DUAL JK FLIP-FLOP WITH RESET; NEGATIVE-EDGE TRIGGER

FEATURES

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

GENERAL DESCRIPTION

The 74HC/HCT73 are high-speed Si-gate CMOS devices and are pin compatible with low power Schottky TTL (LSTTL). They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT73 are dual negative-edge triggered JK-type flip-flops featuring individual J, K, clock ($n\overline{CP}$) and reset ($n\overline{R}$) inputs; also complementary Q and $\overline{Q}$ outputs.

The J and K inputs must be stable one set-up time prior to the HIGH-to-LOW clock transition for predictable operation.

The reset ($n\overline{R}$) is an asynchronous active LOW input. When LOW, it overrides the clock and data inputs, forcing the Q output LOW and the $\overline{Q}$ output HIGH.

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 $n\overline{CP}$ to nQ $n\overline{CP}$ to $n\overline{Q}$ $n\overline{R}$ to nQ, $n\overline{Q}$	C_L = 15 pF V_{CC} = 5 V	 16 16 15	 15 18 15	 ns ns ns
f_{max}	maximum clock frequency		77	79	MHz
C_I	input capacitance		3.5	3.5	pF
C_{PD}	power dissipation capacitance per flip-flop	notes 1 and 2	30	30	pF

GND = 0 V; T_{amb} = 25 °C; $t_r = t_f$ = 6 ns

Notes

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
   $P_D = C_{PD} \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o)$ where:
   f_i = input frequency in MHz
   f_o = output frequency in MHz
   $\Sigma (C_L \times V_{CC}^2 \times f_o)$ = sum of outputs
   C_L = output load capacitance in pF
   V_{CC} = supply voltage in V
2. For HC the condition is V_I = GND to V_{CC}
   For HCT the condition is V_I = 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, 5	$1\overline{CP}$, $2\overline{CP}$	clock input (HIGH-to-LOW, edge-triggered)
2, 6	$1\overline{R}$, $2\overline{R}$	asynchronous reset inputs (active LOW)
4	V_{CC}	positive supply voltage
11	GND	ground (0 V)
12, 9	1Q, 2Q	true flip-flop outputs
13, 8	$1\overline{Q}$, $2\overline{Q}$	complement flip-flop outputs
14, 7, 3, 10	1J, 2J, 1K, 2K	synchronous inputs; flip-flops 1 and 2

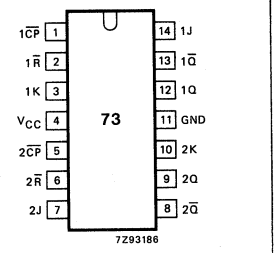

Fig. 1 Pin configuration.

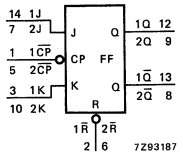

Fig. 2 Logic symbol.

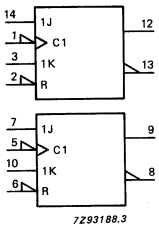

Fig. 3 IEC logic symbol.

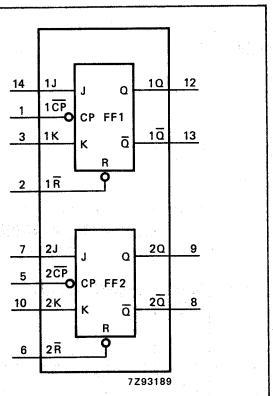

Fig. 4 Functional diagram.

FUNCTION TABLE

OPERATING MODE	INPUTS				OUTPUTS	
	$n\overline{R}$	$n\overline{CP}$	J	K	Q	$\overline{Q}$
asynchronous reset	L	X	X	X	L	H
toggle	H	↓	h	h	$\overline{q}$	q
load "0" (reset)	H	↓	l	h	L	H
load "1" (set)	H	↓	h	l	H	L
hold "no change"	H	↓	l	l	q	$\overline{q}$

H = HIGH voltage level
h = HIGH voltage level one set-up time prior to the HIGH-to-LOW CP transition
L = LOW voltage level
l = LOW voltage level one set-up time prior to the HIGH-to-LOW CP transition
q = lower case letters indicate the state of the referenced output one set-up time prior to the HIGH-to-LOW CP transition
X = don't care
↓ = HIGH-to-LOW CP transition

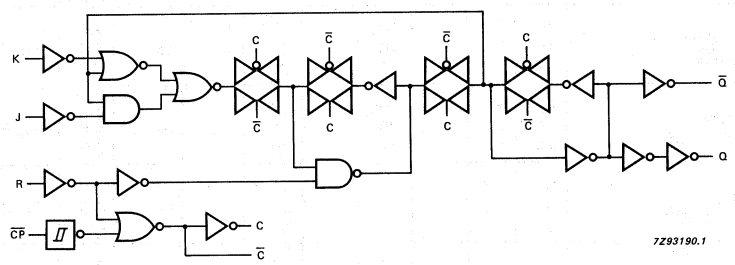

Fig. 5 Logic diagram (one flip-flop).

