HEF4526B

Programmable 4-bit binary down counter

Rev. 5 — 22 November 2011 Product data sheet

1. General description

The HEF4526B is a synchronous programmable 4-bit binary down counter with active HIGH and active LOW clock inputs (CP0, $\overline{CP1}$), an asynchronous parallel load input (PL), four parallel inputs (A0 to A3), a cascade feedback input (CF), four buffered parallel outputs (Q0 to Q3), a terminal count output (TC), an overriding asynchronous master reset input (MR) and a decoded TC output that can be used 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 A0 to A3 is loaded into the counter while PL is HIGH, independent of all other inputs except MR, which must be LOW. When PL and $\overline{CP1}$ are LOW, the counter advances on a LOW-to-HIGH transition of CP0. When PL is LOW and CP0 is HIGH, the counter advances on a HIGH to LOW transition of $\overline{CP1}$. TC is HIGH when the counter is in the zero state (Q0 = Q1 = Q2 = Q3 = LOW) and CF is HIGH and PL is LOW. A HIGH on MR resets the counter (Q0 to Q3 = LOW) independent of other inputs. The clock input is highly tolerant of slower clock rise and fall times due to Schmitt trigger action.

It operates over a recommended V_{DD} power supply range of 3 V to 15 V referenced to V_{SS} (usually ground). Unused inputs must be connected to V_{DD}, V_{SS}, or another input.

2. Features and benefits

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from −40 °C to +85 °C
- Complies with JEDEC standard JESD 13-B

3. Ordering information

Table 1. Ordering information

All types operate from −40 °C to +85 °C.

Type number	Package		
	Name	Description	Version
HEF4526BP	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
HEF4526BT	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

