

# 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<sub>0</sub>) and an active LOW clock input ( $\overline{\text{CP}}_1$ ), buffered outputs from all four bit positions (O<sub>0</sub> to O<sub>3</sub>) and an active HIGH overriding asynchronous master reset input (MR). The counter advances on either the LOW to HIGH transition of the CP<sub>0</sub> input if  $\overline{\text{CP}}_1$  is HIGH or the HIGH to

LOW transition of the  $\overline{\text{CP}}_1$  input if CP<sub>0</sub> is low. Either CP<sub>0</sub> or  $\overline{\text{CP}}_1$  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<sub>0</sub> to O<sub>3</sub> = LOW) independent of CP<sub>0</sub>,  $\overline{\text{CP}}_1$ . Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

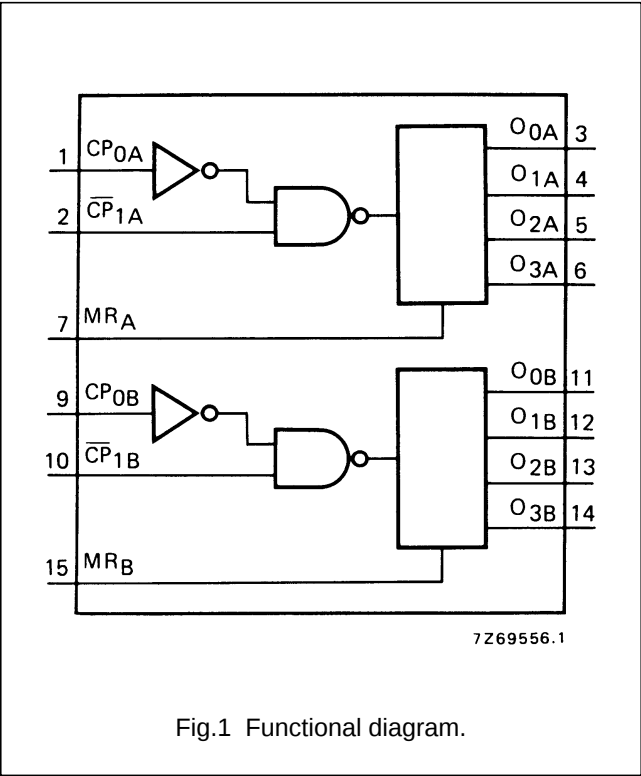
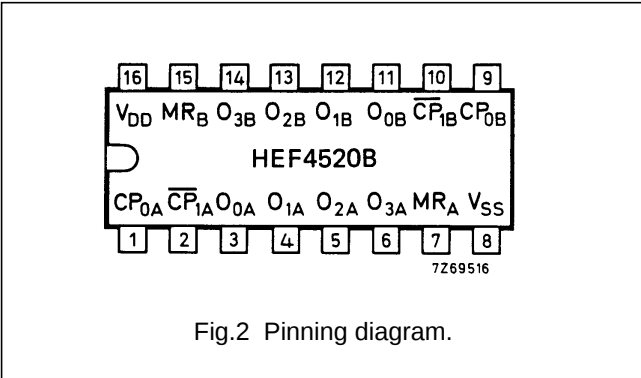


Fig.1 Functional diagram.



- 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<sub>0A</sub>, CP<sub>0B</sub> clock inputs (L to H triggered)
- $\overline{\text{CP}}_{1A}$ ,  $\overline{\text{CP}}_{1B}$  clock inputs (H to L triggered)
- MR<sub>A</sub>, MR<sub>B</sub> master reset inputs
- O<sub>0A</sub> to O<sub>3A</sub> outputs
- O<sub>0B</sub> to O<sub>3B</sub> outputs

