

7-STAGE BINARY RIPPLE COUNTER

FEATURES

- Output capability: standard
- I_{CC} category: MSI

GENERAL DESCRIPTION

The 74HC/HCT4024 are high-speed Si-gate CMOS devices and are pin compatible with the "4024" of the "4000B" series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4024 are 7-stage binary ripple counters with a clock input (CP), an overriding asynchronous master reset input (MR) and seven fully buffered parallel outputs (Q₀ to Q₆).

The counter advances on the HIGH-to-LOW transition of CP.

A HIGH on MR clears all counter stages and forces all outputs LOW, independent of the state of CP.

Each counter stage is a static toggle flip-flop.

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

APPLICATIONS

- Frequency dividing circuits
- Time delay circuits

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
t _{PHL} / t _{PLH}	propagation delay CP to Q ₀	C _L = 15 pF V _{CC} = 5 V	14	14	ns
f _{max}	maximum clock frequency		90	70	MHz
C _I	input capacitance		3.5	3.5	pF
C _{PD}	power dissipation capacitance per package	notes 1 and 2	25	27	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):

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

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
 Σ (C_L × V_{CC}² × f_o) = sum of outputs

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

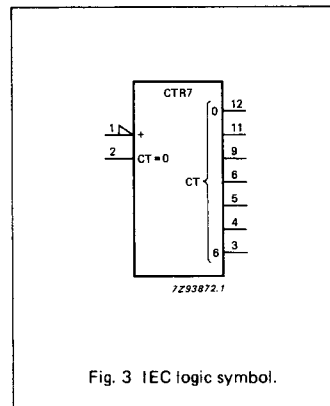
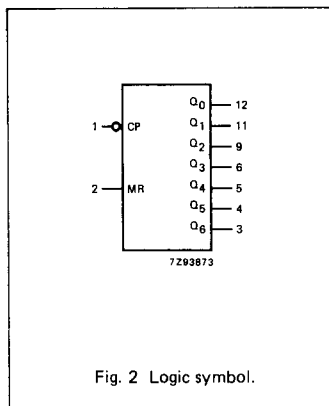
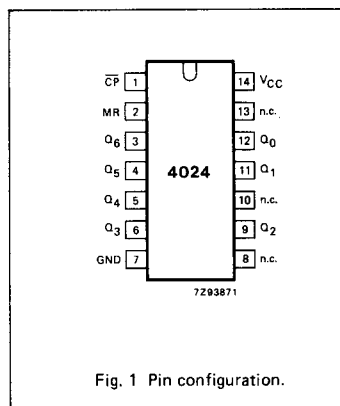
PACKAGE OUTLINES

14-lead DIL; plastic (SOT27).

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

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1	CP	clock input (HIGH-to-LOW, edge-triggered)
2	MR	master reset input (active HIGH)
12, 11, 9, 6, 5, 4, 3	Q ₀ to Q ₆	parallel outputs
7	GND	ground (0 V)
8, 10, 13	n.c.	not connected
14	V _{CC}	positive supply voltage



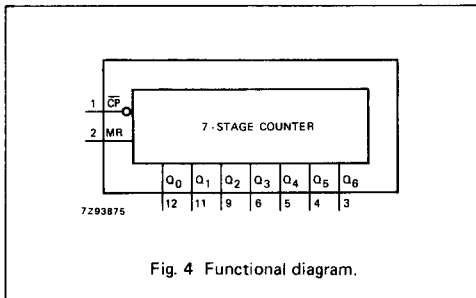


Fig. 4 Functional diagram.