4. Functional diagram

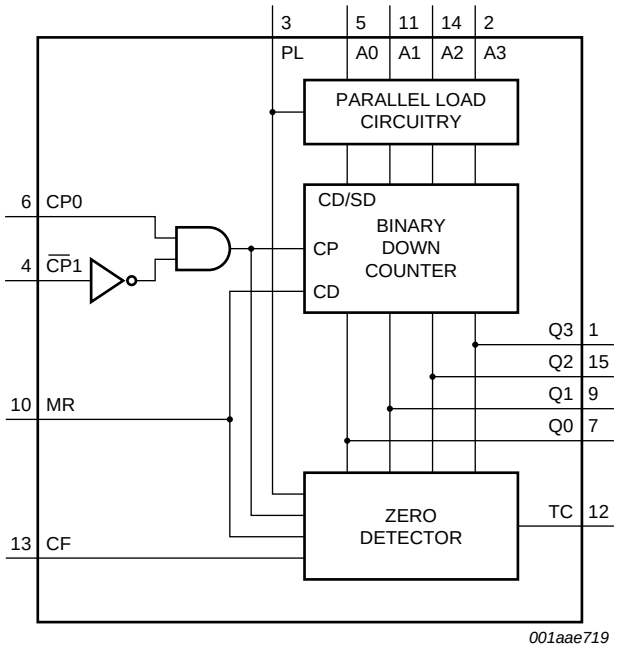

Fig 1. Functional diagram

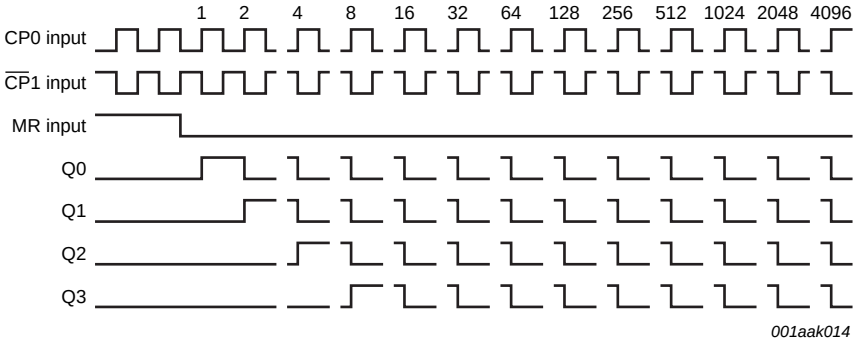

Fig 2. Timing diagram

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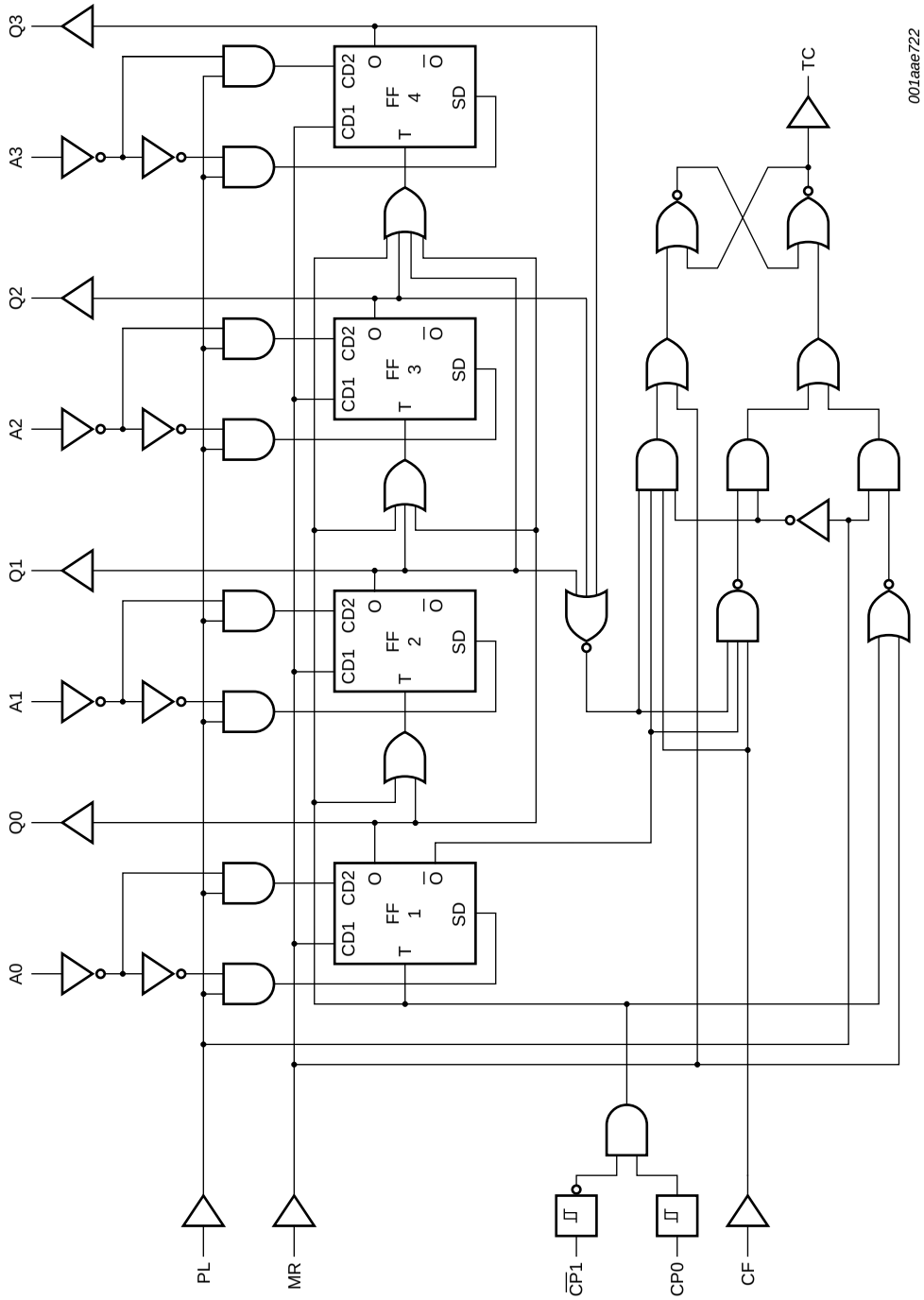

