

SN54LV374A, SN74LV374A OCTAL EDGE-TRIGGERED D-TYPE FLIP-FLOPS WITH 3-STATE OUTPUTS

SCLS408A – APRIL 1998 – REVISED JUNE 1998

- **EPIC™ (Enhanced-Performance Implanted CMOS) Process**
- **Typical V_{OLP} (Output Ground Bounce) $< 0.8\text{ V}$ at V_{CC} , $T_A = 25^\circ\text{C}$**
- **Typical V_{OHV} (Output V_{OH} Undershoot) $> 2\text{ V}$ at V_{CC} , $T_A = 25^\circ\text{C}$**
- **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 ($C = 200\text{ pF}$, $R = 0$)**
- **Package Options Include Plastic Small-Outline (DW, NS), Shrink Small-Outline (DB), Thin Very Small-Outline (DGV), and Thin Shrink Small-Outline (PW) Packages, Ceramic Flat (W) Packages, Chip Carriers (FK), and DIPs (J)**

description

The 'LV374A devices are octal edge-triggered D-type flip-flops designed for 2-V to 5.5-V V_{CC} operation.

These devices 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.

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.

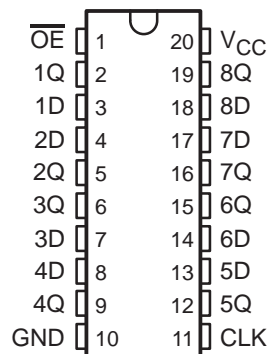
A buffered output-enable (\overline{OE}) input can be used to place the eight outputs in either a normal logic state (high or low logic levels) or high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased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

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

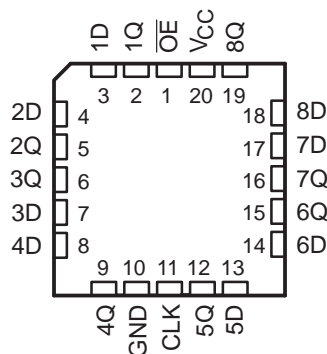
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN54LV374A is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LV374A is characterized for operation from -40°C to 85°C .

SN54LV374A . . . J OR W PACKAGE
SN74LV374A . . . DB, DGV, DW, NS, OR PW PACKAGE
(TOP VIEW)



SN54LV374A . . . FK PACKAGE
(TOP VIEW)



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**TEXAS
INSTRUMENTS**

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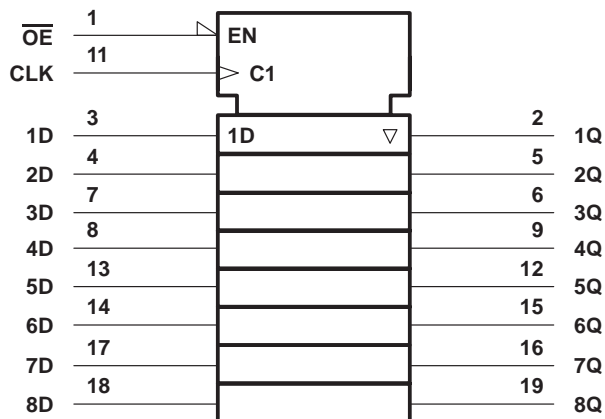
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FUNCTION TABLE
(each flip-flop)

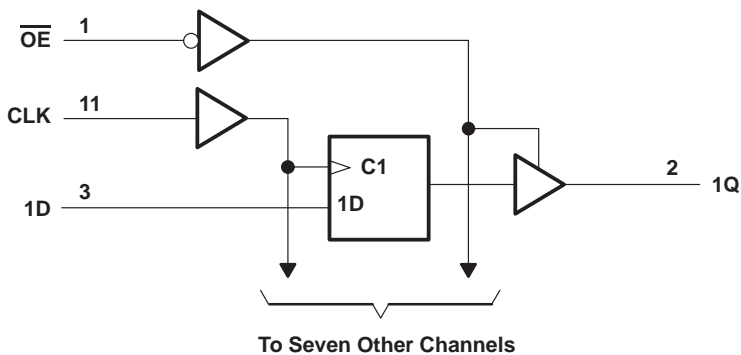
INPUTS			OUTPUT
\overline{OE}	CLK	D	Q
L	↑	H	H
L	↑	L	L
L	L	X	Q_0
H	X	X	Z

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



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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 Notes 1 and 2)	–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 $V_O > V_{CC}$)	±50 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, θ_{JA} (see Note 3):	
DB package	115°C/W
DGV package	146°C/W
DW package	97°C/W
NS package	100°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. This value is limited to 7 V maximum.
 3. The package thermal impedance is calculated in accordance with JESD 51.

