

# SN54AHC04, SN74AHC04 HEX INVERTERS

SCLS234H – OCTOBER 1995 – REVISED JANUARY 2000

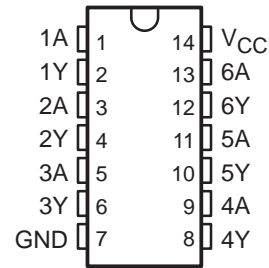
- **EPIC™ (Enhanced-Performance Implanted CMOS) Process**
- **Operating Range 2-V to 5.5-V  $V_{CC}$**
- **Unbuffered Outputs**
- **Latch-Up Performance Exceeds 250 mA Per JESD 17**
- **ESD Protection Exceeds 2000 V Per MIL-STD-883, Method 3015; Exceeds 200 V Using Machine Model ( $C = 200$  pF,  $R = 0$ )**
- **Package Options Include Plastic Small-Outline (D), 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

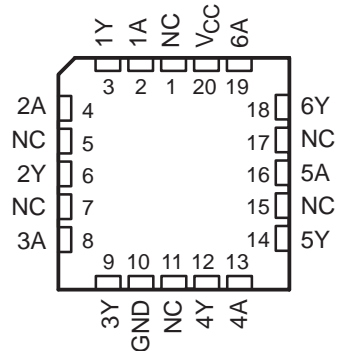
The 'AHC04 devices contain six independent inverters. These devices perform the Boolean function  $Y = \bar{A}$ . Internal circuitry consists of single-stage inverters that can be used in analog applications such as crystal oscillators.

The SN54AHC04 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74AHC04 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54AHC04 . . . J OR W PACKAGE  
SN74AHC04 . . . D, DB, DGV, N, OR PW PACKAGE  
(TOP VIEW)



SN54AHC04 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection

FUNCTION TABLE  
(each inverter)

INPUT A	OUTPUT Y
H	L
L	H



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 **TEXAS  
INSTRUMENTS**

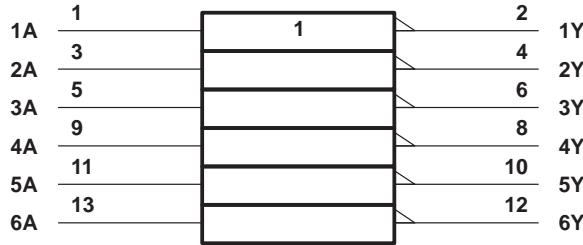
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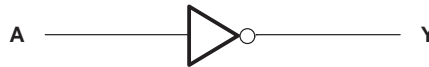
SCLS234H – OCTOBER 1995 – REVISED JANUARY 2000

## logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for the D, DB, DGV, J, N, PW, and W packages.

## 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 $V_O > V_{CC}$ ) .....	$\pm 20$ mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....	$\pm 25$ mA
Continuous current through $V_{CC}$ or GND .....	$\pm 50$ mA
Package thermal impedance, $\theta_{JA}$ (see Note 2):	
D package .....	86°C/W
DB package .....	96°C/W
DGV package .....	127°C/W
N package .....	80°C/W
PW package .....	113°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.

# SN54AHC04, SN74AHC04 HEX INVERTERS

SCLS234H – OCTOBER 1995 – REVISED JANUARY 2000

## recommended operating conditions (see Note 3)

		SN54AHC04		SN74AHC04		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		1.7		V
		V <sub>CC</sub> = 3 V		2.4		
		V <sub>CC</sub> = 5.5 V		4.4		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2 V		0.3		V
		V <sub>CC</sub> = 3 V		0.6		
		V <sub>CC</sub> = 5.5 V		1.1		
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		μA
		V <sub>CC</sub> = 3.3 V ± 0.3 V		-4		
		V <sub>CC</sub> = 5 V ± 0.5 V		-8		
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 2 V		50		μA
		V <sub>CC</sub> = 3.3 V ± 0.3 V		4		
		V <sub>CC</sub> = 5 V ± 0.5 V		8		
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			SN54AHC04		SN74AHC04		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = -50 μA	2 V	1.8	2		1.8		1.8	V	
		3 V	2.7	3		2.7		2.7		
		4.5 V	4	4.5		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			0.2		0.2		0.2	V
		3 V			0.3		0.3		0.3	
		4.5 V			0.5		0.5		0.5	
	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>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V			2		20		20	μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V		2	10				10	pF

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



# SN54AHC04, SN74AHC04 HEX INVERTERS

SCLS234H – OCTOBER 1995 – REVISED JANUARY 2000

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ C$			SN54AHC04		SN74AHC04		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	A	Y	$C_L = 15 pF$	5*	7.1*		1*	8.5*	1	8.5	ns
$t_{PHL}$				5*	7.1*	1*	8.5*	1	8.5		
$t_{PLH}$	A	Y	$C_L = 50 pF$	7.5	10.6		1	12	1	12	ns
$t_{PHL}$				7.5	10.6	1	12	1	12		

