

SN54LV174A, SN74LV174A HEX D-TYPE FLIP-FLOPS WITH CLEAR

SCLS401C – APRIL 1998 – REVISED MAY 2000

- **EPIC™ (Enhanced-Performance Implanted CMOS) Process**
- **Typical V_{OLP} (Output Ground Bounce) <0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$**
- **Typical V_{OHV} (Output V_{OH} Undershoot) >2.3 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$**
- **2-V to 5.5-V V_{CC} Operation**
- **Support Mixed-Mode Voltage Operation on All Ports**
- **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, 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)**

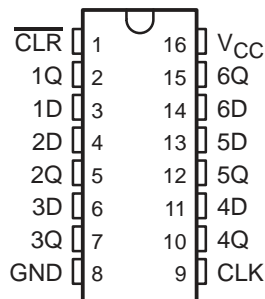
description

The 'LV174A devices are hex D-type flip-flops designed for 2-V to 5.5-V V_{CC} operation.

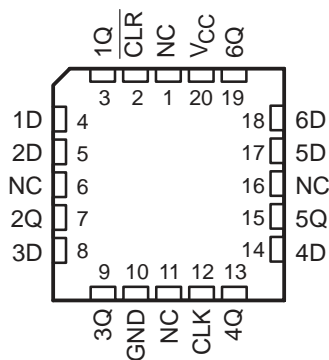
These devices are monolithic positive-edge-triggered flip-flops with a direct clear ($\overline{\text{CLR}}$) input. Information at the data (D) inputs meeting the setup time requirements is transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going edge of the clock pulse. When the clock (CLK) input is at either the high or low level, the D-input signal has no effect at the output.

The SN54LV174A is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74LV174A is characterized for operation from -40°C to 85°C .

SN54LV174A . . . J OR W PACKAGE
SN74LV174A . . . D, DB, DGV, NS, OR PW PACKAGE
(TOP VIEW)



SN54LV174A . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

FUNCTION TABLE

INPUTS			OUTPUT
$\overline{\text{CLR}}$	CLK	D	Q
L	X	X	L
H	\uparrow	H	H
H	\uparrow	L	L
H	L	X	Q_0



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 **TEXAS
INSTRUMENTS**

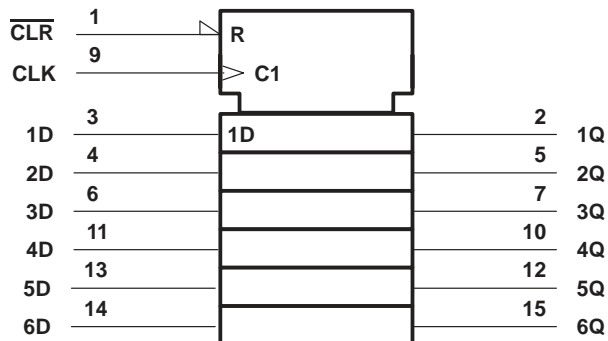
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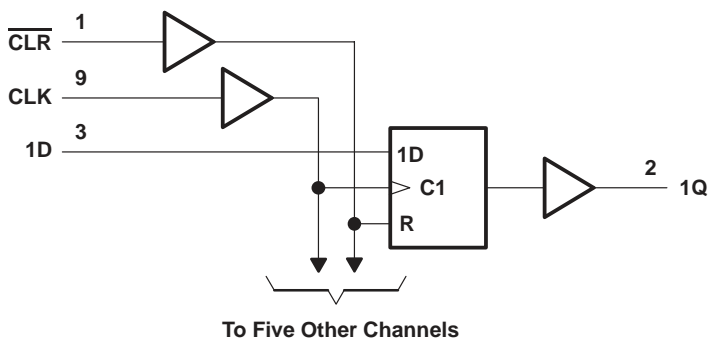
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logic symbol†



† 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, NS, PW, and W packages.

logic diagram (positive logic)



Pin numbers shown are for the D, DB, DGV, J, NS, PW, and W packages.

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
Voltage range applied to any output in the high-impedance or power-off state, V_O (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} ($V_I < 0$)	-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})	± 25 mA
Continuous current through V_{CC} or GND	± 50 mA
Package thermal impedance, θ_{JA} (see Note 3): D package	73°C/W
DB package	82°C/W
DGV package	120°C/W
NS package	64°C/W
PW package	108°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 5.5 V maximum.
3. The package thermal impedance is calculated in accordance with JESD 51.

