

CD54HC74, CD74HC74, CD74HCT74

Dual D Flip-Flop with Set and Reset Positive-Edge Trigger

January 1998

Features

- Hysteresis on Clock Inputs for Improved Noise Immunity and Increased Input Rise and Fall Times
- Asynchronous Set and Reset
- Complementary Outputs
- Buffered Inputs
- Typical $f_{MAX} = 50\text{MHz}$ at $V_{CC} = 5\text{V}$, $C_L = 15\text{pF}$, $T_A = 25^\circ\text{C}$
- Fanout (Over Temperature Range)
 - Standard Outputs 10 LSTTL Loads
 - Bus Driver Outputs 15 LSTTL Loads
- Wide Operating Temperature Range . . . -55°C to 125°C
- Balanced Propagation Delay and Transition Times
- Significant Power Reduction Compared to LSTTL Logic ICs
- HC Types
 - 2V to 6V Operation
 - High Noise Immunity: $N_{IL} = 30\%$, $N_{IH} = 30\%$ of V_{CC} at $V_{CC} = 5\text{V}$
- HCT Types
 - 4.5V to 5.5V Operation
 - Direct LSTTL Input Logic Compatibility, $V_{IL} = 0.8\text{V}$ (Max), $V_{IH} = 2\text{V}$ (Min)
 - CMOS Input Compatibility, $I_I \leq 1\mu\text{A}$ at V_{OL} , V_{OH}

Description

The Harris CD54HC74, CD74HC74 and CD74HCT74 utilize silicon gate CMOS technology to achieve operating speeds equivalent to LSTTL parts. They exhibit the low power consumption of standard CMOS integrated circuits, together with the ability to drive 10 LSTTL loads.

This flip-flop has independent DATA, $\overline{\text{SET}}$, $\overline{\text{RESET}}$ and CLOCK inputs and Q and $\overline{\text{Q}}$ outputs. The logic level present at the data input is transferred to the output during the positive-going transition of the clock pulse. $\overline{\text{SET}}$ and $\overline{\text{RESET}}$ are independent of the clock and are accomplished by a low level at the appropriate input.

The 74HCT logic family is functionally as well as pin compatible with the standard 74LS logic family.

Ordering Information

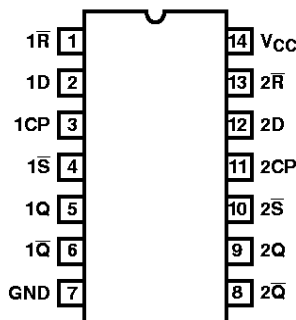
PART NUMBER	TEMP. RANGE (°C)	PACKAGE	PKG. NO.
CD54HC74F	-55 to 125	14 Ld CERDIP	F14.3
CD74HC74E	-55 to 125	14 Ld PDIP	E14.3
CD74HCT74E	-55 to 125	14 Ld PDIP	E14.3
CD74HC74M	-55 to 125	14 Ld SOIC	M14.15
CD74HCT74M	-55 to 125	14 Ld SOIC	M14.15

NOTES:

1. When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.
2. Die is available which meets all electrical specifications. Please contact your local sales office or Harris customer service for ordering information.

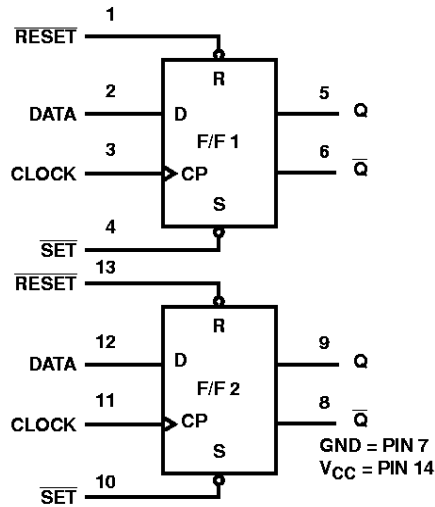
Pinout

CD54HC74, CD74HC74, CD74HCT74
(PDIP, SOIC, CERDIP)
TOP VIEW



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Functional Diagram



TRUTH TABLE

INPUTS				OUTPUTS	
SET	RESET	CP	D	Q	\bar{Q}
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H (Note 3)	H (Note 3)
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q ₀	\bar{Q}_0

NOTE:

H = High Level (Steady State)

L = Low Level (Steady State)

X = Don't Care

↑ = Low-to-High Transition

Q₀ = the level of Q before the indicated input conditions were established.

