

DATA SHEET

For a complete data sheet, please also download:

- The IC04 LOCMOS HE4000B Logic Family Specifications HEF, HEC
- The IC04 LOCMOS HE4000B Logic Package Outlines/Information HEF, HEC

HEF4520B **MSI** Dual binary counter

Product specification
File under Integrated Circuits, IC04

January 1995

Dual binary counter

HEF4520B MSI

DESCRIPTION

The HEF4520B is a dual 4-bit internally synchronous binary counter. The counter has an active HIGH clock input (CP₀) and an active LOW clock input (\overline{CP}_1), buffered outputs from all four bit positions (O₀ to O₃) and an active HIGH overriding asynchronous master reset input (MR). The counter advances on either the LOW to HIGH transition of the CP₀ input if \overline{CP}_1 is HIGH or the HIGH to

LOW transition of the \overline{CP}_1 input if CP₀ is low. Either CP₀ or \overline{CP}_1 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 MR resets the counter (O₀ to O₃ = LOW) independent of CP₀, \overline{CP}_1 . Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

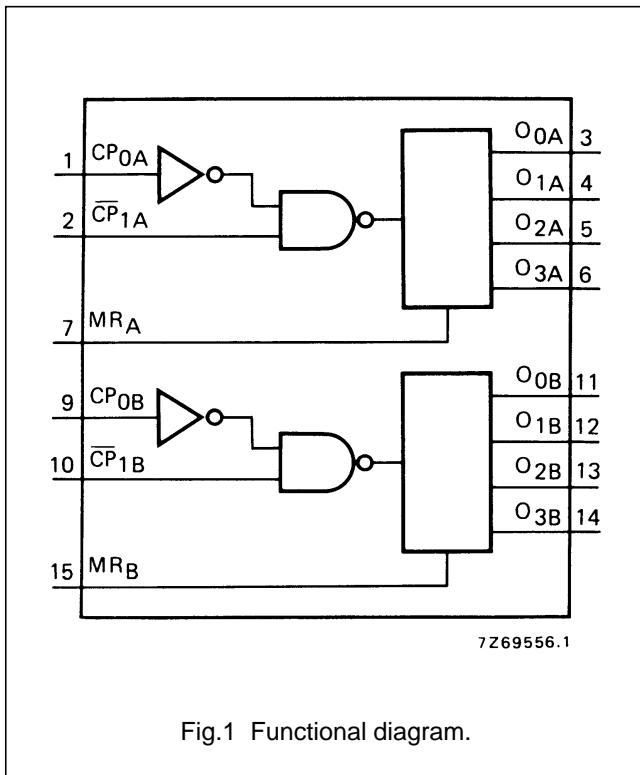
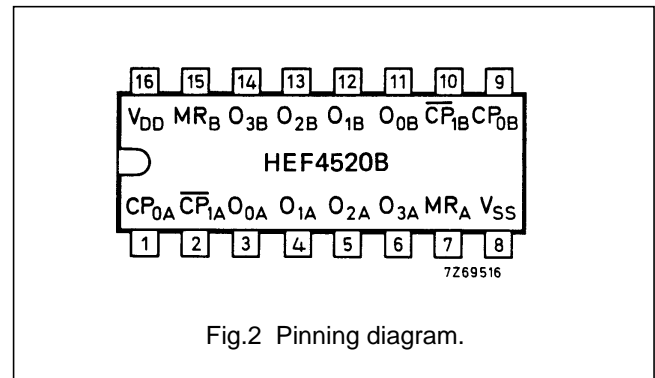


Fig.1 Functional diagram.



- HEF4520BP(N): 16-lead DIL; plastic (SOT38-1)
- HEF4520BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
- HEF4520BT(D): 16-lead SO; plastic (SOT109-1) (SOT109-1)
- (): Package Designator North America

PINNING

- CP_{0A}, CP_{0B} clock inputs (L to H triggered)
- \overline{CP}_{1A} , \overline{CP}_{1B} clock inputs (H to L triggered)
- MRA, MRB master reset inputs
- O_{0A} to O_{3A} outputs
- O_{0B} to O_{3B} outputs

