

INTEGRATED CIRCUITS

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

HEF40195B

MSI

4-bit universal shift register

Product specification
File under Integrated Circuits, IC04

January 1995

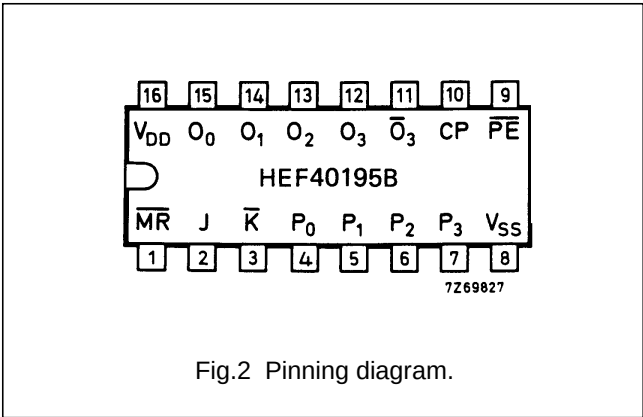
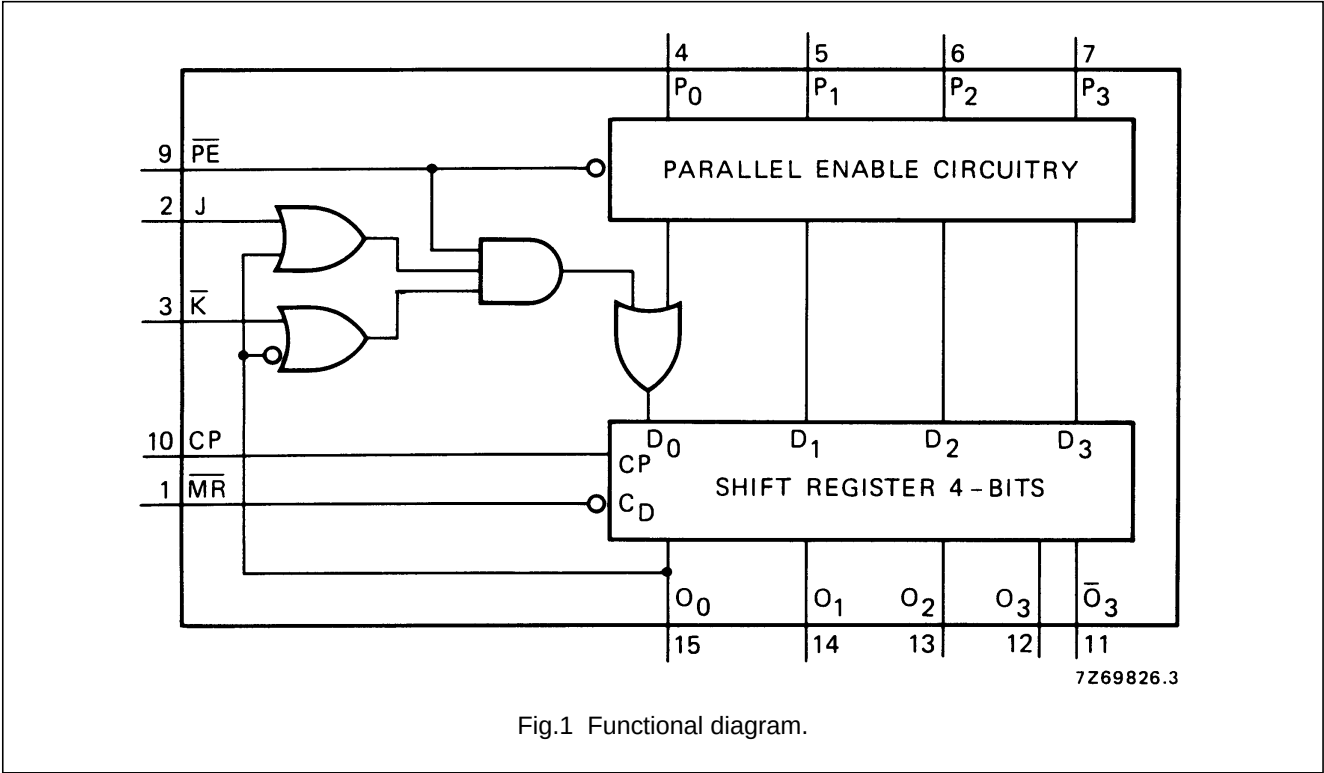
4-bit universal shift register

