

# 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

## **HEF4076B**

### **MSI**

**Quadruple D-type register with  
3-state outputs**

Product specification  
File under Integrated Circuits, IC04

January 1995

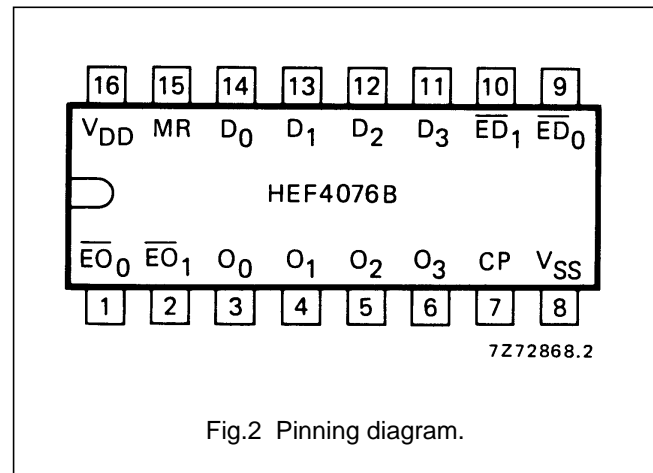
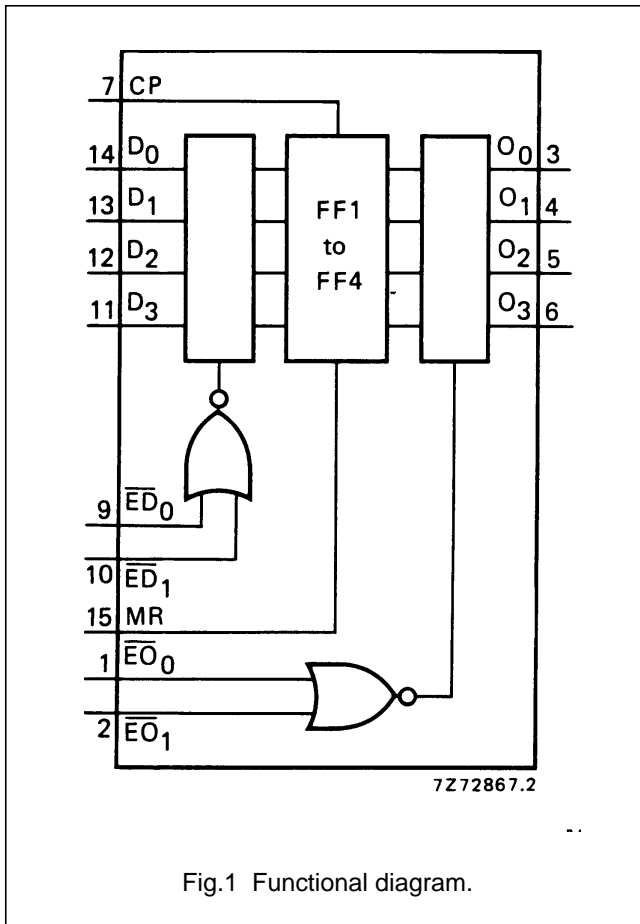
Quadruple D-type register with 3-state outputs

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DESCRIPTION

The HEF4076B is a quadruple edge-triggered D-type flip-flop with four data inputs ( $D_0$  to  $D_3$ ), two active LOW data enable inputs ( $\overline{ED}_0$  and  $\overline{ED}_1$ ), a common clock input (CP), four 3-state outputs ( $O_0$  to  $O_3$ ), two active LOW output enable inputs ( $\overline{EO}_0$  and  $\overline{EO}_1$ ), and an overriding asynchronous master reset input (MR).

Information on  $D_0$  to  $D_3$  is stored in the four flip-flops on the LOW to HIGH transition of CP if both  $\overline{ED}_0$  and  $\overline{ED}_1$  are LOW. A HIGH on either  $\overline{ED}_0$  or  $\overline{ED}_1$  prevents the flip-flops from changing on the LOW to HIGH transition of CP, independent of the information on  $D_0$  to  $D_3$ . When both  $\overline{EO}_0$  and  $\overline{EO}_1$  are LOW, the contents of the four flip-flops are available at  $O_0$  to  $O_3$ . A HIGH on either  $\overline{EO}_0$  or  $\overline{EO}_1$  forces  $O_0$  to  $O_3$  into the high impedance OFF-state. A HIGH on MR resets all four flip-flops, independent of all other input conditions.