Fig 3. Logic diagram

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5. Pinning information

5.1 Pinning

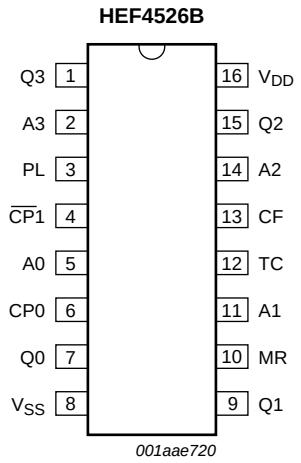

Fig 4. Pin configuration

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
A0 to A3	5, 11, 14, 2	parallel input
PL	3	parallel load input
CP0	6	clock input (LOW-to-HIGH, triggered)
$\overline{CP1}$	4	clock input (HIGH-to-LOW, triggered)
CF	13	cascade feedback input
MR	10	asynchronous master reset input
TC	12	terminal count output
Q0 to Q3	7, 9, 15, 1	buffered parallel output
V_{DD}	16	supply voltage
V_{SS}	8	ground (0 V)

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6. Functional description

Table 3. Function table[1]

MR	PL	CP0	$\overline{CP1}$	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

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; ↑ = positive-going transition; ↓ = negative-going transition.

Table 4. Counting mode

CF = HIGH; PL = LOW; MR = LOW.

Count	Outputs			
	Q3	Q2	Q1	Q0
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

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Table 5. Single stage operation

Divide-by-n; MR = LOW; CF = HIGH; $\overline{CP1}$ = LOW.

PL	A3	A2	A1	A0	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	

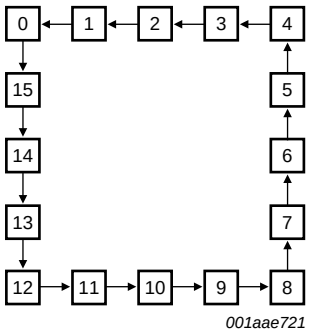

Fig 5. State diagram

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7. Limiting values

Table 6. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{DD}	supply voltage			−0.5	+18	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{DD} + 0.5$ V		-	±10	mA
V_I	input voltage			−0.5	$V_{DD} + 0.5$	V
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{DD} + 0.5$ V		-	±10	mA
$I_{I/O}$	input/output current			-	±10	mA
I_{DD}	supply current	to any supply terminal		-	±100	mA
T_{stg}	storage temperature			−65	+150	°C
T_{amb}	ambient temperature			−40	+85	°C
P_{tot}	total power dissipation	DIP16 package	[1]	-	750	mW
		SO16 package	[2]	-	500	mW
P	power dissipation	per output		-	100	mW

[1] For DIP16 package: P_{tot} derates linearly with 12 mW/K above 70 °C.

[2] For SO16 package: P_{tot} derates linearly with 8 mW/K above 70 °C.

8. Recommended operating conditions

Table 7. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD}	supply voltage		3	-	15	V
V_I	input voltage		0	-	V_{DD}	V
T_{amb}	ambient temperature	in free air	−40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 5 V	-	-	3.75	µs/V
		V_{CC} = 10 V	-	-	0.5	µs/V
		V_{CC} = 15 V	-	-	0.08	µs/V

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9. Static characteristics

Table 8. Static characteristics

V_{SS} = 0 V; V_I = V_{SS} or V_{DD} unless otherwise specified.

