

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

HEF4526B

MSI

Programmable 4-bit binary down counter

Product specification
File under Integrated Circuits, IC04

January 1995

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DESCRIPTION

The HEF4526B is a synchronous programmable 4-bit binary down counter with an active HIGH and an active LOW clock input (CP_0 , $\overline{CP}_1$), an asynchronous parallel load input (PL), four parallel inputs (P_0 to P_3), a cascade feedback input (CF), four buffered parallel outputs (O_0 to O_3), a terminal count output (TC) and an overriding asynchronous master reset input (MR).

This device is a programmable, cascadable down counter with a decoded TC output for divide-by-n applications. In single stage applications the TC output is connected to PL. CF allows cascade divide-by-n operation with no additional gates required.

Information on P_0 to P_3 is loaded into the counter while PL is HIGH, independent of all other input conditions except MR, which must be LOW. When PL and $\overline{CP}_1$ are LOW, the counter advances on a LOW to HIGH transition of CP_0 . When PL is LOW and CP_0 is HIGH, the counter advances on a HIGH to LOW transition of $\overline{CP}_1$. TC is HIGH when the counter is in the zero state ($O_0 = O_1 = O_2 = O_3 = \text{LOW}$) and CF is HIGH and PL is LOW. A HIGH on MR resets the counter (O_0 to $O_3 = \text{LOW}$) independent of other input conditions.

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

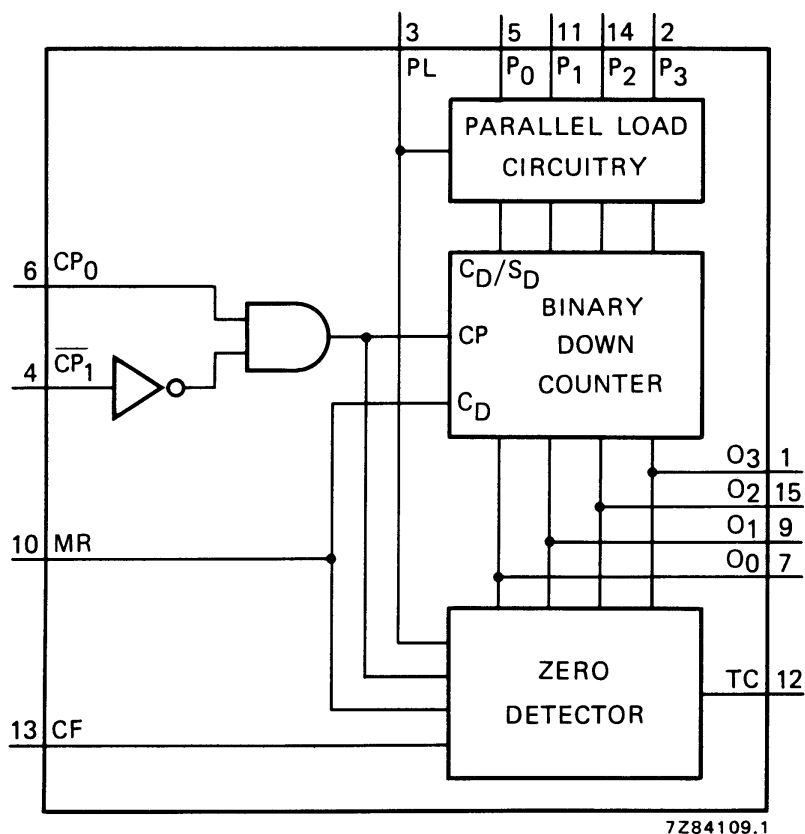


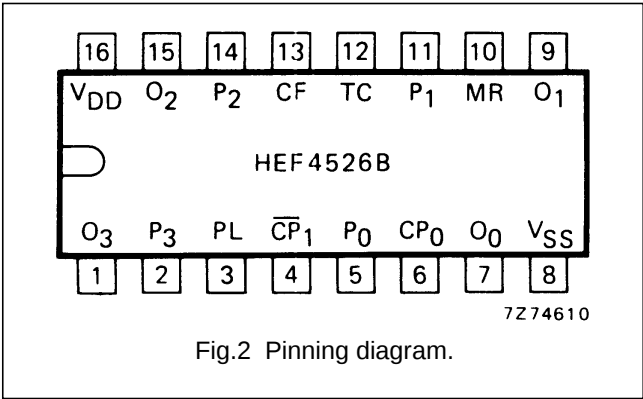
Fig.1 Functional diagram.