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recommended operating conditions (see Note 4)

		SN54LV174A		SN74LV174A		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	0	V_{CC}	0	V_{CC}	V	
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	mA	
		$V_{CC} = 3\text{ V to }3.6\text{ V}$		-6	-6		
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$		-12	-12		
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	mA	
		$V_{CC} = 3\text{ V to }3.6\text{ V}$		6	6		
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$		12	12		
$\Delta t/\Delta v$	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}	SN54LV174A			SN74LV174A			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			
	$I_{OH} = -6\ \text{mA}$	3 V	2.48			2.48			
	$I_{OH} = -12\ \text{mA}$	4.5 V	3.8			3.8			
V_{OL}	$I_{OL} = 50\ \mu\text{A}$	2 V to 5.5 V	0.1			0.1			V
	$I_{OL} = 2\ \text{mA}$	2.3 V	0.4			0.4			
	$I_{OL} = 6\ \text{mA}$	3 V	0.44			0.44			
	$I_{OL} = 12\ \text{mA}$	4.5 V	0.55			0.55			
I_I	$V_I = V_{CC}$ or GND	0 V to 5.5 V	± 1			± 1			μA
I_{CC}	$V_I = V_{CC}$ or GND, $I_O = 0$	5.5 V	20			20			μA
I_{off}	V_I or $V_O = 0$ to 5.5 V	0 V	5			5			μA
C_i	$V_I = V_{CC}$ or GND	3.3 V	1.7			1.7			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)

			$T_A = 25^\circ\text{C}$			SN54LV174A		SN74LV174A		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration	$\overline{\text{CLR}}$ low	6			6.5		6.5	ns	
		CLK high or low	7			7		7		
t_{su}	Setup time before $\text{CLK}\uparrow$	Data	8.5			9.5		9.5	ns	
		$\overline{\text{CLR}}$ inactive	4			4		4		
t_h	Hold time, data after $\text{CLK}\uparrow$		-0.5			0		0	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)

			$T_A = 25^\circ\text{C}$			SN54LV174A		SN74LV174A		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration	$\overline{\text{CLR}}$ low	5			5		5	ns	
		CLK high or low	5			5		5		
t_{su}	Setup time before $\text{CLK}\uparrow$	Data	5			6		6	ns	
		$\overline{\text{CLR}}$ inactive	3			3		3		
t_h	Hold time, data after $\text{CLK}\uparrow$		0			0		0	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)

			$T_A = 25^\circ\text{C}$			SN54LV174A		SN74LV174A		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration	$\overline{\text{CLR}}$ low	5			5		5	ns	
		CLK high or low	5			5		5		
t_{su}	Setup time before $\text{CLK}\uparrow$	Data	4.5			4.5		4.5	ns	
		$\overline{\text{CLR}}$ inactive	2.5			2.5		2.5		
t_h	Hold time, data after $\text{CLK}\uparrow$		0.5			0.5		0.5	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	$T_A = 25^\circ\text{C}$			SN54LV174A		SN74LV174A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}$	55*	115*		50*		50	MHz	
			$C_L = 50\text{ pF}$	45	90		40		40		
t_{pd}	$\overline{\text{CLR}}$	Q	$C_L = 15\text{ pF}$		6.3*	17.3*	1*	19.5*	1	19.5	ns
	CLK				8.4*	17.1*	1*	19*	1	19	
t_{pd}	$\overline{\text{CLR}}$	Q	$C_L = 50\text{ pF}$		8.2	21.9	1	23.5	1	23.5	ns
	CLK				10.8	20.6	1	23	1	23	
$t_{sk(o)}$						2			2	ns	

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

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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	$T_A = 25^\circ\text{C}$			SN54LV174A		SN74LV174A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}$	95*	170*		80*		80		MHz
			$C_L = 50\text{ pF}$	55	130		50		50		
t_{pd}	$\overline{\text{CLR}}$	Q	$C_L = 15\text{ pF}$		4.5*	11.4*	1*	13.5*	1	13.5	ns
	CLK				5.8*	11*	1*	13*	1	13	
t_{pd}	$\overline{\text{CLR}}$	Q	$C_L = 50\text{ pF}$		6	14.9	1	17	1	17	ns
	CLK				7.5	14.5	1	16.5	1	16.5	
$t_{\text{sk(o)}}$						1.5				1.5	

