

# 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

## **HEF4518B** **MSI** Dual BCD counter

Product specification  
File under Integrated Circuits, IC04

January 1995

# Dual BCD counter

# HEF4518B MSI

### DESCRIPTION

The HEF4518B is a dual 4-bit internally synchronous BCD 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.

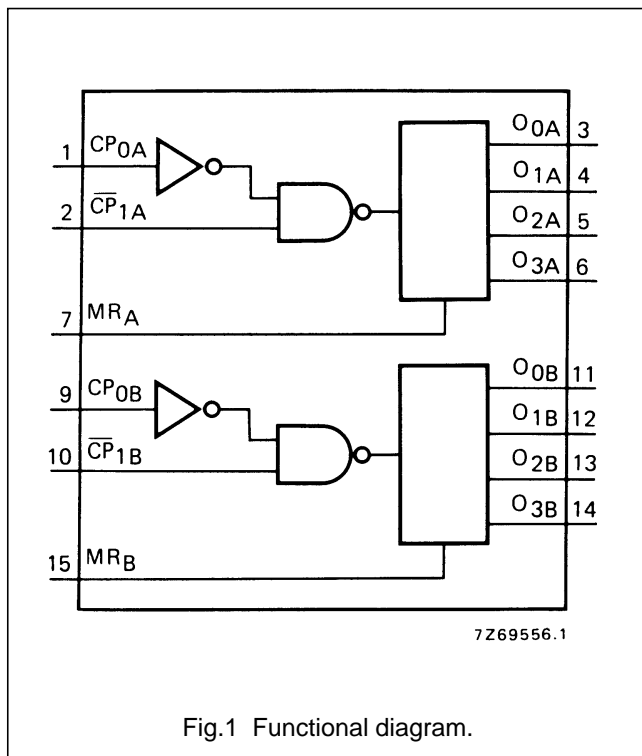


Fig.1 Functional diagram.

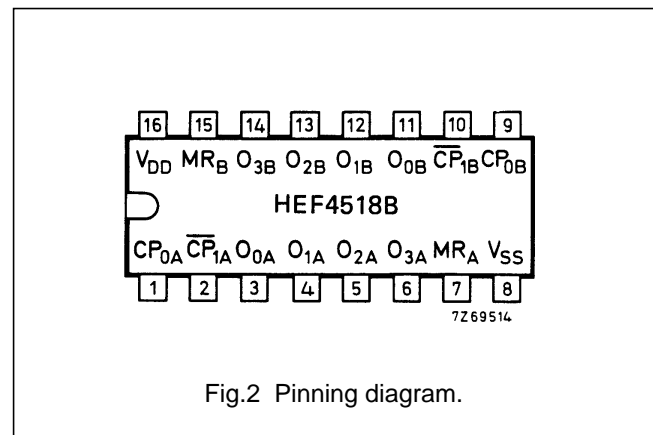


Fig.2 Pinning diagram.

### 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

### APPLICATION INFORMATION

- Some examples of applications for the HEF4518B are:
- Multistage synchronous counting.
  - Multistage asynchronous counting.
  - Frequency dividers.

### FAMILY DATA, $I_{DD}$ LIMITS category MSI

See Family Specifications

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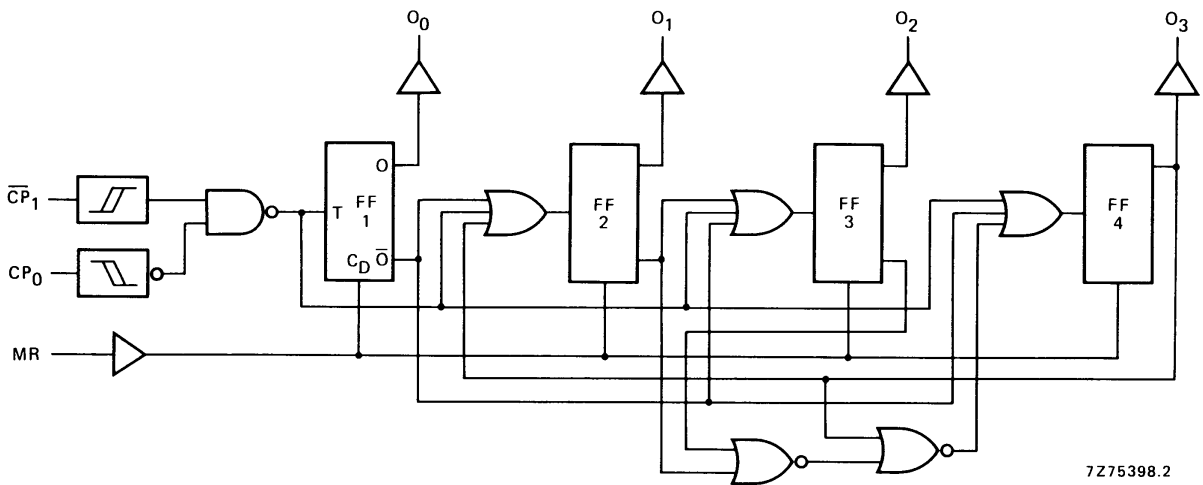


Fig.3 Logic diagram (one counter).