PINNING

- $D_0$  to  $D_3$  data inputs
- $\overline{ED}_0$ ,  $\overline{ED}_1$  data enable inputs (active LOW)
- $\overline{EO}_0$ ,  $\overline{EO}_1$  output enable inputs (active LOW)
- CP clock input (LOW to HIGH, edge-triggered)
- MR master reset input
- $O_0$  to  $O_3$  data outputs

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

See Family Specifications

- HEF4076BP(N): 16-lead DIL; plastic (SOT38-1)
- HEF4076BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
- HEF4076BT(D): 16-lead SO; plastic (SOT109-1)
- ( ): Package Designator North America

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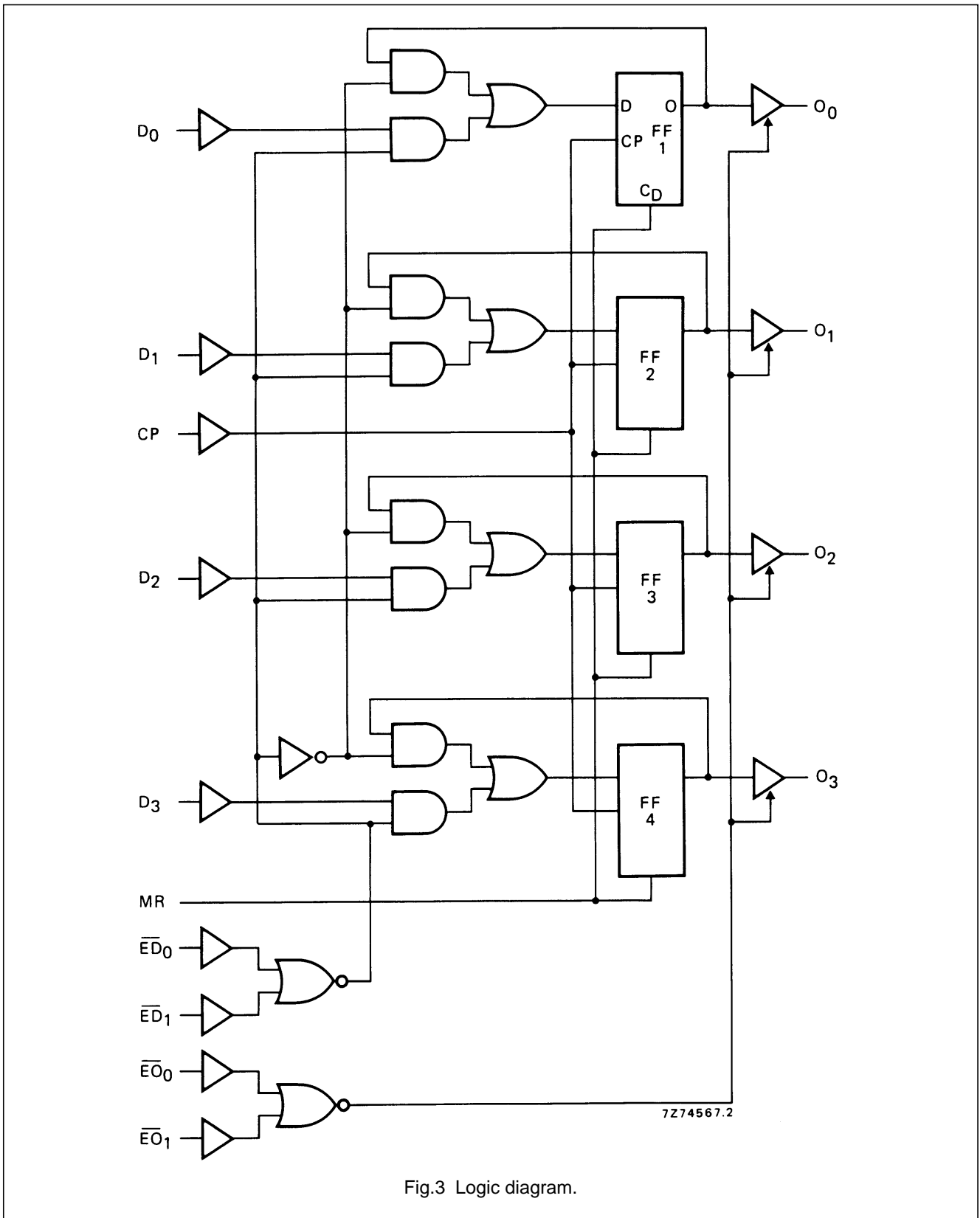


Fig.3 Logic diagram.