3. This configuration is nonstable, that is, it will not persist when set and reset inputs return to their inactive (high) level.

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Absolute Maximum Ratings

DC Supply Voltage, V_{CC}	-0.5V to 7V
DC Input Diode Current, I_{IK}	
For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$	$\pm 20mA$
DC Drain Current, per Output, I_O	
For $-0.5V < V_O < V_{CC} + 0.5V$	$\pm 25mA$
DC Output Diode Current, I_{OK}	
For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$	$\pm 20mA$
DC Output Source or Sink Current per Output Pin, I_O	
For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$	$\pm 25mA$
DC V_{CC} or Ground Current, I_{CC}	$\pm 50mA$

Thermal Information

Thermal Resistance (Typical, Note 4)	θ_{JA} ($^{\circ}C/W$)	θ_{JC} ($^{\circ}C/W$)
PDIP Package	90	-
SOIC Package	120	-
CERDIP Package	130	55
Maximum Junction Temperature (Hermetic Package or Die) . . .	175 $^{\circ}C$	
Maximum Junction Temperature (Plastic Package)	150 $^{\circ}C$	
Maximum Storage Temperature Range	-65 $^{\circ}C$ to 150 $^{\circ}C$	
Maximum Lead Temperature (Soldering 10s)	300 $^{\circ}C$	
	(SOIC - Lead Tips Only)	

Operating Conditions

Temperature Range (T_A)	-55 $^{\circ}C$ to 125 $^{\circ}C$
Supply Voltage Range, V_{CC}	
HC Types	2V to 6V
HCT Types	4.5V to 5.5V
DC Input or Output Voltage, V_I , V_O	0V to V_{CC}
Input Rise and Fall Time	
2V	1000ns (Max)
4.5V	500ns (Max)
6V	400ns (Max)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

- θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	25 $^{\circ}C$			-40 $^{\circ}C$ TO 85 $^{\circ}C$		-55 $^{\circ}C$ TO 125 $^{\circ}C$		UNITS	
		V_I (V)	I_O (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX		
HC TYPES													
High Level Input Voltage	V_{IH}	-	-	2	1.5	-	-	1.5	-	1.5	-	V	
				4.5	3.15	-	-	3.15	-	3.15	-	V	
				6	4.2	-	-	4.2	-	4.2	-	V	
Low Level Input Voltage	V_{IL}	-	-	2	-	-	0.5	-	0.5	-	0.5	V	
				4.5	-	-	1.35	-	1.35	-	1.35	V	
				6	-	-	1.8	-	1.8	-	1.8	V	
High Level Output Voltage CMOS Loads	V_{OH}	V_{IH} or V_{IL}	-0.02	2	1.9	-	-	1.9	-	1.9	-	V	
				4.5	4.4	-	-	4.4	-	4.4	-	V	
				6	5.9	-	-	5.9	-	5.9	-	V	
High Level Output Voltage TTL Loads	V_{OH}	V_{IH} or V_{IL}	-	-	-	-	-	-	-	-	-	V	
				-4	4.5	3.98	-	-	3.84	-	3.7	-	V
				-5.2	6	5.48	-	-	5.34	-	5.2	-	V
Low Level Output Voltage CMOS Loads	V_{OL}	V_{IH} or V_{IL}	0.02	2	-	-	0.1	-	0.1	-	0.1	V	
				4.5	-	-	0.1	-	0.1	-	0.1	V	
				6	-	-	0.1	-	0.1	-	0.1	V	
Low Level Output Voltage TTL Loads	V_{OL}	V_{IH} or V_{IL}	-	-	-	-	-	-	-	-	-	V	
				4	4.5	-	-	0.26	-	0.33	-	0.4	V
				5.2	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I_I	V_{CC} or GND	-	6	-	-	± 0.1	-	± 1	-	± 1	μA	