Symbol	Parameter	Conditions	V_{DD}	T_{amb} = –40 °C		T_{amb} = 25 °C		T_{amb} = 85 °C		Unit
				Min	Max	Min	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$\|I_O\|$ < 1 μA	5 V	3.5	-	3.5	-	3.5	-	V
			10 V	7.0	-	7.0	-	7.0	-	V
			15 V	11.0	-	11.0	-	11.0	-	V
V_{IL}	LOW-level input voltage	$\|I_O\|$ < 1 μA	5 V	-	1.5	-	1.5	-	1.5	V
			10 V	-	3.0	-	3.0	-	3.0	V
			15 V	-	4.0	-	4.0	-	4.0	V
V_{OH}	HIGH-level output voltage	$\|I_O\|$ < 1 μA	5 V	4.95	-	4.95	-	4.95	-	V
			10 V	9.95	-	9.95	-	9.95	-	V
			15 V	14.95	-	14.95	-	14.95	-	V
V_{OL}	LOW-level output voltage	$\|I_O\|$ < 1 μA	5 V	-	0.05	-	0.05	-	0.05	V
			10 V	-	0.05	-	0.05	-	0.05	V
			15 V	-	0.05	-	0.05	-	0.05	V
I_{OL}	LOW-level output current	V_O = 0.4 V	5 V	0.52	-	0.44	-	0.36	-	mA
		V_O = 0.5 V	10 V	1.3	-	1.1	-	0.9	-	mA
		V_O = 1.5 V	15 V	3.6	-	3.0	-	2.4	-	mA
I_{OH}	HIGH-level output current	V_O = 2.5 V	5 V	-	–1.7	-	–1.4	-	–1.1	mA
		V_O = 4.6 V	5 V	-	–0.52	-	–0.44	-	–0.36	mA
		V_O = 9.5 V	10 V	-	–1.3	-	–1.1	-	–0.9	mA
		V_O = 13.5 V	15 V	-	–3.6	-	–3.0	-	–2.4	mA
I_I	input leakage current		15 V	-	±0.3	-	±0.3	-	±1.0	μA
I_{DD}	supply current	I_O = 0 A	5 V	-	20	-	20	-	150	μA
			10 V	-	40	-	40	-	300	μA
			15 V	-	80	-	80	-	600	μA
C_I	input capacitance		-	-	-	-	7.5	-	-	pF

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10. Dynamic characteristics

Table 9. Dynamic characteristics

V_{SS} = 0 V; T_{amb} = 25 °C; for test circuit see Figure 7; unless otherwise specified.

Symbol	Parameter	Conditions	V_{DD}		Extrapolation formula	Min	Typ	Max	Unit
t_{PHL}	HIGH to LOW propagation delay	CP0, $\overline{CP1}$ to Qn; see Figure 6	5 V	[1]	123 ns + (0.55 ns/pF)C_L	-	150	300	ns
			10 V		54 ns + (0.23 ns/pF)C_L	-	65	130	ns
			15 V		42 ns + (0.16 ns/pF)C_L	-	50	100	ns
		CP0, $\overline{CP1}$ to TC; see Figure 6	5 V		183 ns + (0.55 ns/pF)C_L	-	210	420	ns
			10 V		79 ns + (0.23 ns/pF)C_L	-	90	180	ns
			15 V		62 ns + (0.16 ns/pF)C_L	-	70	140	ns
		PL to Qn; see Figure 6	5 V		173 ns + (0.55 ns/pF)C_L	-	200	400	ns
			10 V		69 ns + (0.23 ns/pF)C_L	-	80	160	ns
			15 V		52 ns + (0.16 ns/pF)C_L	-	60	120	ns
		MR to Qn	5 V		113 ns + (0.55 ns/pF)C_L	-	140	280	ns
			10 V		44 ns + (0.23 ns/pF)C_L	-	55	110	ns
			15 V		32 ns + (0.16 ns/pF)C_L	-	40	80	ns
t_{PLH}	LOW to HIGH propagation delay	CP0, $\overline{CP1}$ to Qn; see Figure 6	5 V	[1]	123 ns + (0.55 ns/pF)C_L	-	150	300	ns
			10 V		54 ns + (0.23 ns/pF)C_L	-	65	130	ns
			15 V		42 ns + (0.16 ns/pF)C_L	-	50	100	ns
		CP0, $\overline{CP1}$ to TC; see Figure 6	5 V		183 ns + (0.55 ns/pF)C_L	-	210	420	ns
			10 V		79 ns + (0.23 ns/pF)C_L	-	90	180	ns
			15 V		62 ns + (0.16 ns/pF)C_L	-	70	140	ns
		PL to Qn; see Figure 6	5 V		153 ns + (0.55 ns/pF)C_L	-	180	360	ns
			10 V		59 ns + (0.23 ns/pF)C_L	-	70	140	ns
			15 V		42 ns + (0.16 ns/pF)C_L	-	50	100	ns
t_t	transition time	see Figure 6	5 V	[1]	10 ns + (1.00 ns/pF)C_L	-	60	120	ns
			10 V		9 ns + (0.42 ns/pF)C_L	-	30	60	ns
			15 V		6 ns + (0.28 ns/pF)C_L	-	20	40	ns
t_{su}	set-up time	An to PL; see Figure 6	5 V			30	0	-	ns
			10 V			20	0	-	ns
			15 V			15	0	-	ns
t_h	hold time	An to PL; see Figure 6	5 V			30	5	-	ns
			10 V			20	5	-	ns
			15 V			15	5	-	ns

