

DUAL D-TYPE FLIP-FLOP WITH SET AND RESET; POSITIVE-EDGE TRIGGER

FEATURES

- Output capability: standard
- I_{CC} category: flip-flops

GENERAL DESCRIPTION

The 74HC/HCT74 are high-speed Si-gate CMOS devices and are pin compatible with low power Schottky TTL (LS TTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT74 are dual positive-edge triggered, D-type flip-flops with individual data (D) inputs, clock (CP) inputs, set ($\bar{S}_D$) and reset ($\bar{R}_D$) inputs; also complementary Q and $\bar{Q}$ outputs.

The set and reset are asynchronous active LOW inputs and operate independently of the clock input. Information on the data input is transferred to the Q output on the LOW-to-HIGH transition of the clock pulse. The D inputs must be stable one set-up time prior to the LOW-to-HIGH clock transition for predictable operation.

Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
t_{PHL}/t_{PLH}	propagation delay nCP to nQ, n $\bar{Q}$ n $\bar{S}_D$ to nQ, n $\bar{Q}$ n $\bar{R}_D$ to nQ, n $\bar{Q}$	$C_L = 15$ pF $V_{CC} = 5$ V	14 15 16	15 18 18	ns ns ns
f_{max}	maximum clock frequency		76	59	MHz
C_i	input capacitance		3.5	3.5	pF
C_{PD}	power dissipation capacitance per flip-flop	notes 1 and 2	24	29	pF

GND = 0 V; $T_{amb} = 25^\circ\text{C}$; $t_r = t_f = 6$ ns

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f_i = input frequency in MHz C_L = output load capacitance in pF

f_o = output frequency in MHz V_{CC} = supply voltage in V

$\sum (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs

2. For HC the condition is $V_I = \text{GND to } V_{CC}$
For HCT the condition is $V_I = \text{GND to } V_{CC} - 1.5$ V

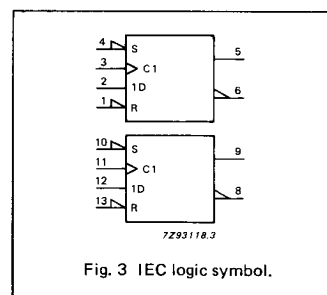
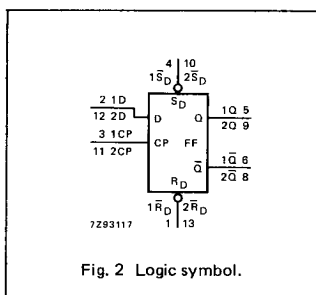
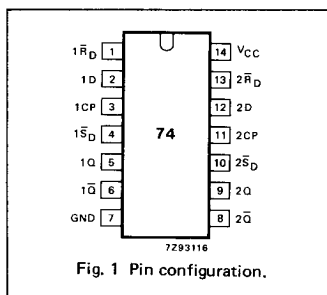
PACKAGE OUTLINES

14-lead DIL; plastic (SOT27).

14-lead mini-pack; plastic (SO14; SOT108A).

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1, 13	$1\bar{R}_D, 2\bar{R}_D$	asynchronous reset-direct input (active LOW)
2, 12	1D, 2D	data inputs clock input (LOW-to-HIGH, edge-triggered) asynchronous set-direct input (active LOW)
3, 11	1CP, 2CP	
4, 10	$1\bar{S}_D, 2\bar{S}_D$	
5, 9	1Q, 2Q	true flip-flop outputs
6, 8	$1\bar{Q}, 2\bar{Q}$	complement flip-flop outputs
7	GND	ground (0 V)
14	V_{CC}	positive supply voltage



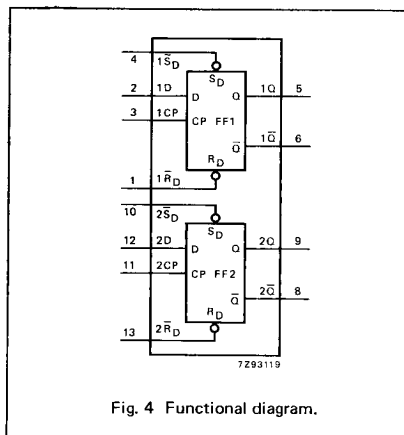


Fig. 4 Functional diagram.

