

DUAL 4-BIT SYNCHRONOUS BINARY COUNTER

FEATURES

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

GENERAL DESCRIPTION

The 74HC/HCT4520 are high-speed Si-gate CMOS devices and are pin compatible with the "4520" of the "4000B" series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4520 are dual 4-bit internally synchronous binary counters with an active HIGH clock input (nCP₀) and an active LOW clock input (nCP₁), buffered outputs from all four bit positions (nQ₀ to nQ₃) and an active HIGH overriding asynchronous master reset input (nMR).

The counter advances on either the LOW-to-HIGH transition of nCP₀ if nCP₁ is HIGH or the HIGH-to-LOW transition of nCP₁ if nCP₀ is LOW. Either nCP₀ or nCP₁ may be used as the clock input to the counter and the other clock input may be used as a clock enable input. A HIGH on nMR resets the counter (nQ₀ to nQ₃ = LOW) independent of nCP₀ and nCP₁.

APPLICATIONS

- Multistage synchronous counting
- Multistage asynchronous counting
- Frequency dividers

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
t _{PHL} / t _{PLH}	propagation delay nCP ₀ , nCP ₁ to nQ _n	C _L = 15 pF V _{CC} = 5 V	24	24	ns
t _{PHL}	propagation delay nMR to nQ _n		13	13	ns
f _{max}	maximum clock frequency		68	64	MHz
C _I	input capacitance		3.5	3.5	pF
CPD	power dissipation capacitance per counter	notes 1 and 2	29	24	pF

GND = 0 V; T_{amb} = 25 °C; t_r = t_f = 6 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
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

16-lead DIL; plastic (SOT38Z).

16-lead mini-pack; plastic (SO16; SOT109A).

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
1, 9	1CP ₀ , 2CP ₀	clock inputs (LOW-to-HIGH, edge-triggered)
2, 10	1CP ₁ , 2CP ₁	clock inputs (HIGH-to-LOW, edge-triggered)
3, 4, 5, 6	1Q ₀ to 1Q ₃	data outputs
7, 15	1MR, 2MR	asynchronous master reset inputs (active HIGH)
8	GND	ground (0 V)
11, 12, 13, 14	2Q ₀ to 2Q ₃	data outputs
16	V _{CC}	positive supply voltage

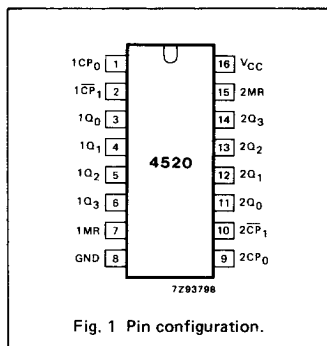


Fig. 1 Pin configuration.

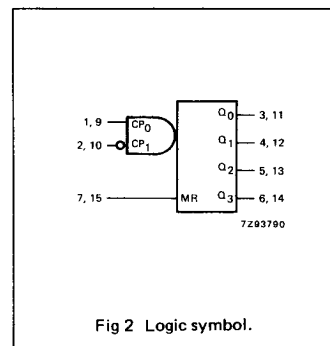


Fig. 2 Logic symbol.

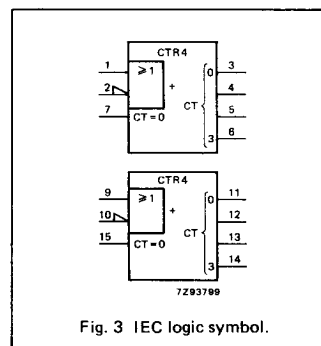


Fig. 3 IEC logic symbol.

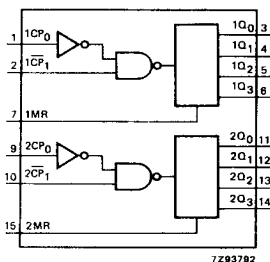


Fig. 4 Functional diagram.