HEF40195B
MSI

DESCRIPTION

The HEF40195B is a fully synchronous edge-triggered 4-bit shift register with a clock input (CP), four synchronous parallel data inputs (P_0 to P_3), two synchronous serial data inputs (J , $\bar{K}$), a synchronous parallel enable input ($\overline{PE}$), buffered parallel outputs from all 4-bit positions (O_0 to O_3), a buffered inverted output from the last bit position ($\bar{O}_3$) and an overriding asynchronous master reset input ($\overline{MR}$). Each register stage is of a D-type master-slave flip-flop. Operation is synchronous (except for $\overline{MR}$) and is edge-triggered on the LOW to HIGH transition of the CP

input. When $\overline{PE}$ is LOW, data are loaded into the register from P_0 to P_3 on the LOW to HIGH transition of CP. When $\overline{PE}$ is HIGH, data are shifted into the first register position from J and $\bar{K}$ and all the data in the register are shifted one position to the right on the LOW to HIGH transition of CP. D-type entry is obtained by interconnecting J and $\bar{K}$. When J is HIGH and $\bar{K}$ is LOW, the first stage is in the toggle mode. When J is LOW and $\bar{K}$ is HIGH, the first stage is in the hold mode.
A LOW on $\overline{MR}$ resets all four bit positions (O_0 to $O_3 = \text{LOW}$, $\bar{O}_3 = \text{HIGH}$) independent of all other input conditions.



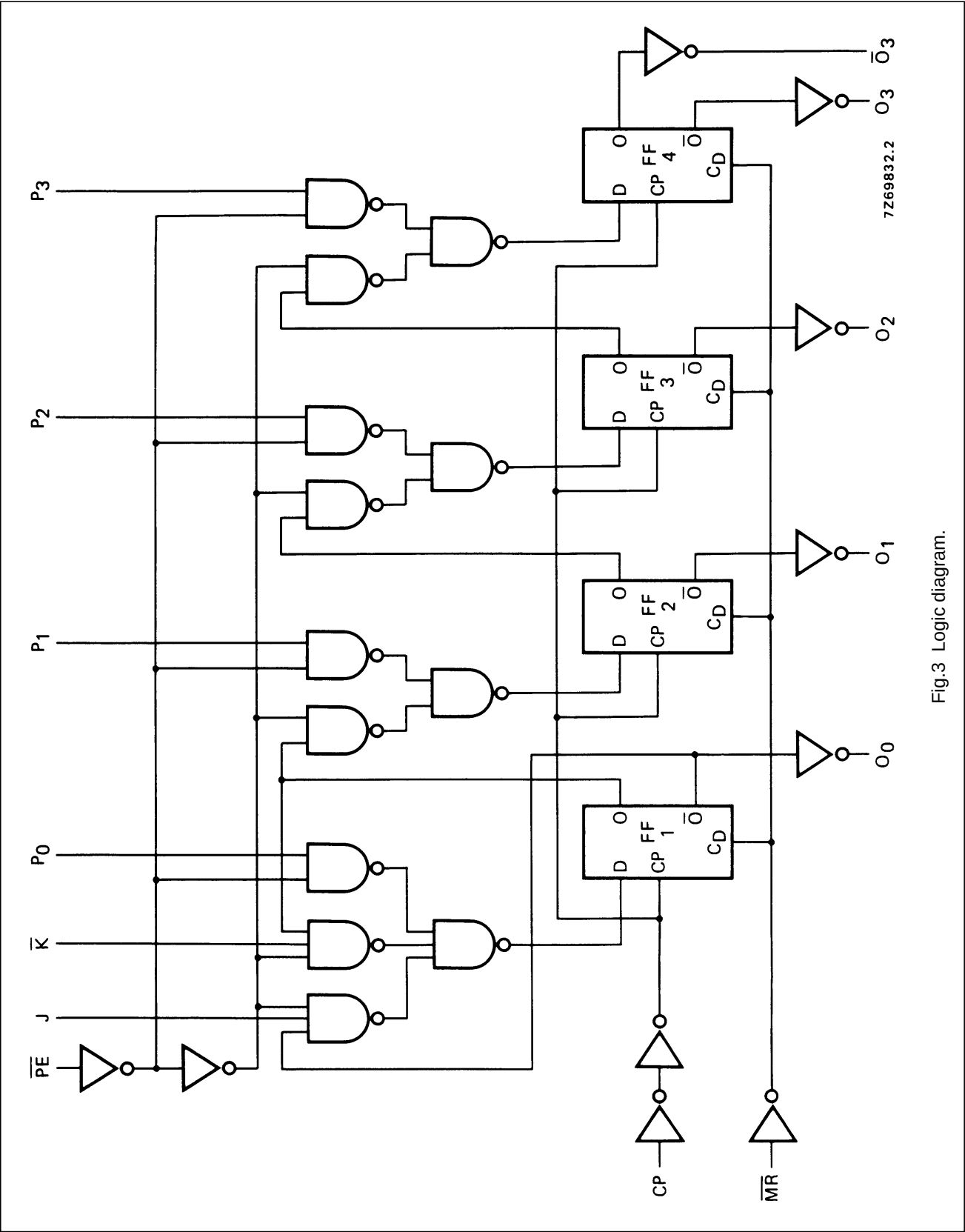
- HEF40195BP(N): 16-lead DIL; plastic (SOT38-1)
- HEF40195BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
- HEF40195BT(D): 16-lead SO; plastic (SOT109-1)
- (): Package Designator North America

