

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

HEF40194B **MSI**

4-bit bidirectional universal shift register

Product specification
File under Integrated Circuits, IC04

January 1995

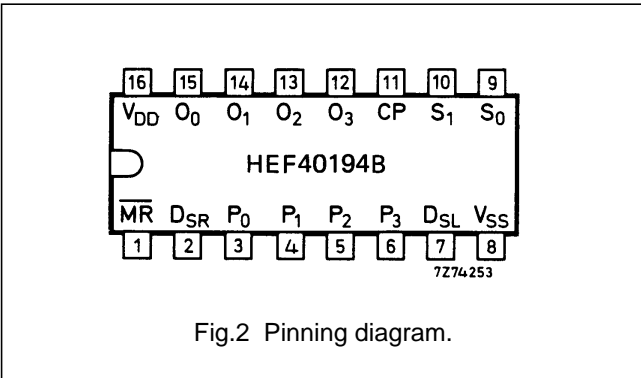
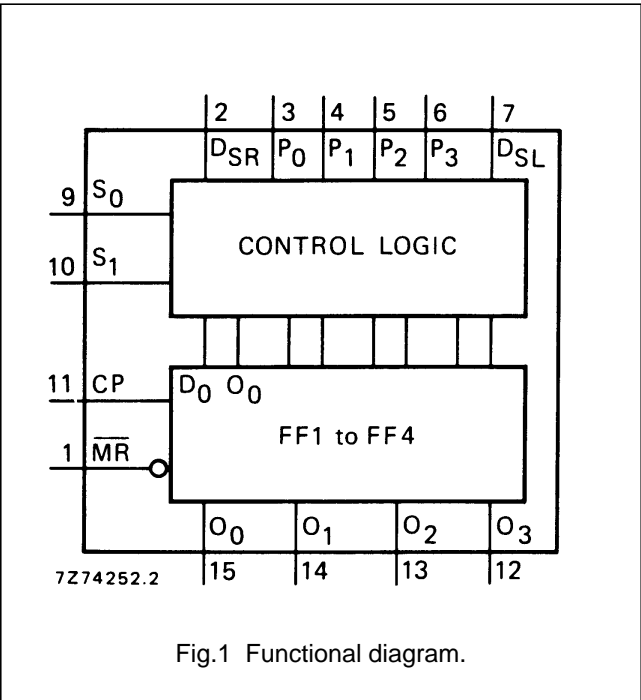
4-bit bidirectional universal shift register

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DESCRIPTION

The HEF40194B is a 4-bit bidirectional shift register with two mode control inputs (S_0 and S_1), a clock input (CP), a serial data shift left input (D_{SL}), a serial data shift right input (D_{SR}), four parallel data inputs (P_0 to P_3), an overriding asynchronous master reset input (\overline{MR}), and four buffered parallel outputs (O_0 to O_3). When LOW, \overline{MR} resets all stages and forces O_0 to O_3 LOW, overriding all other input conditions. When \overline{MR} is HIGH, the operation mode is controlled by S_0 and S_1 as shown in the function table.

Serial and parallel operation are edge-triggered on the LOW to HIGH transition of CP. The inputs at which the data are to be entered and S_0 , S_1 must be stable for a set-up time before the LOW to HIGH transition of CP.



