

OCTAL D-TYPE FLIP-FLOP; POSITIVE EDGE-TRIGGER; 3-STATE

FEATURES

- 3-state non-inverting outputs for bus oriented applications
- 8-bit positive, edge-triggered register
- Common 3-state output enable input
- Independent register and 3-state buffer operation
- Output capability: bus driver
- I_{CC} category: MSI

GENERAL DESCRIPTION

The 74HC/HCT374 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/HCT374 are octal D-type flip-flops featuring separate D-type inputs for each flip-flop and 3-state outputs for bus oriented applications.

A clock (CP) and an output enable ($\overline{OE}$) input are common to all flip-flops.

The 8 flip-flops will store the state of their individual D-inputs that meet the set-up and hold times requirements on the LOW-to-HIGH CP transition.

When $\overline{OE}$ is LOW, the contents of the 8 flip-flops are available at the outputs. When $\overline{OE}$ is HIGH, the outputs go to the high impedance OFF-state. Operation of the $\overline{OE}$ input does not affect the state of the flip-flops.

The "374" is functionally identical to the "534", but has non-inverting outputs.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
t_{PHL}/t_{PLH}	propagation delay CP to Q _n	$C_L = 15 \text{ pF}$ $V_{CC} = 5 \text{ V}$	15	13	ns
f_{max}	maximum clock frequency		77	48	MHz
C_I	input capacitance		3.5	3.5	pF
CPD	power dissipation capacitance per flip-flop	notes 1 and 2	17	17	pF

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

Notes

1. CPD is used to determine the dynamic power dissipation (P_D in μW):

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

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 $V_I = \text{GND to } V_{CC} - 1.5 \text{ V}$

PACKAGE OUTLINES

20-lead DIL; plastic (SOT146).

20-lead mini-pack; plastic (SO20; SOT163A).

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1	$\overline{OE}$	3-state output enable input (active LOW)
2, 5, 6, 9, 12, 15, 16, 19	Q ₀ to Q ₇	3-state flip-flop outputs
3, 4, 7, 8, 13, 14, 17, 18	D ₀ to D ₇	data inputs
10	GND	ground (0 V)
11	CP	clock input (LOW-to-HIGH, edge-triggered)
20	V _{CC}	positive supply voltage

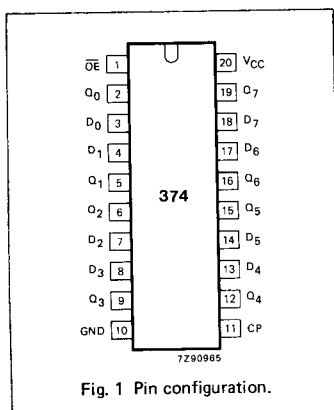


Fig. 1 Pin configuration.

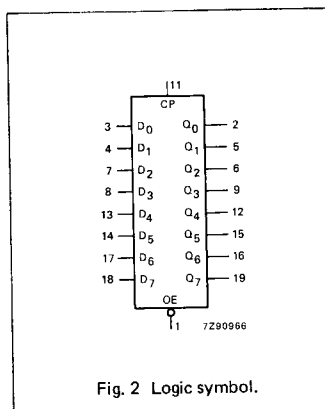


Fig. 2 Logic symbol.

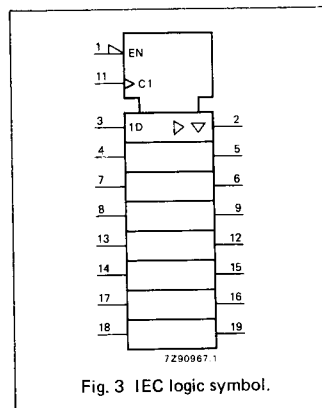
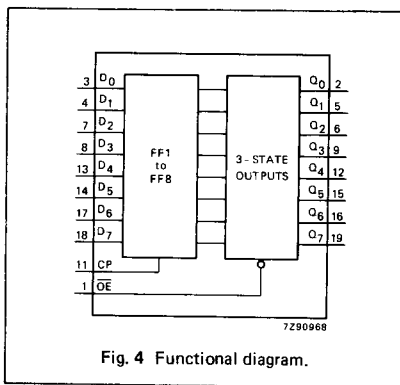


Fig. 3 IEC logic symbol.



FUNCTION TABLE

OPERATING MODES	INPUTS			INTERNAL FLIP-FLOPS	OUTPUTS Q ₀ to Q ₇
	OE	CP	D _n		
load and read register	L	↑	l	L	L
	L		h	H	H
load register and disable outputs	H	↑	l	L	Z
	H		h	H	Z