FAMILY DATA, I_{DD} LIMITS category MSI

See Family Specifications

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HEF4526BP(N): 16-lead DIL; plastic (SOT38-1)
HEF4526BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
HEF4526BT(D): 16-lead SO; plastic (SOT109-1)
(): Package Designator North America

PINNING

- PL parallel load input
- P₀ to P₃ parallel inputs
- CF cascade feedback input
- CP₀ clock input (LOW to HIGH, triggered)
- CP₁ clock input (HIGH to LOW, triggered)
- MR asynchronous master reset input
- TC terminal count output
- O₀ to O₃ buffered parallel outputs

COUNTING MODE

CF = HIGH; PL = LOW; MR = LOW

COUNT	OUTPUTS			
	O ₃	O ₂	O ₁	O ₀
15	H	H	H	H
14	H	H	H	L
13	H	H	L	H
12	H	H	L	L
11	H	L	H	H
10	H	L	H	L
9	H	L	L	H
8	H	L	L	L
7	L	H	H	H
6	L	H	H	L
5	L	H	L	H
4	L	H	L	L
3	L	L	H	H
2	L	L	H	L
1	L	L	L	H
0	L	L	L	L

FUNCTION TABLE

MR	PL	CP ₀	CP ₁	MODE
H	X	X	X	reset (asynchronous)
L	H	X	X	preset (asynchronous)
L	L	↗	H	no change
L	L	L	↘	no change
L	L	↘	X	no change
L	L	X	↗	no change
L	L	↗	L	counter advances
L	L	H	↘	counter advances

Notes

- 1. H = HIGH state (the more positive voltage)
L = LOW state (the less positive voltage)
X = state is immaterial
↗ = positive-going transition
↘ = negative-going transition

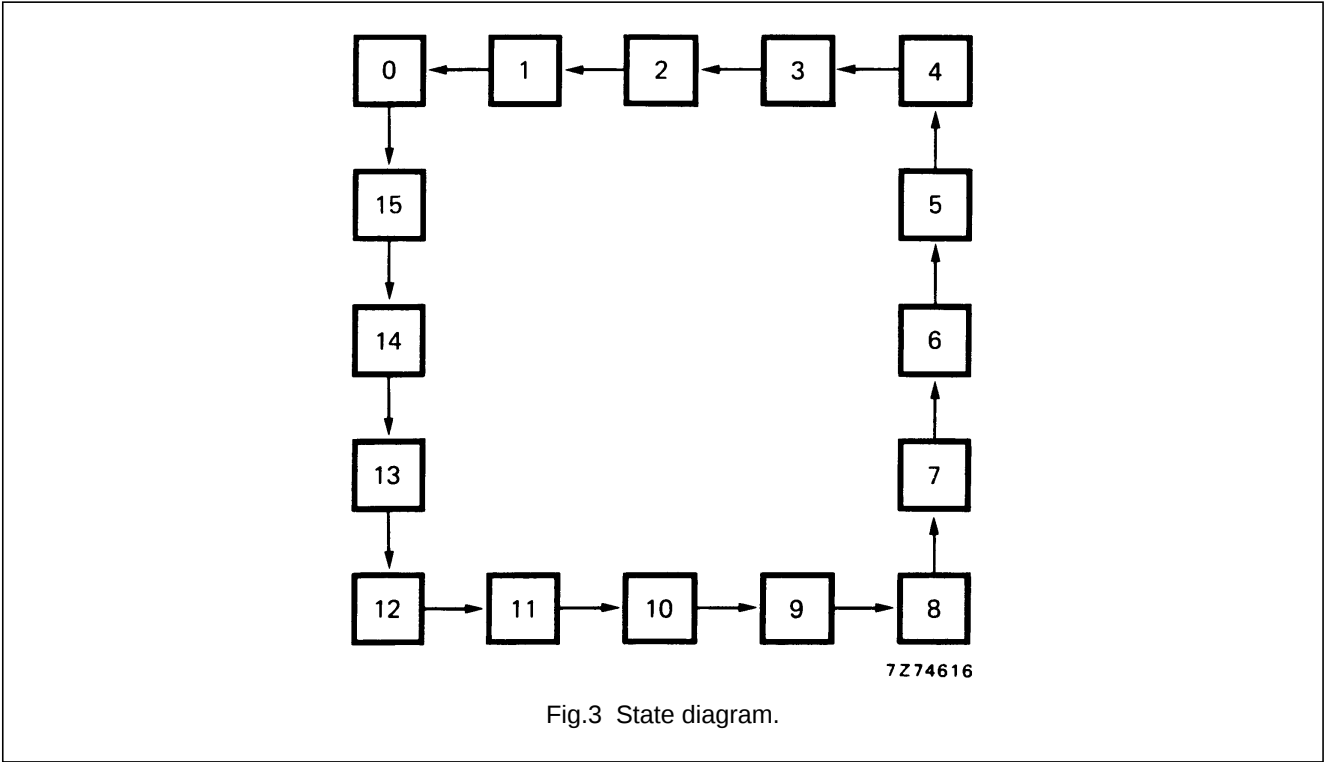
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SINGLE STAGE OPERATION

