

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_{CC} 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

(Q₀ to Q₁₁). 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_{amb} = 25 °C; t_r = t_f = 6 ns

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

For HCT the condition is V_I = GND to V_{CC} – 1.5 V

ORDERING INFORMATION

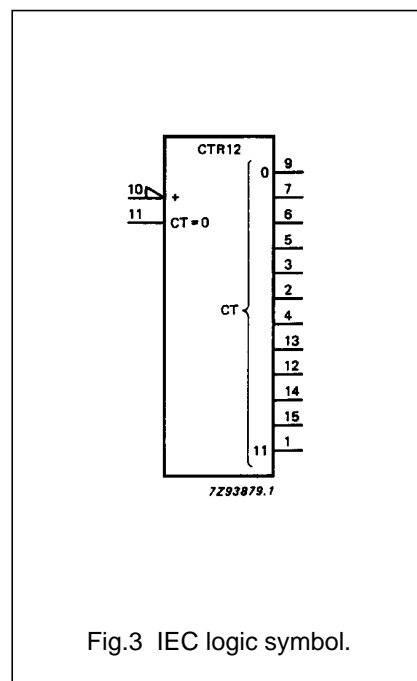
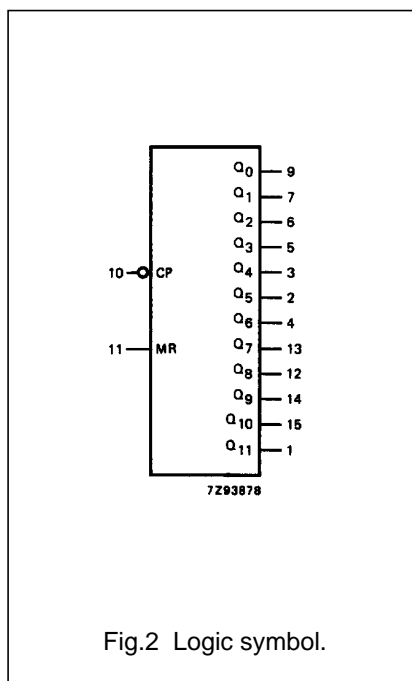
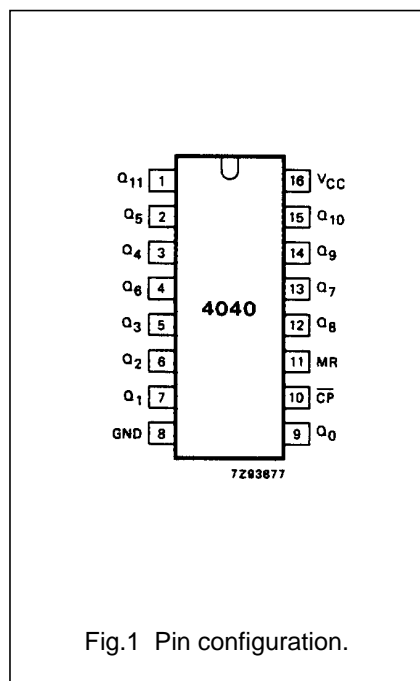
See "74HC/HCT/HCU/HCMOS Logic Package Information".

12-stage binary ripple counter

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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 |



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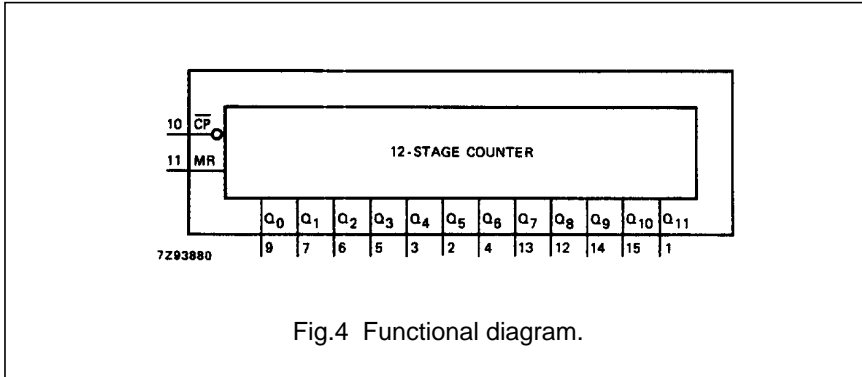


Fig.4 Functional diagram.

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

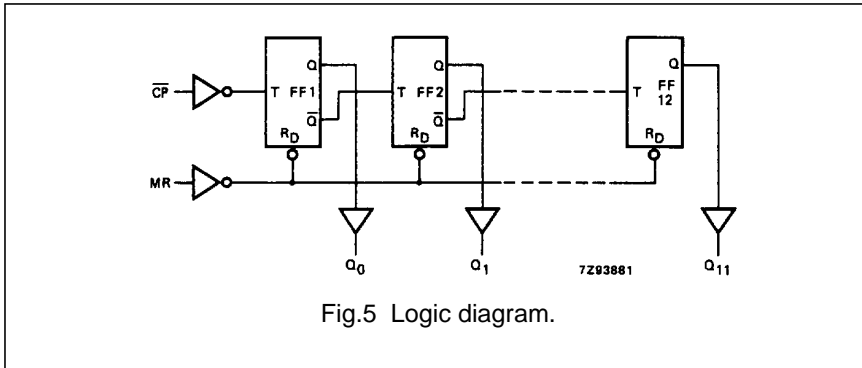


Fig.5 Logic diagram.