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DC Electrical Specifications (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS		V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V _I (V)	I _O (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Quiescent Device Current	I _{CC}	V _{CC} or GND	0	6	-	-	4	-	40	-	80	μA
HCT TYPES												
High Level Input Voltage	V _{IH}	-	-	4.5 to 5.5	2	-	-	2	-	2	-	V
Low Level Input Voltage	V _{IL}	-	-	4.5 to 5.5	-	-	0.8	-	0.8	-	0.8	V
High Level Output Voltage CMOS Loads	V _{OH}	V _{IH} or V _{IL}	-	4.5	4.4	-	-	4.4	-	4.4	-	V
High Level Output Voltage TTL Loads			-0.02	4.5	3.98	-	-	3.84	-	3.7	-	V
Low Level Output Voltage CMOS Loads	V _{OL}	V _{IH} or V _{IL}	-4	4.5	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			0.02	4.5	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I _I	V _{CC} and GND	4	5.5	-	-	±0.1	-	±1	-	±1	μA
Quiescent Device Current	I _{CC}	V _{CC} or GND	0	5.5	-	-	4	-	40	-	80	μA
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	ΔI _{CC} (Note 5)	V _{CC} - 2.1	-	4.5 to 5.5	-	100	360	-	450	-	490	μA

NOTE:

5. For dual-supply systems theoretical worst case (V_I = 2.4V, V_{CC} = 5.5V) specification is 1.8mA.

HCT Input Loading Table

INPUT	UNIT LOADS
D	0.5
\bar{R}	0.5
CP	0.7
\bar{S}	0.75

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical Specifications table, e.g., 360μA max at 25°C.

Prerequisite For Switching Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES											
Data to CP Setup Time (Figure 5)	t _{SU}	-	2	60	-	-	75	-	90	-	ns
			4.5	12	-	-	15	-	18	-	ns
			6	10	-	-	13	-	15	-	ns

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Prerequisite For Switching Specifications (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Hold Time (Figure 5)	t _H	-	2	3	-	-	3	-	3	-	ns
			4.5	3	-	-	3	-	3	-	ns
			6	3	-	-	3	-	3	-	ns
Removal Time \bar{R} , \bar{S} , to CP (Figure 5)	t _{REM}	-	2	30	-	-	40	-	45	-	ns
			4.5	6	-	-	8	-	9	-	ns
			6	5	-	-	7	-	8	-	ns
Pulse Width \bar{R} , \bar{S} (Figure 1)	t _W	-	2	80	-	-	100	-	120	-	ns
			4.5	16	-	-	20	-	24	-	ns
			6	14	-	-	17	-	20	-	ns
Pulse Width CP (Figure 1)	t _W	-	2	80	-	-	100	-	120	-	ns
			4.5	16	-	-	20	-	24	-	ns
			6	14	-	-	17	-	20	-	ns
CP Frequency	f _{MAX}	-	2	6	-	-	5	-	4	-	MHz
			4.5	30	-	-	25	-	20	-	MHz
			6	35	-	-	29	-	23	-	MHz

HCT TYPES

Data to CP Setup Time (Figure 6)	t _{SU}	-	4.5	12	-	-	15	-	18	-	ns
Hold Time (Figure 6)	t _H	-	4.5	3	-	-	3	-	3	-	ns
Removal Time \bar{R} , \bar{S} , to CP (Figure 6)	t _{REM}	-	4.5	6	-	-	8	-	9	-	ns
Pulse Width \bar{R} , \bar{S} (Figure 2)	t _W	-	4.5	16	-	-	20	-	24	-	ns
Pulse Width CP (Figure 2)	t _W	-	4.5	18	-	-	23	-	27	-	ns
CP Frequency	f _{MAX}	-	4.5	25	-	-	20	-	16	-	MHz

