

# 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/HCT4040** 12-stage binary ripple counter

Product specification  
File under Integrated Circuits, IC06

December 1990

## 12-stage binary ripple counter

## 74HC/HCT4040

## FEATURES

- Output capability: standard
- I<sub>CC</sub> category: MSI

## GENERAL DESCRIPTION

The 74HC/HCT4040 are high-speed Si-gate CMOS devices and are pin compatible with “4040” of the “4000B” series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4040 are 12-stage binary ripple counters with a clock input ( $\overline{CP}$ ), an overriding asynchronous master reset input (MR) and twelve parallel outputs

(Q<sub>0</sub> to Q<sub>11</sub>). 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.

## APPLICATIONS

- Frequency dividing circuits
- Time delay circuits
- Control counters

## QUICK REFERENCE DATA

GND = 0 V; T<sub>amb</sub> = 25 °C; t<sub>r</sub> = t<sub>f</sub> = 6 ns

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
t <sub>PHL</sub> / t <sub>PLH</sub>	propagation delay $\overline{CP}$ to Q <sub>0</sub>	C <sub>L</sub> = 15 pF; V <sub>CC</sub> = 5 V	14	16	ns
	Q <sub>n</sub> to Q <sub>n+1</sub>		8	8	ns
f <sub>max</sub>	maximum clock frequency		90	79	MHz
C <sub>I</sub>	input capacitance		3.5	3.5	pF
C <sub>PD</sub>	power dissipation capacitance per package	notes 1 and 2	20	20	pF

## Notes

1. C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> 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<sub>i</sub> = input frequency in MHz

f<sub>o</sub> = output frequency in MHz

∑ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs

C<sub>L</sub> = output load capacitance in pF

V<sub>CC</sub> = supply voltage in V

2. For HC the condition is V<sub>I</sub> = GND to V<sub>CC</sub>

For HCT the condition is V<sub>I</sub> = GND to V<sub>CC</sub> – 1.5 V

## ORDERING INFORMATION

See “74HC/HCT/HCU/HCMOS Logic Package Information”.

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## PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
8	GND	ground (0 V)
9, 7, 6, 5, 3, 2, 4, 13, 12, 14, 15, 1	$Q_0$ to $Q_{11}$	parallel outputs
10	$\overline{CP}$	clock input (HIGH-to-LOW, edge-triggered)
11	MR	master reset input (active HIGH)
16	$V_{CC}$	positive supply voltage

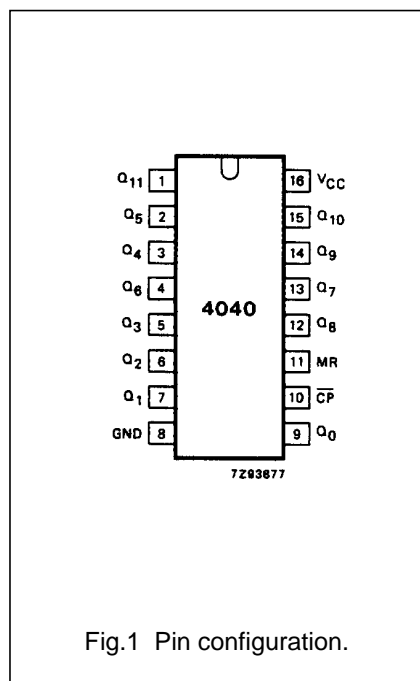


Fig.1 Pin configuration.

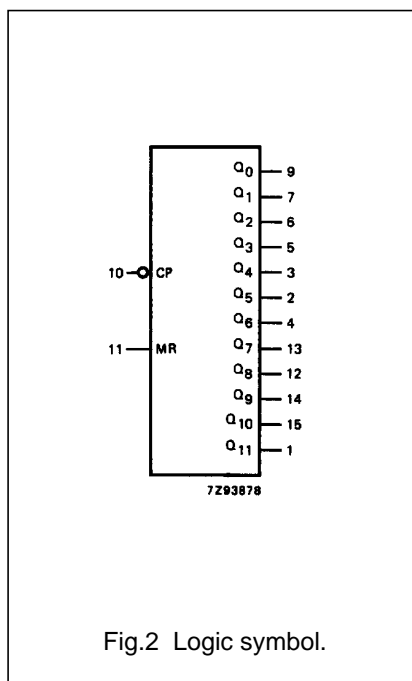


Fig.2 Logic symbol.

