4-bit bidirectional universal shift register

HEF40194B
MSI

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.

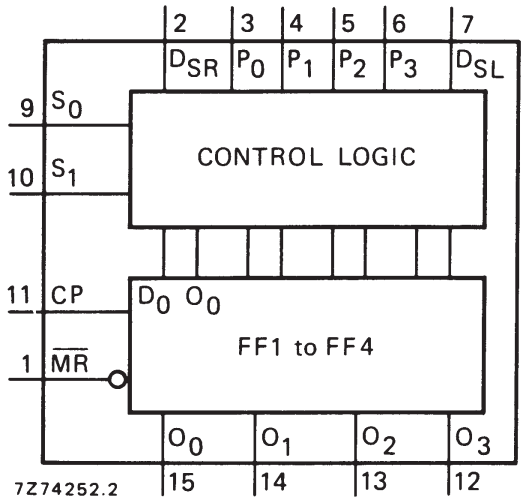

Fig.1 Functional diagram.

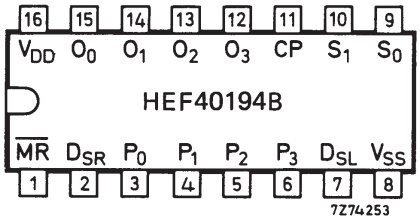

Fig.2 Pinning diagram.

HEF40194BP(N):	16-lead DIL; plastic (SOT38-1)
HEF40194BD(F):	16-lead DIL; ceramic (cerdip) (SOT74)
HEF40194BT(D):	16-lead SO; plastic (SOT109-1)