FUNCTION TABLE

INPUTS				OUTPUTS	
$\overline{S}_D$	$\overline{R}_D$	CP	D	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H	H

INPUTS				OUTPUTS	
$\overline{S}_D$	$\overline{R}_D$	CP	D	Q_{n+1}	$\overline{Q}_{n+1}$
H	H	$\uparrow$	L	L	H
H	H	$\uparrow$	H	H	L

H = HIGH voltage level
L = LOW voltage level
X = don't care
 $\uparrow$ = LOW-to-HIGH CP transition
 Q_{n+1} = state after the next LOW-to-HIGH CP transition

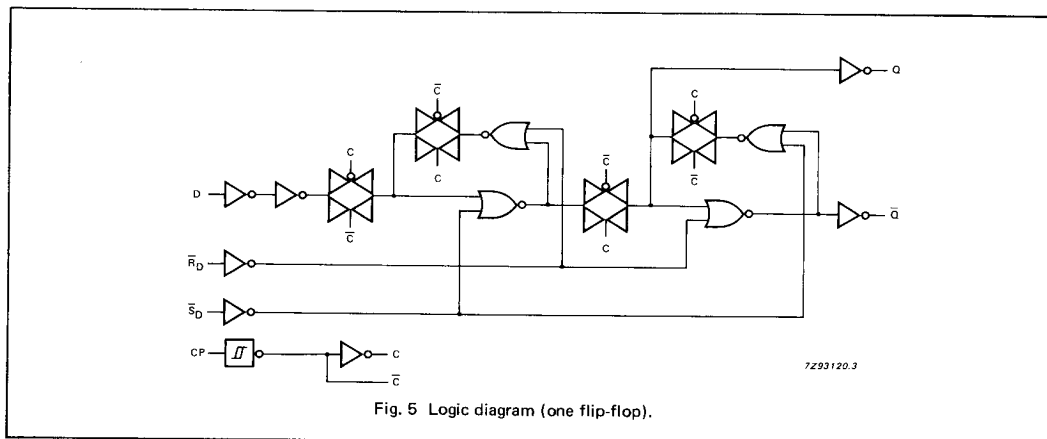


Fig. 5 Logic diagram (one flip-flop).

DC CHARACTERISTICS FOR 74HC

For the DC characteristics see chapter "HCMOS family characteristics", section "Family specifications".

Output capability: standard

I_{CC} category: flip-flops**AC CHARACTERISTICS FOR 74HC**GND = 0 V; t_r = t_f = 6 ns; C_L = 50 pF

SYMBOL	PARAMETER	T _{amb} (°C)								UNIT	TEST CONDITIONS	
		74HC									V _{CC} V	WAVEFORMS
		+25			−40 to +85		−40 to +125					
		min.	typ.	max.	min.	max.	min.	max.				
t _{PHL} / t _{PLH}	propagation delay nCP to nQ, nQ̄		47 17 14	175 35 30		220 44 37		265 53 45	ns	2.0 4.5 6.0	Fig. 6	
t _{PHL} / t _{PLH}	propagation delay nS _D to nQ, nQ̄		50 18 14	200 40 34		250 50 43		300 60 51	ns	2.0 4.5 6.0	Fig. 7	
t _{PHL} / t _{PLH}	propagation delay nR _D to nQ, nQ̄		52 19 15	200 40 34		250 50 43		300 60 51	ns	2.0 4.5 6.0	Fig. 7	
t _{THL} / t _{TLH}	output transition time		19 7 6	75 15 13		95 19 16		110 22 19	ns	2.0 4.5 6.0	Fig. 6	
t _W	clock pulse width HIGH or LOW	80 16 14	19 7 6		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 6	
t _W	set or reset pulse width LOW	80 16 14	19 7 6		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 7	
t _{rem}	removal time set or reset	30 6 5	3 1 1		40 8 7		45 9 8		ns	2.0 4.5 6.0	Fig. 7	
t _{su}	set-up time nD to nCP	60 12 10	6 2 2		75 15 13		90 18 15		ns	2.0 4.5 6.0	Fig. 6	
t _h	hold time nCP to nD	3 3 3	−6 −2 −2		3 3 3		3 3 3		ns	2.0 4.5 6.0	Fig. 6	
f _{max}	maximum clock pulse frequency	6.0 30 35	23 69 82		4.8 24 28		4.0 20 24		MHz	2.0 4.5 6.0	Fig. 6	

DC CHARACTERISTICS FOR 74HCT

For the DC characteristics see chapter "HCMOS family characteristics", section "Family specifications".

Output capability: standard

I_{CC} category: flip-flops

Note to HCT types

The value of additional quiescent supply current (ΔI_{CC}) for a unit load of 1 is given in the family specifications. To determine ΔI_{CC} per input, multiply this value by the unit load coefficient shown in the table below.

