

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

HEF4035B

MSI

4-bit universal shift register

Product specification
File under Integrated Circuits, IC04

January 1995

4-bit universal shift register

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DESCRIPTION

The HEF4035B is a fully synchronous edge-triggered 4-bit shift register with a clock input (CP), four synchronous parallel data inputs (P₀ to P₃), two synchronous serial data inputs (J, \bar{K}), a synchronous parallel enable input (PE), buffered parallel outputs from all 4-bit positions (O₀ to O₃), a true/complement input (T/ \bar{C}) and an overriding asynchronous master reset input (MR). Each register is of a D-type master-slave flip-flop.

Operation is synchronous (except for MR) and is edge-triggered on the LOW to HIGH transition of the CP input. When PE is HIGH, data is loaded into the register from P₀ to P₃ on the LOW to HIGH transition of CP.

When PE is LOW, data is shifted into the first register position from J and \bar{K} and all the data in the register is 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 = HIGH and \bar{K} = LOW the first stage is in the toggle mode. When J = LOW and \bar{K} = HIGH the first stage is in the hold mode.

The outputs (O₀ to O₃) are either inverting or non-inverting, depending on T/ \bar{C} state. With T/ \bar{C} HIGH, O₀ to O₃ are non-inverting (active HIGH) and when T/ \bar{C} is LOW, O₀ to O₃ are inverting (active LOW).

A HIGH on MR resets all four bit positions (O₀ to O₃ = LOW if T/ \bar{C} = HIGH, O₀ to O₃ = HIGH if T/ \bar{C} = LOW) independent of all other input conditions.

Schmitt-trigger action in the clock input makes the circuit highly tolerant to slower clock rise and fall times.

