

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

SCLS261K – DECEMBER 1995 – REVISED JANUARY 2000

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

## description

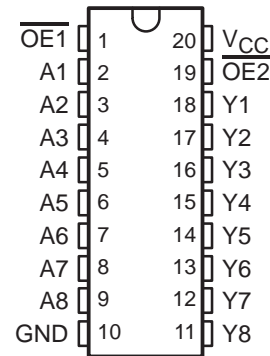
The 'AHC541 octal buffers/drivers are ideal for driving bus lines or buffer memory address registers. These devices feature inputs and outputs on opposite sides of the package to facilitate printed circuit board layout.

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.

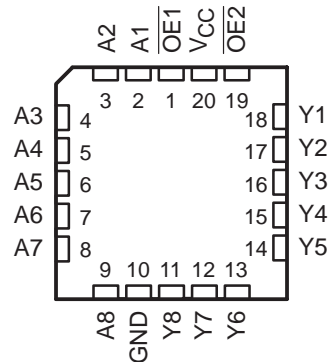
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54AHC541 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74AHC541 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54AHC541 ... J OR W PACKAGE  
SN74AHC541 ... DB, DGV, 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



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.

EPIC is a trademark of Texas Instruments Incorporated.

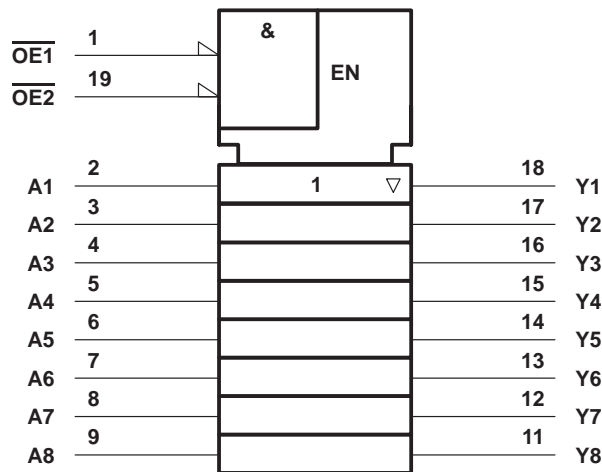
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

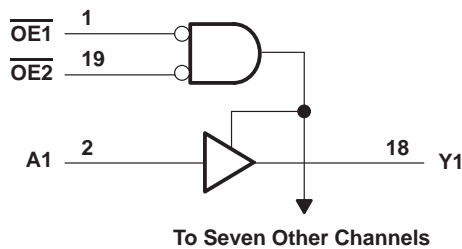
Copyright © 2000, Texas Instruments Incorporated  
On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

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, $I_{IK}$ ( $V_I < 0$ )	–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
Package thermal impedance, $\theta_{JA}$ (see Note 2): DB package	70°C/W
DGV package	92°C/W
DW package	58°C/W
N package	69°C/W
PW package	83°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 JESD 51.

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

SCLS261K – DECEMBER 1995 – REVISED JANUARY 2000

## recommended operating conditions (see Note 3)

			SN54AHC541		SN74AHC541		UNIT
			MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage		2	5.5	2	5.5	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 2 V	1.5		1.5		V
		V <sub>CC</sub> = 3 V	2.1		2.1		
		V <sub>CC</sub> = 5.5 V	3.85		3.85		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2 V		0.5		0.5	V
		V <sub>CC</sub> = 3 V		0.9		0.9	
		V <sub>CC</sub> = 5.5 V		1.65		1.65	
V <sub>I</sub>	Input voltage		0	5.5	0	5.5	V
V <sub>O</sub>	Output voltage		0	V <sub>CC</sub>	0	V <sub>CC</sub>	V
I <sub>OH</sub>	High-level output current	V <sub>CC</sub> = 2 V		–50		–50	μA
		V <sub>CC</sub> = 3.3 V ± 0.3 V		–4		–4	mA
		V <sub>CC</sub> = 5 V ± 0.5 V		–8		–8	
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 2 V		50		50	μA
		V <sub>CC</sub> = 3.3 V ± 0.3 V		4		4	mA
		V <sub>CC</sub> = 5 V ± 0.5 V		8		8	
Δt/Δv	Input transition rise or fall rate	V <sub>CC</sub> = 3.3 V ± 0.3 V		100		100	ns/V
		V <sub>CC</sub> = 5 V ± 0.5 V		20		20	
T <sub>A</sub>	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54AHC541		SN74AHC541		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = –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 <sub>OH</sub> = –4 mA	3 V	2.58			2.48		2.48		
	I <sub>OH</sub> = –8 mA	4.5 V	3.94			3.8		3.8		
V <sub>OL</sub>	I <sub>OL</sub> = 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 <sub>OL</sub> = 4 mA	3 V			0.36		0.5		0.44	
	I <sub>OL</sub> = 8 mA	4.5 V			0.36		0.5		0.44	
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	0 V to 5.5 V			±0.1		±1*		±1	μA
I <sub>OZ</sub> †	V <sub>O</sub> = V <sub>CC</sub> or GND, V <sub>I</sub> (OE) = V <sub>IL</sub> or V <sub>IH</sub>	5.5 V			±0.25		±2.5		±2.5	μA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V			4		40		40	μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V		2	10				10	pF
C <sub>o</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5 V		4						pF