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recommended operating conditions (see Note 4)

		SN54LV374A		SN74LV374A		UNIT	
		MIN	MAX	MIN	MAX		
V_{CC}	Supply voltage	2	5.5	2	5.5	V	
V_{IH}	High-level input voltage	$V_{CC} = 2\text{ V}$	1.5	1.5		V	
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	$V_{CC} \times 0.7$	$V_{CC} \times 0.7$			
		$V_{CC} = 3\text{ V to }3.6\text{ V}$	$V_{CC} \times 0.7$	$V_{CC} \times 0.7$			
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	$V_{CC} \times 0.7$	$V_{CC} \times 0.7$			
V_{IL}	Low-level input voltage	$V_{CC} = 2\text{ V}$		0.5	0.5	V	
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$		$V_{CC} \times 0.3$	$V_{CC} \times 0.3$		
		$V_{CC} = 3\text{ V to }3.6\text{ V}$		$V_{CC} \times 0.3$	$V_{CC} \times 0.3$		
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$		$V_{CC} \times 0.3$	$V_{CC} \times 0.3$		
V_I	Input voltage	0	5.5	0	5.5	V	
V_O	Output voltage	High or low state	0	V_{CC}	0	V_{CC}	V
		3-state	0	5.5	0	5.5	
I_{OH}	High-level output current	$V_{CC} = 2\text{ V}$		-50	-50	μA	
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$		-2	-2		
		$V_{CC} = 3\text{ V to }3.6\text{ V}$		-8	-8	mA	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$		-16	-16		
I_{OL}	Low-level output current	$V_{CC} = 2\text{ V}$		50	50	μA	
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$		2	2		
		$V_{CC} = 3\text{ V to }3.6\text{ V}$		8	8	mA	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$		16	16		
$\Delta t/\Delta v$	Input transition rise or fall rate	$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0	200	0	200	ns/V
		$V_{CC} = 3\text{ V to }3.6\text{ V}$	0	100	0	100	
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	0	20	0	20	
T_A	Operating free-air temperature	-55	125	-40	85	$^{\circ}\text{C}$	

NOTE 4: 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.

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

PARAMETER	TEST CONDITIONS	V_{CC}	SN54LV374A			SN74LV374A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OH}	$I_{OH} = -50\ \mu\text{A}$	2 V to 5.5 V	$V_{CC}-0.1$			$V_{CC}-0.1$			V
	$I_{OH} = -2\ \text{mA}$	2.3 V	2			2			
	$I_{OH} = -8\ \text{mA}$	3 V	2.48			2.48			
	$I_{OH} = -16\ \text{mA}$	4.5 V	3.8			3.8			
V_{OL}	$I_{OL} = 50\ \mu\text{A}$	2 V to 5.5 V				0.1			V
	$I_{OL} = 2\ \text{mA}$	2.3 V				0.4			
	$I_{OL} = 8\ \text{mA}$	3 V				0.44			
	$I_{OL} = 16\ \text{mA}$	4.5 V				0.55			
I_I	$V_I = V_{CC}$ or GND	5.5 V				± 1			μA
I_{OZ}	$V_O = V_{CC}$ or GND	5.5 V				± 5			μA
I_{CC}	$V_I = V_{CC}$ or GND, $I_O = 0$	5.5 V				20			μA
I_{off}	V_I or $V_O = 0$ to 5.5 V	0 V				5			μA
C_i	$V_I = V_{CC}$ or GND	3.3 V	2.9			2.9			pF

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timing requirements over recommended operating free-air temperature range, $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted) (see Figure 1)

		$T_A = 25^\circ\text{C}$		SN54LV374A		SN74LV374A		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration, CLK high or low	6		7		7		ns
t_{su}	Setup time, data before CLK \uparrow	5		5.5		5.5		ns
t_h	Hold time, data after CLK \uparrow	2.5		2.5		2.5		ns

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)