Divide-by-n; MR = LOW; CF = HIGH; $\overline{CP_1}$ = LOW

PL	P ₃	P ₂	P ₁	P ₀	DIVIDE BY	TC OUTPUT PULSE WIDTH
L	X	X	X	X	16	one clock period
TC	H	H	H	H	15	clock pulse HIGH
TC	H	H	H	L	14	
TC	H	H	L	H	13	
TC	H	H	L	L	12	
TC	H	L	H	H	11	
TC	H	L	H	L	10	
TC	H	L	L	H	9	
TC	H	L	L	L	8	
TC	L	H	H	H	7	
TC	L	H	H	L	6	
TC	L	H	L	H	5	
TC	L	H	L	L	4	
TC	L	L	H	H	3	
TC	L	L	H	L	2	
TC	L	L	L	H	1	
TC	L	L	L	L	no operation	



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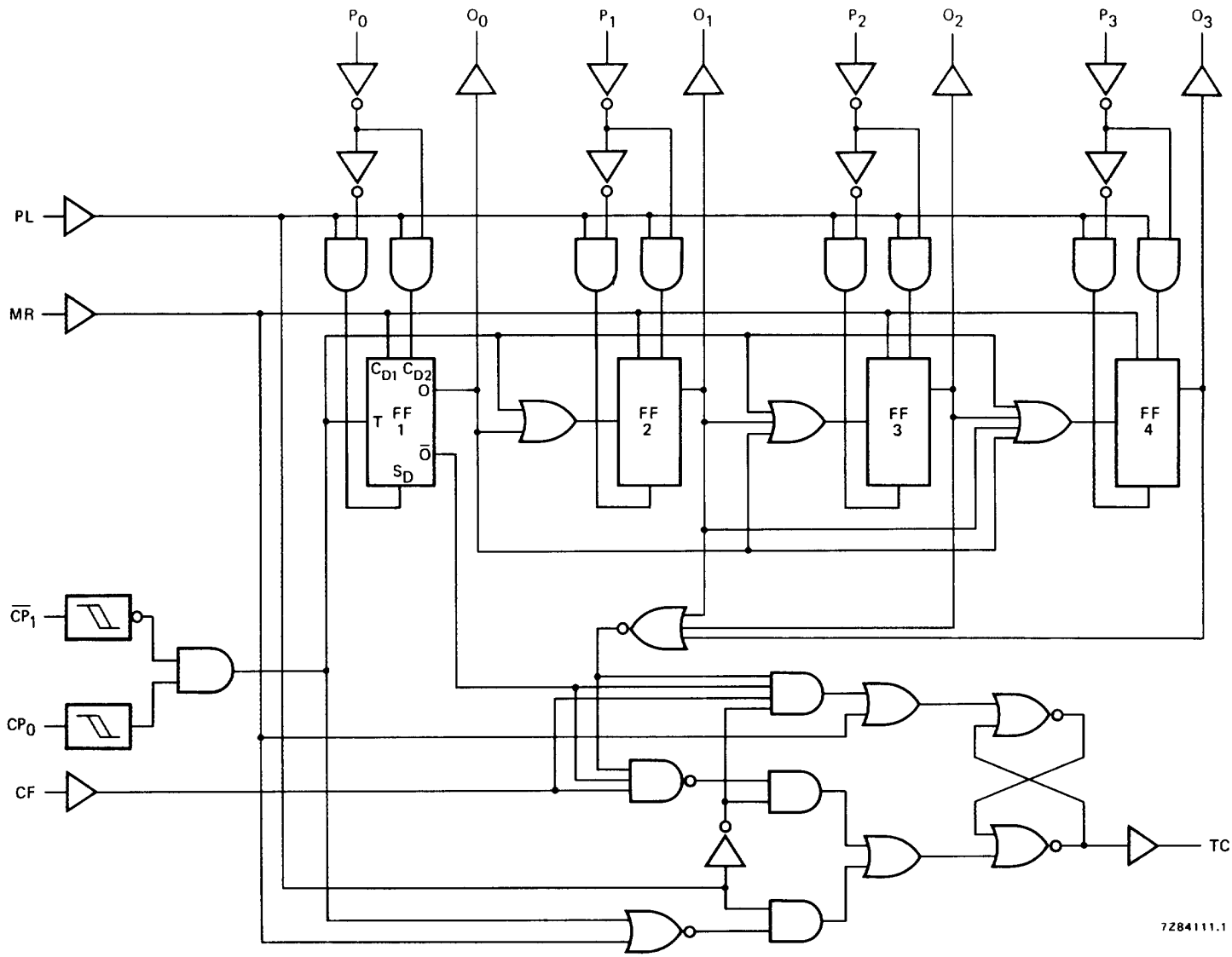


Fig.4 Logic diagram.

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AC CHARACTERISTICS

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

	V_{DD} V	TYPICAL FORMULA FOR P (μW)	
Dynamic power dissipation per package (P)	5 10 15	$1000 f_i + \sum (f_o C_L) \times V_{DD}^2$ $4000 f_i + \sum (f_o C_L) \times V_{DD}^2$ $10\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$	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)

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 ₀ , $\overline{CP_1} \rightarrow O_n$	5	t _{PHL}		150	300	ns	123 ns + (0,55 ns/pF) C _L
HIGH to LOW	10			65	130	ns	54 ns + (0,23 ns/pF) C _L
	15			50	100	ns	42 ns + (0,16 ns/pF) C _L