FAMILY DATA, I_{DD} LIMITS category MSI

See Family Specifications

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PINNING

$\overline{\text{PE}}$	parallel enable input (active LOW)
P_0 to P_3	parallel data inputs
J	first stage J-input (active HIGH)
$\overline{\text{K}}$	first stage K-input (active LOW)
CP	clock input (LOW to HIGH edge triggered)
$\overline{\text{MR}}$	master reset input (active LOW)
O_0 to O_3	buffered parallel outputs
$\overline{\text{O}}_3$	buffered inverted output from last stage

FUNCTION TABLE

OPERATING MODE	INPUTS ($\overline{\text{MR}} = \text{HIGH}$)							OUTPUTS AT t_{n+1}				
	$\overline{\text{PE}}$	J	$\overline{\text{K}}$	P_0	P_1	P_2	P_3	O_0	O_1	O_2	O_3	$\overline{\text{O}}_3$
shift mode	H	L	L	X	X	X	X	L	O_0	O_1	O_2	$\overline{\text{O}}_2$
	H	L	H	X	X	X	X	O_0	O_0	O_1	O_2	$\overline{\text{O}}_2$
	H	H	L	X	X	X	X	$\overline{\text{O}}_0$	O_0	O_1	O_2	$\overline{\text{O}}_2$
	H	H	H	X	X	X	X	H	O_0	O_1	O_2	$\overline{\text{O}}_2$
parallel entry mode	L	X	X	L	L	L	L	L	L	L	L	H
	L	X	X	H	H	H	H	H	H	H	H	L

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

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AC CHARACTERISTICS

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

	V _{DD} V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA	
Propagation delays							
CP → O _n	5	t _{PHL}		105	215	ns	78 ns + (0,55 ns/pF) C _L
HIGH to LOW	10			50	95	ns	39 ns + (0,23 ns/pF) C _L
	15			35	65	ns	27 ns + (0,16 ns/pF) C _L
LOW to HIGH	5	t _{PLH}		90	180	ns	63 ns + (0,55 ns/pF) C _L
	10			45	85	ns	34 ns + (0,23 ns/pF) C _L
	15			30	60	ns	22 ns + (0,16 ns/pF) C _L
CP → $\overline{\text{O}}_3$	5	t _{PHL}		125	255	ns	98 ns + (0,55 ns/pF) C _L
HIGH to LOW	10			50	100	ns	39 ns + (0,23 ns/pF) C _L
	15			35	70	ns	27 ns + (0,16 ns/pF) C _L
LOW to HIGH	5	t _{PLH}		120	240	ns	93 ns + (0,55 ns/pF) C _L
	10			50	105	ns	39 ns + (0,23 ns/pF) C _L
	15			35	75	ns	27 ns + (0,16 ns/pF) C _L
$\overline{\text{MR}} \rightarrow \text{O}_n$	5	t _{PHL}		100	205	ns	73 ns + (0,55 ns/pF) C _L
HIGH to LOW	10			45	90	ns	34 ns + (0,23 ns/pF) C _L
	15			30	65	ns	22 ns + (0,16 ns/pF) C _L
LOW to HIGH	5	t _{PLH}		125	235	ns	98 ns + (0,55 ns/pF) C _L
	10			55	115	ns	44 ns + (0,23 ns/pF) C _L
	15			40	85	ns	32 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

