

# SN54AC374, SN74AC374 OCTAL D-TYPE EDGE-TRIGGERED FLIP-FLOPS WITH 3-STATE OUTPUTS

SCAS543B – OCTOBER 1995 - REVISED JUNE 1996

- 3-State Noninverting Outputs Drive Bus Lines Directly
- Full Parallel Access for Loading
- **EPIC™** (Enhanced-Performance Implanted CMOS) 1-μm Process
- Package Options Include Plastic Small-Outline (DW) Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages, Ceramic Chip Carriers (FK) and Flatpacks (W), and Standard Plastic (N) and Ceramic (J) DIPs

## description

These 8-bit flip-flops feature 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. The devices are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

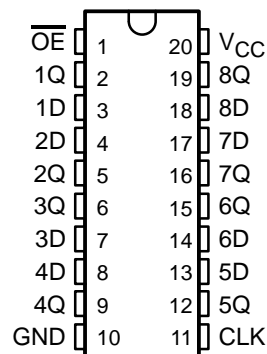
The eight flip-flops of the 'AC374 are D-type edge-triggered flip-flops. On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels set up at the data (D) inputs.

A buffered output-enable ( $\overline{OE}$ ) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased drive provide the capability to drive bus lines in bus-organized systems without need for interface or pullup components.

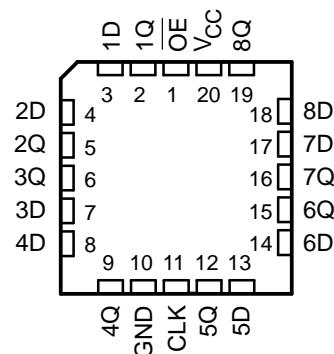
$\overline{OE}$  does not affect internal operations of the flip-flop. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

The SN54AC374 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74AC374 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54AC374 . . . J OR W PACKAGE  
SN74AC374 . . . DB, DW, N, OR PW PACKAGE  
(TOP VIEW)



SN54AC374 . . . FK PACKAGE  
(TOP VIEW)



FUNCTION TABLE  
(each flip-flop)

INPUTS			OUTPUT Q
$\overline{OE}$	CLK	D	
L	$\uparrow$	H	H
L	$\uparrow$	L	L
L	H or L	X	$Q_0$
H	X	X	Z



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**TEXAS  
INSTRUMENTS**

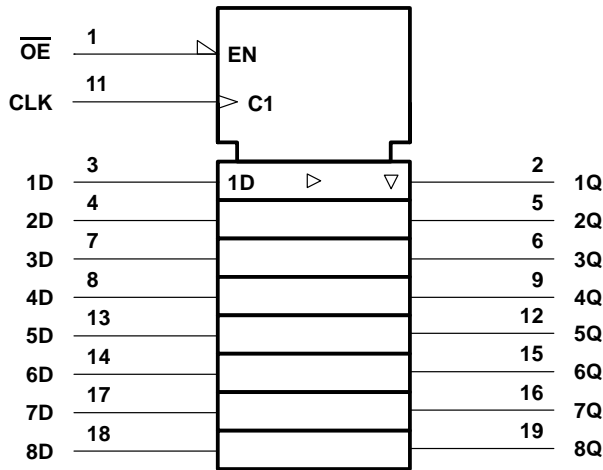
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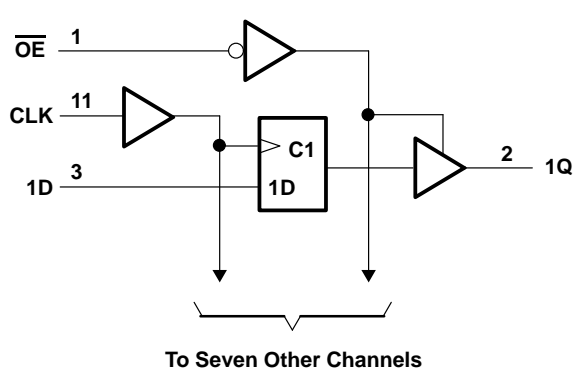
SCAS543B – OCTOBER 1995 - REVISED JUNE 1996

## 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 $V_{CC} + 0.5$ 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 $V_{CC}$ )	± 50 mA
Continuous current through $V_{CC}$ or GND	± 200 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.