LOW to HIGH	5	t _{PLH}		150	300	ns	123 ns + (0,55 ns/pF) C _L
	10			65	130	ns	54 ns + (0,23 ns/pF) C _L
	15			50	100	ns	42 ns + (0,16 ns/pF) C _L
CP ₀ , $\overline{CP_1} \rightarrow TC$	5	t _{PHL}		210	420	ns	183 ns + (0,55 ns/pF) C _L
HIGH to LOW	10			90	180	ns	79 ns + (0,23 ns/pF) C _L
	15			70	140	ns	62 ns + (0,16 ns/pF) C _L
LOW to HIGH	5	t _{PLH}		210	420	ns	183 ns + (0,55 ns/pF) C _L
	10			90	180	ns	79 ns + (0,23 ns/pF) C _L
	15			70	140	ns	62 ns + (0,16 ns/pF) C _L
PL → O _n	5	t _{PHL}		200	400	ns	173 ns + (0,55 ns/pF) C _L
HIGH to LOW	10			80	160	ns	69 ns + (0,23 ns/pF) C _L
	15			60	120	ns	52 ns + (0,16 ns/pF) C _L
LOW to HIGH	5	t _{PLH}		180	360	ns	153 ns + (0,55 ns/pF) C _L
	10			70	140	ns	59 ns + (0,23 ns/pF) C _L
	15			50	100	ns	42 ns + (0,16 ns/pF) C _L
MR → O _n	5	t _{PHL}		140	280	ns	113 ns + (0,55 ns/pF) C _L
HIGH to LOW	10			55	110	ns	44 ns + (0,23 ns/pF) C _L
	15			40	80	ns	32 ns + (0,16 ns/pF) C _L
Output transition times	5	t _{THL}		60	120	ns	10 ns + (1,0 ns/pF) C _L
HIGH to LOW	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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AC CHARACTERISTICS