		$T_A = 25^\circ\text{C}$		SN54LV374A		SN74LV374A		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration, CLK high or low	5		5.5		5.5		ns
t_{su}	Setup time, data before CLK \uparrow	4		4		4		ns
t_h	Hold time, data after CLK \uparrow	2		2		2		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)

		$T_A = 25^\circ\text{C}$		SN54LV374A		SN74LV374A		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration, CLK high or low	5		5		5		ns
t_{su}	Setup time, data before CLK \uparrow	3		3		3		ns
t_h	Hold time, data after CLK \uparrow	2		2		2		ns

switching characteristics over recommended operating free-air temperature range, $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	$T_A = 25^\circ\text{C}$			SN54LV374A		SN74LV374A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}^*$	60	105		50		50	MHz	
			$C_L = 50\text{ pF}$	50	85		40		40		
t_{pd}^*	CLK	Q	$C_L = 15\text{ pF}$	9.7	16.3		1	19	1	19	ns
t_{en}^*	\overline{OE}	Q		8.9	15.9		1	19	1	19	
t_{dis}^*	\overline{OE}	Q		6.3	12.6		1	15	1	15	
t_{pd}	CLK	Q	$C_L = 50\text{ pF}$	11.8	19.3		1	23	1	23	ns
t_{en}	\overline{OE}	Q		10.9	18.8		1	22	1	22	
t_{dis}	\overline{OE}	Q		8.2	17.3		1	19	1	19	
$t_{sk(o)}^\dagger$						2				2	

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

† Skew between any two outputs of the same package switching in the same direction

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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	$T_A = 25^\circ\text{C}$			SN54LV374A		SN74LV374A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}^*$	80	150		70		70		MHz
			$C_L = 50\text{ pF}$	55	110		50		50		
t_{pd}^*	CLK	Q	$C_L = 15\text{ pF}$		6.8	12.7	1	15	1	15	ns
t_{en}^*	$\overline{\text{OE}}$	Q			6.3	11	1	13	1	13	
t_{dis}^*	$\overline{\text{OE}}$	Q			4.7	10.5	1	12.5	1	12.5	
t_{pd}	CLK	Q	$C_L = 50\text{ pF}$		8.3	16.2	1	18.5	1	18.5	ns
t_{en}	$\overline{\text{OE}}$	Q			7.7	14.5	1	16.5	1	16.5	
t_{dis}	$\overline{\text{OE}}$	Q			5.9	14	1	16	1	16	
$t_{\text{sk(o)}}^\dagger$							1.5			1.5	

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

† Skew between any two outputs of the same package switching in the same direction

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	$T_A = 25^\circ\text{C}$			SN54LV374A		SN74LV374A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}^*$	130	205		110		110		MHz
			$C_L = 50\text{ pF}$	85	170		75		75		
t_{pd}^*	CLK	Q	$C_L = 15\text{ pF}$		4.9	8.1	1	9.5	1	9.5	ns
t_{en}^*	$\overline{\text{OE}}$	Q			4.6	7.6	1	9	1	9	
t_{dis}^*	$\overline{\text{OE}}$	Q			3.4	6.8	1	8	1	8	
t_{pd}	CLK	Q	$C_L = 50\text{ pF}$		5.9	10.1	1	11.5	1	11.5	ns
t_{en}	$\overline{\text{OE}}$	Q			5.5	9.6	1	11	1	11	
t_{dis}	$\overline{\text{OE}}$	Q			4	8.8	1	10	1	10	
$t_{\text{sk(o)}}^\dagger$							1			1	

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

† Skew between any two outputs of the same package switching in the same direction

noise characteristics, $V_{CC} = 3.3\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$ (see Note 5)

PARAMETER		SN74LV374A			UNIT
		MIN	TYP	MAX	
$V_{\text{OL(P)}}$	Quiet output, maximum dynamic V_{OL}		0.57	0.8	V
$V_{\text{OL(V)}}$	Quiet output, minimum dynamic V_{OL}		-0.53	-0.8	V
$V_{\text{OH(V)}}$	Quiet output, minimum dynamic V_{OH}		2.88		V
$V_{\text{IH(D)}}$	High-level dynamic input voltage		2.31		V
$V_{\text{IL(D)}}$	Low-level dynamic input voltage			0.99	V

NOTE 5: Characteristics are for surface-mount packages only.