PINNING

- S_0 , S_1

mode control inputs
- P_0 to P_3

parallel data inputs
- D_{SR}

serial data shift right input
- D_{SL}

serial data shift left input
- CP

clock input (LOW to HIGH edge-triggered)
- \overline{MR}

master reset input (active LOW)
- O_0 to O_3

buffered parallel outputs

FAMILY DATA, I_{DD} LIMITS category MSI

See Family Specifications

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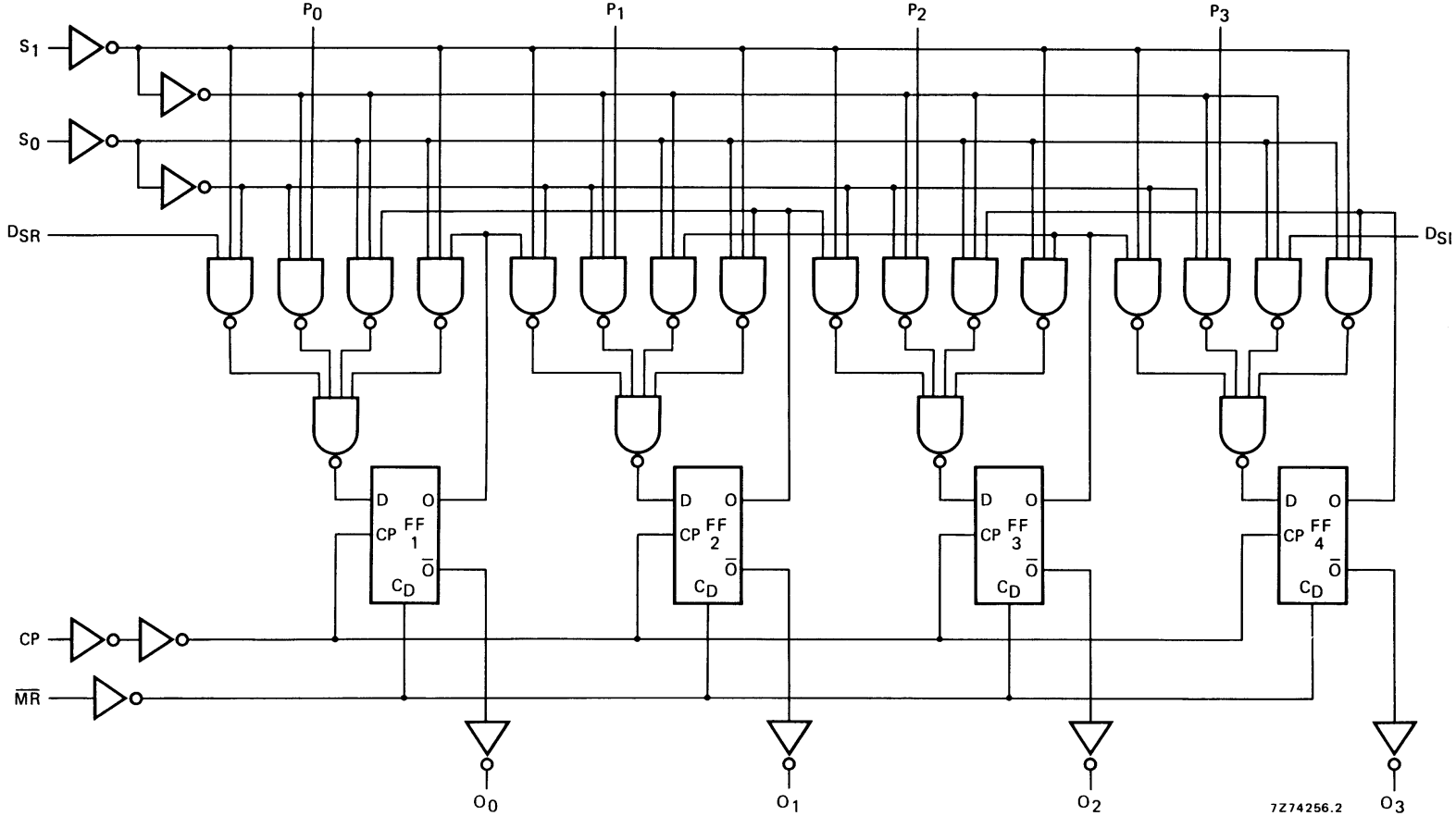


Fig.3 Logic diagram.

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FUNCTION TABLE

OPERATING MODE	INPUTS ($\overline{MR} = \text{HIGH}$)					OUTPUTS AT T_{n+1}			
	S_1	S_0	D_{SR}	D_{SL}	P_0 TO P_3	O_0	O_1	O_2	O_3
hold	L	L	X	X	X	O_0	O_1	O_2	O_3
shift left	H	L	X	L	X	O_1	O_2	O_3	L
	H	L	X	H	X	O_1	O_2	O_3	H
shift right	L	H	L	X	X	L	O_0	O_1	O_2
	L	H	H	X	X	H	O_0	O_1	O_2
parallel load	H	H	X	X	L	L	L	L	L
	H	H	X	X	H	H	H	H	H

Notes

1. H = HIGH state (the more positive voltage)
2. L = LOW state (the less positive voltage)
3. X = state is immaterial
4. t_{n+1} = state after next LOW to HIGH transition of CP