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

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ C$			SN54AHC04		SN74AHC04		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$t_{PLH}$	A	Y	$C_L = 15 pF$	3.5*	5.5*		1*	6*	1	6.5	ns
$t_{PHL}$				3.5*	5.5*	1*	6*	1	6.5		
$t_{PLH}$	A	Y	$C_L = 50 pF$	5	7		1	8	1	8	ns
$t_{PHL}$				5	7	1	8	1	8		

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

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

PARAMETER	SN74AHC04			UNIT
	MIN	TYP	MAX	
$V_{OL(P)}$ Quiet output, maximum dynamic $V_{OL}$		0.5		V
$V_{OL(V)}$ Quiet output, minimum dynamic $V_{OL}$		-0.5		V
$V_{OH(V)}$ Quiet output, minimum dynamic $V_{OH}$		4.3		V
$V_{IH(D)}$ High-level dynamic input voltage		4		V
$V_{IL(D)}$ Low-level dynamic input voltage			1	V

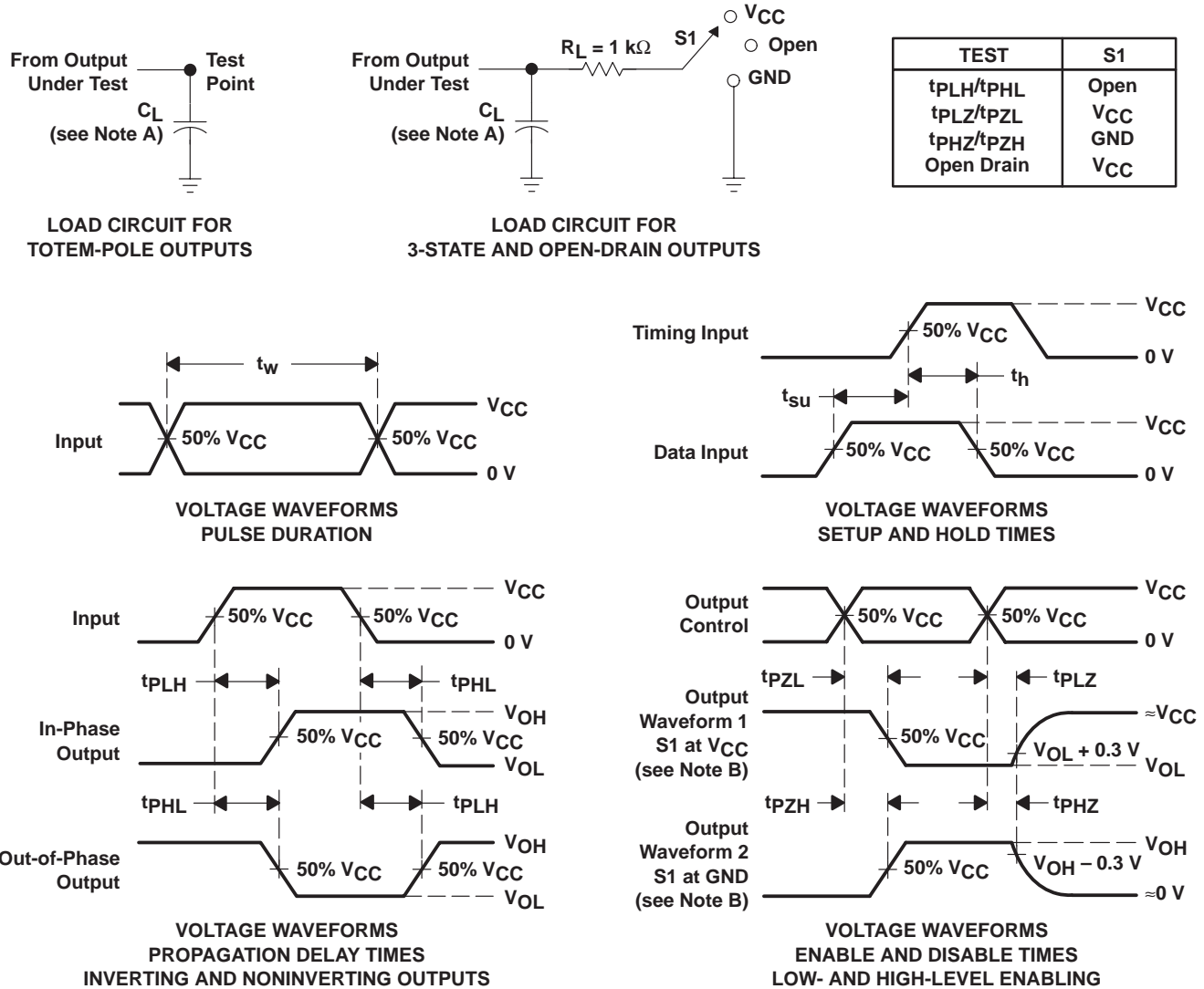
NOTE 4: Characteristics are for surface-mount packages only.

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

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	No load, $f = 1 MHz$	7.3	pF



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

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