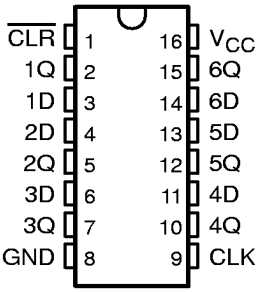
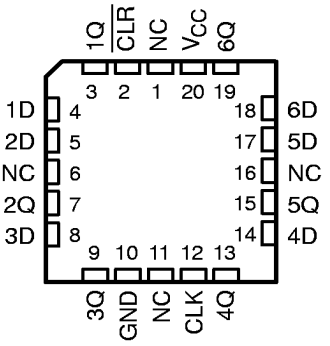
- **Operating Range 2-V to 5.5-V V_{CC}**
- ***EPIC*™ (Enhanced-Performance Implanted CMOS) Process**
- **Contain Six Flip-Flops With Single-Rail Outputs**
- **Applications Include:**
  - **Buffer/Storage Registers**
  - **Shift Registers**
  - **Pattern Generators**
- **Latch-Up Performance Exceeds 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), Shrink Small-Outline (DB), Thin Very Small-Outline (DGV), Thin Shrink Small-Outline (PW), and Ceramic Flat (W) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) DIPs**

SN54AHC174 . . . J OR W PACKAGE
SN74AHC174 . . . D, DB, DGV, N, OR PW PACKAGE
(TOP VIEW)



SN54AHC174 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

description

The 'AHC174 devices are positive-edge-triggered D-type flip-flops with a direct clear ($\overline{CLR}$) input and are designed for 2-V to 5.5-V V_{CC} operation.

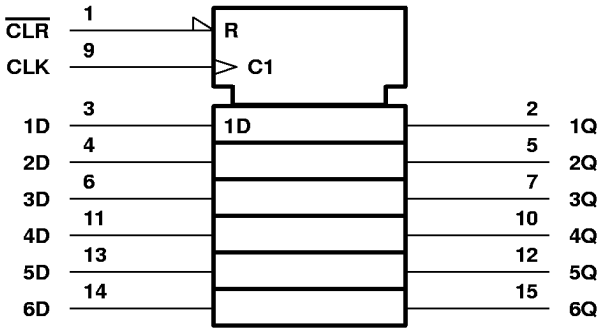
Information at the data (D) inputs meeting the setup time requirements is transferred to the outputs on the positive-going edge of the clock (CLK) pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going edge of CLK. When CLK is at either the high or low level, the D input has no effect at the output.

The SN54AHC174 is characterized for operation over the full military temperature range of –55°C to 125°C. The SN74AHC174 is characterized for operation from –40°C to 85°C.

FUNCTION TABLE
(each flip-flop)

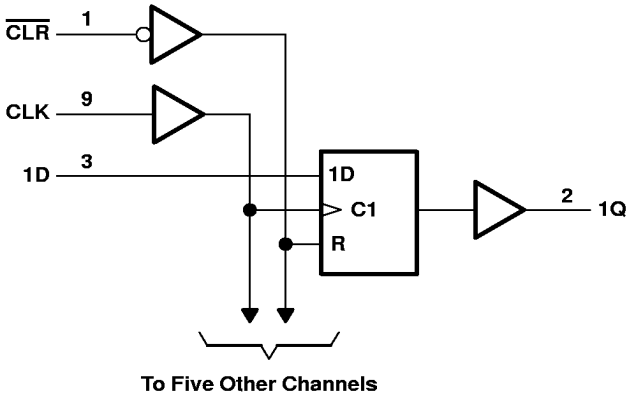
INPUTS			OUTPUT
$\overline{CLR}$	CLK	D	Q
L	X	X	L
H	↑	H	H
H	↑	L	L
H	L	X	Q_0

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, N, PW, and W packages.

logic diagram (positive logic)



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

absolute maximum ratings over operating free-air temperature range†

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 Note 1) . . . . . –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}) . . . . . ±20 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 2): D package . . . . . 113°C/W
DB package . . . . . 131°C/W
DGV package . . . . . 180°C/W
N package . . . . . 78°C/W
PW package . . . . . 149°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 JESD 51, except for through-hole packages, which use a trace length of zero.

recommended operating conditions (see Note 3)