Switching Specifications Input t_r, t_f = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES											
Propagation Delay, CP to Q, \bar{Q} (Figure 3)	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	-	175	-	220	-	265	ns
		C _L = 50pF	4.5	-	-	35	-	44	-	53	ns
		C _L = 15pF	5	-	14	-	-	-	-	-	ns
		C _L = 50pF	6	-	-	30	-	37	-	45	ns
Propagation Delay, \bar{R} , \bar{S} to Q, \bar{Q} (Figure 3)	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	-	200	-	250	-	300	ns
		C _L = 50pF	4.5	-	-	40	-	50	-	60	ns
		C _L = 15pF	5	-	17	-	-	-	-	-	ns
		C _L = 50pF	6	-	-	34	-	43	-	51	ns
Transition Time (Figure 3)	t _{TLH} , t _{THL}	C _L = 50pF	2	-	-	75	-	95	-	110	ns
		C _L = 50pF	4.5	-	-	15	-	19	-	22	ns
		C _L = 50pF	6	-	-	13	-	16	-	19	ns
Input Capacitance	C _I	-	-	-	-	10	-	10	-	10	pF

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Switching Specifications Input $t_r, t_f = 6\text{ns}$ (Continued)

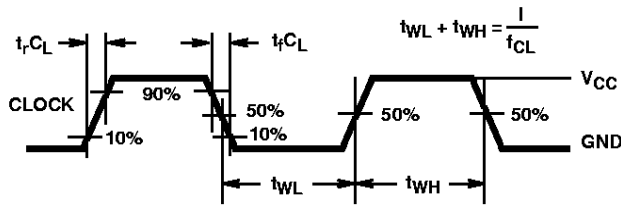
PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
CP Frequency	f_{MAX}	$C_L = 15\text{pF}$	5	-	50	-	-	-	-	-	MHz
Power Dissipation Capacitance (Notes 6, 7)	C_{PD}	-	5	-	25	-	-	-	-	-	pF
HCT TYPES											
Propagation Delay, CP to Q, \bar{Q} (Figure 4)	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	-	35	-	44	-	53	ns
Propagation Delay, R, S to Q, (Figure 4)	t_{PHL}, t_{PLH}	$C_L = 50\text{pF}$	4.5	-	-	40	-	50	-	60	ns
Transition Time (Figure 4)	t_{TLH}, t_{THL}	$C_L = 50\text{pF}$	4.5	-	-	15	-	19	-	22	ns
Input Capacitance	C_I	-	-	-	-	10	-	10	-	10	pF
CP Frequency	f_{MAX}	$C_L = 15\text{pF}$	5	-	50	-	-	-	-	-	MHz
Power Dissipation Capacitance (Notes 6, 7)	C_{PD}	-	5	-	30	-	-	-	-	-	pF

NOTES:

6. C_{PD} is used to determine the dynamic power consumption, per flip-flop.

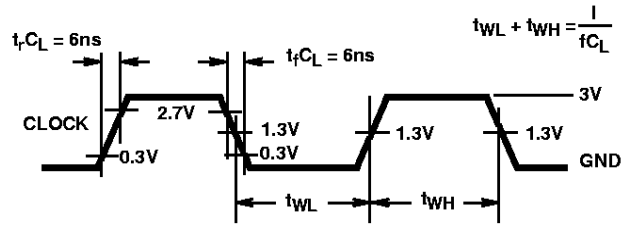
7. $P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L V_{CC}^2 f_o)$ where f_i = input frequency, f_o = output frequency, C_L = output load capacitance, V_{CC} = supply voltage.

Test Circuits and Waveforms



NOTE: Outputs should be switching from 10% V_{CC} to 90% V_{CC} in accordance with device truth table. For f_{MAX} , input duty cycle = 50%.

FIGURE 1. HC CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH



NOTE: Outputs should be switching from 10% V_{CC} to 90% V_{CC} in accordance with device truth table. For f_{MAX} , input duty cycle = 50%.