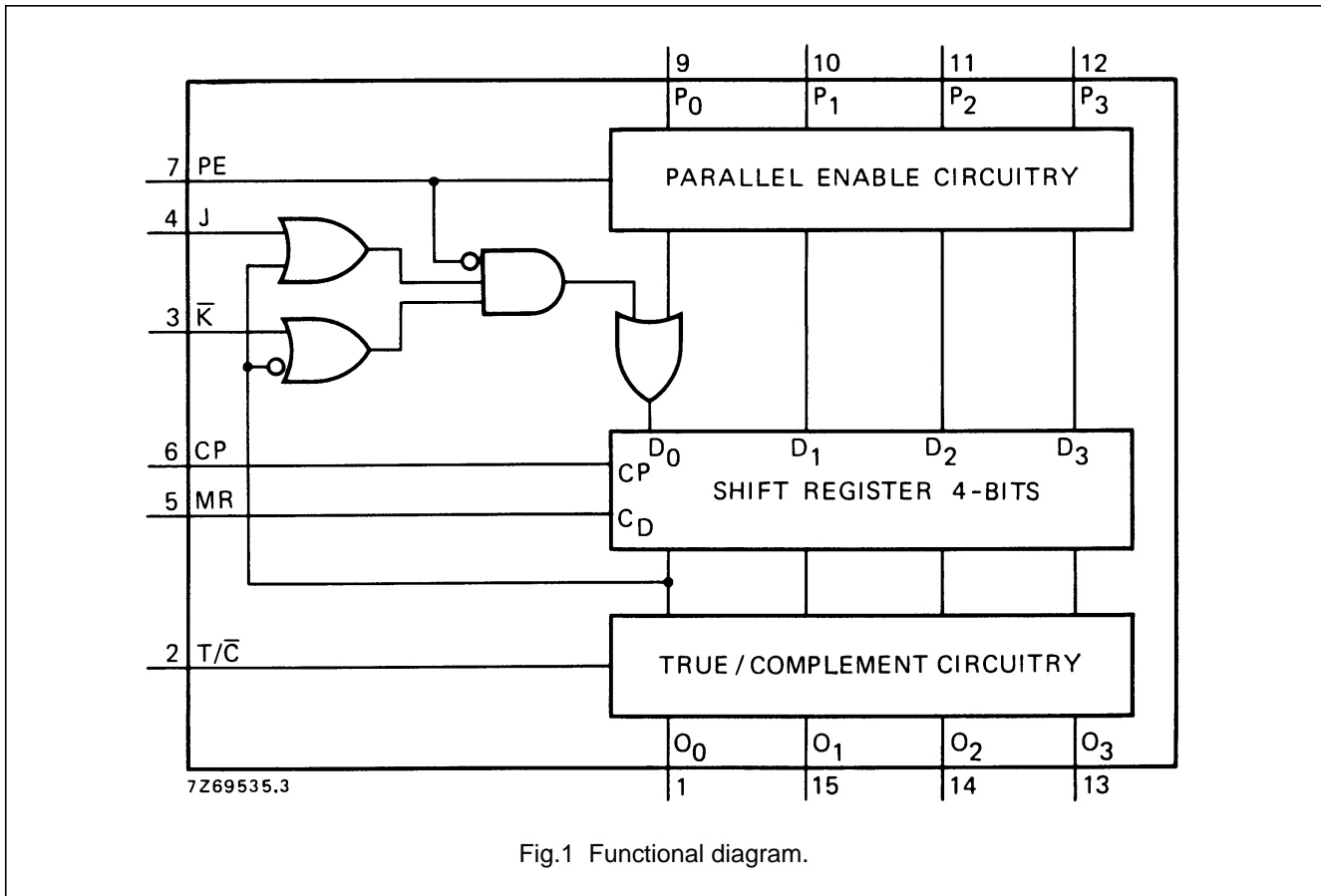


Fig.1 Functional diagram.

