

# SN54AHC74, SN74AHC74 DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH CLEAR AND PRESET

SCLS255G – DECEMBER 1995 – REVISED JANUARY 20000

- **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
- 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

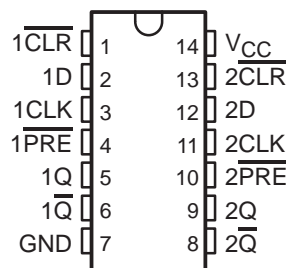
## description

The 'AHC74 dual positive-edge-triggered devices are D-type flip-flops.

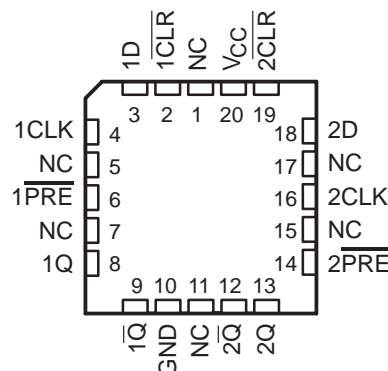
A low level at the preset ( $\overline{PRE}$ ) or clear ( $\overline{CLR}$ ) inputs sets or resets the outputs, regardless of the levels of the other inputs. When  $\overline{PRE}$  and  $\overline{CLR}$  are inactive (high), data at the data (D) input meeting the setup time requirements is transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold-time interval, data at the D input can be changed without affecting the levels at the outputs.

The SN54AHC74 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74AHC74 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54AHC74 . . . J OR W PACKAGE  
SN74AHC74 . . . D, DB, DGV, N, OR PW PACKAGE  
(TOP VIEW)



SN54AHC74 . . . FK PACKAGE  
(TOP VIEW)



NC – No internal connection



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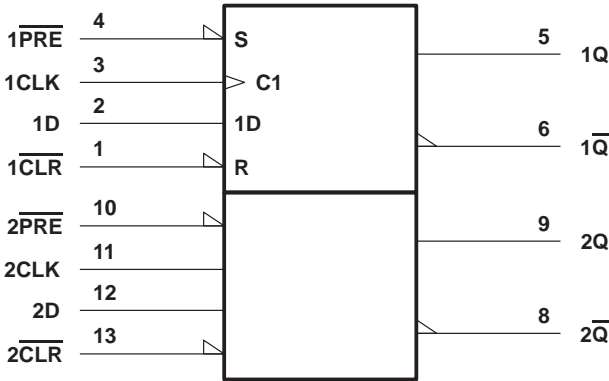
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FUNCTION TABLE  
 (each flip-flop)

INPUTS				OUTPUTS	
$\overline{\text{PRE}}$	$\overline{\text{CLR}}$	CLK	D	Q	$\overline{\text{Q}}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H <sup>†</sup>	H <sup>†</sup>
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q <sub>0</sub>	$\overline{\text{Q}}_0$

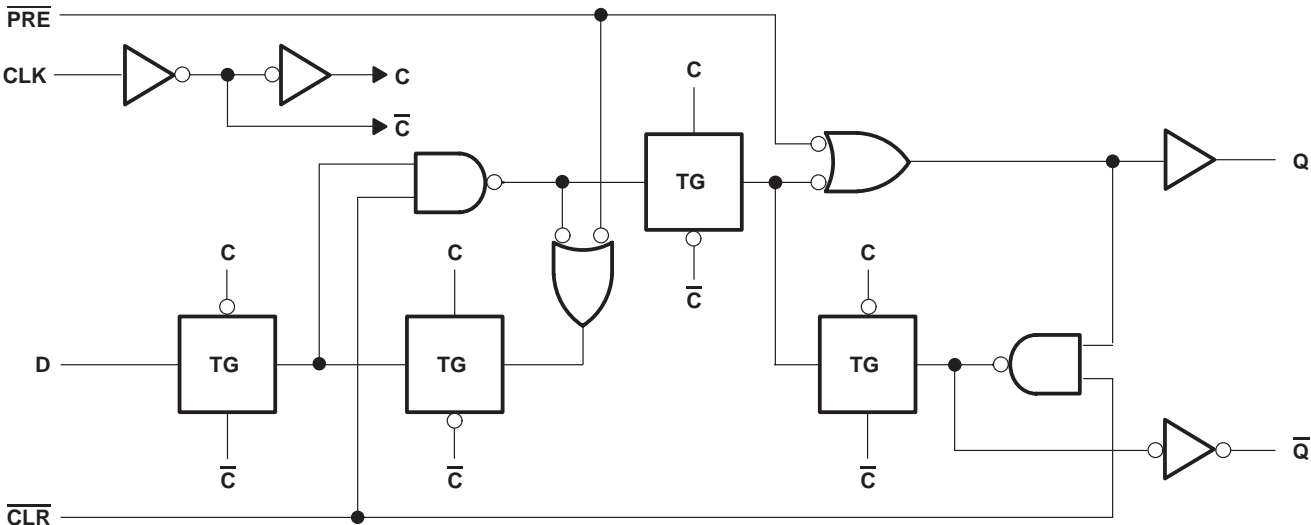
<sup>†</sup> This configuration is nonstable; that is, it does not persist when  $\overline{\text{PRE}}$  or  $\overline{\text{CLR}}$  returns to its inactive (high) level.