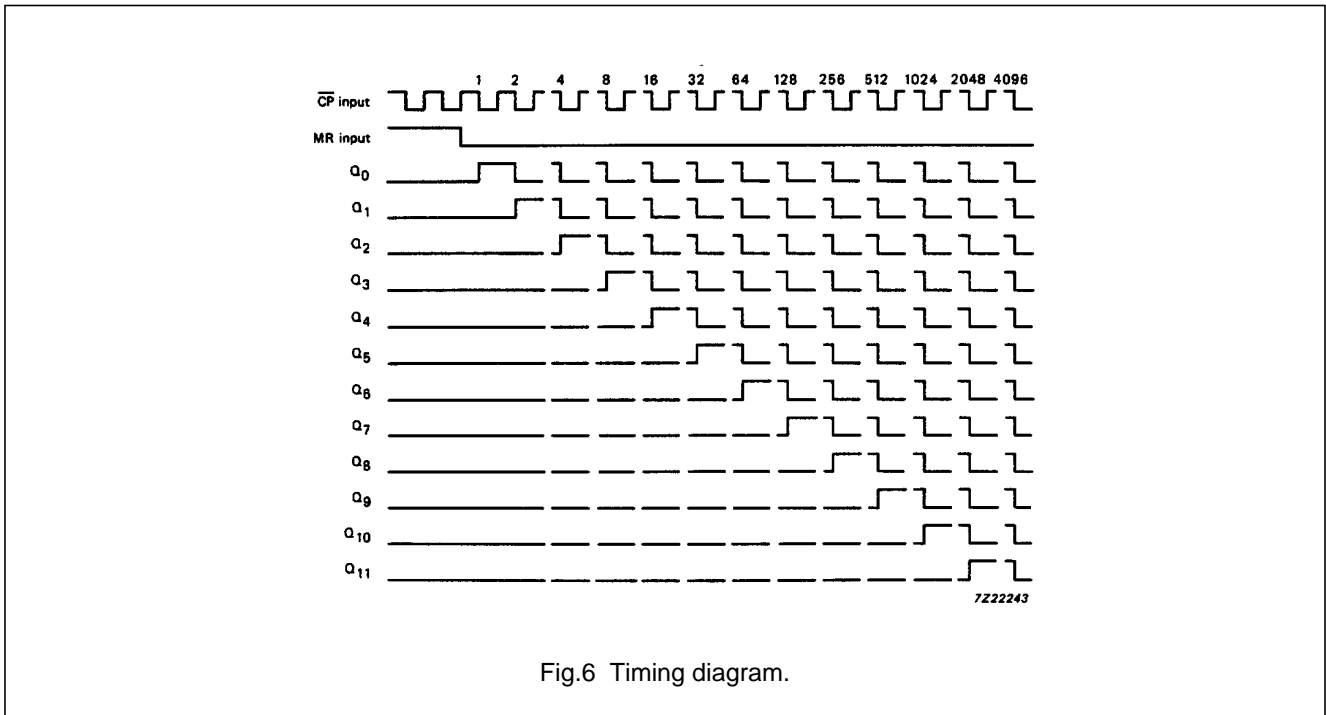


Fig.6 Timing diagram.

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_{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 | 150 30 26 | | 190 38 33 | | 225 45 38 | ns | 2.0 4.5 6.0 | Fig.7 |
| t _{PHL} / t _{PLH} | propagation delay Q _n to Q _{n+1} | | 28 10 8 | 100 20 17 | | 125 25 21 | | 150 30 26 | ns | 2.0 4.5 6.0 | Fig.7 |
| t _{PHL} | propagation delay MR to Q _n | | 61 22 18 | 185 37 31 | | 230 46 39 | | 280 56 48 | 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.7 |
| t _w | 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 _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.7 |
| t _{rem} | 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 _{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.7 |

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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} | 0.85 |
| MR | 1.10 |

AC CHARACTERISTICS FOR 74HCT

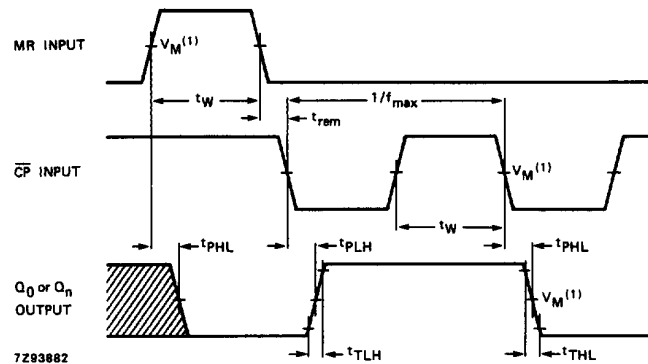
GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

| 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 ₀ | | 19 | 40 | | 50 | | 60 | ns | 4.5 | Fig.7 |
| t _{PHL} / t _{PLH} | propagation delay Q _n to Q _{n+1} | | 10 | 20 | | 25 | | 30 | ns | 4.5 | Fig.7 |
| t _{PHL} | propagation delay MR to Q _n | | 23 | 45 | | 56 | | 68 | ns | 4.5 | Fig.7 |
| t _{THL} / t _{TLH} | output transition time | | 7 | 15 | | 19 | | 22 | ns | 4.5 | Fig.7 |
| t _w | clock pulse width HIGH or LOW | 16 | 7 | | 20 | | 24 | | ns | 4.5 | Fig.7 |
| t _w | master reset pulse width; HIGH | 16 | 6 | | 20 | | 24 | | ns | 4.5 | Fig.7 |
| t _{rem} | removal time MR to \overline{CP} | 10 | 2 | | 13 | | 15 | | ns | 4.5 | Fig.7 |
| f _{max} | 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".



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