# SN54AC374, SN74AC374

## OCTAL D-TYPE EDGE-TRIGGERED FLIP-FLOPS

### WITH 3-STATE OUTPUTS

SCAS543B – OCTOBER 1995 - REVISED JUNE 1996

#### recommended operating conditions (see Note 3)

			SN54AC374		SN74AC374		UNIT
			MIN	MAX	MIN	MAX	
V <sub>CC</sub>	Supply voltage		2	6	2	6	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 3 V	2.1		2.1		V
		V <sub>CC</sub> = 4.5 V	3.15		3.15		
		V <sub>CC</sub> = 5.5 V	3.85		3.85		
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 3 V		0.9		0.9	V
		V <sub>CC</sub> = 4.5 V		1.35		1.35	
		V <sub>CC</sub> = 5.5 V		1.65		1.65	
V <sub>I</sub>	Input voltage		0	V <sub>CC</sub>	0	V <sub>CC</sub>	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> = 3 V		-12		-12	mA
		V <sub>CC</sub> = 4.5 V		-24		-24	
		V <sub>CC</sub> = 5.5 V		-24		-24	
I <sub>OL</sub>	Low-level output current	V <sub>CC</sub> = 3 V		12		12	mA
		V <sub>CC</sub> = 4.5 V		24		24	
		V <sub>CC</sub> = 5.5 V		24		24	
Δt/Δv	Input transition rise or fall rate		0	8	0	8	ns/V
T <sub>A</sub>	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 <sub>CC</sub>	T <sub>A</sub> = 25°C			SN54AC374		SN74AC374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = -50 μA	3 V	2.9			2.9		2.9		V
		4.5 V	4.4			4.4		4.4		
		5.5 V	5.4			5.4		5.4		
	I <sub>OH</sub> = -12 mA	3 V	2.56			2.4		2.46		
		4.5 V	3.86			3.7		3.76		
		5.5 V	4.86			4.7		4.76		
V <sub>OL</sub>	I <sub>OL</sub> = 50 μA	3 V			0.1		0.1		0.1	V
		4.5 V			0.1		0.1		0.1	
		5.5 V			0.1		0.1		0.1	
	I <sub>OL</sub> = 12 mA	3 V			0.36		0.5		0.44	
		4.5 V			0.36		0.5		0.44	
		5.5 V			0.36		0.5		0.44	
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5 V			±0.1		±1		±1	μA
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or GND	5.5 V			±0.25		±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		80		40	μA
C <sub>i</sub>	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V		4.5						pF



# SN54AC374, SN74AC374

## OCTAL D-TYPE EDGE-TRIGGERED FLIP-FLOPS

### WITH 3-STATE OUTPUTS

SCAS543B – OCTOBER 1995 - REVISED JUNE 1996

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

		$T_A = 25^\circ\text{C}$		SN54AC374		SN74AC374		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$t_W$	Pulse duration, CLK high or low	5.5		6.5		6		ns
$t_{SU}$	Setup time, data before CLK $\uparrow$	5.5		6.5		6		ns
$t_H$	Hold time, data after CLK $\uparrow$	1		1		1		ns

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

		$T_A = 25^\circ\text{C}$		SN54AC374		SN74AC374		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$t_W$	Pulse duration, CLK high or low	4		5		4.5		ns
$t_{SU}$	Setup time, data before CLK $\uparrow$	4		5		4.5		ns
$t_H$	Hold time, data after CLK $\uparrow$	1.5		1.5		1.5		ns

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	TO (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			SN54AC374		SN74AC374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{max}$			60	110		60		60		MHz
$t_{PLH}$	CLK	Q	3	11	13.5	3	16.5	1.5	15.5	ns
$t_{PHL}$			2.5	10	12.5	3	15	2	14	
$t_{PZH}$	$\overline{OE}$	Q	3	9.5	11.5	1	14	1.5	13	ns
$t_{PZL}$			3.5	9	11.5	1	14	1.5	13	
$t_{PHZ}$	$\overline{OE}$	Q	3	10.5	12.5	1	16	2	14.5	ns
$t_{PLZ}$			2	8	11.5	1	13	1	12.5	

