

DATA SHEET

For a complete data sheet, please also download:

- The IC06 74HC/HCT/HCU/HCMOS Logic Family Specifications
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Information
- The IC06 74HC/HCT/HCU/HCMOS Logic Package Outlines

74HC/HCT4024 7-stage binary ripple counter

Product specification
File under Integrated Circuits, IC06

December 1990

7-stage binary ripple counter

74HC/HCT4024

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 ($\overline{CP}$), an overriding asynchronous master reset input (MR) and seven fully buffered parallel outputs (Q_0 to Q_6).

The counter advances on the HIGH-to-LOW transition of $\overline{CP}$.

A HIGH on MR clears all counter stages and forces all outputs LOW, independent of the state of $\overline{CP}$.

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

QUICK REFERENCE DATA

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

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
t_{PHL} / t_{PLH}	propagation delay $\overline{CP}$ to Q_0	$C_L = 15\text{ pF}$; $V_{CC} = 5\text{ V}$	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

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

f_o = output frequency in MHz

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

C_L = output load capacitance in pF

V_{CC} = supply voltage in V

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

ORDERING INFORMATION

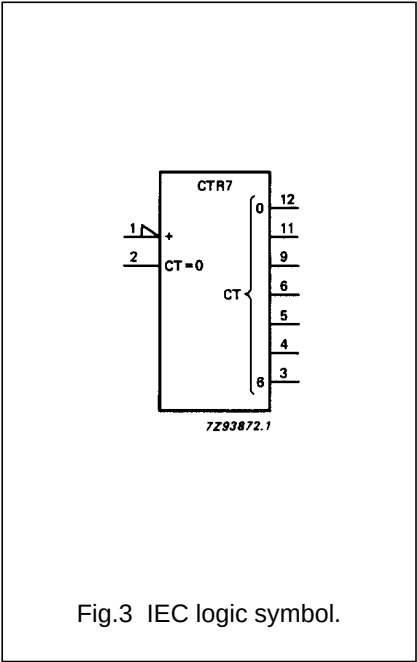
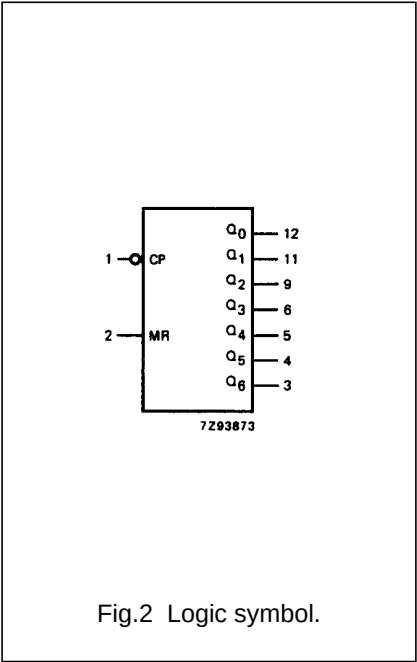
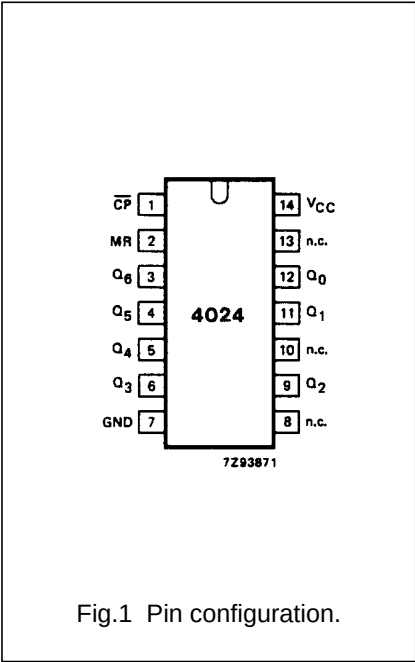
See "74HC/HCT/HCU/HCMOS Logic Package Information".

7-stage binary ripple counter

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PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1	$\overline{\text{CP}}$	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



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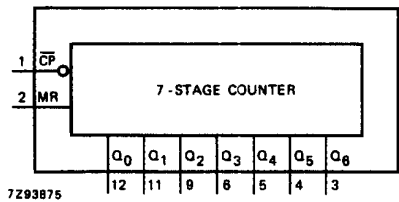


Fig.4 Functional diagram.

FUNCTION TABLE

INPUTS		OUTPUTS
CP	MR	Q _n
↑	L	no change count
↓	L	
X	H	L

Notes

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

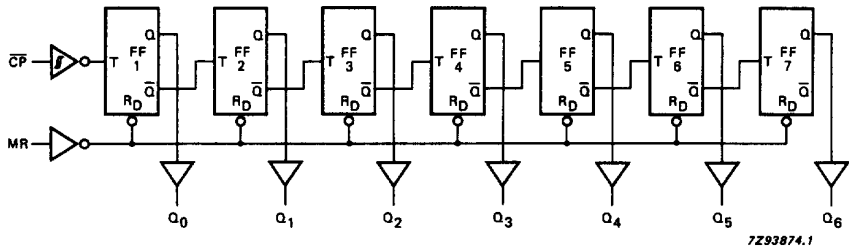


Fig.5 Logic diagram.

7-stage binary ripple counter

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DC CHARACTERISTICS FOR 74HC

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic 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 +125		−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 $\overline{\text{CP}}$	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

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DC CHARACTERISTICS FOR 74HCT

For the DC characteristics see *"74HC/HCT/HCU/HCMOS Logic 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

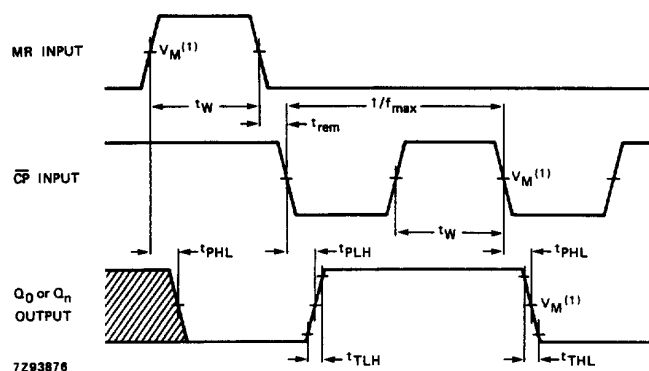
GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

SYMBOL	PARAMETER	T _{amb} (°C)							UNIT	TEST CONDITIONS	
		74HCT								V _{CC} (V)	WAVEFORMS
		+25			−40 to +125		−40 to +125				
		min.	typ.	max.	min.	max.	min.	max.			
t _{PHL} / t _{PLH}	propagation delay 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 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

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AC WAVEFORMS



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.

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

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.

PACKAGE OUTLINES

See *"74HC/HCT/HCU/HCMOS Logic Package Outlines"*.