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FUNCTION TABLE

CP <sub>0</sub>	$\overline{CP}_1$	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 <sub>0</sub> to O <sub>3</sub> = 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** $V_{SS} = 0$  V;  $T_{amb} = 25$  °C;  $C_L = 50$  pF; input transition times  $\leq 20$  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	$t_{PHL}$	120	240	ns	$93 \text{ ns} + (0,55 \text{ ns/pF}) C_L$
	10		55	110	ns	$44 \text{ ns} + (0,23 \text{ ns/pF}) C_L$
	15		40	80	ns	$32 \text{ ns} + (0,16 \text{ ns/pF}) C_L$
	5	$t_{PLH}$	120	240	ns	$93 \text{ ns} + (0,55 \text{ ns/pF}) C_L$
	10		55	110	ns	$44 \text{ ns} + (0,23 \text{ ns/pF}) C_L$
	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 $CP_0 \rightarrow \overline{CP}_1$  $\overline{CP}_1 \rightarrow CP_0$	5	$t_{su}$	50	25	ns	
	10		30	15	ns	
	15		20	10	ns	
	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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AC CHARACTERISTICS

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

	$V_{DD}$ V	TYPICAL FORMULA FOR P ( $\mu\text{W}$ )	
Dynamic power dissipation per package (P)	5	$750f_i + \sum (f_o C_L) \times V_{DD}^2$	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	$3300 f_i + \sum (f_o C_L) \times V_{DD}^2$	
	15	$8000 f_i + \sum (f_o C_L) \times V_{DD}^2$	

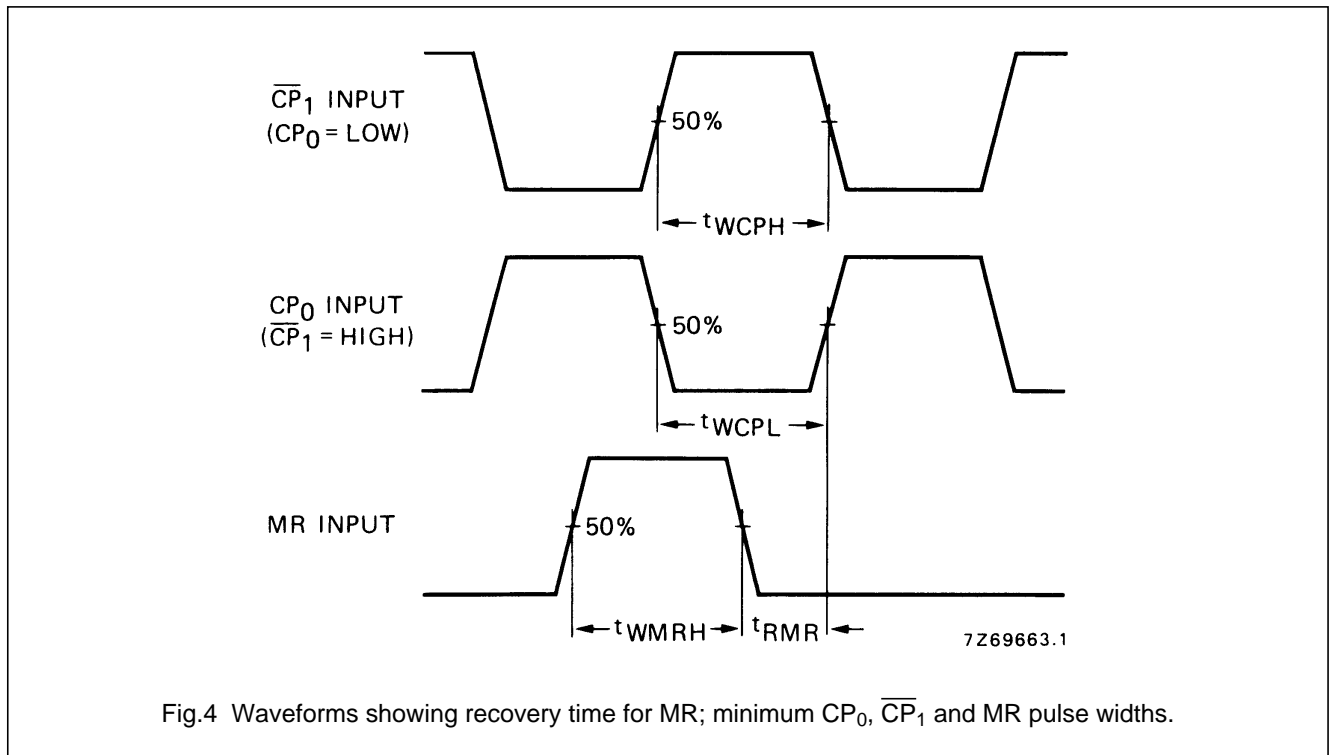
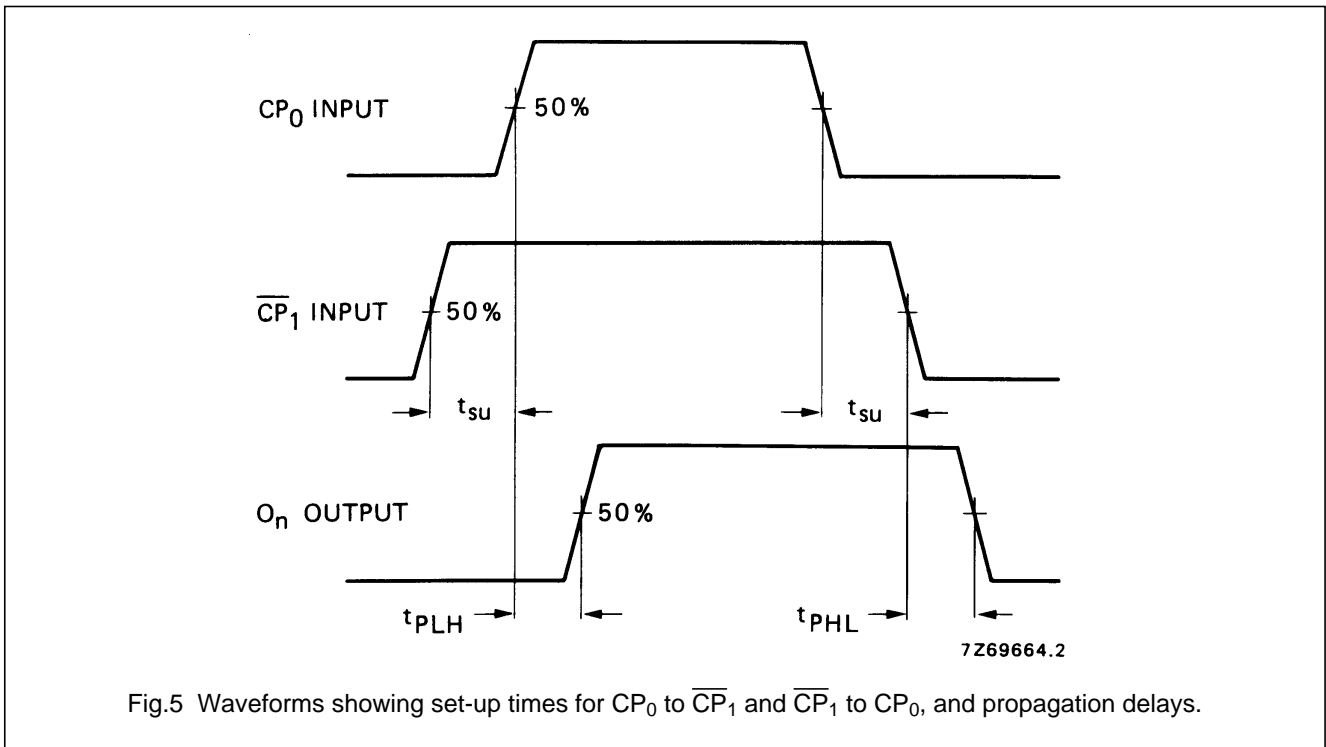