( ): Package Designator North America

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

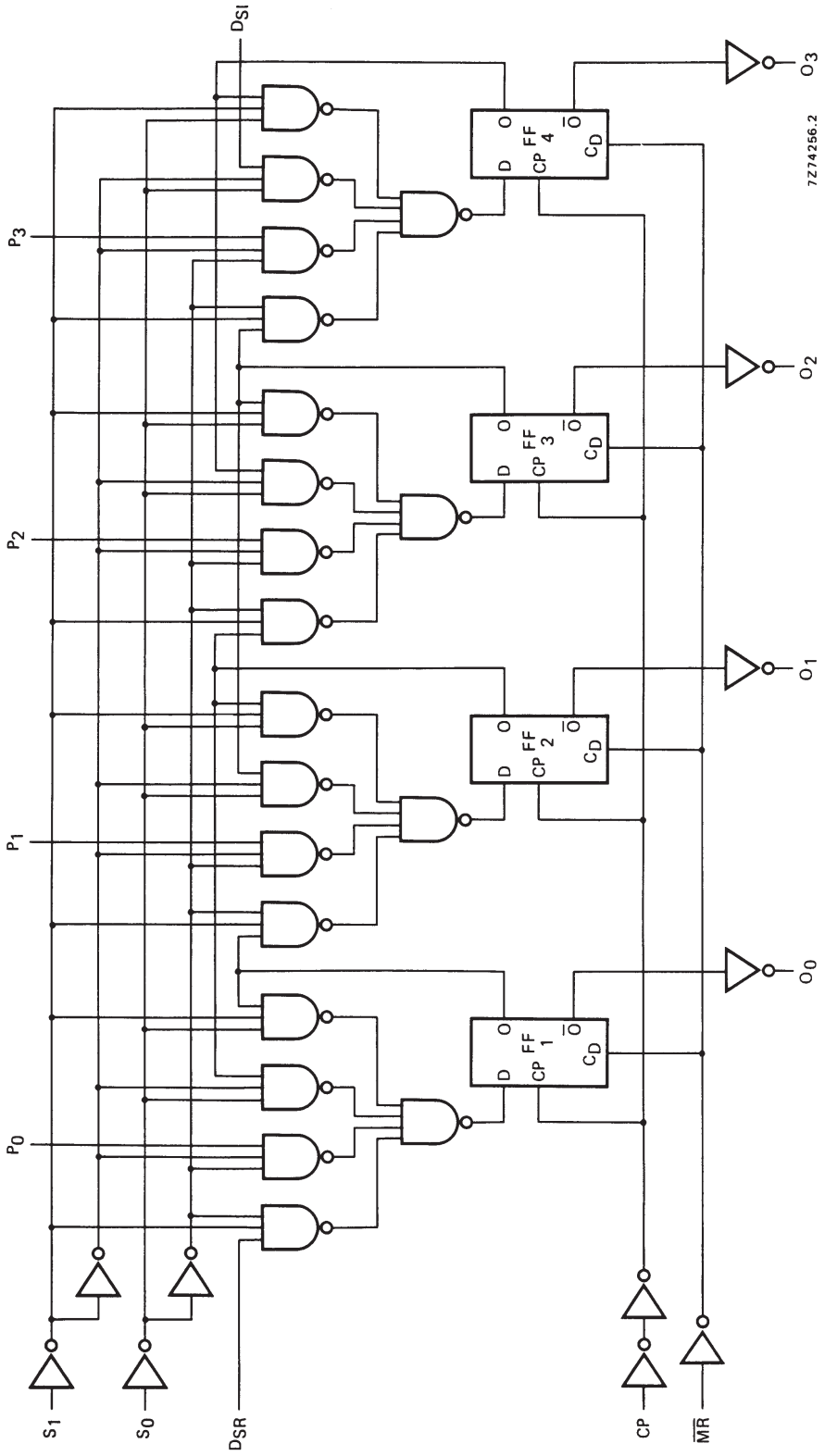

Fig.3 Logic diagram.

FUNCTION TABLE

OPERATING MODE	INPUTS ($\overline{MR}$ = 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 (μW)	
Dynamic power dissipation per package (P)	5	$1\,500\ f_i + \sum (f_o C_L) \times V_{DD}^2$	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)
	10	$6\,900\ f_i + \sum (f_o C_L) \times V_{DD}^2$	
	15	$18\,900\ f_i + \sum (f_o C_L) \times V_{DD}^2$	

AC CHARACTERISTICS

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

	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
	5			80	165	ns	53 ns + (0,55 ns/pF) C_L
LOW to HIGH	10	t_{PLH}		35	70	ns	24 ns + (0,23 ns/pF) C_L
	15			25	55	ns	17 ns + (0,16 ns/pF) C_L
$\overline{MR}$ → 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	5			60	120	ns	10 ns + (1,0 ns/pF) C_L
HIGH to LOW	10	t_{THL}		30	60	ns	9 ns + (0,42 ns/pF) C_L
	15			20	40	ns	6 ns + (0,28 ns/pF) C_L
	5			60	120	ns	10 ns + (1,0 ns/pF) C_L
LOW to HIGH	10	t_{TLH}		30	60	ns	9 ns + (0,42 ns/pF) C_L
	15			20	40	ns	6 ns + (0,28 ns/pF) C_L

	V_{DD} V	SYMBOL	MIN.	TYP.	MAX.		TYPICAL EXTRAPOLATION FORMULA
Set-up times	5		80	40		ns	
P_n, D_{SR}, D_{SL} → CP	10	t_{su}	30	15		ns	
	15		20	10		ns	
	5		140	70		ns	
S_n → CP	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	
	5		25	–45		ns	
S_n → CP	10	t_{hold}	15	–15		ns	
	15		10	–10		ns	see also waveforms Figs 4 and 5
Minimum clock	5		50	25		ns	
pulse width; LOW	10	t_{WCPL}	20	10		ns	
	15		20	10		ns	
Minimum $\overline{MR}$	5		80	40		ns	
pulse width; LOW	10	t_{WMRL}	40	20		ns	
	15		30	15		ns	
Recovery time	5		30	10		ns	
for $\overline{MR}$	10	t_{RMR}	15	5		ns	
	15		15	5		ns	
Maximum clock	5		6	12		MHz	
pulse frequency	10	f_{max}	15	30		MHz	
	15		20	40		MHz	