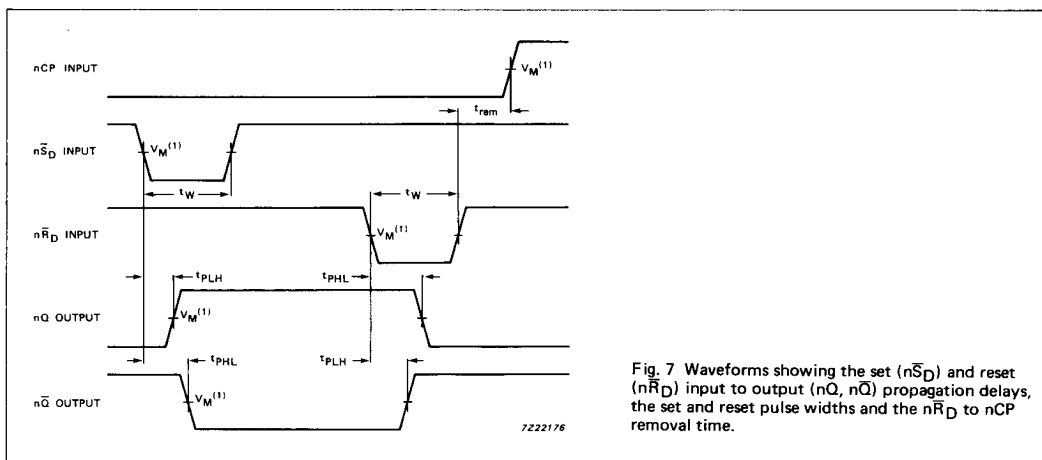
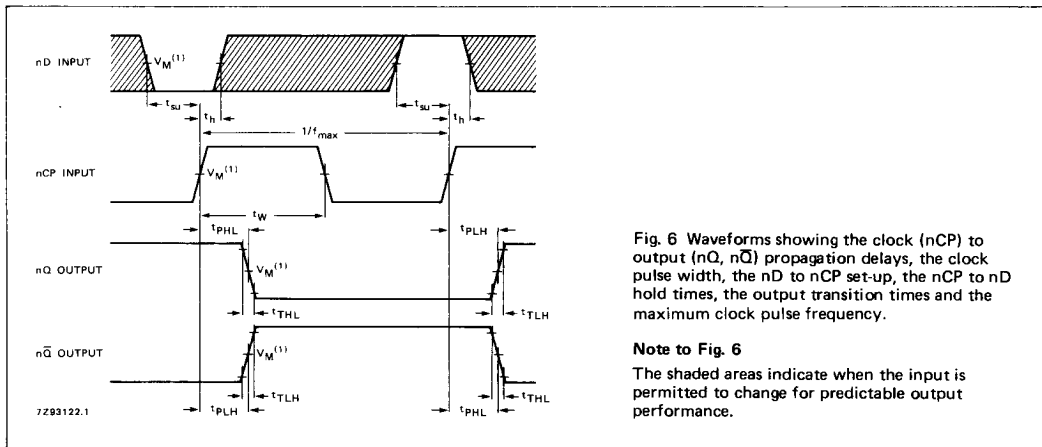
INPUT	UNIT LOAD COEFFICIENT
nD	0.70
nR _D	0.70
nS _D	0.80
nCP	0.80

AC CHARACTERISTICS FOR 74HCT

GND = 0 V; t_r = t_f = 6 ns; C_L = 50 pF

SYMBOL	PARAMETER	T _{amb} (°C)							UNIT	TEST CONDITIONS	
		74HCT								V _{CC} V	WAVEFORMS
		+25			−40 to +85		−40 to +125				
		min.	typ.	max.	min.	max.	min.	max.			
t _{PHL} / t _{PLH}	propagation delay nCP to nQ, nQ̄		18	35		44		53	ns	4.5	Fig. 6
t _{PHL} / t _{PLH}	propagation delay nS _D to nQ, nQ̄		23	40		50		60	ns	4.5	Fig. 7
t _{PHL} / t _{PLH}	propagation delay nR _D to nQ, nQ̄		24	40		50		60	ns	4.5	Fig. 7
t _{THL} / t _{TLH}	output transition time		7	15		19		22	ns	4.5	Fig. 6
t _W	clock pulse width HIGH or LOW	18	9		23		27		ns	4.5	Fig. 6
t _W	set or reset pulse width LOW	16	9		20		24		ns	4.5	Fig. 7
t _{rem}	removal time set or reset	6	1		8		9		ns	4.5	Fig. 7
t _{su}	set-up time nD to nCP	12	5		15		18		ns	4.5	Fig. 6
t _h	hold time nD to nCP	3	−3		3		3		ns	4.5	Fig. 6
f _{max}	maximum clock pulse frequency	27	54		22		18		MHz	4.5	Fig. 6

AC WAVEFORMS

**Note to AC waveforms**

- (1) HC : $V_M = 50\%$; $V_I = \text{GND to } V_{CC}$.
HCT: $V_M = 1.3\text{ V}$; $V_I = \text{GND to } 3\text{ V}$.