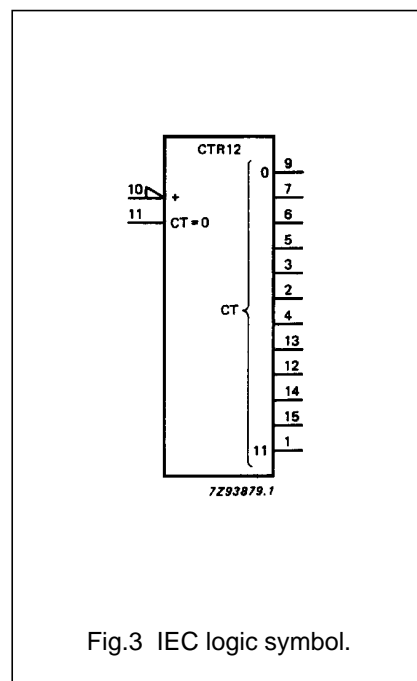


Fig.3 IEC logic symbol.

# 12-stage binary ripple counter

# 74HC/HCT4040

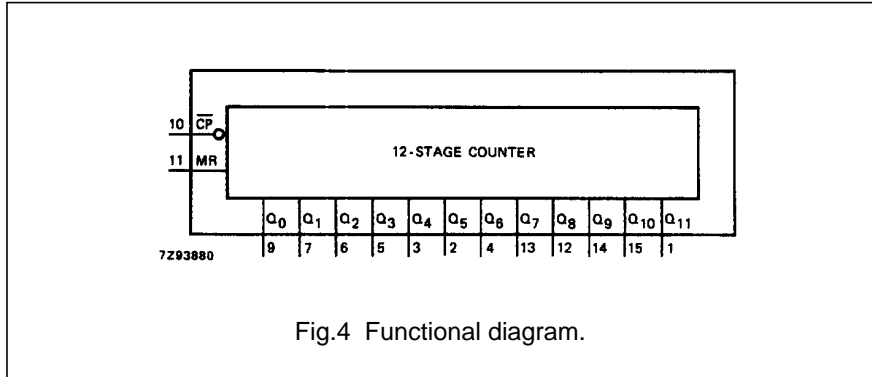


Fig.4 Functional diagram.

### FUNCTION TABLE

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

### Notes

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

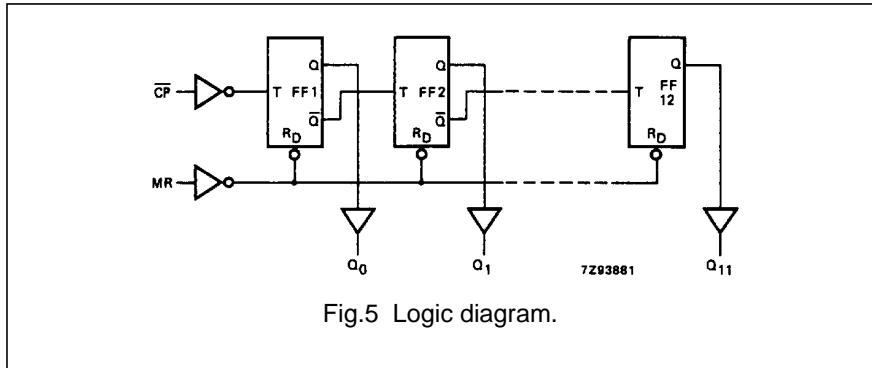


Fig.5 Logic diagram.

