

**INTEGRATED CIRCUITS**

# 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 ( $CP_0$ ) and an active LOW clock input ( $\overline{CP}_1$ ), buffered outputs from all four bit positions ( $O_0$  to  $O_3$ ) and an active HIGH overriding asynchronous master reset input (MR). The counter advances on either the LOW to HIGH transition of the  $CP_0$  input if  $\overline{CP}_1$  is HIGH or the HIGH to

LOW transition of the  $\overline{CP}_1$  input if  $CP_0$  is low. Either  $CP_0$  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 ( $O_0$  to  $O_3 = \text{LOW}$ ) independent of  $CP_0$ ,  $\overline{CP}_1$ . Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

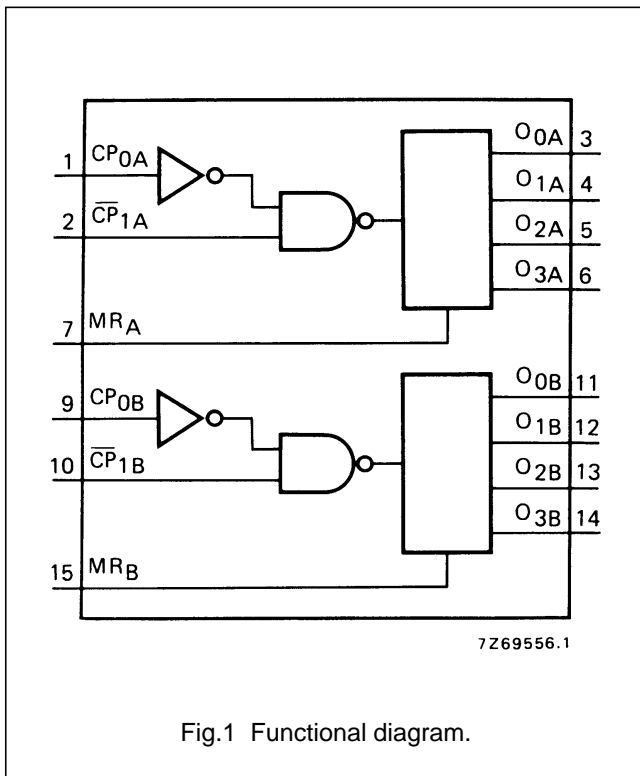


Fig.1 Functional diagram.

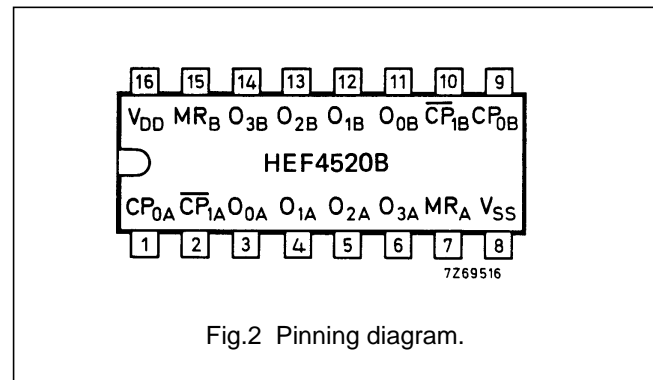


Fig.2 Pinning diagram.

### PINNING

- $CP_{0A}$ ,  $CP_{0B}$  clock inputs (L to H triggered)
- $\overline{CP}_{1A}$ ,  $\overline{CP}_{1B}$  clock inputs (H to L triggered)
- $MR_A$ ,  $MR_B$  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