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

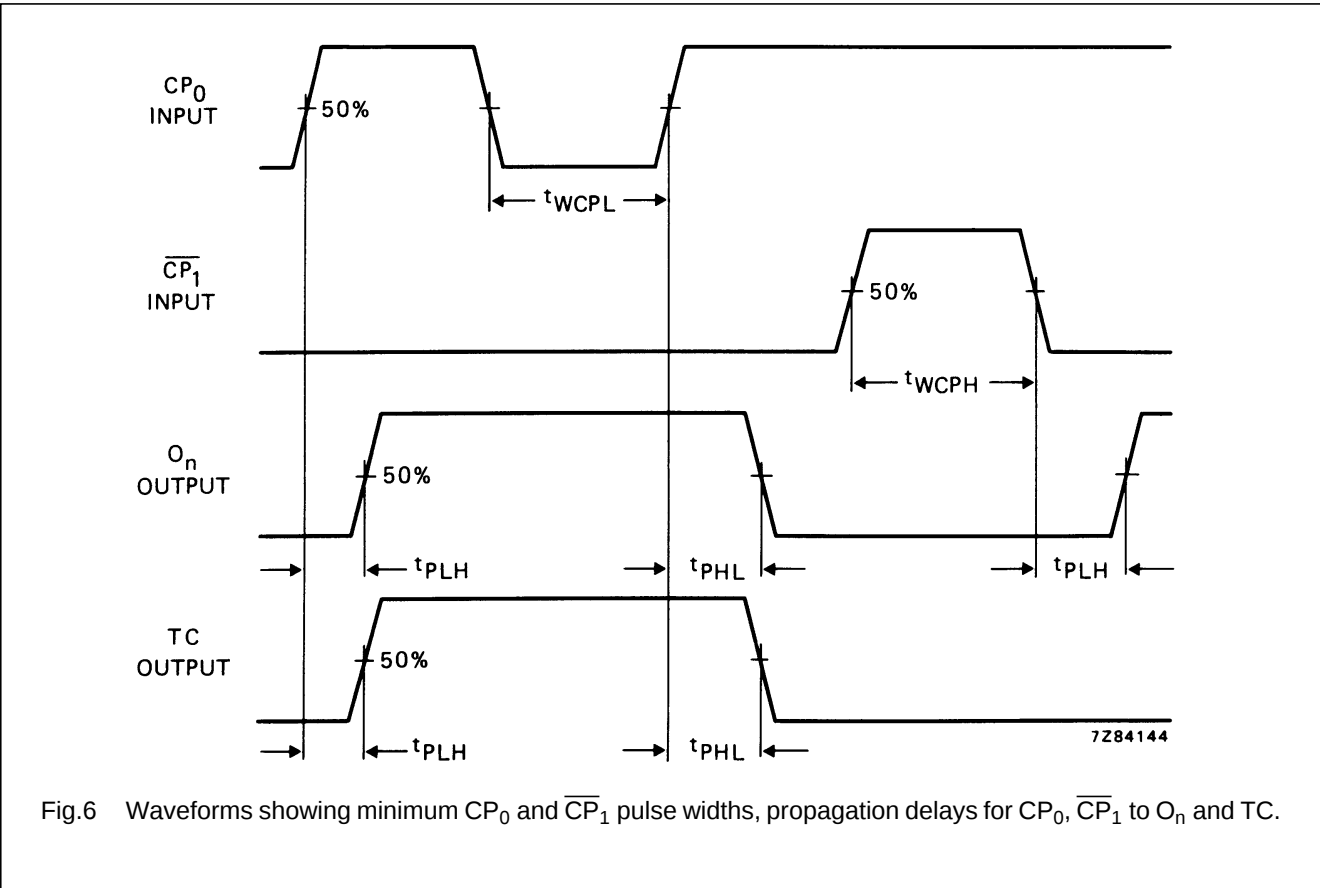
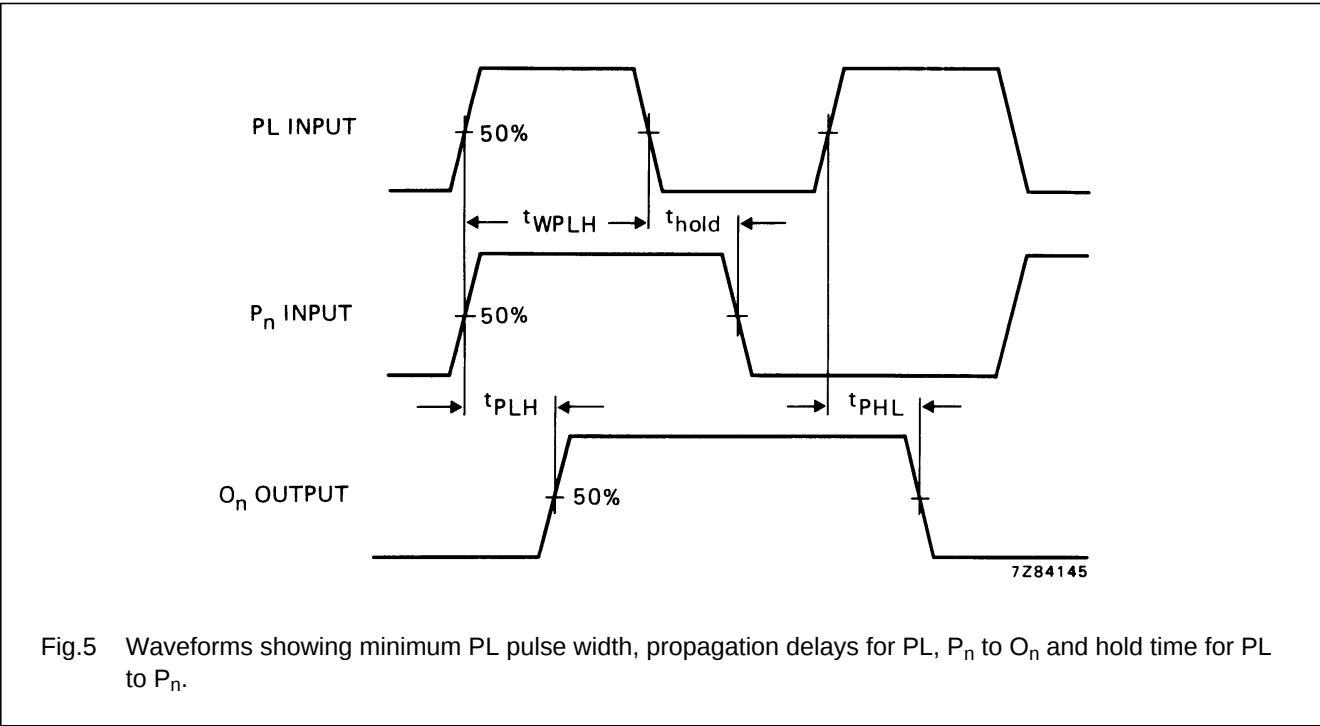
	V_{DD} V	SYMBOL	MIN.	TYP.	MAX.	
Minimum clock pulse width CP_0 LOW	5 10 15	t_{WCPL}	80 40 30	40 20 15	ns ns ns	see also waveforms Figs 5 and 6
Minimum clock pulse width $\overline{CP}_1$ HIGH	5 10 15	t_{WCPH}	80 40 30	40 20 15	ns ns ns	
Minimum PL pulse width; HIGH	5 10 15	t_{WPLH}	100 40 32	50 20 16	ns ns ns	
Minimum MR pulse width; HIGH	5 10 15	t_{WMRH}	130 50 40	65 25 20	ns ns ns	
Hold time $P_n \rightarrow PL$	5 10 15	t_{hold}	30 20 15	5 5 5	ns ns ns	
Set-up time $P_n \rightarrow PL$	5 10 15	t_{su}	30 20 15	0 0 0	ns ns ns	
Maximum clock pulse frequency PL = LOW	5 10 15	f_{max}	6 12 16	12 25 32	MHz MHz MHz	see note 1

