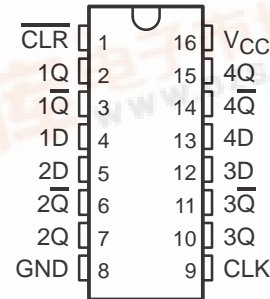# SN54LV175A, SN74LV175A
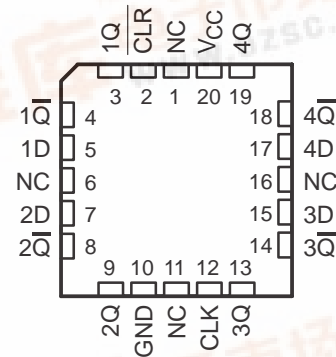## QUADRUPLE D-TYPE FLIP-FLOPS WITH CLEAR

SCLS400C – 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°C**
- **Typical V_{OHV} (Output V_{OH} Undershoot) >2.3 V at V_{CC} = 3.3 V, T_A = 25°C**
- **2-V to 5.5-V V_{CC} Operation**
- **Support Mixed-Mode Voltage Operation on All Ports**
- **Contain Four Flip-Flops With Double-Rail Outputs**
- **Applications Include:**
  - **Buffer/Storage Registers**
  - **Shift Registers**
  - **Pattern Generators**
- **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)**

SN54LV175A . . . J OR W PACKAGE
SN74LV175A . . . D, DB, DGV, NS, OR PW PACKAGE
(TOP VIEW)

$\overline{CLR}$	1	16	V_{CC}
1Q	2	15	4Q
$1\overline{Q}$	3	14	$4\overline{Q}$
1D	4	13	4D
2D	5	12	3D
$2\overline{Q}$	6	11	$3\overline{Q}$
2Q	7	10	3Q
GND	8	9	CLK

SN54LV175A . . . FK PACKAGE
(TOP VIEW)

NC – No internal connection

description

The 'LV175A devices are quadruple D-type flip-flops designed for 2-V to 5.5-V V_{CC} operation.

These devices have a direct clear ($\overline{CLR}$) input and feature complementary outputs from each flip-flop.

Information at the data (D) inputs meeting the setup time requirements is transferred to the outputs on the positive-going edge of the clock (CLK) pulse.

Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going edge of CLK. When CLK is at either the high or low level, the D input has no effect at the output.

The SN54LV175A is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74LV175A is characterized for operation from –40°C to 85°C.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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TEXAS INSTRUMENTS

FUNCTION TABLE
(each flip-flop)

INPUTS			OUTPUTS	
$\overline{CLR}$	CLK	D	Q	$\overline{Q}$
L	X	X	L	H
H	↑	H	H	L
H	↑	L	L	H
H	L	X	Q_0	$\overline{Q}_0$

logic symbol†
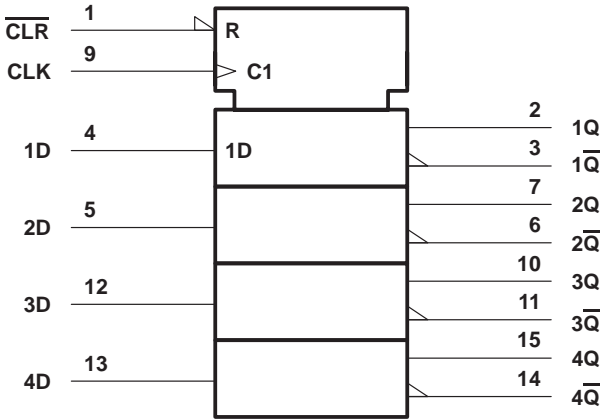
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for the D, DB, DGV, J, NS, PW, and W packages.

logic diagram (positive logic)
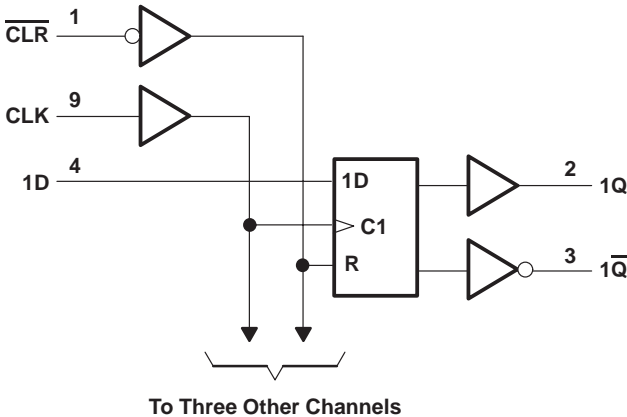
To Three Other Channels

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.