## logic symbol<sup>‡</sup>



<sup>‡</sup> 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, each flip-flop (positive logic)



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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

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	±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

<sup>†</sup> 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.

## recommended operating conditions (see Note 3)

			SN54AHC74		SN74AHC74		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: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.



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**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			SN54AHC74		SN74AHC74		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>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.

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

			T <sub>A</sub> = 25°C		SN54AHC74		SN74AHC74		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>w</sub>	Pulse duration	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ low	6		7		7		ns
		CLK	6		7		7		
t <sub>su</sub>	Setup time before CLK↑	Data	6		7		7		ns
		$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ inactive	5		5		5		
t <sub>h</sub>	Hold time, data after CLK↑		0.5		0.5		0.5		ns

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

			T <sub>A</sub> = 25°C		SN54AHC74		SN74AHC74		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t <sub>w</sub>	Pulse duration	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ low	5		5		5		ns
		CLK	5		5		5		
t <sub>su</sub>	Setup time before CLK↑	Data	5		5		5		ns
		$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$ inactive	3		3		3		
t <sub>h</sub>	Hold time, data after CLK↑		0.5		0.5		0.5		ns



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## DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH CLEAR AND PRESET

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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	$T_A = 25^\circ\text{C}$			SN54AHC74		SN74AHC74		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\max}$			$C_L = 15\text{ pF}$	80*	125*		70*		70		MHz
			$C_L = 50\text{ pF}$	50	75		45		45		
$t_{PLH}$	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\overline{Q}$	$C_L = 15\text{ pF}$		7.6*	12.3*	1*	14.5*	1	14.5	ns
$t_{PHL}$					7.6*	12.3*	1*	14.5*	1	14.5	
$t_{PLH}$	CLK	Q or $\overline{Q}$	$C_L = 15\text{ pF}$		6.7*	11.9*	1*	14*	1	14	ns
$t_{PHL}$					6.7*	11.9*	1*	14*	1	14	
$t_{PLH}$	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\overline{Q}$	$C_L = 50\text{ pF}$		10.1	15.8	1	18	1	18	ns
$t_{PHL}$					10.1	15.8	1	18	1	18	
$t_{PLH}$	CLK	Q or $\overline{Q}$	$C_L = 50\text{ pF}$		9.2	15.4	1	17.5	1	17.5	ns
$t_{PHL}$					9.2	15.4	1	17.5	1	17.5	

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

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54AHC74		SN74AHC74		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\max}$			$C_L = 15\text{ pF}$	130*	170*		110*		110		MHz
			$C_L = 50\text{ pF}$	90	115		75		75		
$t_{PLH}$	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\overline{Q}$	$C_L = 15\text{ pF}$		4.8*	7.7*	1*	9*	1	9	ns
$t_{PHL}$					4.8*	7.7*	1*	9*	1	9	
$t_{PLH}$	CLK	Q or $\overline{Q}$	$C_L = 15\text{ pF}$		4.6*	7.3*	1*	8.5*	1	8.5	ns
$t_{PHL}$					4.6*	7.3*	1*	8.5*	1	8.5	
$t_{PLH}$	$\overline{\text{PRE}}$ or $\overline{\text{CLR}}$	Q or $\overline{Q}$	$C_L = 50\text{ pF}$		6.3	9.7	1	11	1	11	ns
$t_{PHL}$					6.3	9.7	1	11	1	11	
$t_{PLH}$	CLK	Q or Q	$C_L = 50\text{ pF}$		6.1	9.3	1	10.5	1	10.5	ns
$t_{PHL}$					6.1	9.3	1	10.5	1	10.5	