FIGURE 2. HCT CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH

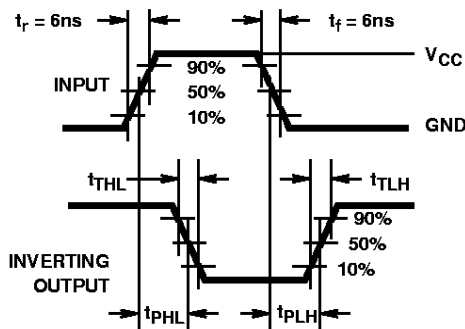


FIGURE 3. HC AND HCU TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

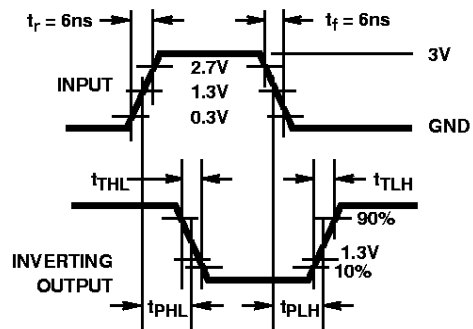


FIGURE 4. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

Test Circuits and Waveforms (Continued)

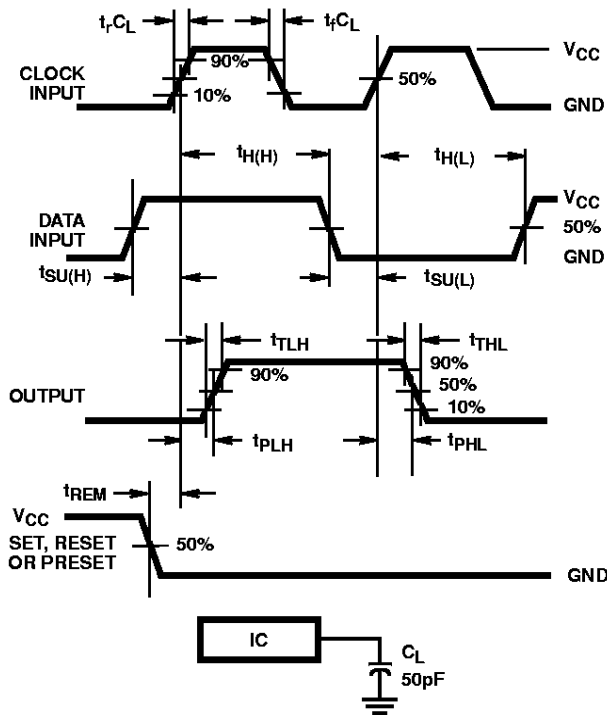


FIGURE 5. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

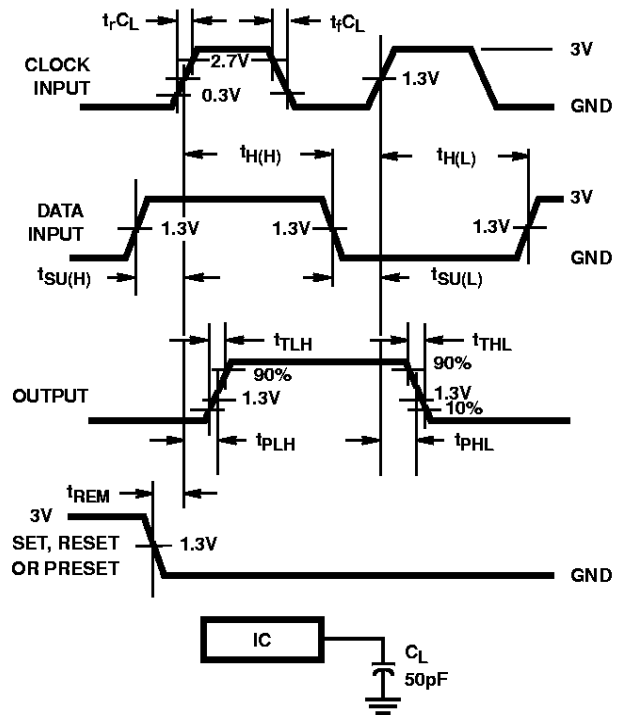


FIGURE 6. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

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 1130 Brussels, Belgium
 TEL: (32) 2.724.2111
 FAX: (32) 2.724.22.05

ASIA
 Harris Semiconductor PTE Ltd.
 No. 1 Tannery Road
 Cencon 1, #09-01
 Singapore 1334
 TEL: (65) 748-4200
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