\* On products compliant to MIL-PRF-38535, this parameter is not production tested at V<sub>CC</sub> = 0 V.

† For input and output, I<sub>OZ</sub> includes the input leakage current.



# SN54AHC541, SN74AHC541

## OCTAL BUFFERS/DRIVERS

### WITH 3-STATE OUTPUTS

SCLS261K – DECEMBER 1995 – REVISED JANUARY 2000

**switching characteristics over recommended operating free-air temperature range,  
V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T <sub>A</sub> = 25°C			SN54AHC541		SN74AHC541		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A	Y	C <sub>L</sub> = 15 pF		5*	7*	1*	8.5*	1	8.5	ns
t <sub>PHL</sub>					5*	7*	1*	8.5*	1	8.5	
t <sub>PZH</sub>	$\overline{\text{OE}}$	Y	C <sub>L</sub> = 15 pF		6*	10.5*	1*	11*	1	11	ns
t <sub>PZL</sub>					6*	10.5*	1*	11*	1	11	
t <sub>PHZ</sub>	$\overline{\text{OE}}$	Y	C <sub>L</sub> = 15 pF		7*	11*	1*	12*	1	12	ns
t <sub>PLZ</sub>					7*	11*	1*	12*	1	12	
t <sub>PLH</sub>	A	Y	C <sub>L</sub> = 50 pF		7.5	10.5	1	12	1	12	ns
t <sub>PHL</sub>					7.5	10.5	1	12	1	12	
t <sub>PZH</sub>	$\overline{\text{OE}}$	Y	C <sub>L</sub> = 50 pF		8	14	1	16	1	16	ns
t <sub>PZL</sub>					8	14	1	16	1	16	
t <sub>PHZ</sub>	$\overline{\text{OE}}$	Y	C <sub>L</sub> = 50 pF		9	15.4	1	17.5	1	17.5	ns
t <sub>PLZ</sub>					9	15.4	1	17.5	1	17.5	
t <sub>sk(o)</sub>			C <sub>L</sub> = 50 pF			1.5**				1.5	ns

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

\*\* On products compliant to MIL-PRF-38535, this parameter does not apply.

**switching characteristics over recommended operating free-air temperature range,  
V<sub>CC</sub> = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T <sub>A</sub> = 25°C			SN54AHC541		SN74AHC541		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A	Y	C <sub>L</sub> = 15 pF		3.5*	5*	1*	6*	1	6	ns
t <sub>PHL</sub>					3.5*	5*	1*	6*	1	6	
t <sub>PZH</sub>	$\overline{\text{OE}}$	Y	C <sub>L</sub> = 15 pF		4.7*	7.2*	1*	8.5*	1	8.5	ns
t <sub>PZL</sub>					4.7*	7.2*	1*	8.5*	1	8.5	
t <sub>PHZ</sub>	$\overline{\text{OE}}$	Y	C <sub>L</sub> = 15 pF		5*	7.5*	1*	8*	1	8	ns
t <sub>PLZ</sub>					5*	7.5*	1*	8*	1	8	
t <sub>PLH</sub>	A	Y	C <sub>L</sub> = 50 pF		5	7	1	8	1	8	ns
t <sub>PHL</sub>					5	7	1	8	1	8	
t <sub>PZH</sub>	$\overline{\text{OE}}$	Y	C <sub>L</sub> = 50 pF		6.2	9.2	1	10.5	1	10.5	ns
t <sub>PZL</sub>					6.2	9.2	1	10.5	1	10.5	
t <sub>PHZ</sub>	$\overline{\text{OE}}$	Y	C <sub>L</sub> = 50 pF		6	8.8	1	10	1	10	ns
t <sub>PLZ</sub>					6	8.8	1	10	1	10	
t <sub>sk(o)</sub>			C <sub>L</sub> = 50 pF			1**				1	ns

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

\*\* On products compliant to MIL-PRF-38535, this parameter does not apply.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

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

SCLS261K – DECEMBER 1995 – REVISED JANUARY 2000

noise characteristics,  $V_{CC} = 5\text{ V}$ ,  $C_L = 50\text{ pF}$ ,  $T_A = 25^\circ\text{C}$  (see Note 4)

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 4: Characteristics are for surface-mount packages only.