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Table 9. Dynamic characteristics *...continued*

V_{SS} = 0 V; T_{amb} = 25 °C; for test circuit see Figure 7; unless otherwise specified.

Symbol	Parameter	Conditions	V_{DD}	Extrapolation formula	Min	Typ	Max	Unit
t_W	pulse width	CP0 input; LOW; see Figure 6	5 V		80	40	-	ns
			10 V		40	20	-	ns
			15 V		30	15	-	ns
		$\overline{CP1}$ input; HIGH; see Figure 6	5 V		80	40	-	ns
			10 V		40	20	-	ns
			15 V		30	15	-	ns
		PL input; HIGH; see Figure 6	5 V		100	50	-	ns
			10 V		40	20	-	ns
			15 V		32	16	-	ns
		MR input; LOW	5 V		130	65	-	ns
			10 V		50	25	-	ns
			15 V		40	20	-	ns
f_{max}	maximum frequency	PL = LOW; see Figure 6	5 V	[2]	6	12	-	MHz
			10 V		12	25	-	MHz
			15 V		16	32	-	MHz

[1] The typical values of the propagation delay and transition times are calculated from the extrapolation formulas shown (C_L in pF).

[2] In the divide-by-n mode (PL connected to TC), the CP0 or $\overline{CP1}$ pulse width must be greater than the maximum HIGH to LOW propagation delay for CP0 or $\overline{CP1}$ to TC.

Table 10. Dynamic power dissipation P_D

P_D can be calculated from the formulas shown. V_{SS} = 0 V; $t_r = t_f \leq 20$ ns; T_{amb} = 25 °C.

Symbol	Parameter	V_{DD}	Typical formula for P_D (µW)	where:
P_D	dynamic power dissipation	5 V	$P_D = 1000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_i = input frequency in MHz,
		10 V	$P_D = 4000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	f_o = output frequency in MHz,
		15 V	$P_D = 10000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	C_L = output load capacitance in pF,
				V_{DD} = supply voltage in V,
				$\Sigma(f_o \times C_L)$ = sum of the outputs.