Note

1. In the divide-by-n mode (PL connected to TC), one has to observe the maximum HIGH to LOW propagation delay for CP to TC, before applying the next clock pulse.

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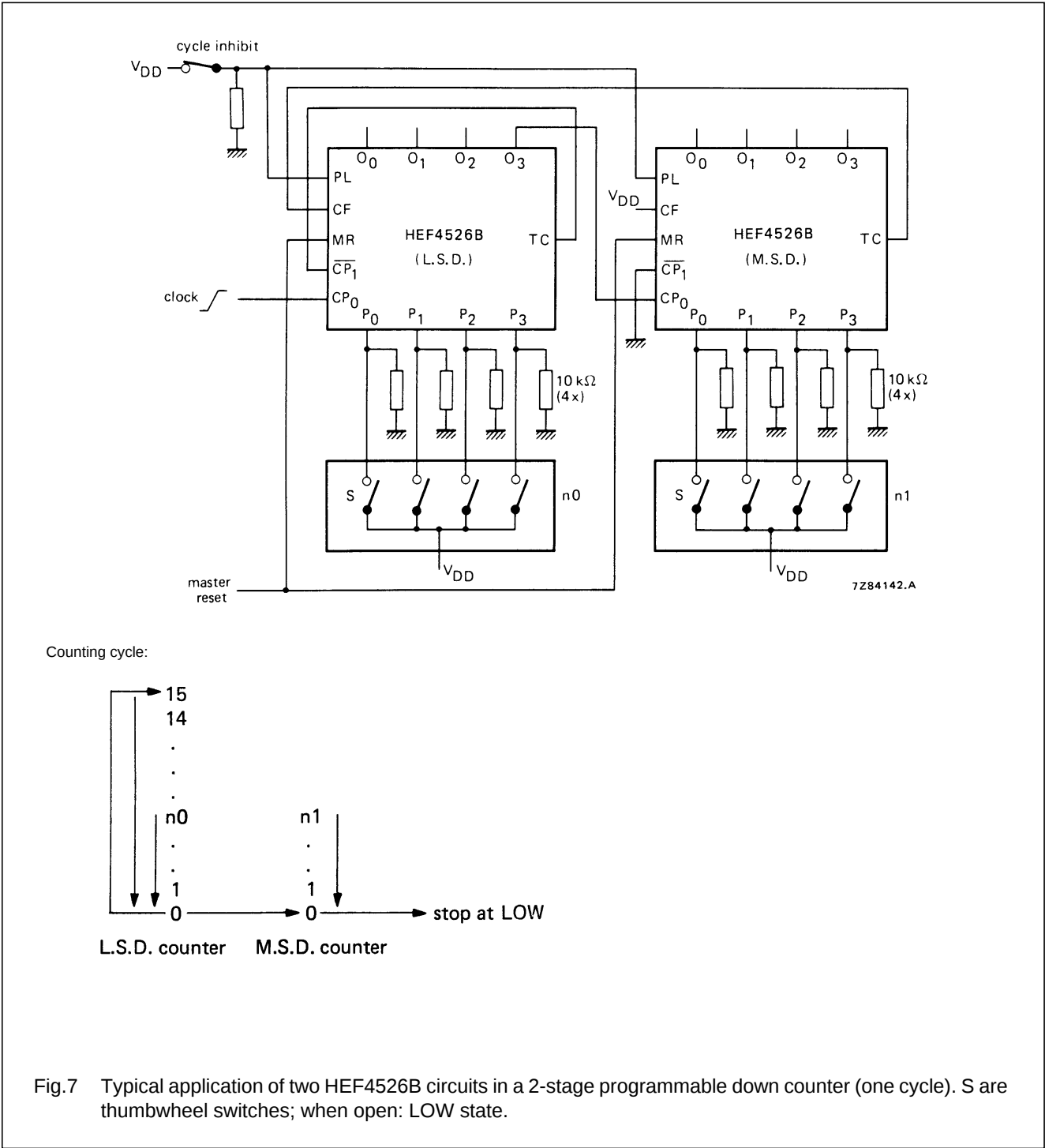
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APPLICATION INFORMATION