FAMILY DATA, I_{DD} LIMITS category MSI

See Family Specifications

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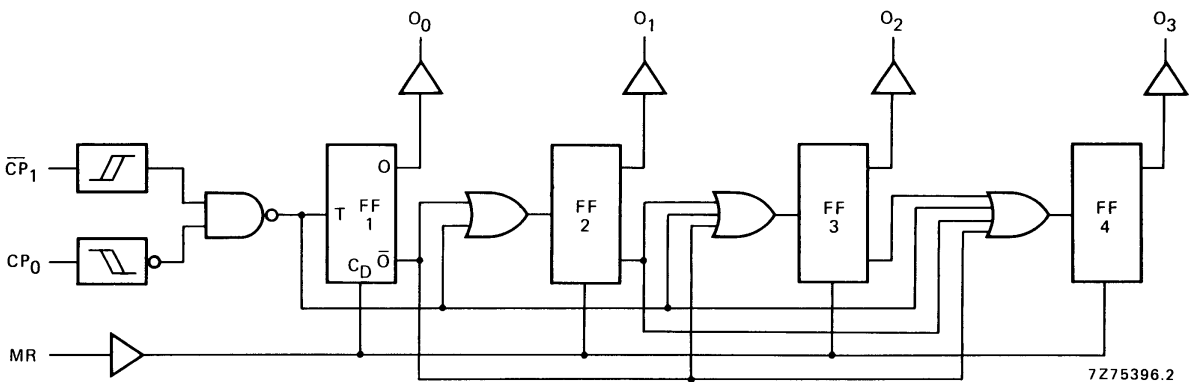


Fig.3 Logic diagram (one counter).

FUNCTION TABLE

CP ₀	\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	O ₀ to O ₃ = LOW

Notes

- H = HIGH state (the more positive voltage)
 L = LOW state (the less positive voltage)
 X = state is immaterial
 ↗ = positive-going transition
 ↘ = negative-going transition

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MSI**AC CHARACTERISTICS** $V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; $C_L = 50\text{ pF}$; input transition times $\leq 20\text{ ns}$

	V_{DD} V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA	
Propagation delays $CP_0, \overline{CP}_1 \rightarrow O_n$ HIGH to LOW LOW to HIGH $MR \rightarrow O_n$ HIGH to LOW	5	t_{PHL}		110	220	ns	$83\text{ ns} + (0,55\text{ ns/pF}) C_L$
	10		50	100	ns	$39\text{ ns} + (0,23\text{ ns/pF}) C_L$	
	15		40	80	ns	$32\text{ ns} + (0,16\text{ ns/pF}) C_L$	
	5	t_{PLH}		110	220	ns	$83\text{ ns} + (0,55\text{ ns/pF}) C_L$
	10		50	100	ns	$39\text{ ns} + (0,23\text{ ns/pF}) C_L$	
	15		40	80	ns	$32\text{ ns} + (0,16\text{ ns/pF}) C_L$	
	5	t_{PHL}		75	150	ns	$48\text{ ns} + (0,55\text{ ns/pF}) C_L$
	10		35	70	ns	$24\text{ ns} + (0,23\text{ ns/pF}) C_L$	
	15		25	50	ns	$17\text{ ns} + (0,16\text{ ns/pF}) C_L$	
Output transition times HIGH to LOW LOW to HIGH	5	t_{THL}		60	120	ns	$10\text{ ns} + (1,0\text{ ns/pF}) C_L$
	10		30	60	ns	$9\text{ ns} + (0,42\text{ ns/pF}) C_L$	
	15		20	40	ns	$6\text{ ns} + (0,28\text{ ns/pF}) C_L$	
	5	t_{TLH}		60	120	ns	$10\text{ ns} + (1,0\text{ ns/pF}) C_L$
	10		30	60	ns	$9\text{ ns} + (0,42\text{ ns/pF}) C_L$	
	15		20	40	ns	$6\text{ ns} + (0,28\text{ ns/pF}) C_L$	
Minimum CP_0 pulse width; LOW	5	t_{WCPL}	60	30		ns	see also waveforms Figs 4 and 5
	10		30	15		ns	
	15		20	10		ns	
Minimum \overline{CP}_1 pulse width; HIGH	5	t_{WCPH}	60	30		ns	
	10		30	15		ns	
	15		20	10		ns	
Minimum MR pulse width; HIGH	5	t_{WMRH}	30	15		ns	
	10		20	10		ns	
	15		16	8		ns	
Recovery time for MR	5	t_{RMR}	50	25		ns	
	10		30	15		ns	
	15		20	10		ns	
Set-up times $CP_0 \rightarrow \overline{CP}_1$	5	t_{su}	50	25		ns	
	10		30	15		ns	
	15		20	10		ns	
$\overline{CP}_1 \rightarrow CP_0$	5	t_{su}	50	25		ns	
	10		30	15		ns	
	15		20	10		ns	
Maximum clock pulse frequency	5	f_{max}	8	16		MHz	
	10		15	30		MHz	
	15		20	40		MHz	