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

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT	
C_{pd}	Power dissipation capacitance	Outputs enabled	$C_L = 50\text{ pF}$, $f = 10\text{ MHz}$	3.3 V	21.1	pF
				5 V	22.8	

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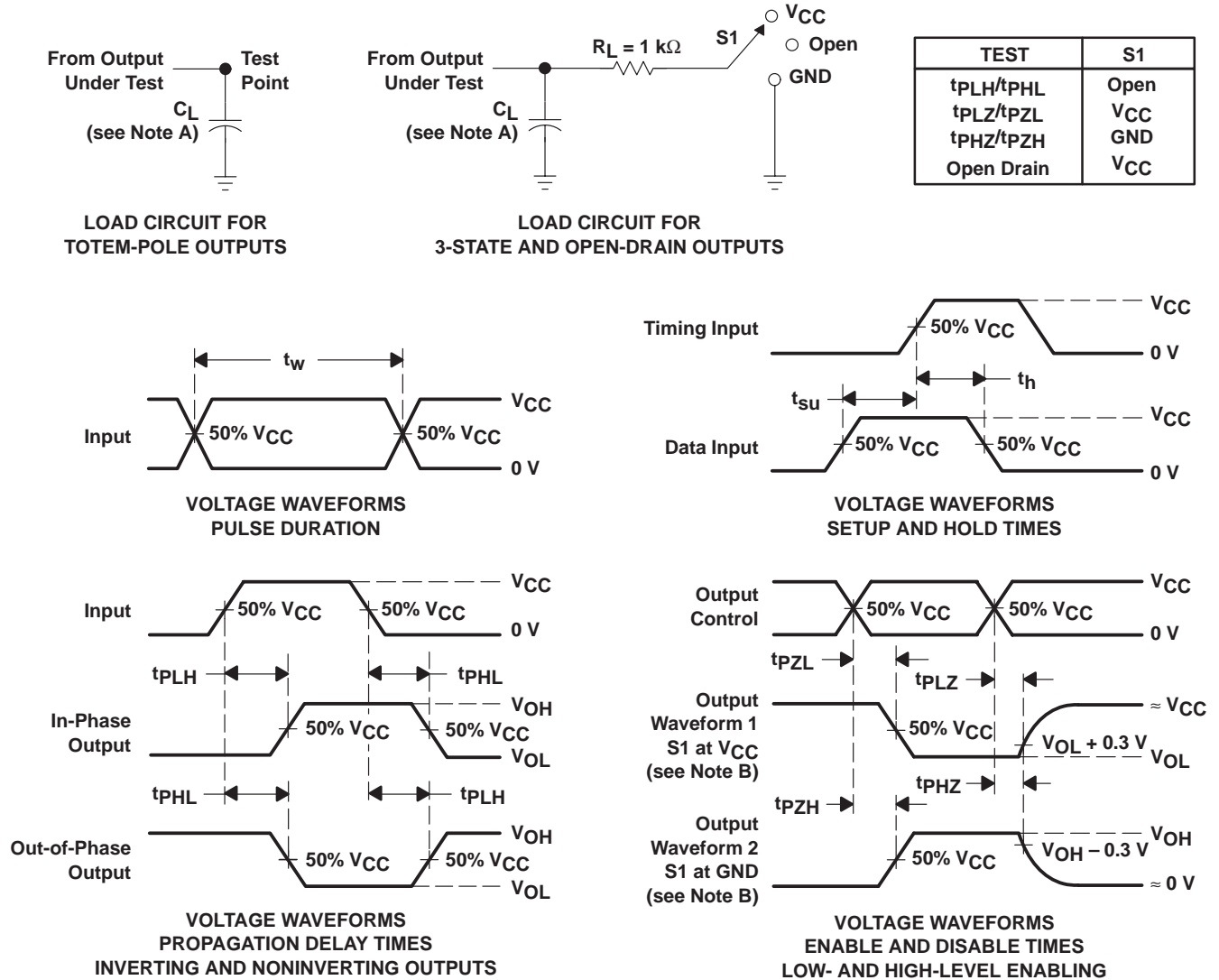


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PARAMETER MEASUREMENT INFORMATION



- 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.
 - E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - F. t_{PZL} and t_{PZH} are the same as t_{en} .
 - G. t_{PHL} and t_{PLH} are the same as t_{pd} .

Figure 1. Load Circuit and Voltage Waveforms

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