TEXAS
INSTRUMENTS

SN54LV175A, SN74LV175A
QUADRUPLE D-TYPE FLIP-FLOPS
WITH CLEAR

recommended operating conditions (see Note 4)

			SN54LV175A		SN74LV175A		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} = 2.3 V to 2.7 V	$V_{CC} \times 0.7$		$V_{CC} \times 0.7$		
		V_{CC} = 3 V to 3.6 V	$V_{CC} \times 0.7$		$V_{CC} \times 0.7$		
		V_{CC} = 4.5 V to 5.5 V	$V_{CC} \times 0.7$		$V_{CC} \times 0.7$		
V_{IL}	Low-level input voltage	V_{CC} = 2 V		0.5		0.5	V
		V_{CC} = 2.3 V to 2.7 V		$V_{CC} \times 0.3$		$V_{CC} \times 0.3$	
		V_{CC} = 3 V to 3.6 V		$V_{CC} \times 0.3$		$V_{CC} \times 0.3$	
		V_{CC} = 4.5 V to 5.5 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 V		−50		−50	μA
		V_{CC} = 2.3 V to 2.7 V		−2		−2	mA
		V_{CC} = 3 V to 3.6 V		−6		−6	
		V_{CC} = 4.5 V to 5.5 V		−12		−12	
I_{OL}	Low-level output current	V_{CC} = 2 V		50		50	μA
		V_{CC} = 2.3 V to 2.7 V		2		2	mA
		V_{CC} = 3 V to 3.6 V		6		6	
		V_{CC} = 4.5 V to 5.5 V		12		12	
$\Delta t/\Delta v$	Input transition rise or fall rate	V_{CC} = 2.3 V to 2.7 V	0	200	0	200	ns/V
		V_{CC} = 3 V to 3.6 V	0	100	0	100	
		V_{CC} = 4.5 V to 5.5 V	0	20	0	20	
T_A	Operating free-air temperature		−55	125	−40	85	°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.

TEXAS
INSTRUMENTS

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

PARAMETER	TEST CONDITIONS	V_{CC}	SN54LV175A MIN	SN54LV175A TYP	SN54LV175A MAX	SN74LV175A MIN	SN74LV175A TYP	SN74LV175A MAX	UNIT
V_{OH}	$I_{OH} = -50\ \mu A$	2 V to 5.5 V	V_{CC}–0.1			V_{CC}–0.1			V
	$I_{OH} = -2\ mA$	2.3 V	2			2			
	$I_{OH} = -6\ mA$	3 V	2.48			2.48			
	$I_{OH} = -12\ mA$	4.5 V	3.8			3.8			
V_{OL}	$I_{OL} = 50\ \mu A$	2 V to 5.5 V			0.1			0.1	V
	$I_{OL} = 2\ mA$	2.3 V			0.4			0.4	
	$I_{OL} = 6\ mA$	3 V			0.44			0.44	
	$I_{OL} = 12\ mA$	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		1.4			1.4		pF

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

			$T_A = 25°C$ MIN	$T_A = 25°C$ MAX	SN54LV175A MIN	SN54LV175A MAX	SN74LV175A MIN	SN74LV175A MAX	UNIT
t_w	Pulse duration	$\overline{CLR}$ low	6		6		6		ns
		CLK high or low	6.5		7		7		
t_{su}	Setup time before CLK↑	Data	7		7.5		7.5		ns
		$\overline{CLR}$ inactive	7		7.5		7.5		
t_h	Hold time, data after CLK↑		0.5		1		1		ns

