

# SN54HC374, SN74HC374

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

### WITH 3-STATE OUTPUTS

SCLS141C – DECEMBER 1982 – REVISED JULY 1998

- Eight D-Type Flip-Flops in a Single Package
- High-Current 3-State True Outputs Can Drive up to 15 LSTTL Loads
- Full Parallel Access for Loading
- Package Options Include Plastic Shrink Small-Outline (DB), Small-Outline (DW), Thin Shrink Small-Outline (PW), and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), 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. They are particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The eight flip-flops of the 'HC374 devices are edge-triggered D-type flip-flops. On the positive transition of the clock (CLK) input, the Q outputs are set to the logic levels that were set up at the data (D) inputs.

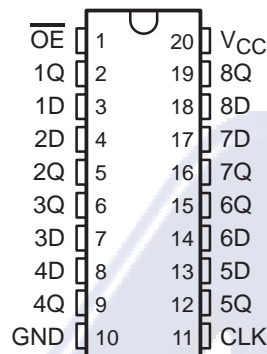
An output-enable ( $\overline{OE}$ ) input places the eight outputs in either a normal logic state (high or low logic levels) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and increased drive provide the capability to drive bus lines without interface or pullup components.

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

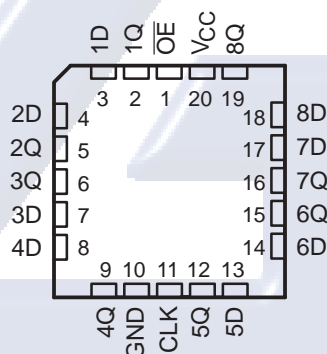
To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54HC374 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74HC374 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

SN54HC374 . . . J OR W PACKAGE  
SN74HC374 . . . DB, DW, N, OR PW PACKAGE  
(TOP VIEW)



SN54HC374 . . . 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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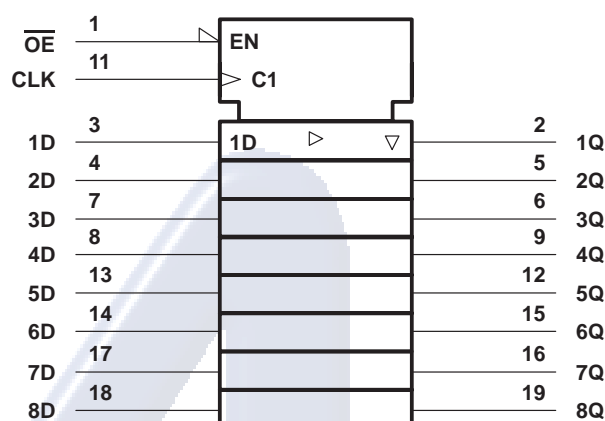
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### WITH 3-STATE OUTPUTS

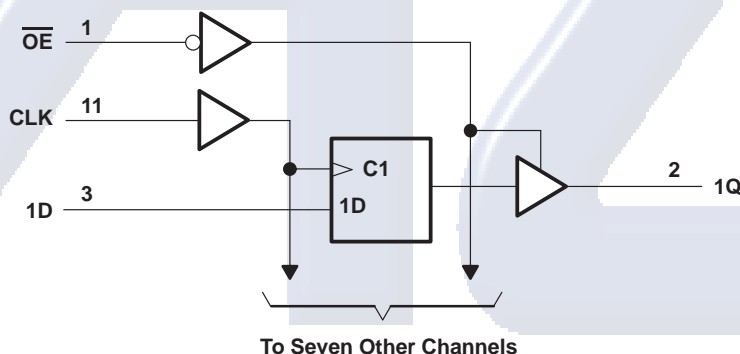
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#### logic symbol†



† 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 clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ ) (see Note 1)	±20 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 1)	±20 mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )	±35 mA
Continuous current through $V_{CC}$ or GND	±70 mA
Package thermal impedance, $\theta_{JA}$ (see Note 2): DB package	115°C/W
DW package	97°C/W
N package	67°C/W
PW package	128°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 JEDEC 51, except for through-hole packages, which use a trace length of zero.