FAMILY DATA, I<sub>DD</sub> LIMITS category MSI

See Family Specifications

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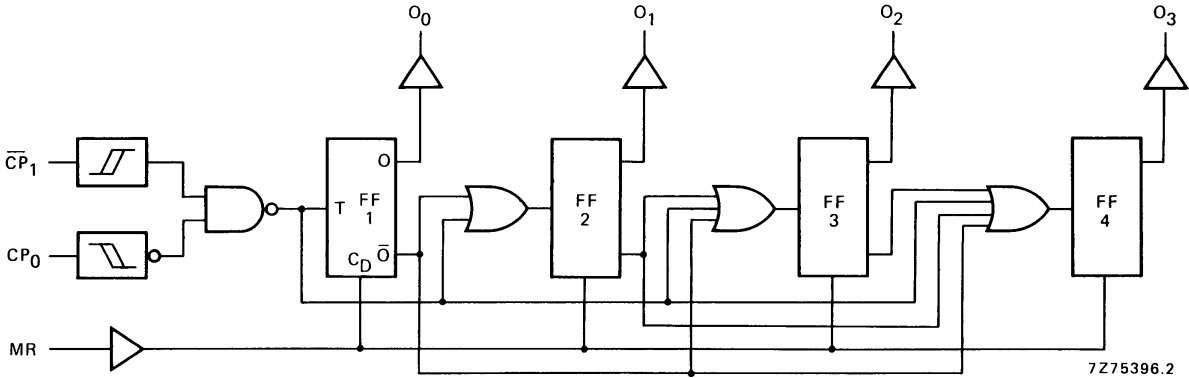


Fig.3 Logic diagram (one counter).

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

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## AC CHARACTERISTICS

 $V_{SS} = 0$  V;  $T_{amb} = 25$  °C;  $C_L = 50$  pF; input transition times  $\leq 20$  ns

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

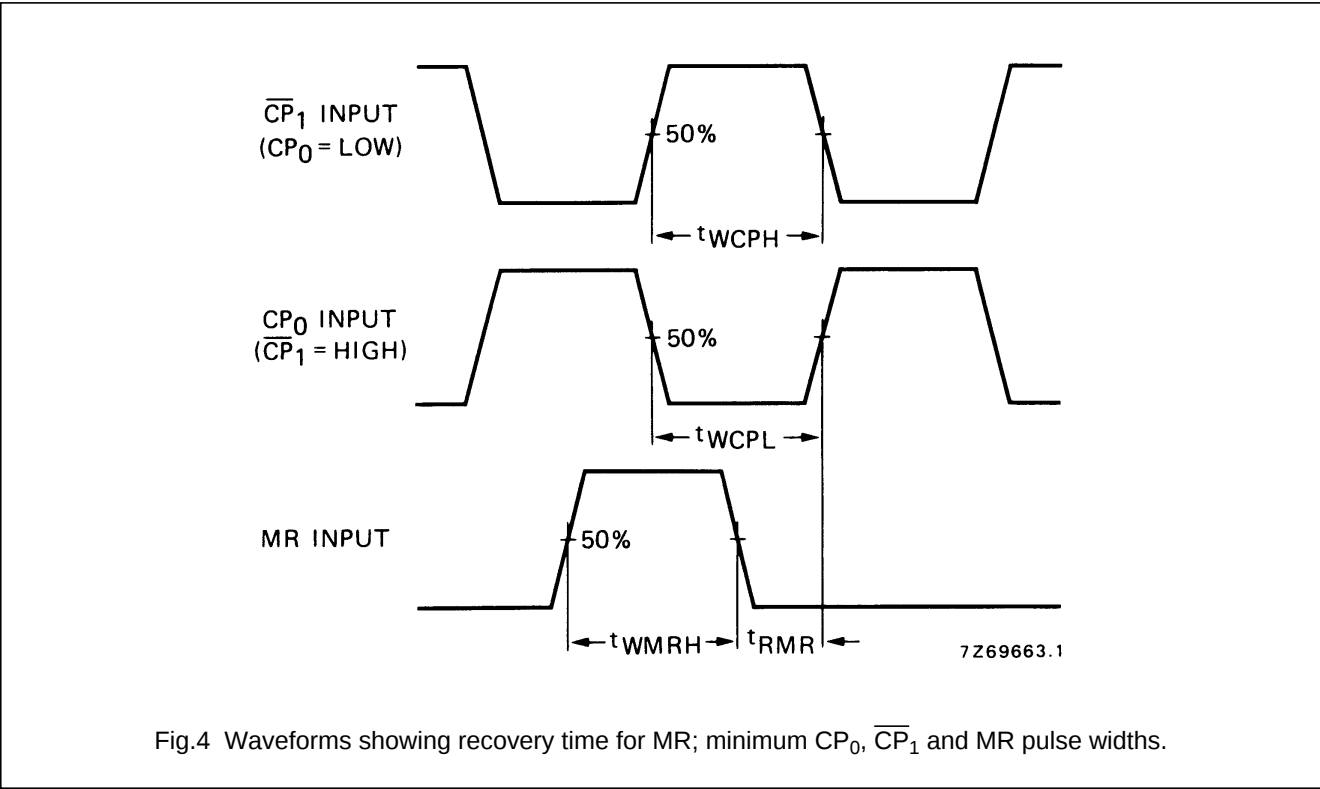
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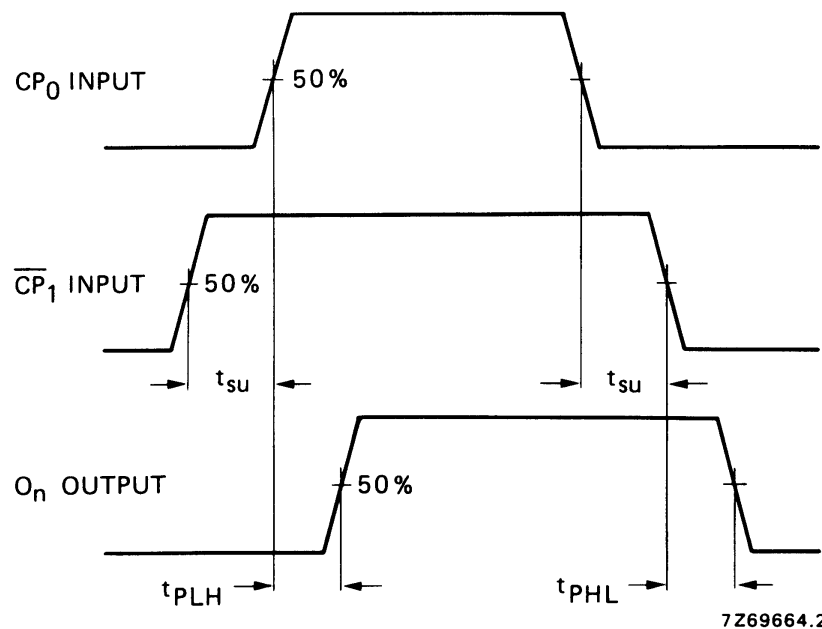
AC CHARACTERISTICS