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FUNCTION TABLE

INPUTS					OUTPUTS
MR	CP	$\overline{ED}_0$	$\overline{ED}_1$	$D_n$	$O_n$
H	X	X	X	X	L
L	$\nearrow$	H	X	X	no change
L	$\nearrow$	X	H	X	no change
L	$\nearrow$	L	L	H	H
L	$\nearrow$	L	L	L	L
L	$\searrow$	X	X	X	no change

Notes

- $\overline{EO}_0 = \overline{EO}_1 = \text{LOW}$   
When either  $\overline{EO}_0$  or  $\overline{EO}_1$  is HIGH, the outputs are disabled (high impedance OFF-state).  
H = HIGH state (the more positive voltage)  
L = LOW state (the less positive voltage)  
X = state is immaterial  
 $\nearrow$  = positive-going transition  
 $\searrow$  = negative-going transition

AC CHARACTERISTICS

$V_{SS} = 0 \text{ V}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ ;  $C_L = 50 \text{ pF}$ ; input transition times  $\leq 20 \text{ ns}$ ; see also waveforms Fig.4

	$V_{DD}$ V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA							
Propagation delays	5	$t_{PHL}$		150	305	ns	$123 \text{ ns} + (0,55 \text{ ns/pF}) C_L$						
								CP $\rightarrow$ $O_n$					
									HIGH to LOW				
	10									60	120	ns	$49 \text{ ns} + (0,23 \text{ ns/pF}) C_L$
	15							5	160	320	ns	$133 \text{ ns} + (0,55 \text{ ns/pF}) C_L$	
													LOW to HIGH
	15							5	95	190	ns	$68 \text{ ns} + (0,55 \text{ ns/pF}) C_L$	
													MR $\rightarrow$ $O_n$
HIGH to LOW		10	40	85	ns	$29 \text{ ns} + (0,23 \text{ ns/pF}) C_L$							
Output transition times	5	$t_{THL}$		60	120	ns	$10 \text{ ns} + (1,0 \text{ ns/pF}) C_L$						
								HIGH to LOW					
									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							60	120	ns	$10 \text{ ns} + (1,0 \text{ ns/pF}) C_L$		
												LOW to HIGH	
10		30	60	ns	$9 \text{ ns} + (0,42 \text{ ns/pF}) C_L$								
15	20	40	ns	$6 \text{ ns} + (0,28 \text{ ns/pF}) C_L$									
3-state propagation times	5	$t_{PHZ}$		50	105	ns							
								Output disable times					
									$\overline{EO}_n \rightarrow O_n$				
	HIGH									10	35	70	ns
	15							5	45	90	ns		
													LOW
10		30	65	ns									
	15	30	60	ns									

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	V <sub>DD</sub> V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA
Output enable times $\overline{E}O_n \rightarrow O_n$ HIGH	5	t <sub>PZH</sub>		65	130	ns
	10			30	55	ns
	15			20	40	ns
LOW	5	t <sub>PZL</sub>		60	120	ns
	10			25	50	ns
	15			20	35	ns

**AC CHARACTERISTICS**V<sub>SS</sub> = 0 V; T<sub>amb</sub> = 25 °C; C<sub>L</sub> = 50 pF; input transition times ≤ 20 ns

	V <sub>DD</sub> V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA
Set-up times D <sub>n</sub> → CP	5	t <sub>su</sub>	10	-15	ns	see also waveforms Fig.4
	10		0	-10	ns	
	15		0	-5	ns	
$\overline{E}D_n \rightarrow CP$	5	t <sub>su</sub>	0	-50	ns	
	10		0	-20	ns	
	15		0	-15	ns	
Hold times D <sub>n</sub> → CP	5	t <sub>hold</sub>	55	30	ns	
	10		20	10	ns	
	15		15	10	ns	
$\overline{E}D_n \rightarrow CP$	5	t <sub>hold</sub>	25	-25	ns	
	10		10	-10	ns	
	15		5	-5	ns	
Minimum clock pulse width; LOW	5	t <sub>WCPL</sub>	120	60	ns	
	10		45	20	ns	
	15		30	15	ns	
Minimum MR pulse width; HIGH	5	t <sub>WMRH</sub>	55	25	ns	
	10		30	15	ns	
	15		20	10	ns	
Recovery time for MR	5	t <sub>RMR</sub>	90	45	ns	
	10		35	15	ns	
	15		20	10	ns	
Maximum clock pulse frequency	5	f <sub>max</sub>	4	8	MHz	
	10		11	22	MHz	
	15		16	32	MHz	