AC CHARACTERISTICS

 $V_{SS} = 0$ V; $T_{amb} = 25$ °C; input transition times ≤ 20 ns

	V_{DD} V	TYPICAL FORMULA FOR P (μ W)	
Dynamic power dissipation per package (P)	5 10 15	$1\,500 f_i + \sum (f_o C_L) \times V_{DD}^2$ $6\,900 f_i + \sum (f_o C_L) \times V_{DD}^2$ $18\,900 f_i + \sum (f_o C_L) \times V_{DD}^2$	where f_i = input freq. (MHz) f_o = output freq. (MHz) C_L = load cap. (pF) $\sum (f_o C_L)$ = sum of outputs V_{DD} = supply voltage (V)

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	V _{DD} V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA	
Propagation delays							
CP → O _n	5			100	205	ns	73 ns + (0,55 ns/pF) C _L
HIGH to LOW	10	t _{PHL}		40	85	ns	29 ns + (0,23 ns/pF) C _L
	15			30	60	ns	22 ns + (0,16 ns/pF) C _L
LOW to HIGH	5	t _{PLH}		80	165	ns	53 ns + (0,55 ns/pF) C _L
	10			35	70	ns	24 ns + (0,23 ns/pF) C _L
	15			25	55	ns	17 ns + (0,16 ns/pF) C _L
$\overline{\text{MR}} \rightarrow \text{O}_n$	5			85	175	ns	58 ns + (0,55 ns/pF) C _L
HIGH to LOW	10	t _{PHL}		40	80	ns	29 ns + (0,23 ns/pF) C _L
	15			30	60	ns	22 ns + (0,16 ns/pF) C _L
Output transition times							
HIGH to LOW	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
LOW to HIGH	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

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	V _{DD} V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA
Set-up times	5		80	40	ns	see also waveforms Figs 4 and 5
P _n , D _{SR} , D _{SL} → CP	10	t _{su}	30	15	ns	
	15		20	10	ns	
S _n → CP	5		140	70	ns	
	10	t _{su}	60	30	ns	
	15		40	20	ns	
Hold times	5		10	−30	ns	
P _n , D _{SR} , D _{SL} → CP	10	t _{hold}	5	−10	ns	
	15		5	−5	ns	
S _n → CP	5		25	−45	ns	
	10	t _{hold}	15	−15	ns	
	15		10	−10	ns	
Minimum clock pulse width; LOW	5		50	25	ns	
	10	t _{WCPL}	20	10	ns	
	15		20	10	ns	
Minimum $\overline{\text{MR}}$ pulse width; LOW	5		80	40	ns	
	10	t _{WMRL}	40	20	ns	
	15		30	15	ns	
Recovery time for $\overline{\text{MR}}$	5		30	10	ns	
	10	t _{RMR}	15	5	ns	
	15		15	5	ns	
Maximum clock pulse frequency	5		6	12	MHz	
	10	f _{max}	15	30	MHz	
	15		20	40	MHz	