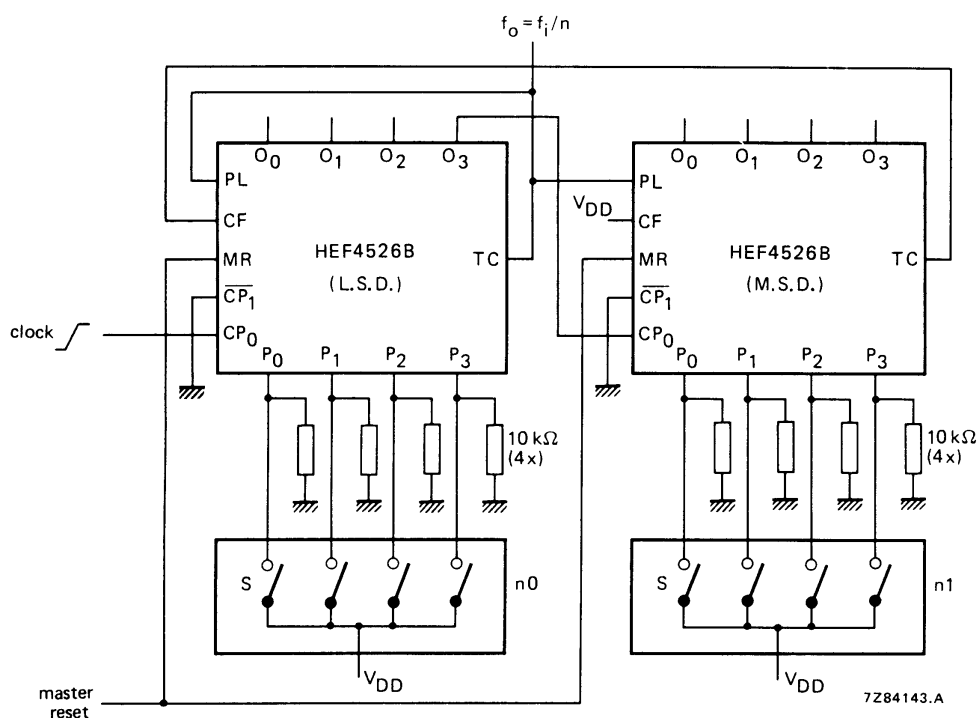
Some examples of applications for the HEF4526B are:

- Divide-by-n counter
- Programmable frequency divider



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Counting cycle:

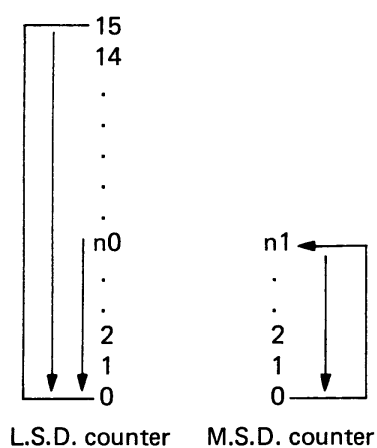


Fig.8 Typical application of two HEF4526B circuits in a 2-stage programmable frequency divider. S are thumbwheel switches; when open: LOW state.