4-bit universal shift register

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AC CHARACTERISTICS

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

	V_{DD} V	SYMBOL	MIN.	TYP.	MAX.	
Set-up times $J, \bar{K} \rightarrow CP$ $P_n \rightarrow CP$ $\overline{PE} \rightarrow CP$	5	t_{su}	70	35	ns	see also waveforms Figs 4 and 5
	10		20	10	ns	
	15		10	5	ns	
	5	t_{su}	85	40	ns	
	10		25	10	ns	
	15		10	5	ns	
	5	t_{su}	115	55	ns	
	10		45	20	ns	
	15		30	15	ns	
Hold times $J, \bar{K} \rightarrow CP$ $P_n \rightarrow CP$ $\overline{PE} \rightarrow CP$	5	t_{hold}	15	-20	ns	
	10		5	-5	ns	
	15		0	-5	ns	
	5	t_{hold}	20	-25	ns	
	10		10	-5	ns	
	15		0	-5	ns	
	5	t_{hold}	10	-50	ns	
	10		5	-20	ns	
	15		5	-10	ns	
Minimum clock pulse width; LOW	5	t_{WCPL}	60	30	ns	
	10		25	10	ns	
	15		20	10	ns	
Minimum $\overline{MR}$ pulse width; HIGH	5	t_{WMRL}	100	50	ns	
	10		40	20	ns	
	15		30	15	ns	
Recovery time for $\overline{MR}$	5	t_{RMR}	30	10	ns	
	10		15	5	ns	
	15		15	5	ns	
Maximum clock pulse frequency	5	f_{max}	5	10	MHz	
	10		14	28	MHz	
	15		19	39	MHz	

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	V_{DD} V	TYPICAL FORMULA FOR P (μ W)	
Dynamic power dissipation per package (P)	5	$1900 f_i + \sum (f_o C_L) \times V_{DD}^2$	where
	10	$8300 f_i + \sum (f_o C_L) \times V_{DD}^2$	f_i = input freq. (MHz)
	15	$22\,800 f_i + \sum (f_o C_L) \times V_{DD}^2$	f_o = output freq. (MHz)
			C_L = load capacitance (pF)
			$\sum (f_o C_L)$ = sum of outputs
			V_{DD} = supply voltage (V)