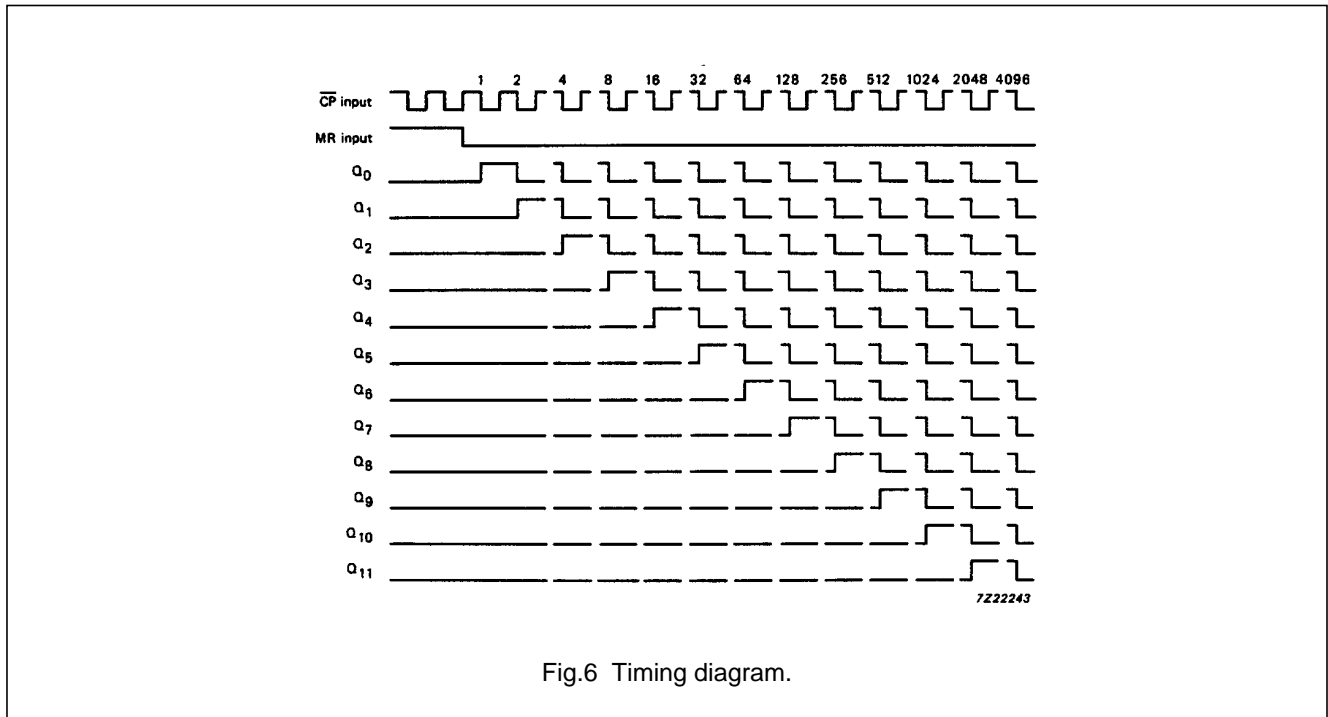


Fig.6 Timing diagram.