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

			SN54HC374			SN74HC374			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V <sub>CC</sub>	Supply voltage		2	5	6	2	5	6	V
V <sub>IH</sub>	High-level input voltage	V <sub>CC</sub> = 2 V	1.5			1.5			V
		V <sub>CC</sub> = 4.5 V	3.15			3.15			
		V <sub>CC</sub> = 6 V	4.2			4.2			
V <sub>IL</sub>	Low-level input voltage	V <sub>CC</sub> = 2 V	0		0.5	0		0.5	V
		V <sub>CC</sub> = 4.5 V	0		1.35	0		1.35	
		V <sub>CC</sub> = 6 V	0		1.8	0		1.8	
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
t <sub>t</sub>	Input transition (rise and fall) time	V <sub>CC</sub> = 2 V	0		1000	0		1000	ns
		V <sub>CC</sub> = 4.5 V	0		500	0		500	
		V <sub>CC</sub> = 6 V	0		400	0		400	
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			SN54HC374		SN74HC374		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = –20 µA	2 V	1.9	1.998		1.9		1.9		V
			4.5 V	4.4	4.499		4.4		4.4		
			6 V	5.9	5.999		5.9		5.9		
		I <sub>OH</sub> = –6 mA	4.5 V	3.98	4.3		3.7		3.84		
		I <sub>OH</sub> = –7.8 mA	6 V	5.48	5.8		5.2		5.34		
V <sub>OL</sub>	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 20 µA	2 V		0.002	0.1		0.1		0.1	V
			4.5 V		0.001	0.1		0.1		0.1	
			6 V		0.001	0.1		0.1		0.1	
		I <sub>OL</sub> = 6 mA	4.5 V		0.17	0.26		0.4		0.33	
		I <sub>OL</sub> = 7.8 mA	6 V		0.15	0.26		0.4		0.33	
I <sub>I</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0		6 V		±0.1	±100		±1000		±1000	nA
I <sub>OZ</sub>	V <sub>O</sub> = V <sub>CC</sub> or 0		6 V		±0.01	±0.5		±10		±5	µA
I <sub>CC</sub>	V <sub>I</sub> = V <sub>CC</sub> or 0, I <sub>O</sub> = 0		6 V			8		160		80	µA
C <sub>i</sub>			2 V to 6 V		3	10		10		10	pF



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**timing requirements over recommended operating free-air temperature range (unless otherwise noted)**

	$V_{CC}$	$T_A = 25^\circ\text{C}$		SN54HC374		SN74HC374		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$f_{\text{clock}}$ Clock frequency	2 V		6		4		5	MHz
	4.5 V		30		20		24	
	6 V		35		24		28	
$t_W$ Pulse duration, CLK high or low	2 V		80		120		100	ns
	4.5 V		16		24		20	
	6 V		14		20		17	
$t_{\text{su}}$ Setup time, data before CLK $\uparrow$	2 V		100		150		125	ns
	4.5 V		20		30		25	
	6 V		17		25		21	
$t_h$ Hold time, data after CLK $\uparrow$	2 V		10		13		12	ns
	4.5 V		5		5		5	
	6 V		5		5		5	

**switching characteristics over recommended operating free-air temperature range,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC374		SN74HC374		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\text{max}}$			2 V	6	12		4		5		MHz
			4.5 V	30	60		20		24		
			6 V	35	70		24		28		
$t_{\text{pd}}$	CLK	Any Q	2 V		63	180		270		225	ns
			4.5 V		17	36		54		45	
			6 V		15	31		46		38	
$t_{\text{en}}$	$\overline{\text{OE}}$	Any Q	2 V		60	150		225		190	ns
			4.5 V		16	30		45		38	
			6 V		14	26		38		32	
$t_{\text{dis}}$	$\overline{\text{OE}}$	Any Q	2 V		36	150		225		190	ns
			4.5 V		17	30		45		38	
			6 V		16	26		38		32	
$t_t$		Any Q	2 V		28	60		90		75	ns
			4.5 V		8	12		18		15	
			6 V		6	10		15		13	



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switching characteristics over recommended operating free-air temperature range,  $C_L = 150 \text{ pF}$  (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC}$	$T_A = 25^\circ\text{C}$			SN54HC374		SN74HC374		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
$f_{\max}$			2 V	6	12				5		MHz
			4.5 V	30	60				24		
			6 V	35	70				28		
$t_{pd}$	CLK	Any Q	2 V		80	230		345		290	ns
			4.5 V		22	46		69		58	
			6 V		19	39		58		49	
$t_{en}$	$\overline{OE}$	Any Q	2 V		70	200		300		250	ns
			4.5 V		25	40		60		50	
			6 V		22	34		51		43	
$t_t$		Any Q	2 V		45	210		315		265	ns
			4.5 V		17	42		63		53	
			6 V		13	36		53		45	

operating characteristics,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	TYP	UNIT
$C_{pd}$	Power dissipation capacitance per flip-flop	No load	100	pF