FUNCTION TABLE

INPUTS		OUTPUTS
\overline{CP}	MR	Q_n
↑	L	no change
↓	L	count
X	H	L

H = HIGH voltage level
 L = LOW voltage level
 X = don't care
 ↑ = LOW-to-HIGH clock transition
 ↓ = HIGH-to-LOW clock transition

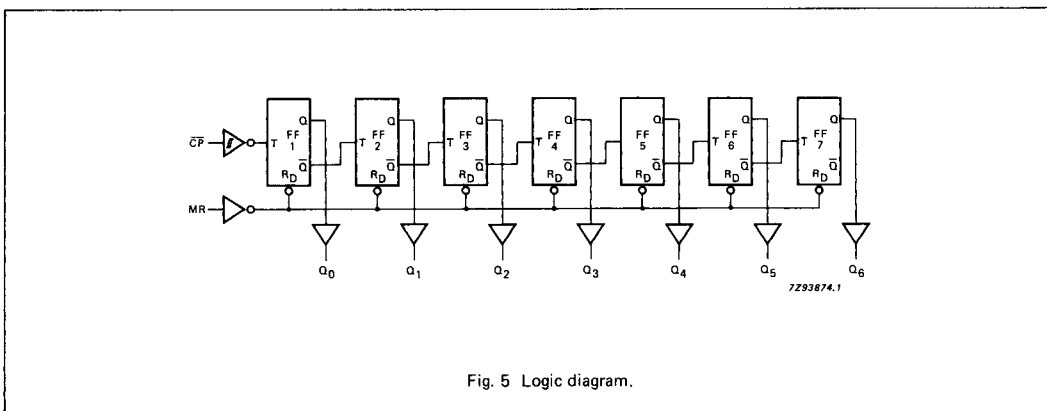


Fig. 5 Logic diagram.

DC CHARACTERISTICS FOR 74HC

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

Output capability: standard

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 ₀		47 17 14	175 35 30		220 44 37		265 53 45	ns	2.0 4.5 6.0	Fig. 6
t _{PHL}	propagation delay MR to Q ₀		63 23 18	200 40 34		250 50 43		300 60 51	ns	2.0 4.5 6.0	Fig. 6
t _{PHL} / t _{PLH}	propagation delay Q _n to Q _{n+1}		25 9 7	80 16 14		100 20 17		120 24 20	ns	2.0 4.5 6.0	Fig. 6
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	17 6 5		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 6
t _W	master reset pulse width HIGH	80 16 14	22 8 6		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 6
t _{rem}	removal time MR to CP	50 10 9	6 2 2		65 13 11		75 15 13		ns	2.0 4.5 6.0	Fig. 6
f _{max}	maximum clock pulse frequency	6.0 30 35	27 82 98		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: 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{CP}	0.75
MR	0.85

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 \overline{CP} to Q ₀		17	35		44		53	ns	4.5	Fig. 6
t _{PHL}	propagation delay MR to Q ₀		21	40		50		60	ns	4.5	Fig. 6
t _{PHL} / t _{PLH}	propagation delay Q _n to Q _{n+1}		9	16		20		24	ns	4.5	Fig. 6
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	9		20		24		ns	4.5	Fig. 6
t _w	master reset pulse width HIGH	16	6		20		24		ns	4.5	Fig. 6
t _{rem}	removal time MR to \overline{CP}	10	0		13		15		ns	4.5	Fig. 6
f _{max}	maximum clock pulse frequency	30	64		24		20		MHz	4.5	Fig. 6

AC WAVEFORMS

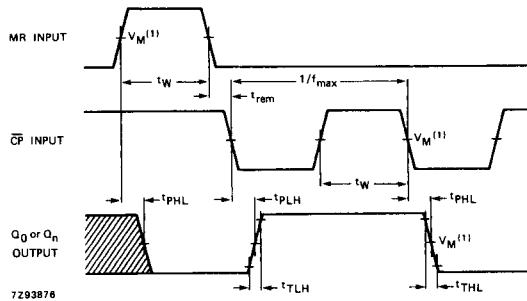


Fig. 6 Waveforms showing the clock (\overline{CP}) to output (Q_n) propagation delays, the clock pulse width, the output transition times and the maximum clock frequency.

Also showing the master reset (MR) pulse width, the master reset to output (Q_n) propagation delays and the master reset to clock (\overline{CP}) removal time.

Note to AC waveforms

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