FUNCTION TABLE

nCP_0	$n\overline{CP}_1$	MR	MODE
↑	H	L	counter advances
L	↓	L	counter advances
↓	X	L	no change
X	↑	L	no change
↑	L	L	no change
H	↓	L	no change
X	X	H	Q_0 to Q_3 = LOW

H = HIGH voltage level

L = LOW voltage level

X = don't care

↑ = LOW-to-HIGH clock transition

↓ = HIGH-to-LOW clock transition

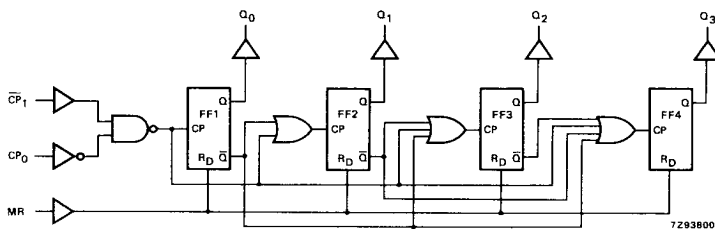


Fig. 5 Logic diagram (one counter).

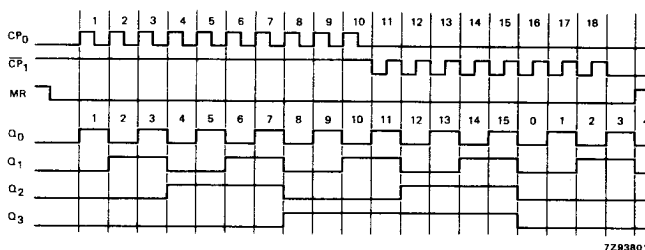


Fig. 6 Timing diagram.

DC CHARACTERISTICS FOR 74HC

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

Output capability: standard

ICC 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 nCP ₀ to nQ _n		77 28 22	240 48 41		300 60 51		360 72 61	ns	2.0 4.5 6.0	Fig. 8	
t _{PHL} / t _{PLH}	propagation delay nCP ₁ to nQ _n		77 28 22	240 48 41		300 60 51		360 72 61	ns	2.0 4.5 6.0	Fig. 8	
t _{PHL}	propagation delay nMR to nQ _n		44 16 13	150 30 26		190 38 33		225 45 38	ns	2.0 4.5 6.0	Fig. 9	
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. 8	
t _W	clock pulse width HIGH or LOW	80 16 14	22 8 6		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 7	
t _W	master reset pulse width HIGH	120 24 20	39 14 11		150 30 26		180 36 31		ns	2.0 4.5 6.0	Fig. 7	
t _{rem}	removal time nMR to nCP ₀ ; nCP ₁	0 0 0	−28 −10 −8		0 0 0		0 0 0		ns	2.0 4.5 6.0	Fig. 7	
t _{su}	set-up time nCP ₁ to nCP ₀ ; nCP ₀ to nCP ₁	80 16 14	14 5 4		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 8	
f _{max}	maximum clock pulse frequency	6.0 30 35	19 58 69		4.8 24 28		4.0 20 24		MHz	2.0 4.5 6.0	Fig. 7	

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.