			SN54AHC174		SN74AHC174		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} = 3 V	2.1		2.1		
		V_{CC} = 5.5 V	3.85		3.85		
V_{IL}	Low-level input voltage	V_{CC} = 2 V		0.5		0.5	V
		V_{CC} = 3 V		0.9		0.9	
		V_{CC} = 5.5 V		1.65		1.65	
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} = 3.3 V ± 0.3 V		–4		–4	mA
		V_{CC} = 5 V ± 0.5 V		–8		–8	
I_{OL}	Low-level output current	V_{CC} = 2 V		50		50	μA
		V_{CC} = 3.3 V ± 0.3 V		4		4	mA
		V_{CC} = 5 V ± 0.5 V		8		8	
$\Delta t/\Delta v$	Input transition rise or fall rate	V_{CC} = 3.3 V ± 0.3 V		100		100	ns/V
		V_{CC} = 5 V ± 0.5 V		20		20	
T_A	Operating free-air temperature		–55	125	–40	85	°C

NOTE 3: 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}	T_A = 25°C			SN54AHC174		SN74AHC174		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}	I_{OH} = –50 μA	2 V	1.9	2		1.9		1.9		V
		3 V	2.9	3		2.9		2.9		
		4.5 V	4.4	4.5		4.4		4.4		
	I_{OH} = –4 mA	3 V	2.58			2.48		2.48		
	I_{OH} = –8 mA	4.5 V	3.94			3.8		3.8		
V_{OL}	I_{OL} = 50 μA	2 V			0.1		0.1		0.1	V
		3 V			0.1		0.1		0.1	
		4.5 V			0.1		0.1		0.1	
	I_{OL} = 4 mA	3 V			0.36		0.5		0.44	
	I_{OL} = 8 mA	4.5 V			0.36		0.5		0.44	
I_I	$V_I = V_{CC}$ or GND	5.5 V			± 0.1		± 1		± 1	μA
I_{CC}	$V_I = V_{CC}$ or GND, I_O = 0	5.5 V			4		40		40	μA
C_i	$V_I = V_{CC}$ or GND	5 V		1.7	10				10	pF

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

			T_A = 25°C		SN54AHC174		SN74AHC174		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	5		6		6		ns
		$\overline{CLR}$ inactive	3		3		3		
t_h	Hold time, data after CLK↑		0		0		0		ns

timing requirements over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted)

			T_A = 25°C		SN54AHC174		SN74AHC174		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	4.5		4.5		4.5		ns
		$\overline{CLR}$ inactive	2.5		2.5		2.5		
t_h	Hold time, data after CLK↑		0.5		0.5		0.5		ns

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	OUTPUT CAPACITANCE	SN54AHC174					UNIT
				T_A = 25°C			MIN	MAX	
				MIN	TYP	MAX			
f_{max}			C_L = 15 pF*	95	170		80		MHz
			C_L = 50 pF	55	130		50		
t_{PHL}*	$\overline{CLR}$	Any Q	C_L = 15 pF		4.5	11.4	1	13.5	ns
t_{pd}*	CLK				5.8	11	1	13	
t_{PHL}	$\overline{CLR}$	Any Q	C_L = 50 pF		6	14.9	1	17	ns
t_{pd}	CLK				7.5	14.5	1	16.5	

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

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	OUTPUT CAPACITANCE	SN74AHC174					UNIT
				T_A = 25°C			MIN	MAX	
				MIN	TYP	MAX			
f_{max}			C_L = 15 pF	95	170		80		MHz
			C_L = 50 pF	55	130		50		
t_{PHL}	$\overline{CLR}$	Any Q	C_L = 15 pF		4.5	11.4	1	13.5	ns
t_{pd}	CLK				5.8	11	1	13	
t_{PHL}	$\overline{CLR}$	Any Q	C_L = 50 pF		6	14.9	1	17	ns
t_{pd}	CLK				7.5	14.5	1	16.5	
$t_{sk(o)}$†			C_L = 50 pF			1.5		1.5	ns

† 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 V ± 0.5 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	OUTPUT CAPACITANCE	SN54AHC174					UNIT
				T_A = 25°C			MIN	MAX	
				MIN	TYP	MAX			
f_{max}			C_L = 15 pF*	130	240		110		MHz
			C_L = 50 pF	90	180		80		
t_{PHL}*	$\overline{CLR}$	Any Q	C_L = 15 pF		3	7.6	1	9	ns
t_{pd}*	CLK				4.1	7.2	1	8.5	
t_{PHL}	$\overline{CLR}$	Any Q	C_L = 50 pF		4.2	9.6	1	11	ns
t_{pd}	CLK				5.5	9.2	1	10.5	