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$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; input transition times $\leq 20\text{ ns}$

	V_{DD} V	TYPICAL FORMULA FOR P (μW)	
Dynamic power dissipation per package (P)	5	$850 f_i + \sum (f_o C_L) \times V_{DD}^2$	where f_i = input freq. (MHz) f_o = output freq. (MHz) C_L = load capacitance (pF) $\sum(f_o C_L)$ = sum of outputs V_{DD} = supply voltage (V)
	10	$3\,800 f_i + \sum (f_o C_L) \times V_{DD}^2$	
	15	$10\,200 f_i + \sum (f_o C_L) \times V_{DD}^2$	

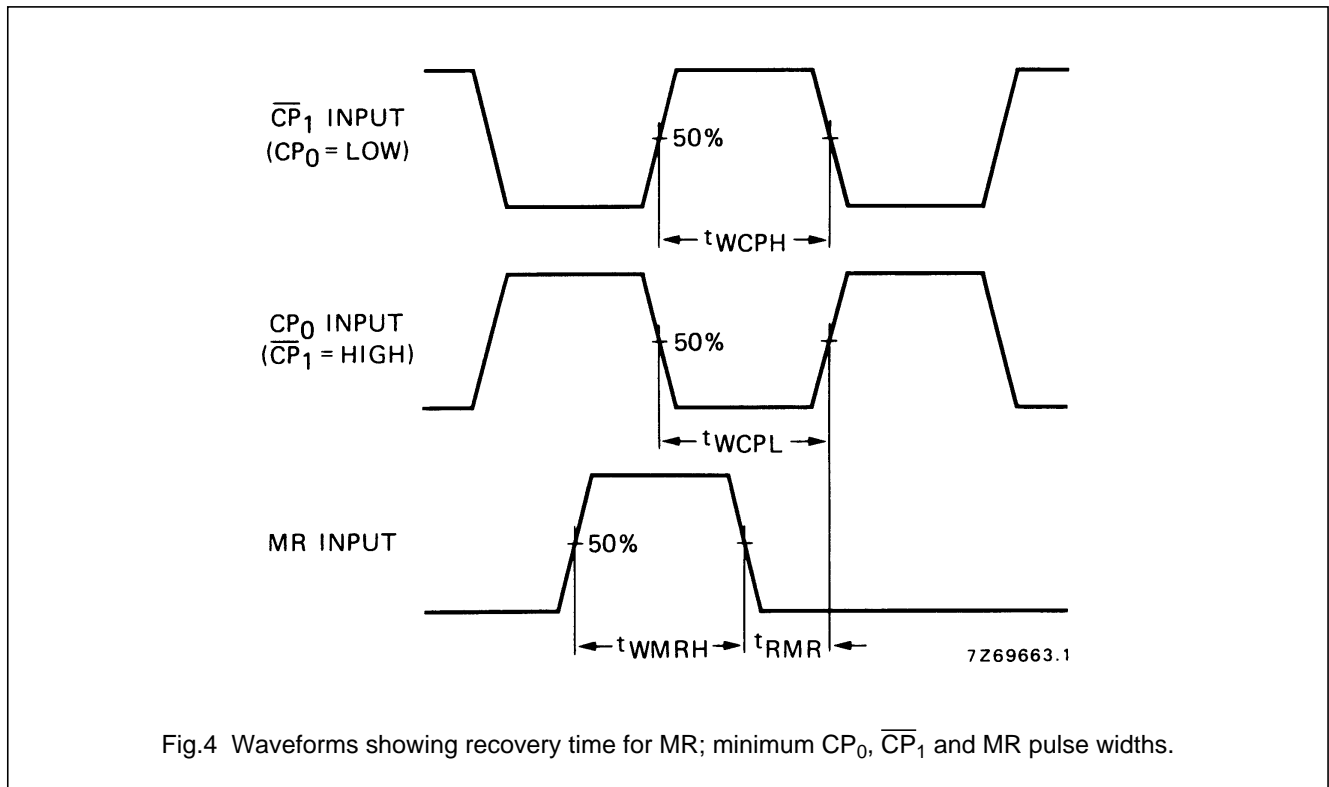


Fig.4 Waveforms showing recovery time for MR; minimum CP_0 , \overline{CP}_1 and MR pulse widths.

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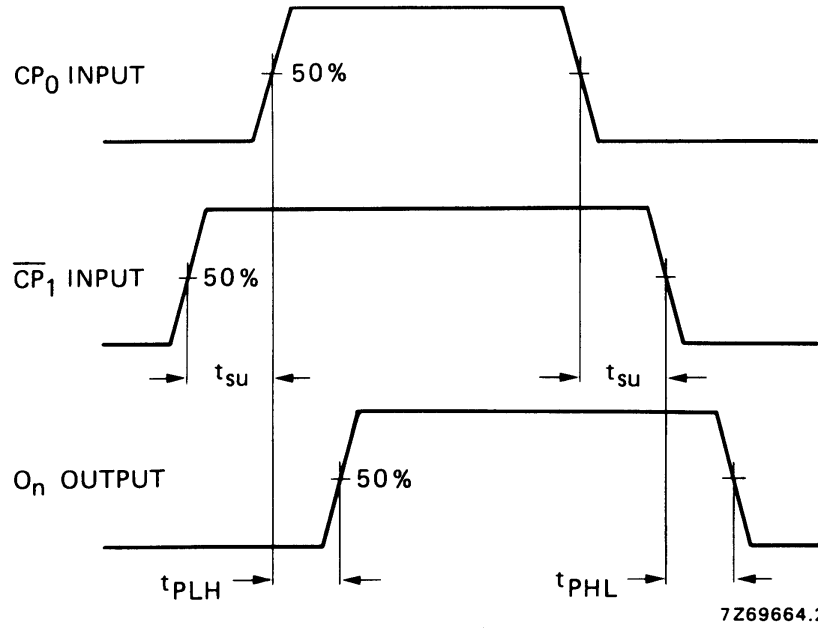
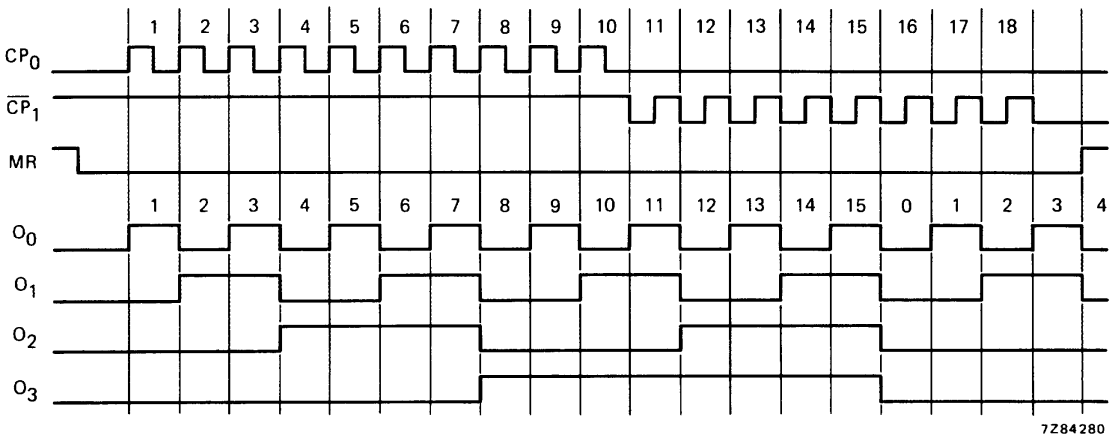


Fig.5 Waveforms showing set-up times for CP₀ to CP₁ and CP₁ to CP₀, and propagation delays.

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Fig.6 Timing diagram.