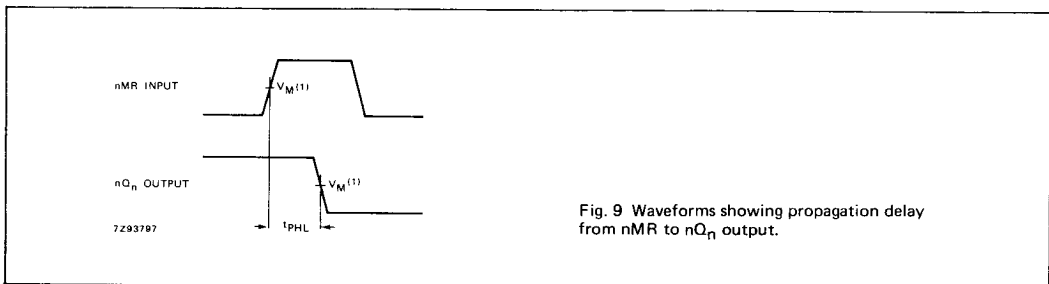
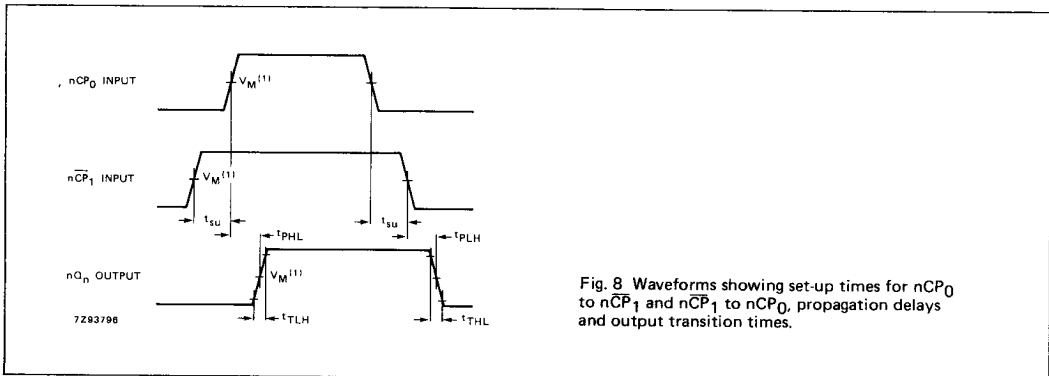
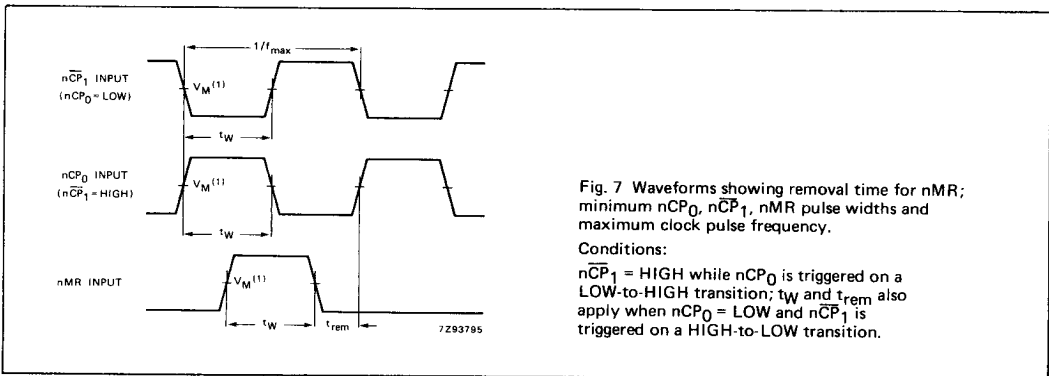
INPUT	UNIT LOAD COEFFICIENT
nCP ₀ , nCP ₁	0.80
nMR	1.50

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 nCP ₀ to nQ _n		28	53		66		80	ns	4.5	Fig. 8
t _{PHL} / t _{PLH}	propagation delay nCP ₁ to nQ _n		25	53		66		80	ns	4.5	Fig. 8
t _{PHL}	propagation delay nMR to nQ _n		16	35		44		53	ns	4.5	Fig. 9
t _{THL} / t _{TLH}	output transition time		7	15		19		22	ns	4.5	Fig. 8
t _W	clock pulse width HIGH or LOW	20	10		25		30		ns	4.5	Fig. 7
t _W	master reset pulse width HIGH	20	12		25		30		ns	4.5	Fig. 7
t _{rem}	removal time nMR to nCP ₀ ; nCP ₁	0	−8		0		0		ns	4.5	Fig. 7
t _{su}	set-up time nCP ₁ to nCP ₀ ; nCP ₀ to nCP ₁	16	6		20		24		ns	4.5	Fig. 8
f _{max}	maximum clock pulse frequency	30	58		24		20		MHz	4.5	Fig. 7

AC WAVEFORMS



Note to AC waveforms

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