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

			$T_A = 25°C$ MIN	$T_A = 25°C$ MAX	SN54LV175A MIN	SN54LV175A MAX	SN74LV175A MIN	SN74LV175A MAX	UNIT
t_w	Pulse duration	$\overline{CLR}$ low	5		5		5		ns
		CLK high or low	5		5		5		
t_{su}	Setup time before CLK↑	Data	5		5		5		ns
		$\overline{CLR}$ inactive	5		5		5		
t_h	Hold time, data after CLK↑		1		1		1		ns

TEXAS INSTRUMENTS

SN54LV175A, SN74LV175A
QUADRUPLE D-TYPE FLIP-FLOPS
WITH CLEAR
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timing requirements over recommended operating free-air temperature range, V_{CC} = 5 V $\pm$ 0.5 V (unless otherwise noted) (see Figure 1)

			T_A = 25°C		SN54LV175A		SN74LV175A		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration	$\overline{CLR}$ low	5		5		5		ns
		CLK high or low	5		5		5		
t_{su}	Setup time before CLK↑	Data	4		4		4		ns
		$\overline{CLR}$ inactive	5		5		5		
t_h	Hold time, data after CLK↑		1		1		1		ns

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T_A = 25°C			SN54LV175A		SN74LV175A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			C_L = 15 pF	50*	105*		45*		45		MHz
			C_L = 50 pF	40	80		35		35		
t_{pd}	$\overline{CLR}$	Any	C_L = 15 pF		7.9*	16.6*	1*	20*	1	20	ns
	CLK	Any			9.3*	18.8*	1*	22*	1	22	
t_{pd}	$\overline{CLR}$	Any	C_L = 50 pF		10.4	21.6	1	25.5	1	25.5	ns
	CLK	Any			12	23.3	1	27	1	27	
$t_{sk(o)}$			C_L = 50 pF			2				2	ns

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

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T_A = 25°C			SN54LV175A		SN74LV175A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			C_L = 15 pF	90*	155*		75*		75		MHz
			C_L = 50 pF	50	120		45		45		
t_{pd}	$\overline{CLR}$	Any	C_L = 15 pF		5.5*	10.1*	1*	12*	1	12	ns
	CLK	Any			6.5*	11.5*	1*	13.5*	1	13.5	
t_{pd}	$\overline{CLR}$	Any	C_L = 50 pF		7.4	13.6	1	15.5	1	15.5	ns
	CLK	Any			8.4	15	1	17	1	17	
$t_{sk(o)}$			C_L = 50 pF			1.5				1.5	ns

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

TEXAS
INSTRUMENTS

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	LOAD CAPACITANCE	T_A = 25°C			SN54LV175A		SN74LV175A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			C_L = 15 pF	150*	215*		125*		125		MHz
			C_L = 50 pF	85	165		75		75		
t_{pd}	$\overline{CLR}$	Any	C_L = 15 pF		3.7*	6.4*	1*	7.5*	1	7.5	ns
	CLK	Any			4.6*	7.3*	1*	8.5*	1	8.5	
t_{pd}	$\overline{CLR}$	Any	C_L = 50 pF		5.3	8.4	1	9.5	1	9.5	ns
	CLK	Any			6	9.3	1	10.5	1	10.5	
$t_{sk(o)}$			C_L = 50 pF			1				1	ns

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

noise characteristics, V_{CC} = 3.3 V, C_L = 50 pF, T_A = 25°C (see Note 5)

PARAMETER		SN74LV175A			UNIT
		MIN	TYP	MAX	
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		0.3	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		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°C

PARAMETER		TEST CONDITIONS	V_{CC}	TYP	UNIT
C_{pd}	Power dissipation capacitance	C_L = 50 pF, f = 10 MHz	3.3 V	13.6	pF
			5 V	14.5	

PARAMETER MEASUREMENT INFORMATION

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND
Open Drain	V_{CC}

LOAD CIRCUIT FOR TOTEM-POLE OUTPUTS

LOAD CIRCUIT FOR 3-STATE AND OPEN-DRAIN OUTPUTS

VOLTAGE WAVEFORMS PULSE DURATION

VOLTAGE WAVEFORMS SETUP AND HOLD TIMES

VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES INVERTING AND NONINVERTING OUTPUTS

VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES LOW- AND HIGH-LEVEL ENABLING

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 ≤ 1 MHz, Z_O = 50 Ω, t_r ≤ 3 ns, t_f ≤ 3 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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