* 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 V ± 0.5 V (unless otherwise noted) (see Figure 1)

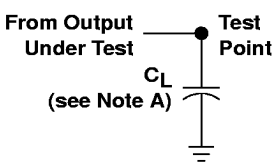
PARAMETER	FROM (INPUT)	TO (OUTPUT)	OUTPUT CAPACITANCE	SN74AHC174					UNIT
				T_A = 25°C			MIN	MAX	
				MIN	TYP	MAX			
f_{max}			C_L = 15 pF	130	240		110		MHz
			C_L = 50 pF	90	180		80		
t_{PHL}	$\overline{CLR}$	Any Q	C_L = 15 pF		3	7.6	1	9	ns
t_{pd}	CLK				4.1	7.2	1	8.5	
t_{PHL}	$\overline{CLR}$	Any Q	C_L = 50 pF		4.2	9.6	1	11	ns
t_{pd}	CLK				5.5	9.2	1	10.5	
$t_{sk(o)}$†			C_L = 50 pF			1		1	ns

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

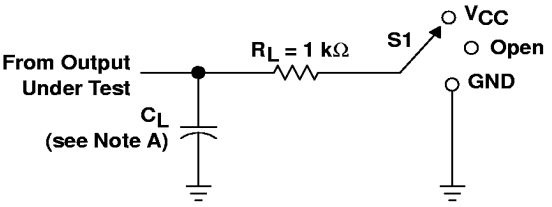
operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load	15.2	pF

PARAMETER MEASUREMENT INFORMATION

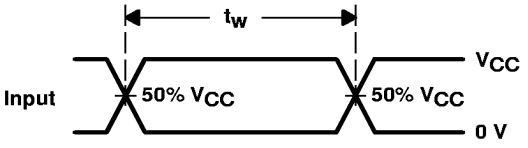


LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS

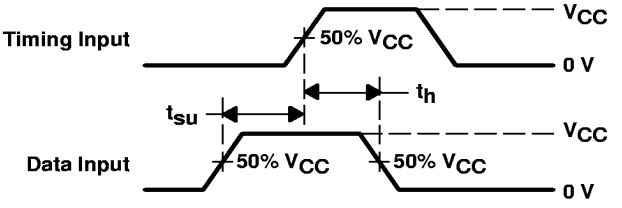


LOAD CIRCUIT FOR
3-STATE AND OPEN-DRAIN OUTPUTS

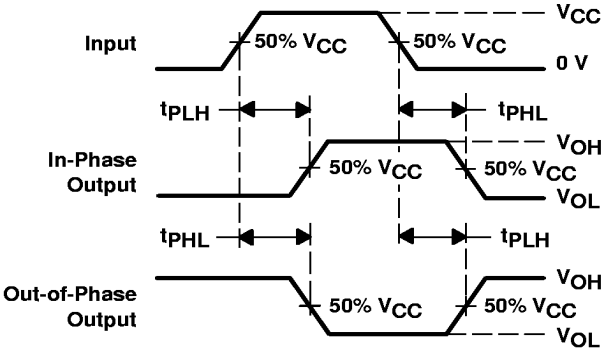
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	V_{CC}
t_{PHZ}/t_{PZH}	GND
Open Drain	V_{CC}



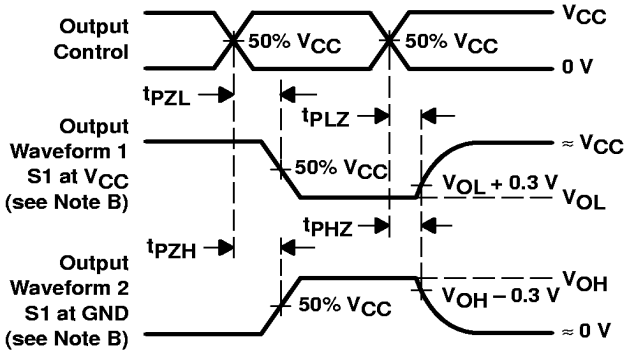
VOLTAGE WAVEFORMS
PULSE DURATION



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.

Figure 1. Load Circuit and Voltage Waveforms