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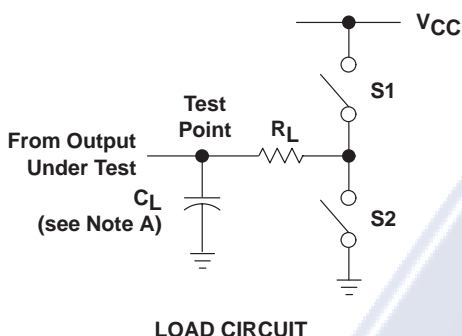
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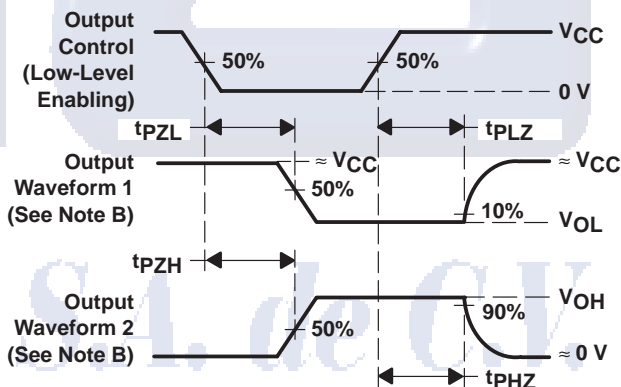
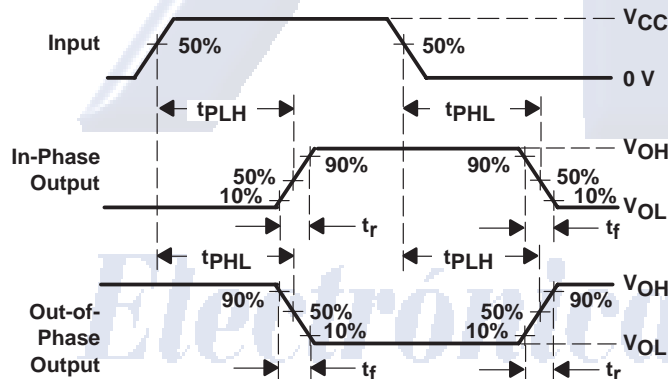
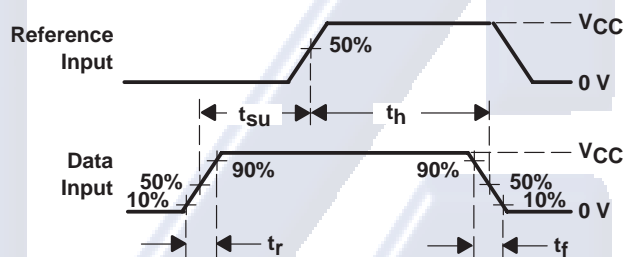
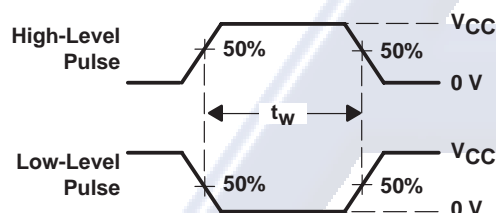
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#### PARAMETER MEASUREMENT INFORMATION



PARAMETER	$R_L$	$C_L$	S1	S2
$t_{en}$	1 k $\Omega$	50 pF or 150 pF	Open	Closed
			Closed	Open
$t_{dis}$	1 k $\Omega$	50 pF	Open	Closed
			Closed	Open
$t_{pd}$ or $t_t$	—	50 pF or 150 pF	Open	Open



- NOTES:
- $C_L$  includes probe and test-fixture 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.
  - Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_O = 50 \Omega$ ,  $t_r = 6$  ns,  $t_f = 6$  ns.
  - For clock inputs,  $f_{max}$  is measured when the input duty cycle is 50%.
  - The outputs are measured one at a time with one input transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

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