Fig.4 Waveforms showing recovery time for MR; minimum  $CP_0$ ,  $\overline{CP}_1$  and MR pulse widths.

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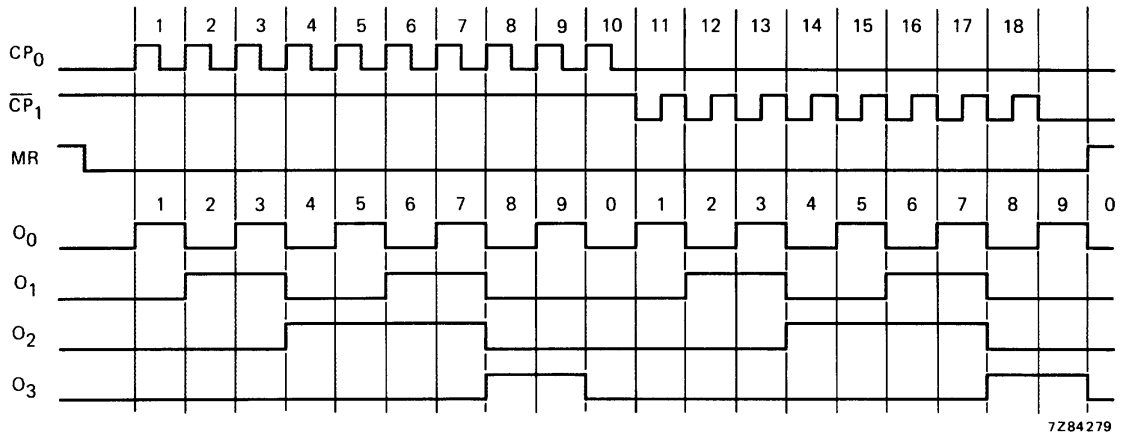


Fig.6 Timing diagram.