* 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	$T_A = 25^\circ\text{C}$			SN54LV174A		SN74LV174A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			$C_L = 15\text{ pF}$	130*	240*		110*		110		MHz
			$C_L = 50\text{ pF}$	90	180		80		80		
t_{pd}	$\overline{\text{CLR}}$	Q	$C_L = 15\text{ pF}$		3*	7.6*	1*	9*	1	9	ns
	CLK				4.1*	7.2*	1*	8.5*	1	8.5	
t_{pd}	$\overline{\text{CLR}}$	Q	$C_L = 50\text{ pF}$		4.2	9.6	1	11	1	11	ns
	CLK				5.5	9.2	1	10.5	1	10.5	
$t_{\text{sk(o)}}$						1				1	

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

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

PARAMETER		SN74LV174A			UNIT
		MIN	TYP	MAX	
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		0.34	0.8	V
$V_{OL(V)}$	Quiet output, minimum dynamic V_{OL}		-0.3	-0.8	V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}		3.02		V
$V_{IH(D)}$	High-level dynamic input voltage		2.31		V
$V_{IL(D)}$	Low-level dynamic input voltage			0.99	V

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

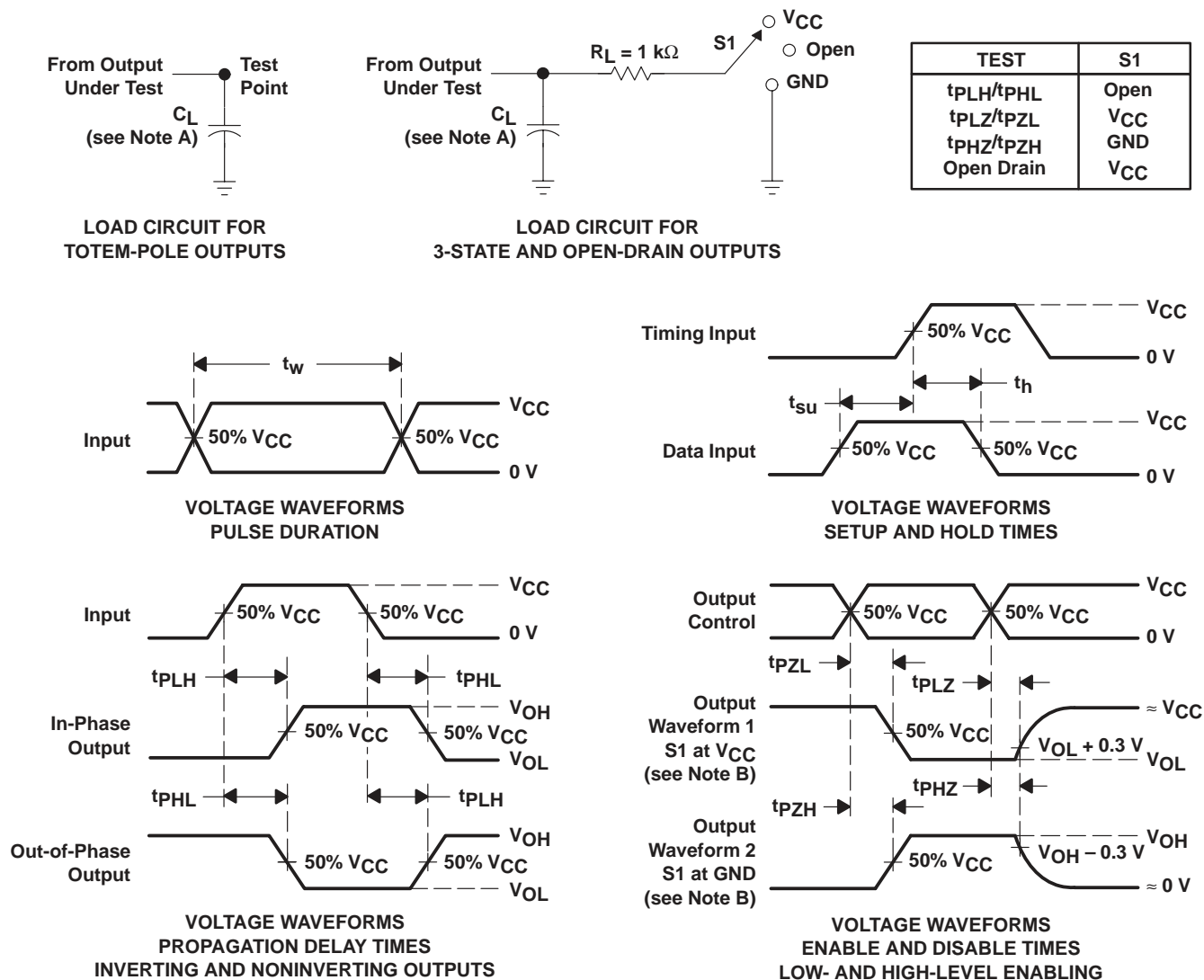
operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance	$C_L = 50\text{ pF}$, $f = 10\text{ MHz}$	3.3 V	14	pF
			5 V	15.1	