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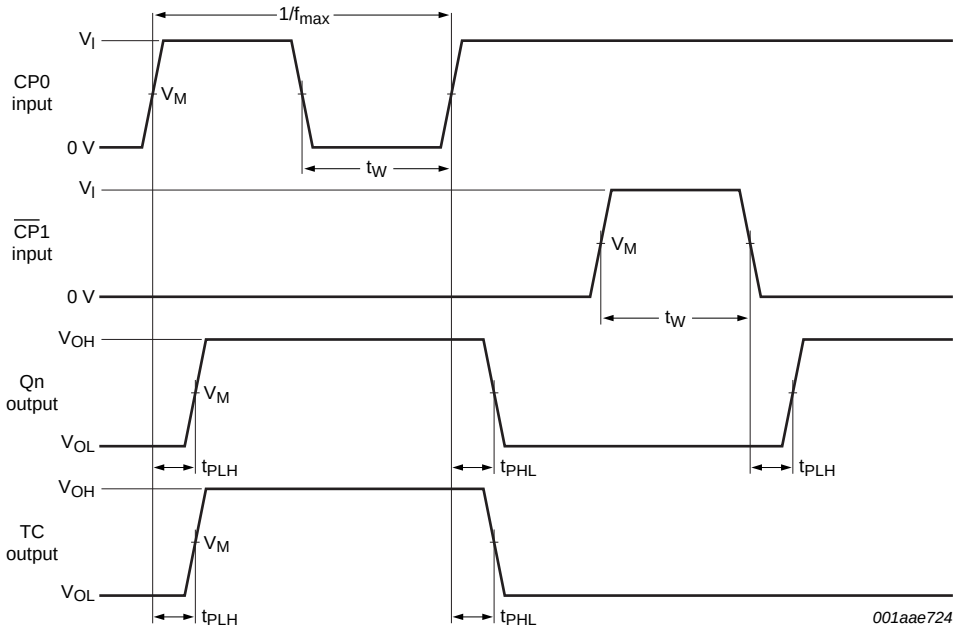
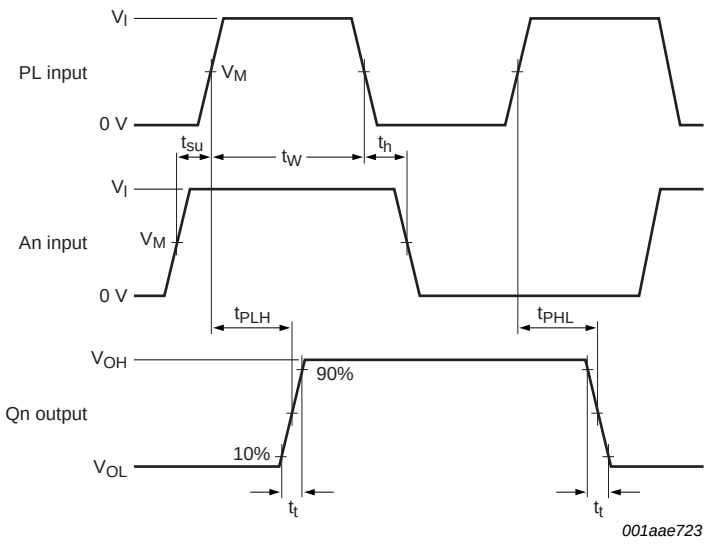
11. Waveforms



a. Propagation delays for CP0, $\overline{CP}1$ to Qn, and TC, minimum CP0 and $\overline{CP}1$ pulse widths and maximum frequency



b. Propagation delays for PL and An to Qn, setup and hold times for PL to An, Qn transition times and minimum PL pulse width

Measurement points are given in Table 11.

The logic levels V_{OH} and V_{OL} are typical output voltage levels that occur with the output load.

Fig 6. Waveforms showing switching times

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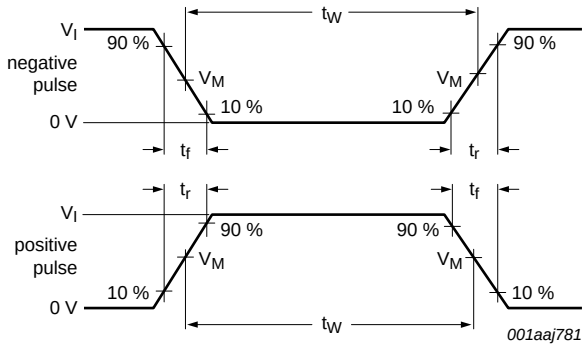
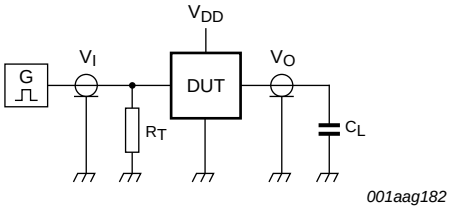


a. Input waveforms



b. Test circuit

Test data is given in Table 11;