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

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

PARAMETER		SN74AHC74		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, $f = 1\text{ MHz}$	32	pF



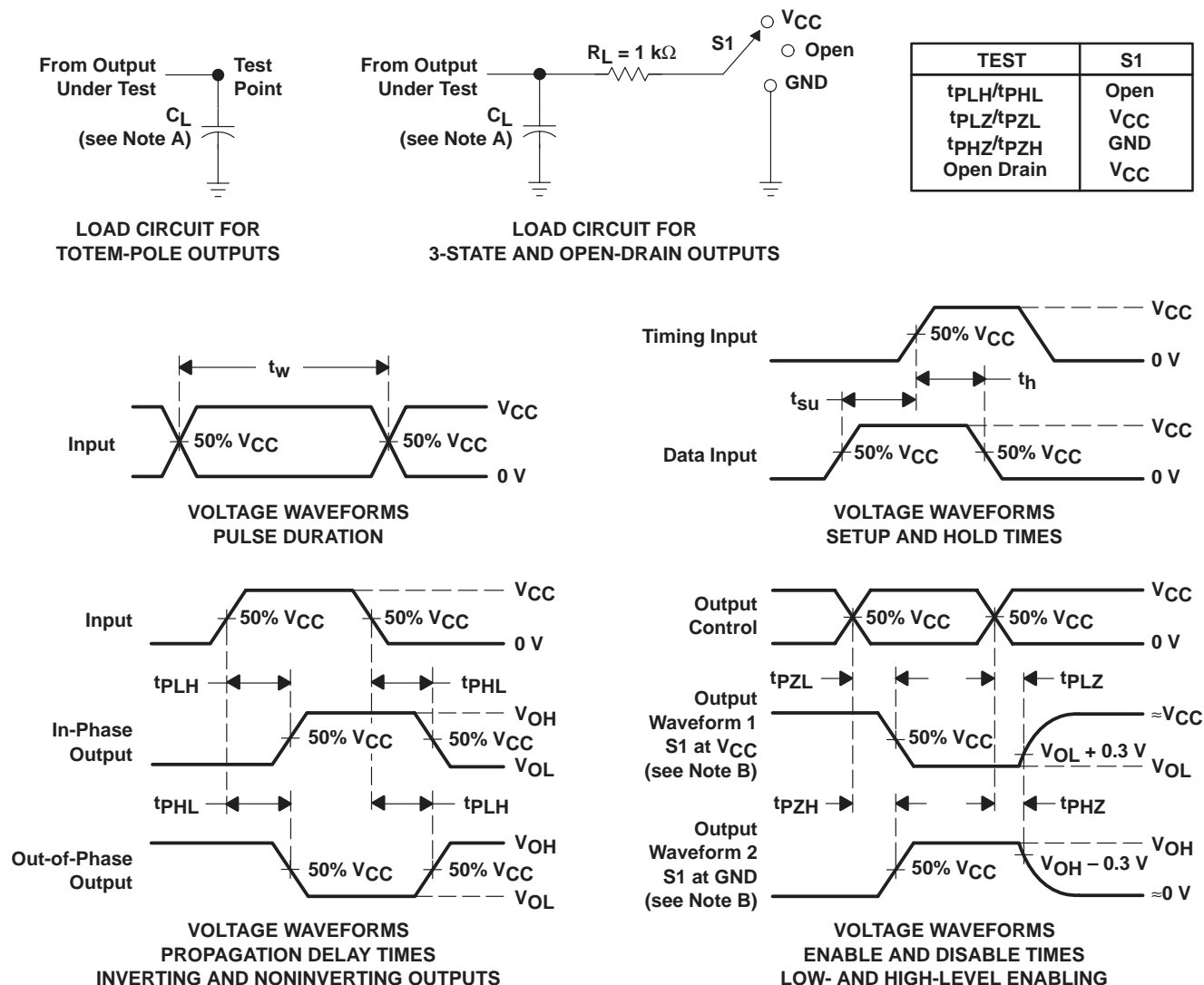
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### WITH CLEAR AND PRESET

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#### 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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