4-bit bidirectional universal shift register

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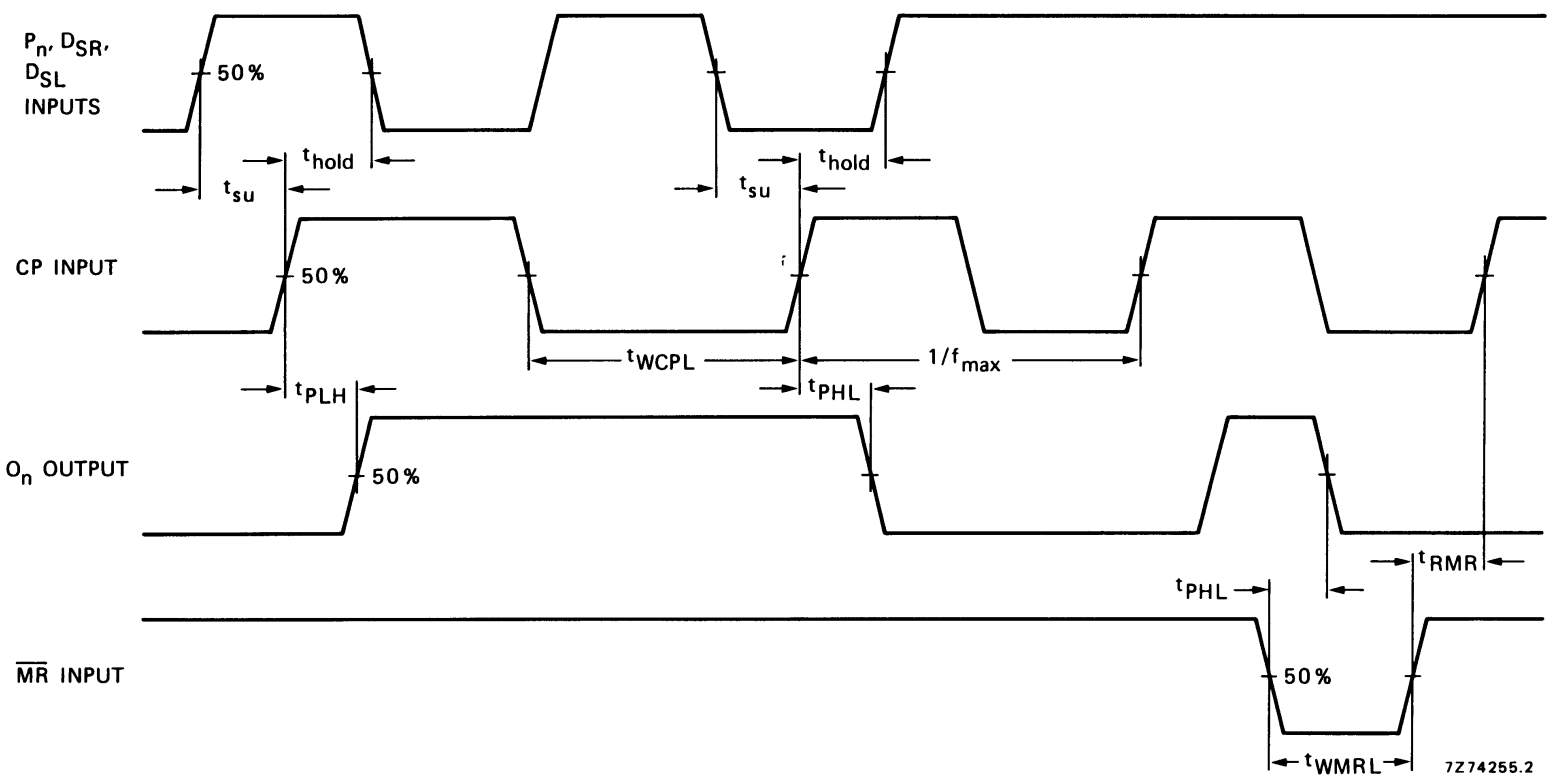


Fig.4 Waveforms showing set-up times, hold times for D_{SR} , D_{SL} and P_n inputs; minimum \overline{MR} pulse width, \overline{MR} to output delays and \overline{MR} to CP recovery time; minimum CP pulse width and CP to output delays. Set-up and hold times are shown as positive values but may be specified as negative values.

4-bit bidirectional universal shift register

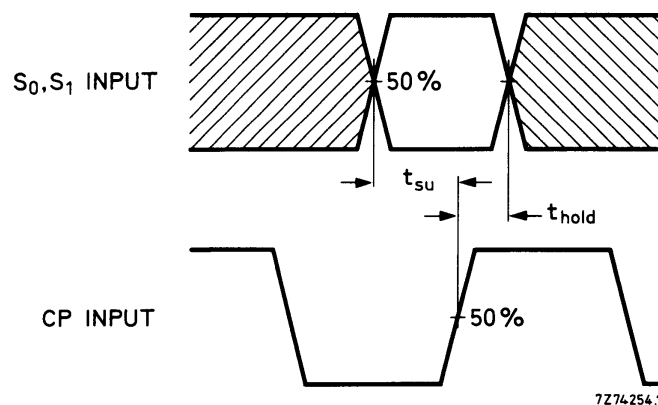
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Fig.5 Waveforms showing set-up times and hold times for S_0 and S_1 inputs. Set-up and hold times are shown as positive values but may be specified as negative values.

APPLICATION INFORMATION

Some examples of applications for the HEF40194B are:

- Arithmetic unit register
- Serial/parallel converter.