FAMILY DATA, I_{DD} LIMITS category MSI

See Family Specifications

4-bit universal shift register

HEF4035B
MSI

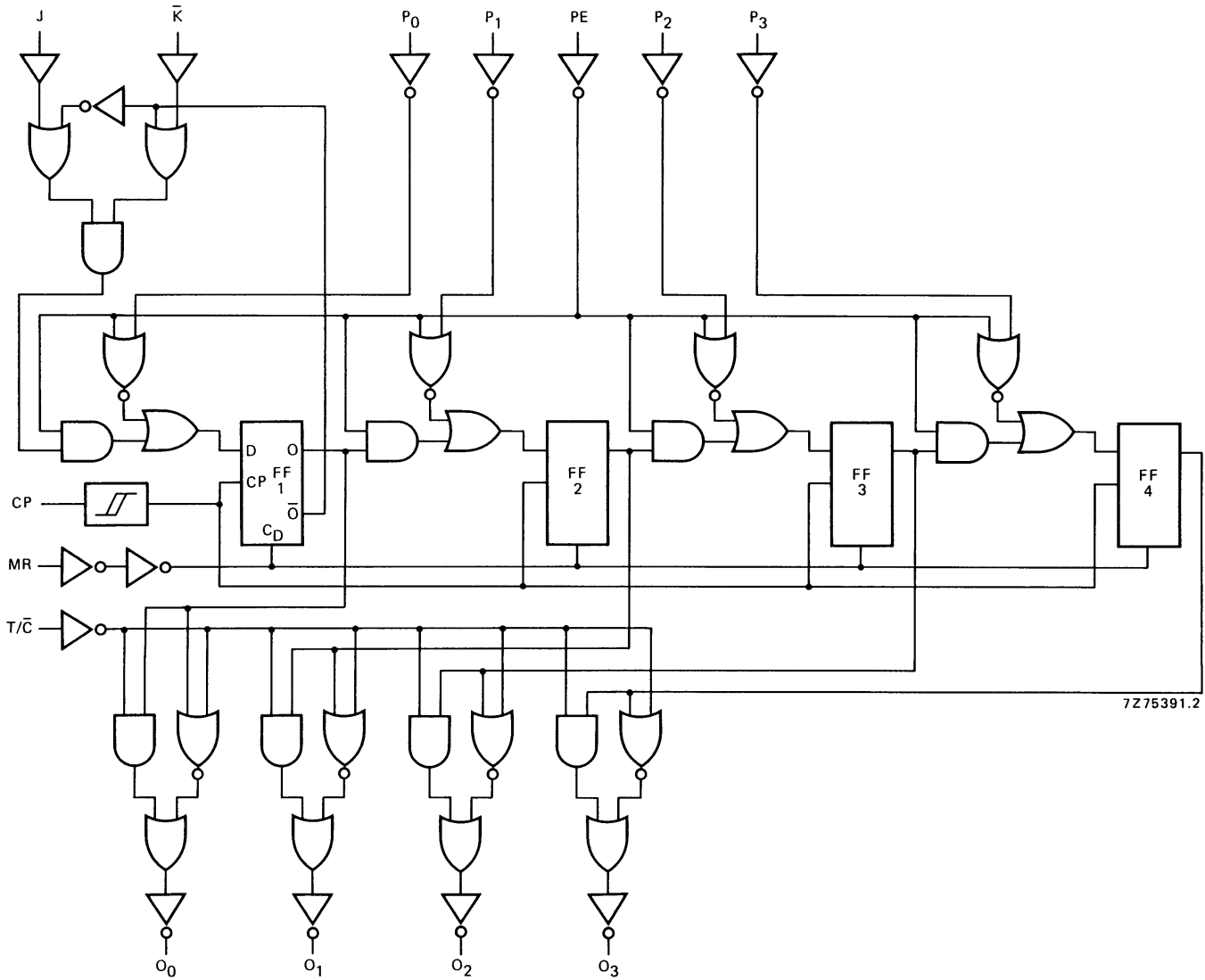


Fig.2 Logic diagram.

4-bit universal shift register

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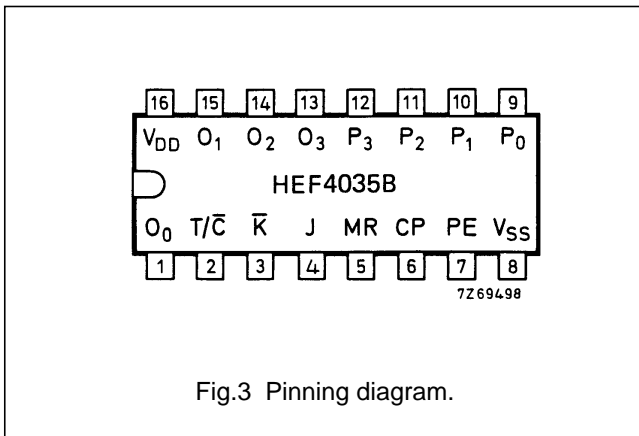


Fig.3 Pinning diagram.

- HEF4035BP(N): 16-lead DIL; plastic (SOT38-1)
 - HEF4035BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
 - HEF4035BT(D): 16-lead SO; plastic (SOT109-1)
- (): Package Designator North America

PINNING

- PE parallel enable input
- P₀ to P₃ parallel data inputs
- J first stage J-input (active HIGH)
- \bar{K} first stage K-input (active LOW)
- CP clock input (LOW to HIGH edge-triggered)
- T/\bar{C} true/complement input
- MR master reset input
- O₀ to O₃ buffered parallel outputs

FUNCTION TABLES

Serial operation first stage

INPUTS				OUTPUT	MODE OF OPERATION
CP	J	\bar{K}	MR	O ₀₊₁	
↗	H	H	L	H	D flip-flop
↗	L	L	L	L	D flip-flop
↗	H	L	L	\bar{O}_0	toggle
↗	L	H	L	O ₀	no change
X	X	X	H	L	reset

Note

1. T/\bar{C} = HIGH; PE = LOW

Parallel operation

CP	INPUTS				OUTPUTS			
	P ₀	P ₁	P ₂	P ₃	O ₀	O ₁	O ₂	O ₃
↗	H	H	H	H	H	H	H	H
↗	L	L	L	L	L	L	L	L

Notes

1. T/\bar{C} = HIGH; PE = HIGH; MR = LOW
 ↗ = positive-going transition
 H = HIGH state (the more positive voltage)
 L = LOW state (the less positive voltage)
 X = state is immaterial