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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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SN74LV174A, Hex D-Type Flip-Flops With Clear

DEVICE STATUS: **ACTIVE**

PARAMETER NAME	SN74LV174A
Voltage Nodes (V)	5, 3.3, 2.5

FEATURES

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- *EPIC*[™] (Enhanced-Performance Implanted CMOS) Process
- Typical V_{OLP} (Output Ground Bounce) < 0.8 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- Typical V_{OHV} (Output V_{OH} Undershoot) > 2.3 V at $V_{CC} = 3.3$ V, $T_A = 25^\circ\text{C}$
- 2-V to 5.5-V V_{CC} Operation
- Support Mixed-Mode Voltage Operation on All Ports
- 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, 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)

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DESCRIPTION

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The 'LV174A devices are hex D-type flip-flops designed for 2-V to 5.5-V V_{CC} operation.

These devices are monolithic positive-edge-triggered flip-flops with a direct clear (CLR) input. Information at the data (D) inputs meeting the setup time requirements is transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going edge of the

clock pulse. When the clock (CLK) input is at either the high or low level, the D-input signal has no effect at the output.

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TECHNICAL DOCUMENTS

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DATASHEET

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Full datasheet in Acrobat PDF: [scls401c.pdf](#) (146 KB) (Updated: 05/22/2000)

Full datasheet in Zipped PostScript: [scls401c.psz](#) (148 KB)

APPLICATION NOTES

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- [CMOS Power Consumption and CPD Calculation](#) (SCAA035B - Updated: 06/01/1997)
- [Implications of Slow or Floating CMOS Inputs](#) (SCBA004C - Updated: 02/01/1998)
- [Input and Output Characteristics of Digital Integrated Circuits](#) (SDYA010 - Updated: 10/01/1996)
- [Live Insertion](#) (SDYA012 - Updated: 10/01/1996)
- [Understanding Advanced Bus-Interface Products Design Guide](#) (SCAA029, 253 KB - Updated: 05/01/1996)

RELATED DOCUMENTS

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- [Documentation Rules \(SAP\) And Ordering Information](#) (SZZU001B, 4 KB - Updated: 05/06/1999)
- [Logic Selection Guide Second Half 2000](#) (SDYU001N, 5035 KB - Updated: 04/17/2000)
- [MicroStar Junior BGA Design Summary](#) (SCET004, 167 KB - Updated: 07/28/2000)
- [More Power In Less Space - Technical Article](#) (SCAU001A, 850 KB - Updated: 03/01/1996)

SAMPLES

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<u>ORDERABLE DEVICE</u>	<u>PACKAGE</u>	<u>PINS</u>	<u>TEMP (°C)</u>	<u>STATUS</u>	<u>SAMPLES</u>
SN74LV174APWR	<u>PW</u>	16	-40 TO 85	ACTIVE	Request Samples

PRICING/ AVAILABILITY

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<u>ORDERABLE DEVICE</u>	<u>PACKAGE</u>	<u>PINS</u>	<u>TEMP (°C)</u>	<u>STATUS</u>	<u>BUDGETARY PRICE US\$/UNIT QTY= 1000+</u>	<u>PACK QTY</u>	<u>PRICING/AVAILABILITY</u>
SN74LV174AD	<u>D</u>	16	-40 TO 85	ACTIVE	0.37	40	Check stock or order
SN74LV174ADBR	<u>DB</u>	16	-40 TO 85	ACTIVE	0.37	2000	Check stock or order
SN74LV174ADGVR	<u>DGV</u>	16	-40 TO 85	ACTIVE	0.45	2000	Check stock or order
SN74LV174ADR	<u>D</u>	16	-40 TO	ACTIVE	0.40	2500	Check stock or order

			85				
SN74LV174APWR	<u>PW</u>	16	-40 TO 85	ACTIVE	0.37	2000	<u>Check stock or order</u>

MODELS

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- [Hex D-Type Flop-Flop With Clear](#) (SCEM133, 114 KB - Updated: 07/17/2000)
[Hex D-Type Flop-Flop With Clear](#) (SCEM133, 16 KB, ZIP - Updated: 07/17/2000)

Table Data Updated on: 11/ 17/ 2000

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