- 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

Dual binary counter

HEF4520B  
MSI

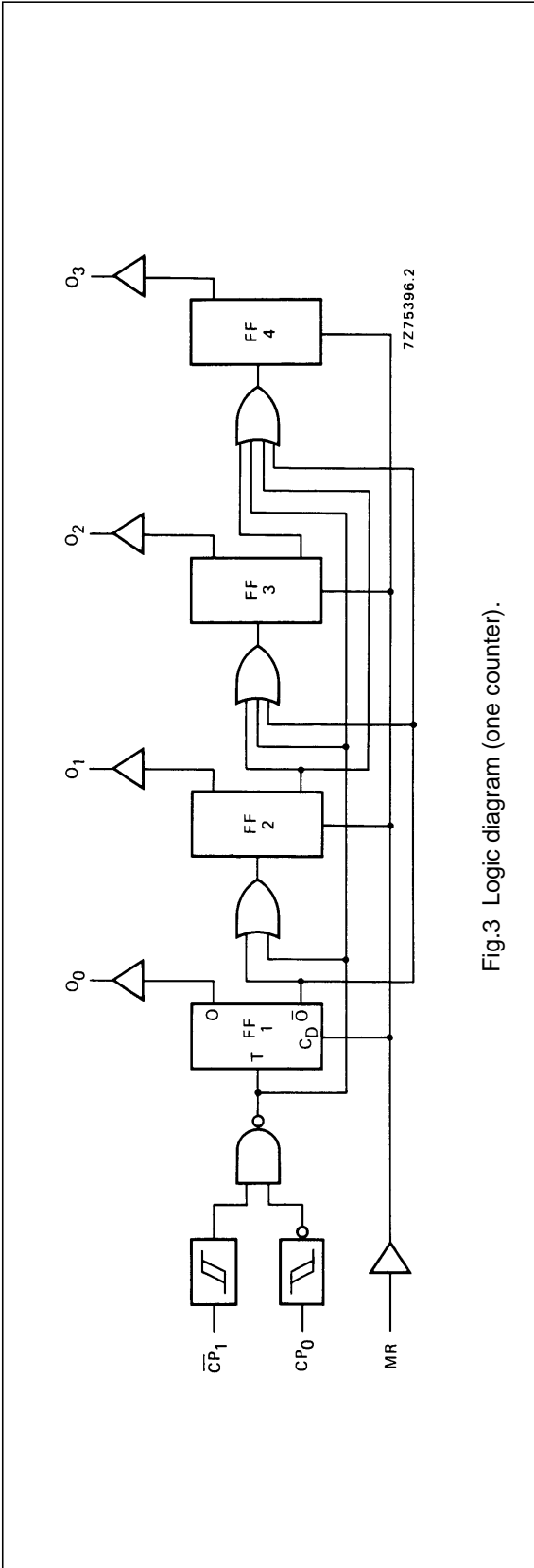


Fig.3 Logic diagram (one counter).

FUNCTION TABLE

CP <sub>0</sub>	$\overline{\text{CP}}_1$	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 <sub>0</sub> to O <sub>3</sub> = LOW

Notes

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

## Dual binary counter

HEF4520B  
MSI**AC CHARACTERISTICS** $V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ;  $C_L = 50\text{ pF}$ ; 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 10 15	$t_{PHL}$	110	220	ns	$83\text{ ns} + (0,55\text{ ns/pF}) C_L$
			50	100	ns	$39\text{ ns} + (0,23\text{ ns/pF}) C_L$
			40	80	ns	$32\text{ ns} + (0,16\text{ ns/pF}) C_L$
	5 10 15	$t_{PLH}$	110	220	ns	$83\text{ ns} + (0,55\text{ ns/pF}) C_L$
			50	100	ns	$39\text{ ns} + (0,23\text{ ns/pF}) C_L$
			40	80	ns	$32\text{ ns} + (0,16\text{ ns/pF}) C_L$
	5 10 15	$t_{PHL}$	75	150	ns	$48\text{ ns} + (0,55\text{ ns/pF}) C_L$
			35	70	ns	$24\text{ ns} + (0,23\text{ ns/pF}) C_L$
			25	50	ns	$17\text{ ns} + (0,16\text{ ns/pF}) C_L$
Output transition times HIGH to LOW  LOW to HIGH	5 10 15	$t_{THL}$	60	120	ns	$10\text{ ns} + (1,0\text{ ns/pF}) C_L$
			30	60	ns	$9\text{ ns} + (0,42\text{ ns/pF}) C_L$
			20	40	ns	$6\text{ ns} + (0,28\text{ ns/pF}) C_L$
	5 10 15	$t_{TLH}$	60	120	ns	$10\text{ ns} + (1,0\text{ ns/pF}) C_L$
			30	60	ns	$9\text{ ns} + (0,42\text{ ns/pF}) C_L$
			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	

Dual binary counter

HEF4520B  
MSI

AC CHARACTERISTICS

V<sub>SS</sub> = 0 V; T<sub>amb</sub> = 25 °C; input transition times ≤ 20 ns

	V <sub>DD</sub> V	TYPICAL FORMULA FOR P (μW)	
Dynamic power dissipation per package (P)	5	850 f <sub>i</sub> + ∑ (f <sub>o</sub> C <sub>L</sub> ) × V <sub>DD</sub> <sup>2</sup>	where f <sub>i</sub> = input freq. (MHz) f <sub>o</sub> = output freq. (MHz) C <sub>L</sub> = load capacitance (pF) ∑(f <sub>o</sub> C <sub>L</sub> ) = sum of outputs V <sub>DD</sub> = supply voltage (V)
	10	3 800 f <sub>i</sub> + ∑ (f <sub>o</sub> C <sub>L</sub> ) × V <sub>DD</sub> <sup>2</sup>	
	15	10 200 f <sub>i</sub> + ∑ (f <sub>o</sub> C <sub>L</sub> ) × V <sub>DD</sub> <sup>2</sup>	