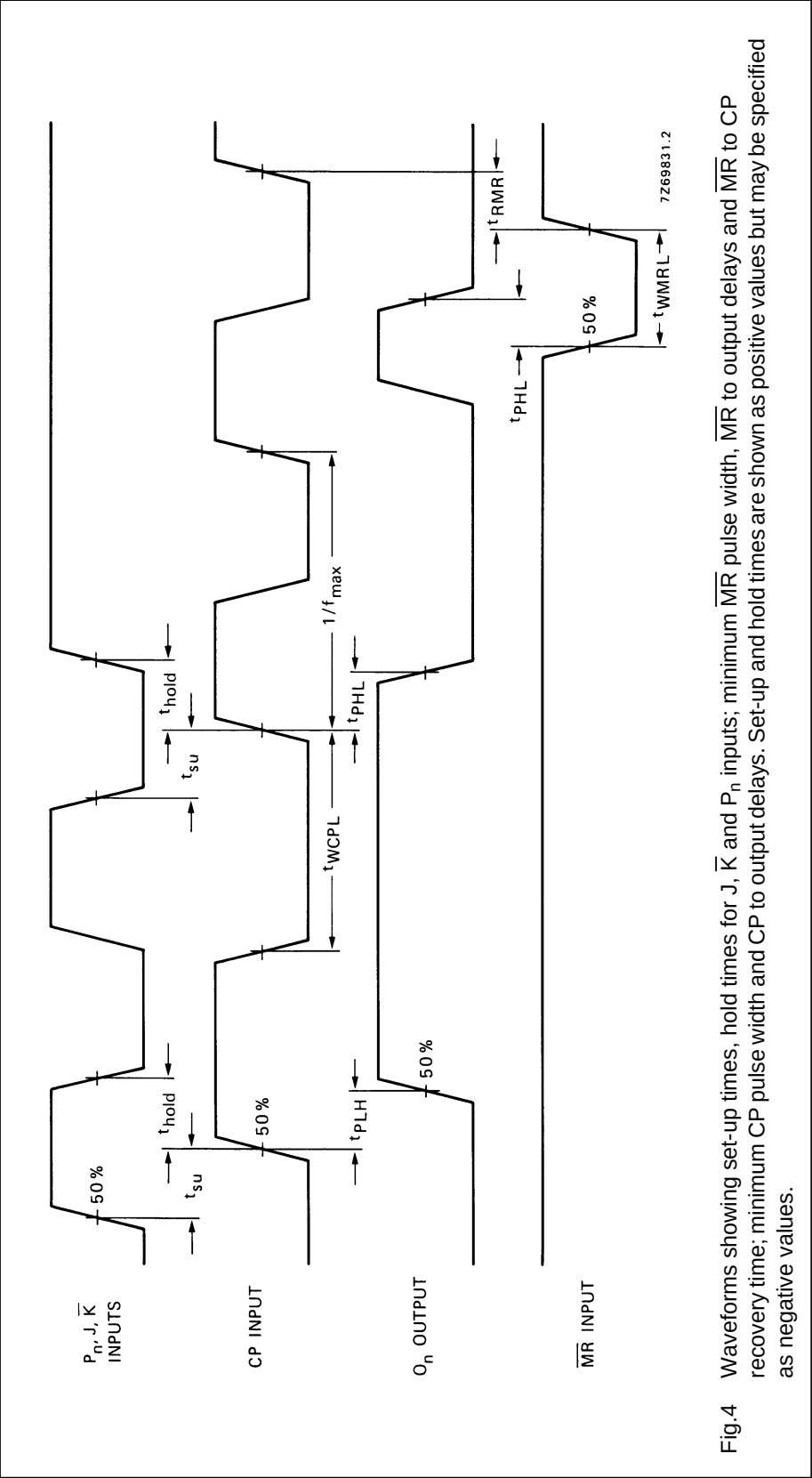


Fig.4 Waveforms showing set-up times, hold times for J, $\bar{K}$ and P_n inputs; minimum $\overline{MR}$ pulse width, $\overline{MR}$ to output delays and $\overline{MR}$ to CP recovery time; minimum CP pulse width and CP to output delays. Set-up and hold times are shown as positive values but may be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

4-bit universal shift register

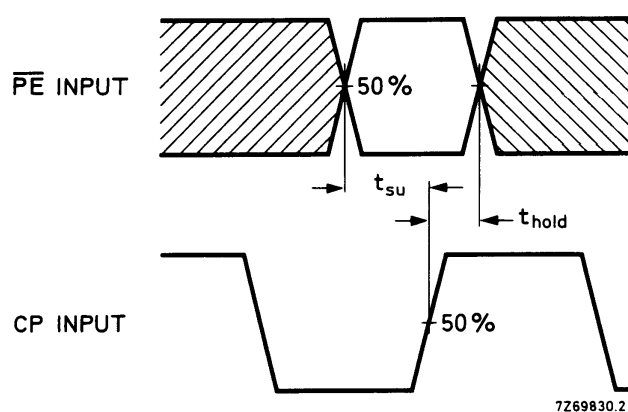
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Fig.5 Waveforms showing set-up and hold times for $\overline{PE}$ input. Set-up and hold times are shown as positive values but may be specified as negative values.

APPLICATION INFORMATION

Some examples of applications for the HEF40195B are:

- Serial data transfer
- Parallel data transfer
- Serial to parallel data transfer
- Parallel to serial data transfer