H = HIGH voltage level

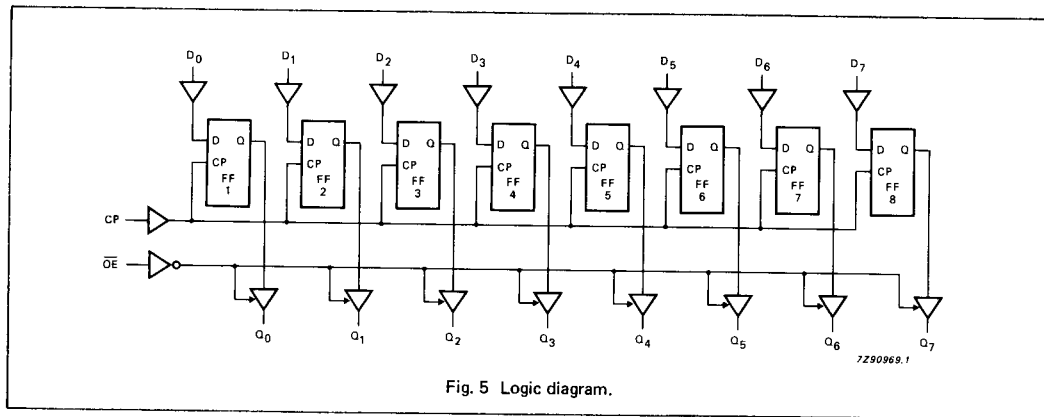
h = HIGH voltage level one set-up time
prior to the LOW-to-HIGH CP transition

L = LOW voltage level

l = LOW voltage level one set-up time
prior to the LOW-to-HIGH CP transition

Z = high impedance OFF-state

↑ = LOW-to-HIGH CP transition



DC CHARACTERISTICS FOR 74HC

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

Output capability: bus driver

I_{CC} category: MSI

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 CP to Q _N		50 18 14	165 33 28		205 41 35		250 50 43	ns	2.0 4.5 6.0	Fig. 6	
t _{PZH} / t _{PZL}	3-state output enable time OE to Q _N		41 15 12	150 30 26		190 38 33		225 45 38	ns	2.0 4.5 6.0	Fig. 7	
t _{PHZ} / t _{PLZ}	3-state output disable time OE to Q _N		50 18 14	150 30 26		190 38 33		225 45 38	ns	2.0 4.5 6.0	Fig. 7	
t _{THL} / t _{TLH}	output transition time		14 5 4	60 12 10		75 15 13		90 18 15	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 _{su}	set-up time D _N to CP	60 12 10	14 5 4		75 15 13		90 18 15		ns	2.0 4.5 6.0	Fig. 8	
t _h	hold time D _N to CP	5 5 5	-6 -2 -2		5 5 5		5 5 5		ns	2.0 4.5 6.0	Fig. 8	
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: bus driver

I_{CC} category: MSI

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
$\overline{OE}$	1.25
CP	0.90
D_n	0.35

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 CP to Q _n		16	32		40		48	ns	4.5	Fig. 6
t _{pZH} / t _{pZL}	3-state output enable time OE to Q _n		16	30		38		45	ns	4.5	Fig. 7
t _{PHZ} / t _{PLZ}	3-state output disable time OE to Q _n		18	28		35		42	ns	4.5	Fig. 7
t _{THL} / t _{TLH}	output transition time		5	12		15		18	ns	4.5	Fig. 6
t _W	clock pulse width HIGH or LOW	19	11		24		29		ns	4.5	Fig. 6
t _{su}	set-up time D _n to CP	12	7		15		18		ns	4.5	Fig. 8
t _h	hold time D _n to CP	5	—3		5		5		ns	4.5	Fig. 8
f _{max}	maximum clock pulse frequency	26	44		21		17		MHz	4.5	Fig. 6

AC WAVEFORMS

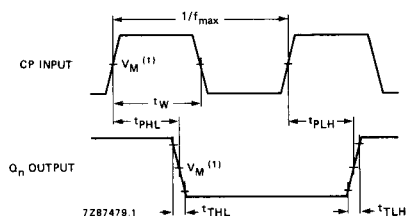


Fig. 6 Waveforms showing the clock (CP) to output (Q_n) propagation delays, the clock pulse width, output transition times and the maximum clock pulse frequency.

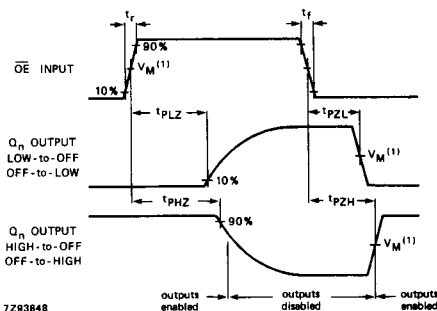


Fig. 7 Waveforms showing the 3-state enable and disable times.

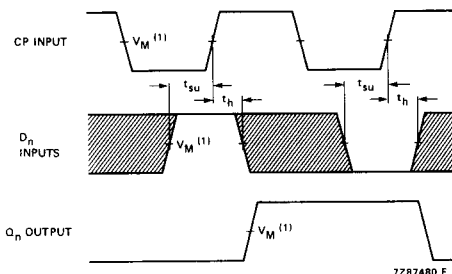


Fig. 8 Waveforms showing the data set-up and hold times for D_n input.

Note to Fig. 8

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

Note to AC waveforms

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

HCT: $V_M = 1.3 \text{ V}$; $V_I = \text{GND to } 3 \text{ V}$.