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	TO (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$			SN54AC374		SN74AC374		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{max}$			100	155		95		100		MHz
$t_{PLH}$	CLK	Q	2.5	8	9.5	3	12	1.5	10.5	ns
$t_{PHL}$			2	7	9	3	11	1.5	10	
$t_{PZH}$	$\overline{OE}$	Q	2	7	8.5	1.5	10	1	9.5	ns
$t_{PZL}$			2	6.5	8.5	1.5	10.5	1	9.5	
$t_{PHZ}$	$\overline{OE}$	Q	2	8	11	1.5	12.5	2	12.5	ns
$t_{PLZ}$			1.5	6.5	8.5	1.5	10.5	1	10	

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

PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{pd}$ Power dissipation capacitance	$C_L = 50\text{ pF}$ , $f = 1\text{ MHz}$	40	pF

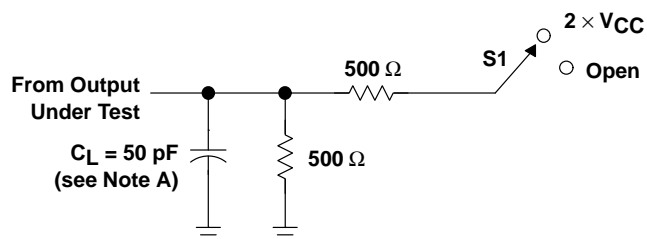


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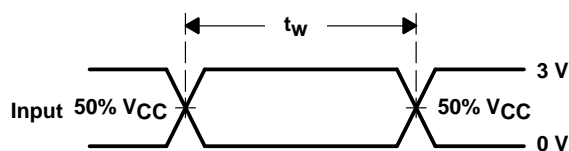
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## PARAMETER MEASUREMENT INFORMATION

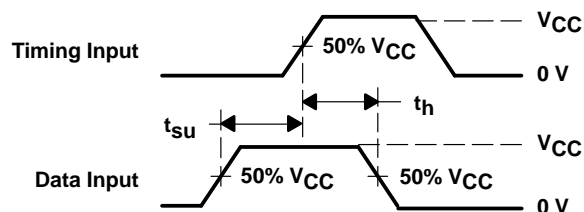


LOAD CIRCUIT

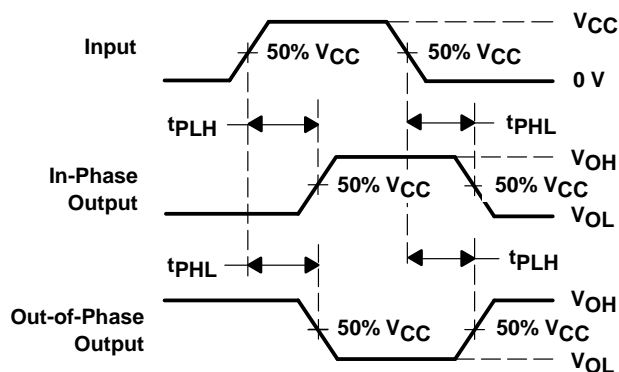
TEST	S1
$t_{PLH}/t_{PHL}$	Open
$t_{PLZ}/t_{PZL}$	$2 \times V_{CC}$
$t_{PHZ}/t_{PZH}$	Open



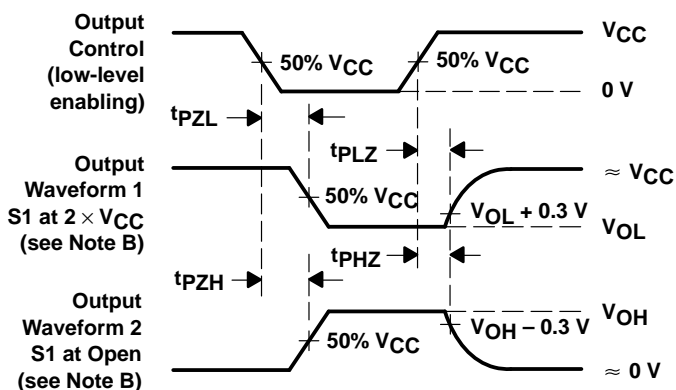
VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS



VOLTAGE WAVEFORMS

- NOTES:
- $C_L$  includes probe and jig capacitance.
  - 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.
  - All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .
  - 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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