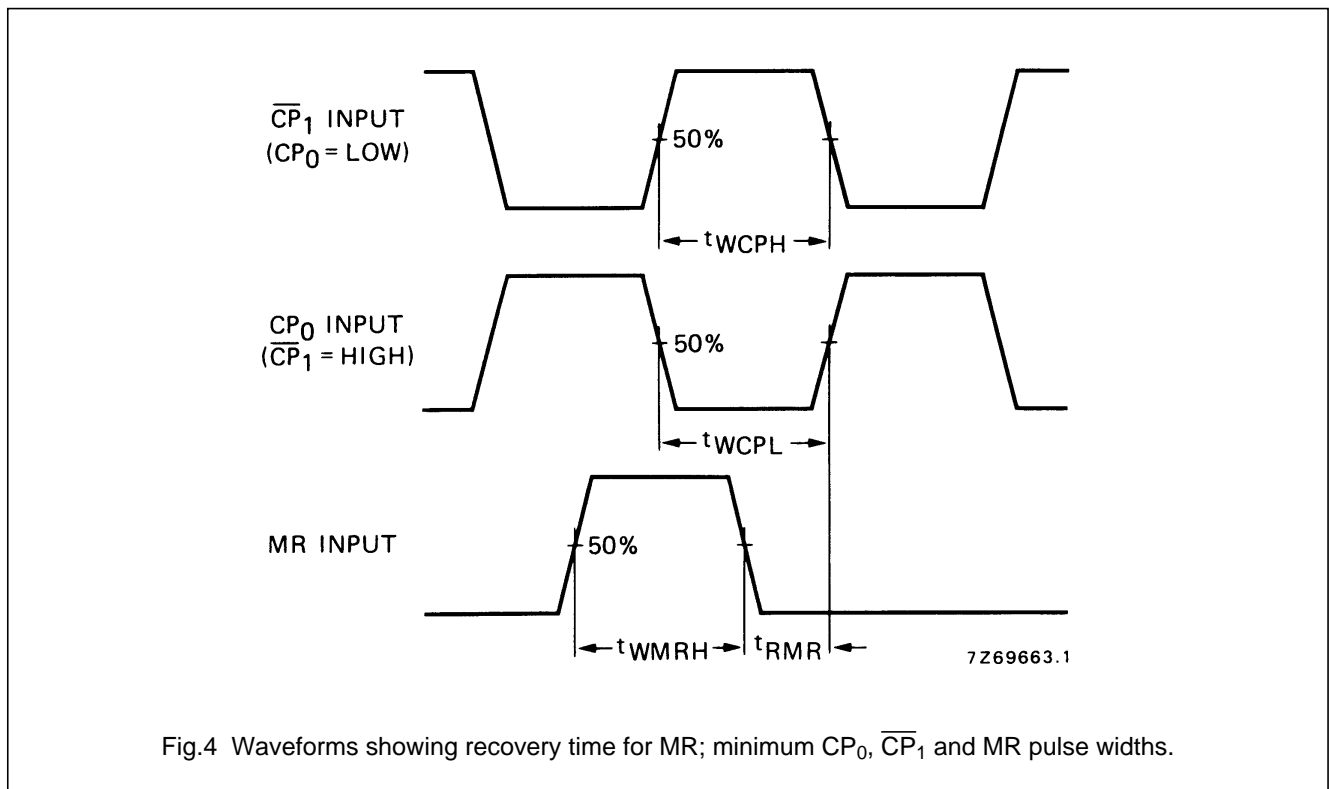


Fig.4 Waveforms showing recovery time for MR; minimum CP<sub>0</sub>, CP<sub>1</sub> and MR pulse widths.