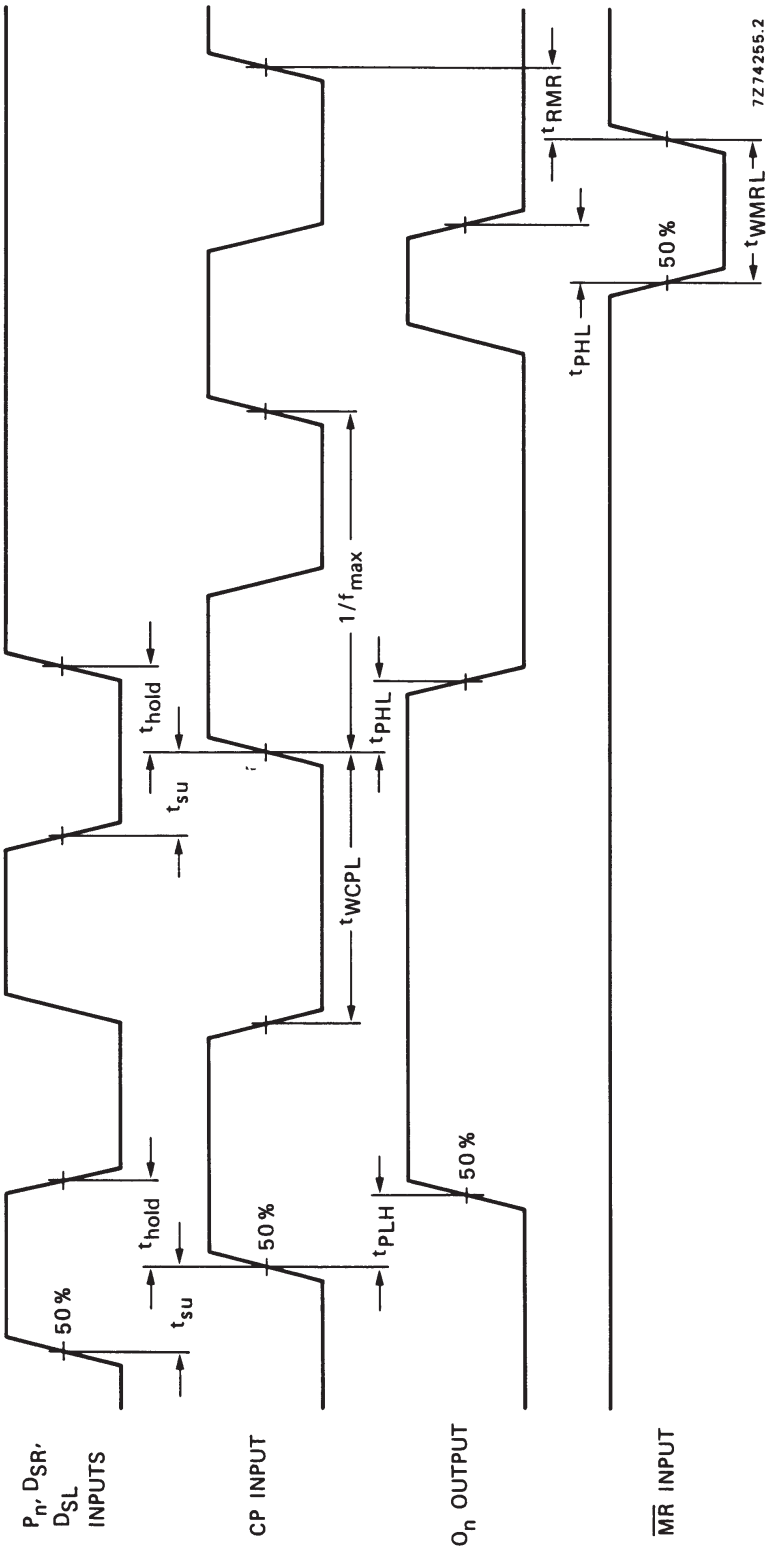

Fig.4 Waveforms showing set-up times, hold times for D_{SR}, D_{SL} and P_n inputs; minimum $\overline{MR}$ pulse width, $\overline{MR}$ to output delays and $\overline{MR}$ to CP recovery time; minimum CP pulse width and CP to output delays. Set-up and hold times are shown as positive values but may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

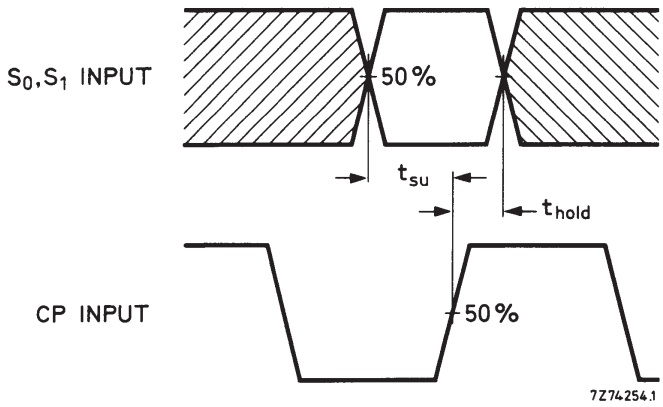

Fig.5 Waveforms showing set-up times and hold times for S_0 and S_1 inputs. Set-up and hold times are shown as positive values but may be specified as negative values.

APPLICATION INFORMATION

Some examples of applications for the HEF40194B are:

- Arithmetic unit register
- Serial/parallel converter.