5	1	12	
t_{PZH}	\overline{OE}	Y	$C_L = 50 \text{ pF}$	8	14	1	16	ns
t_{PZL}				8	14	1	16	
t_{PHZ}	\overline{OE}	Y	$C_L = 50 \text{ pF}$	9	15.4	1	17.5	ns
t_{PLZ}				9	15.4	1	17.5	

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

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	SN74AHC541				UNIT
				$T_A = 25^\circ\text{C}$			MIN	MAX
				MIN	TYP	MAX		
t_{PLH}	A	Y	$C_L = 15 \text{ pF}$	5	7	1	8.5	ns
t_{PHL}				5	7	1	8.5	
t_{PZH}	\overline{OE}	Y	$C_L = 15 \text{ pF}$	6	10.5	1	11	ns
t_{PZL}				6	10.5	1	11	
t_{PHZ}	\overline{OE}	Y	$C_L = 15 \text{ pF}$	7	11	1	12	ns
t_{PLZ}				7	11	1	12	
t_{PLH}	A	Y	$C_L = 50 \text{ pF}$	7.5	10.5	1	12	ns
t_{PHL}				7.5	10.5	1	12	
t_{PZH}	\overline{OE}	Y	$C_L = 50 \text{ pF}$	8	14	1	16	ns
t_{PZL}				8	14	1	16	
t_{PHZ}	\overline{OE}	Y	$C_L = 50 \text{ pF}$	9	15.4	1	17.5	ns
t_{PLZ}				9	15.4	1	17.5	

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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	SN54AHC541				UNIT	
				T _A = 25°C			MIN		MAX
				MIN	TYP	MAX			
t _{PLH} *	A	Y	C _L = 15 pF	3.5	5	1	6	ns	
t _{PHL} *				3.5	5	1	6		
t _{PZH} *	OE	Y	C _L = 15 pF	4.7	7.2	1	8.5	ns	
t _{PZL} *				4.7	7.2	1	8.5		
t _{PHZ} *	OE	Y	C _L = 15 pF	5	7.5	1	8	ns	
t _{PLZ} *				5	7.5	1	8		
t _{PLH}	A	Y	C _L = 50 pF	5	7	1	8	ns	
t _{PHL}				5	7	1	8		
t _{PZH}	OE	Y	C _L = 50 pF	6.2	9.2	1	10.5	ns	
t _{PZL}				6.2	9.2	1	10.5		
t _{PHZ}	OE	Y	C _L = 50 pF	6	8.8	1	10	ns	
t _{PLZ}				6	8.8	1	10		

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

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	SN74AHC541				UNIT	
				T _A = 25°C			MIN		MAX
				MIN	TYP	MAX			
t _{PLH}	A	Y	C _L = 15 pF	3.5	5	1	6	ns	
t _{PHL}				3.5	5	1	6		
t _{PZH}	\overline{OE}	Y	C _L = 15 pF	4.7	7.2	1	8.5	ns	
t _{PZL}				4.7	7.2	1	8.5		
t _{PHZ}	\overline{OE}	Y	C _L = 15 pF	5	7.5	1	8	ns	
t _{PLZ}				5	7.5	1	8		
t _{PLH}	A	Y	C _L = 50 pF	5	7	1	8	ns	
t _{PHL}				5	7	1	8		
t _{PZH}	\overline{OE}	Y	C _L = 50 pF	6.2	9.2	1	10.5	ns	
t _{PZL}				6.2	9.2	1	10.5		
t _{PHZ}	\overline{OE}	Y	C _L = 50 pF	6	8.8	1	10	ns	
t _{PLZ}				6	8.8	1	10		

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V _{CC}	SN74AHC541				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.



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

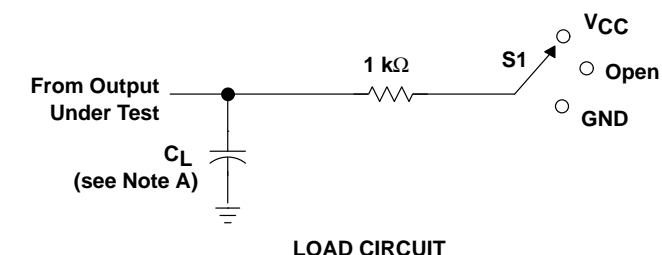
PARAMETER	SN74AHC541		UNIT
	MIN	MAX	
$V_{OL(P)}$ Quiet output, maximum dynamic V_{OL}		0.8	V
$V_{OL(V)}$ Quiet output, minimum dynamic V_{OL}		-0.8	V
$V_{OH(V)}$ Quiet output, minimum dynamic V_{OH}	4.7		V
$V_{IH(D)}$ High-level dynamic input voltage	3.5		V
$V_{IL(D)}$ Low-level dynamic input voltage		1.5	V

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

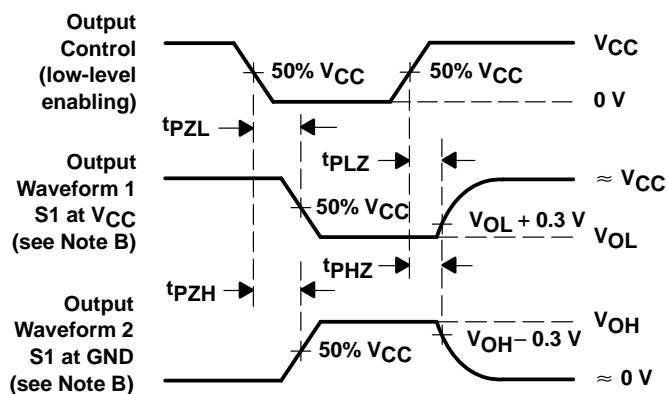
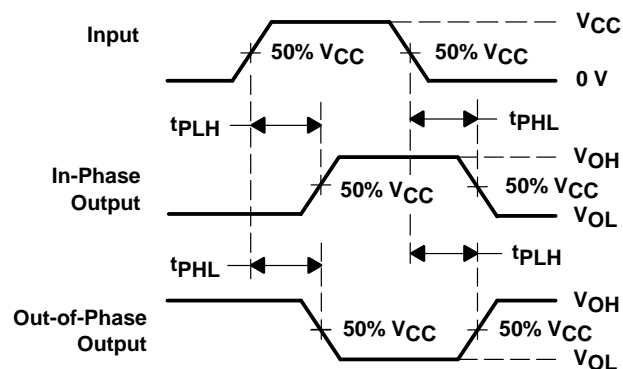
operating characteristics, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$

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

PARAMETER MEASUREMENT INFORMATION



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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