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

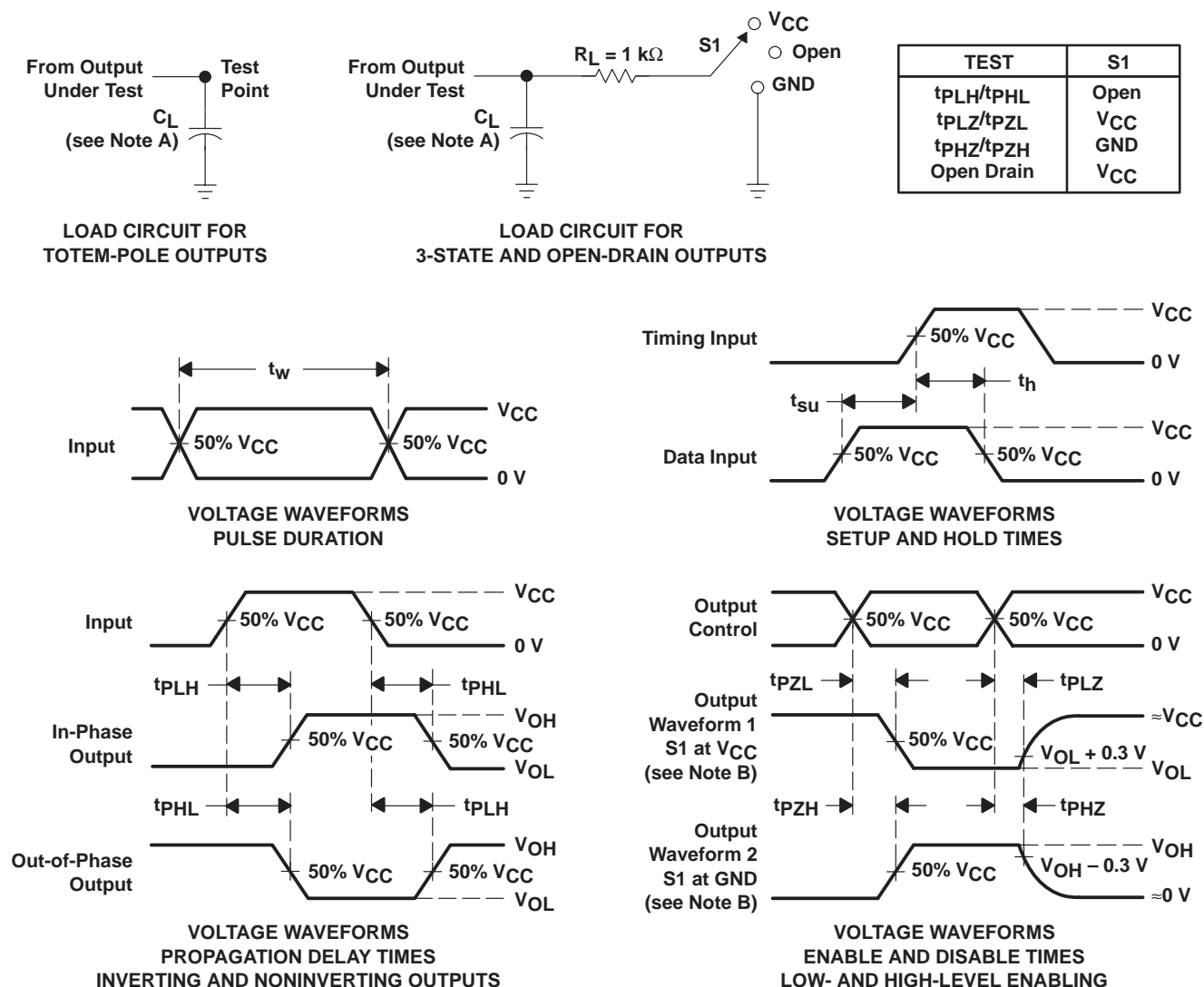
PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	No load, $f = 1\text{ MHz}$	12	pF



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

SCLS261K – DECEMBER 1995 – REVISED JANUARY 2000

## PARAMETER MEASUREMENT INFORMATION



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

Figure 1. Load Circuit and Voltage Waveforms

## **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.