## 12-stage binary ripple counter

## 74HC/HCT4040

**DC CHARACTERISTICS FOR 74HC**

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

Output capability: standard

I<sub>CC</sub> category: MSI

**AC CHARACTERISTICS FOR 74HC**

GND = 0 V; t<sub>r</sub> = t<sub>f</sub> = 6 ns; C<sub>L</sub> = 50 pF

SYMBOL	PARAMETER	T <sub>amb</sub> (°C)						UNIT	TEST CONDITIONS		
		74HC							V <sub>CC</sub> (V)	WAVEFORMS	
		+25			-40 to +85		-40 to +125				
		min.	typ.	max.	min.	max.	min.				max.
t <sub>PHL</sub> / t <sub>PLH</sub>	propagation delay CP to Q <sub>0</sub>		47 17 14	150 30 26		190 38 33		225 45 38	ns	2.0 4.5 6.0	Fig.7
t <sub>PHL</sub> / t <sub>PLH</sub>	propagation delay Q <sub>n</sub> to Q <sub>n+1</sub>		28 10 8	100 20 17		125 25 21		150 30 26	ns	2.0 4.5 6.0	Fig.7
t <sub>PHL</sub>	propagation delay MR to Q <sub>n</sub>		61 22 18	185 37 31		230 46 39		280 56 48	ns	2.0 4.5 6.0	Fig.7
t <sub>THL</sub> / t <sub>TLH</sub>	output transition time		19 7 6	75 15 13		95 19 16		110 22 19	ns	2.0 4.5 6.0	Fig.7
t <sub>w</sub>	clock pulse width HIGH or LOW	80 16 14	14 5 4		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig.7
t <sub>w</sub>	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.7
t <sub>rem</sub>	removal time MR to CP	50 10 9	8 3 2		65 13 11		75 15 13		ns	2.0 4.5 6.0	Fig.7
f <sub>max</sub>	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.7

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## 74HC/HCT4040

**DC CHARACTERISTICS FOR 74HCT**

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

Output capability: standard

I<sub>CC</sub> category: MSI

**Note to HCT types**

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

INPUT	UNIT LOAD COEFFICIENT
$\overline{CP}$	0.85
MR	1.10

**AC CHARACTERISTICS FOR 74HCT**

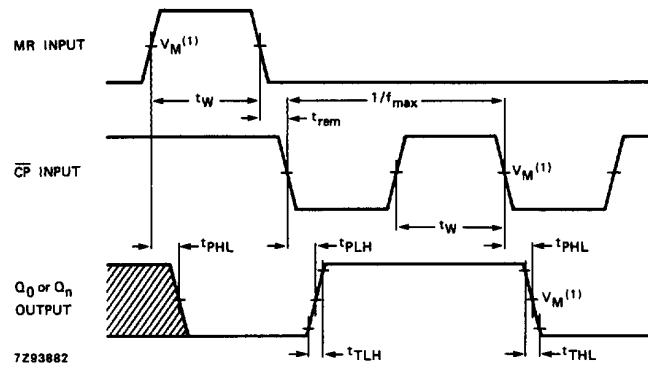
GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF

SYMBOL	PARAMETER	T <sub>amb</sub> (°C)							UNIT	TEST CONDITIONS	
		74HCT								V <sub>CC</sub> (V)	WAVEFORMS
		+25			-40 to +85		-40 to +125				
		min.	typ.	max.	min.	max.	min.	max.			
t <sub>PHL</sub> / t <sub>PLH</sub>	propagation delay CP to Q <sub>0</sub>		19	40		50		60	ns	4.5	Fig.7
t <sub>PHL</sub> / t <sub>PLH</sub>	propagation delay Q <sub>n</sub> to Q <sub>n+1</sub>		10	20		25		30	ns	4.5	Fig.7
t <sub>PHL</sub>	propagation delay MR to Q <sub>n</sub>		23	45		56		68	ns	4.5	Fig.7
t <sub>THL</sub> / t <sub>TLH</sub>	output transition time		7	15		19		22	ns	4.5	Fig.7
t <sub>w</sub>	clock pulse width HIGH or LOW	16	7		20		24		ns	4.5	Fig.7
t <sub>w</sub>	master reset pulse width; HIGH	16	6		20		24		ns	4.5	Fig.7
t <sub>rem</sub>	removal time MR to $\overline{CP}$	10	2		13		15		ns	4.5	Fig.7
f <sub>max</sub>	maximum clock pulse frequency	30	72		24		20		MHz	4.5	Fig.7

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## AC WAVEFORMS



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

Fig.7 Waveforms showing the clock ( $\overline{\text{CP}}$ ) to output ( $Q_n$ ) propagation delays, the clock pulse width, the output transition times and the maximum clock pulse frequency.  
 Also showing the master reset (MR) pulse width, the master reset to output ( $Q_n$ ) propagation delays and the master reset to clock ( $\overline{\text{CP}}$ ) removal time.

## PACKAGE OUTLINES

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