4-bit universal shift register

HEF4035B
MSI**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 \rightarrow O _n HIGH to LOW	5		170	340	ns	143 ns + (0,55 ns/pF) C _L
	10	t _{PHL}	70	140	ns	59 ns + (0,23 ns/pF) C _L
	15		50	100	ns	42 ns + (0,16 ns/pF) C _L
LOW to HIGH	5		150	300	ns	123 ns + (0,55 ns/pF) C _L
	10	t _{PLH}	65	130	ns	54 ns + (0,23 ns/pF) C _L
	15		50	100	ns	42 ns + (0,16 ns/pF) C _L
MR \rightarrow O _n HIGH to LOW	5		115	230	ns	88 ns + (0,55 ns/pF) C _L
	10	t _{PHL}	50	100	ns	39 ns + (0,23 ns/pF) C _L
	15		40	80	ns	32 ns + (0,16 ns/pF) C _L
LOW to HIGH	5		115	230	ns	88 ns + (0,55 ns/pF) C _L
	10	t _{PLH}	50	100	ns	39 ns + (0,23 ns/pF) C _L
	15		40	80	ns	32 ns + (0,16 ns/pF) C _L
T/ \bar{C} \rightarrow O _n HIGH to LOW	5		105	210	ns	78 ns + (0,55 ns/pF) C _L
	10	t _{PHL}	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		85	170	ns	58 ns + (0,55 ns/pF) C _L
	10	t _{PLH}	45	90	ns	34 ns + (0,23 ns/pF) C _L
	15		35	70	ns	27 ns + (0,16 ns/pF) C _L
Output transition times HIGH to LOW	5		60	120	ns	10 ns + (1,0 ns/pF) C _L
	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
LOW to HIGH	5		60	120	ns	10 ns + (1,0 ns/pF) C _L
	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

4-bit universal shift register

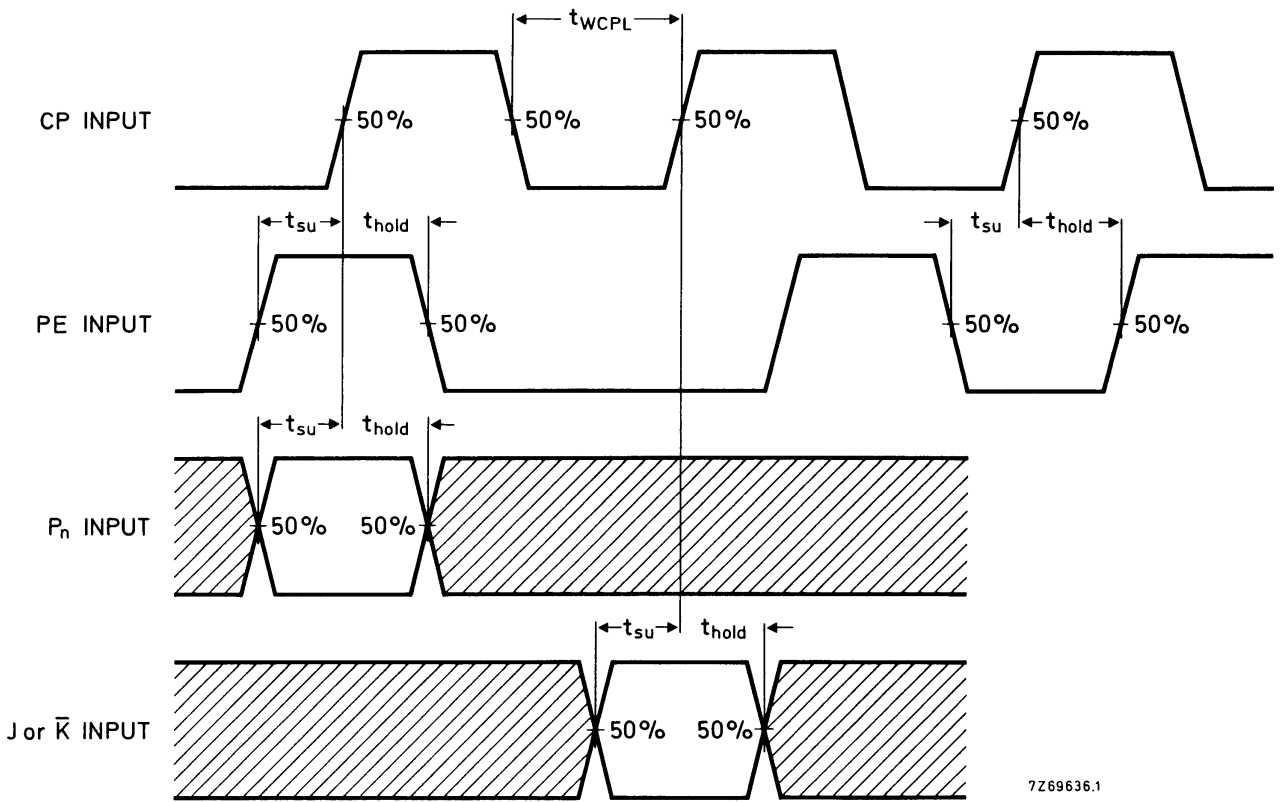
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	V _{DD} V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA
Minimum clock pulse width; LOW	5	t _{WCPL}	80	40	ns	see also waveforms Figs 4 and 5
	10		40	20	ns	
	15		30	15	ns	
Minimum MR pulse width; HIGH	5	t _{WMRH}	50	25	ns	
	10		30	15	ns	
	15		20	10	ns	
Recovery time for MR	5	t _{RMR}	50	20	ns	
	10		40	15	ns	
	15		25	10	ns	
Set-up times P _n → CP PE → CP J, \bar{K} → CP	5	t _{su}	40	5	ns	
	10		25	0	ns	
	15		15	0	ns	
	5	t _{su}	50	25	ns	
	10		35	15	ns	
	15		30	10	ns	
	5	t _{su}	55	40	ns	
	10		35	15	ns	
	15		25	10	ns	
Hold times P _n → CP PE → CP J, \bar{K} → CP	5	t _{hold}	25	10	ns	
	10		20	10	ns	
	15		20	10	ns	
	5	t _{hold}	15	-5	ns	
	10		10	-5	ns	
	15		5	-5	ns	
	5	t _{hold}	10	-5	ns	
	10		10	0	ns	
	15		10	0	ns	
	Maximum clock pulse frequency	5	f _{max}	5	10	MHz
		10		12	25	MHz
		15		15	30	MHz