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	$V_{DD}$ V	TYPICAL FORMULA FOR P ( $\mu$ W)	
Dynamic power	5	$2200 f_i + \sum (f_o C_L) \times V_{DD}^2$	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)
dissipation per	10	$9300 f_i + \sum (f_o C_L) \times V_{DD}^2$	
package (P)	15	$24\,500 f_i + \sum (f_o C_L) \times V_{DD}^2$	

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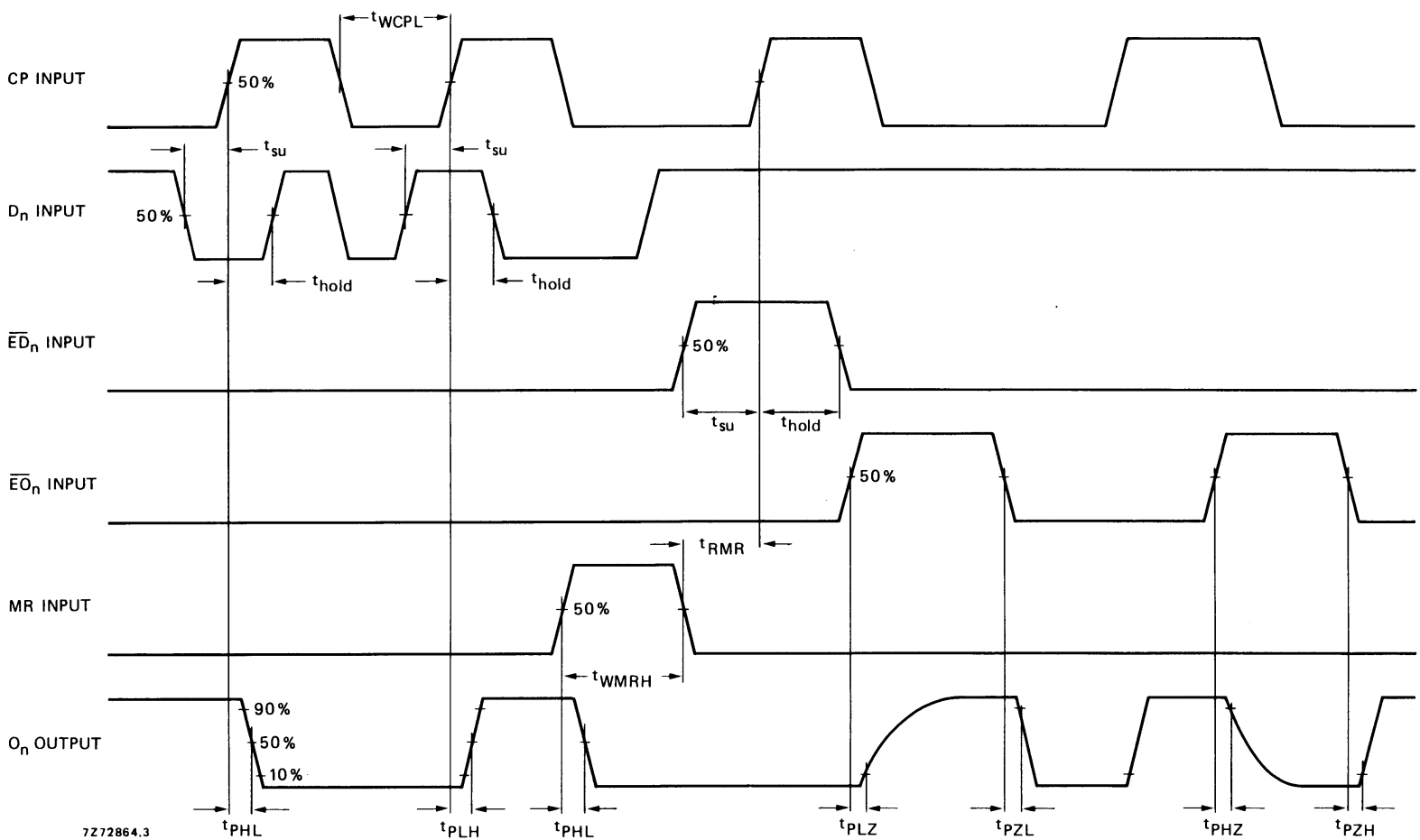


Fig.4 Waveforms showing propagation delays, output disable/enable times, minimum CP and MR pulse widths, set-up and hold times for D<sub>n</sub> to CP and  $\overline{ED}_n$  to CP, and recovery time for MR. Set-up and hold times are shown as positive values but may be specified as negative values.

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