Dual binary counter

HEF4520B  
MSI

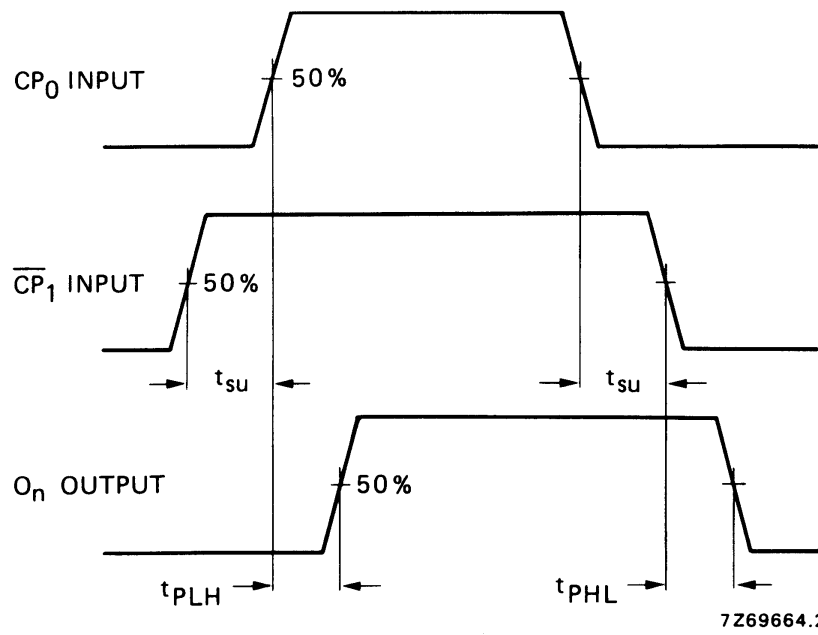


Fig.5 Waveforms showing set-up times for CP<sub>0</sub> to CP<sub>1</sub> and CP<sub>1</sub> to CP<sub>0</sub>, and propagation delays.

# Dual binary counter

HEF4520B  
MSI

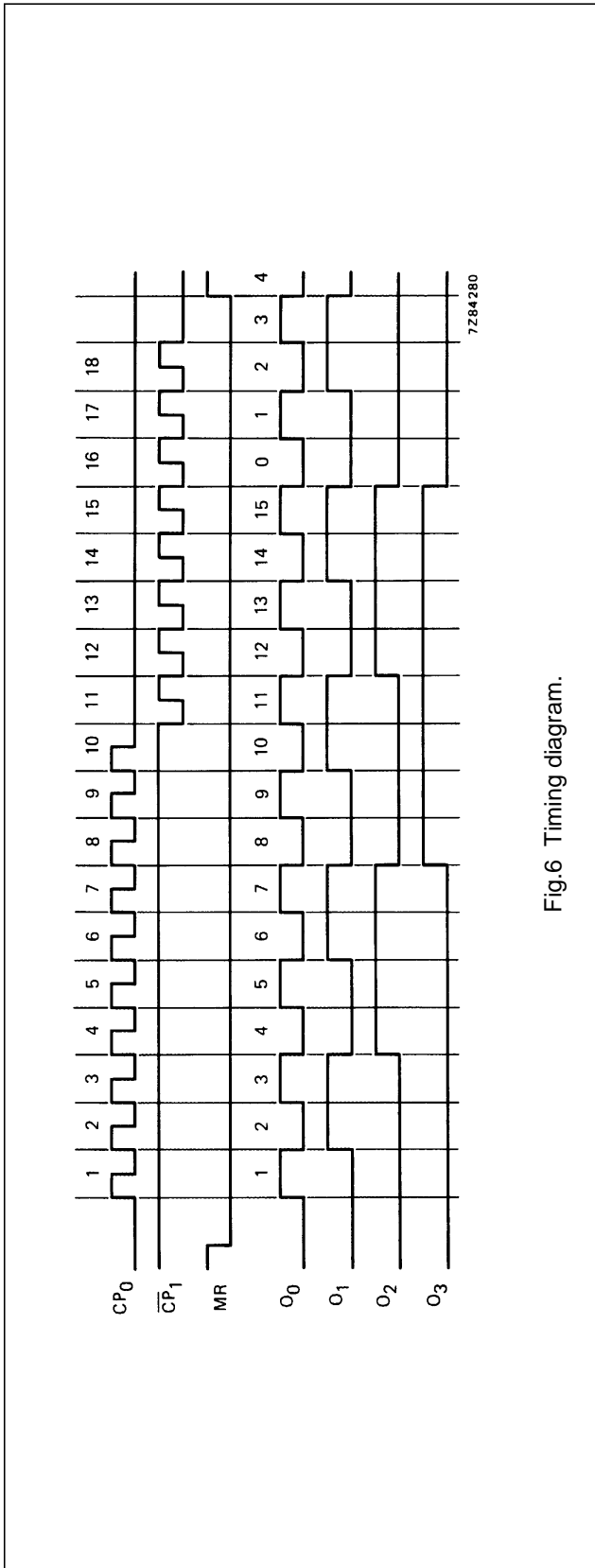


Fig.6 Timing diagram.