	V _{DD} V	TYPICAL FORMULA FOR P (μW)	
Dynamic power dissipation per package (P)	5	1 000 f _i + ∑ (f _o C _L) × V _{DD} ²	where f _i = input freq. (MHz) f _o = output freq. (MHz) C _L = load cap. (pF) ∑ (f _o C _L) = sum of outputs V _{DD} = supply voltage (V)
	10	6 000 f _i + ∑ (f _o C _L) × V _{DD} ²	
	15	20 000 f _i + ∑ (f _o C _L) × V _{DD} ²	

4-bit universal shift register

HEF4035B
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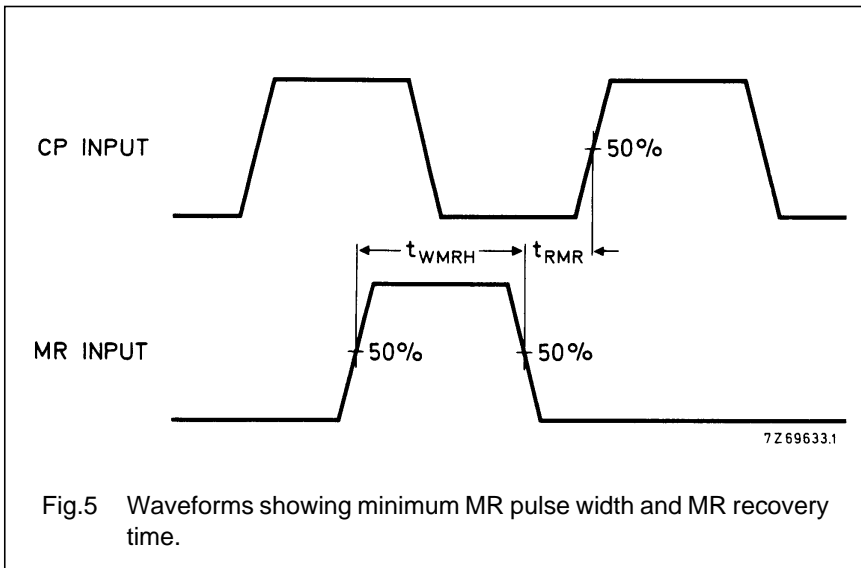


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Fig.4 Waveforms showing minimum clock pulse width, set-up times, hold times. Set-up times and hold times are shown as positive values but may be specified as negative values.