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 $n\overline{CP}$ to nQ		52 19 15	160 32 27		200 40 34		240 48 41	ns	2.0 4.5 6.0	Fig. 6
t_{PHL}/t_{PLH}	propagation delay $n\overline{CP}$ to $n\overline{Q}$		52 19 15	160 32 27		200 40 34		240 48 41	ns	2.0 4.5 6.0	Fig. 6
t_{PHL}/t_{PLH}	propagation delay $n\overline{R}$ to nQ, $n\overline{Q}$		50 18 14	145 29 25		180 36 31		220 44 38	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	22 8 6		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 6
t_W	reset pulse width HIGH or LOW	80 16 14	22 8 6		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 7
t_{rem}	removal time $n\overline{R}$ to $n\overline{CP}$	80 16 14	22 8 6		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 7
t_{su}	set-up time nJ, nK to $n\overline{CP}$	80 16 14	22 8 6		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 6
t_h	hold time nJ, nK to $n\overline{CP}$	3 3 3	−8 −3 −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 70 83		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
nK	0.60
$n\overline{R}$	0.65
$n\overline{CP}$, nJ	1.00

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	
		74 HCT								V_{CC} V	WAVEFORMS
		+25			−40 to +85		−40 to +125				
		min.	typ.	max.	min.	max.	min.	max.			
t_{PHL}/t_{PLH}	propagation delay $n\overline{CP}$ to nQ		18	38		48		57	ns	4.5	Fig. 6
t_{PHL}/t_{PLH}	propagation delay $n\overline{CP}$ to $n\overline{Q}$		21	36		45		54	ns	4.5	Fig. 6
t_{PHL}/t_{PLH}	propagation delay $n\overline{R}$ to nQ, $n\overline{Q}$		20	34		43		51	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	16	8		20		24		ns	4.5	Fig. 6
t_W	reset pulse width HIGH or LOW	18	9		23		27		ns	4.5	Fig. 7
t_{rem}	removal time $n\overline{R}$ to $n\overline{CP}$	14	8		18		21		ns	4.5	Fig. 7
t_{su}	set-up time nJ, nK to $n\overline{CP}$	12	6		15		18		ns	4.5	Fig. 6
t_h	hold time nJ, nK to $n\overline{CP}$	3	−2		3		3		ns	4.5	Fig. 6
f_{max}	maximum clock pulse frequency	30	72		24		20		MHz	4.5	Fig. 6

AC WAVEFORMS

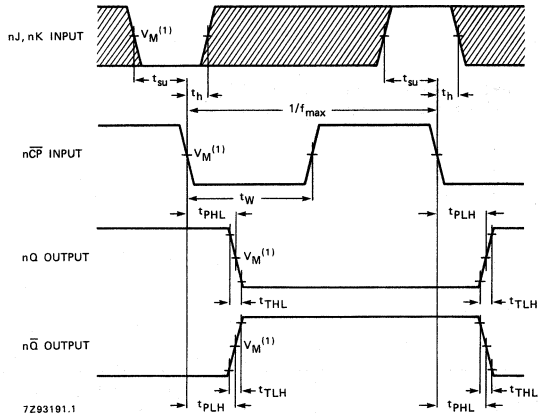

Fig. 6 Waveforms showing the clock (n$\overline{CP}$) to output (nQ, nQ̄) propagation delays, the clock pulse width, the J and K to n$\overline{CP}$ set-up and hold times, the output transition times and the maximum clock pulse frequency.

Note to Fig. 6

The shaded areas indicate when the input is permitted to change for predictable output performance.

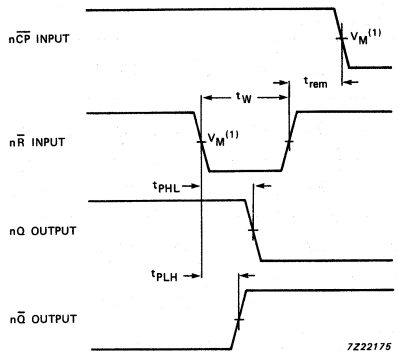

Fig. 7 Waveforms showing the reset (n$\overline{R}$) input to output (nQ, nQ̄) propagation delays and the reset pulse width and the n$\overline{R}$ to n$\overline{CP}$ removal time.

Note to AC waveforms

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