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

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



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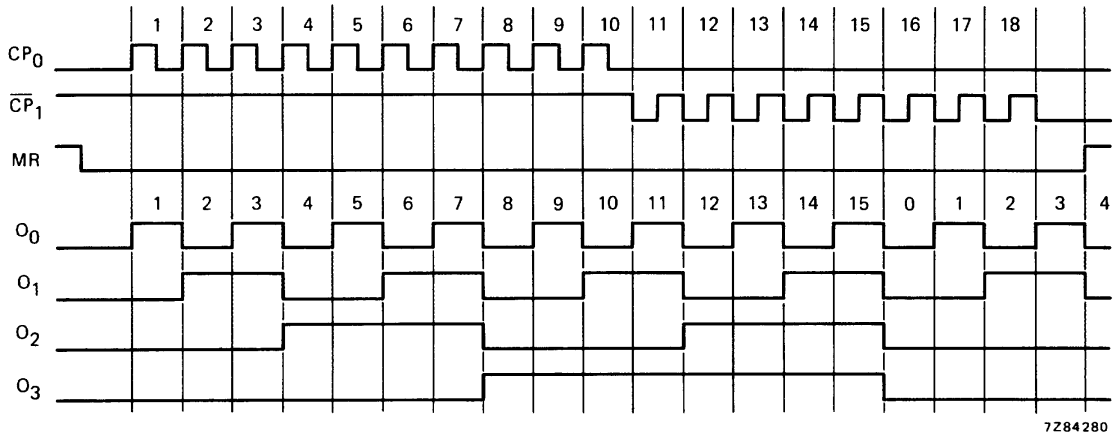


Fig.6 Timing diagram.



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