4-bit universal shift register

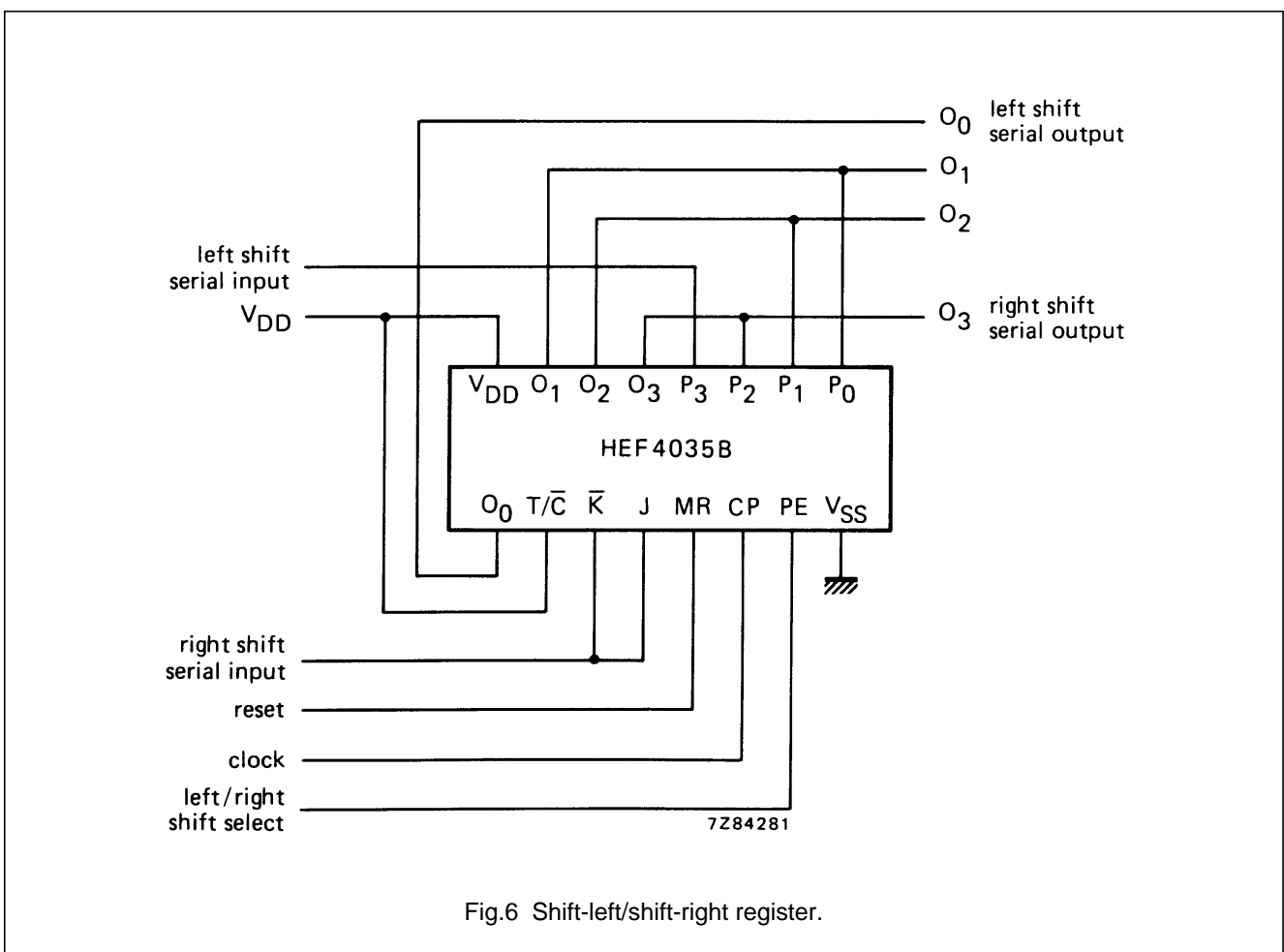
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APPLICATION INFORMATION

Some examples of applications for the HEF4035B are:

- Counters, registers, arithmetic-unit registers, shift-left/shift-right registers.
- Serial-to-parallel/parallel-to-serial conversions.
- Sequence generation.
- Control circuits.
- Code conversion.





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