Definitions for test circuit:

DUT = Device Under Test;

C_L = Load capacitance, including jig and probe capacitance;

R_L = Load resistance;

R_T = Termination resistance, should be equal to the output impedance Z_o of the pulse generator.

Fig 7. Test circuit for switching times

Table 11. Measurement points and test data

Supply voltage	Input			Load	
	V_I	V_M	t_r, t_f	C_L	R_L
5 V to 15 V	V_{DD}	$0.5V_I$	≤ 20 ns	50 pF	1 kΩ

12. Application information

Some examples of HEF4526B applications are:

- Divide-by-n counter
- Programmable frequency divider

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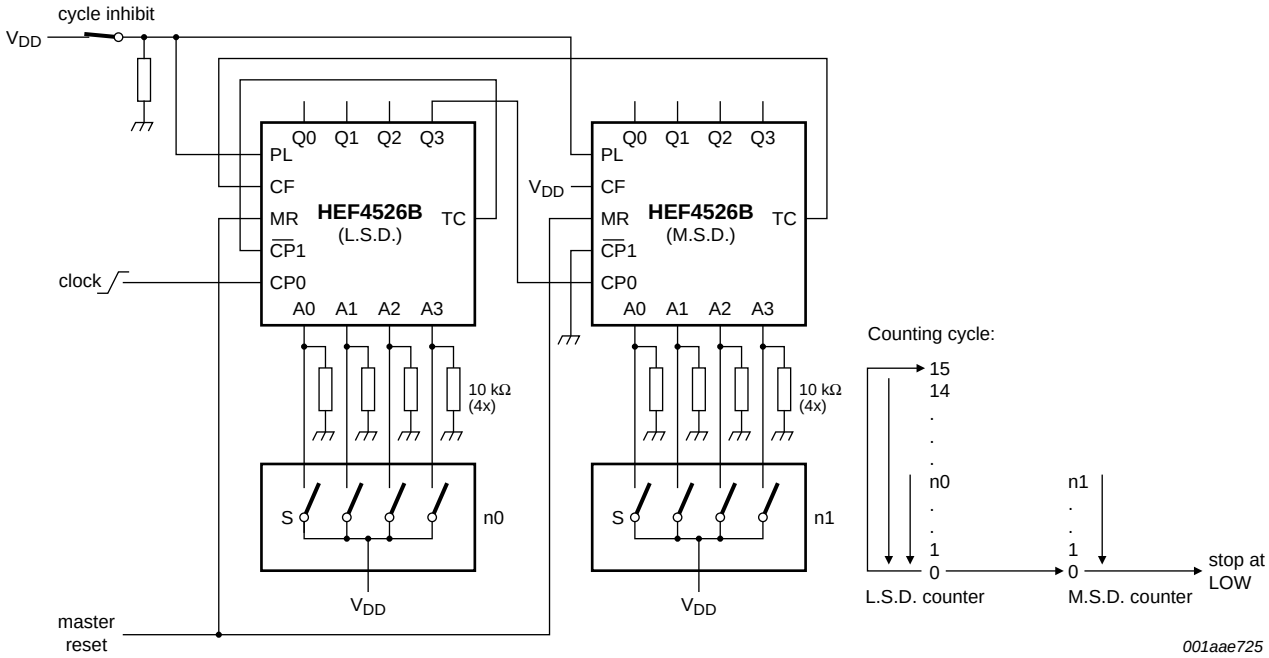
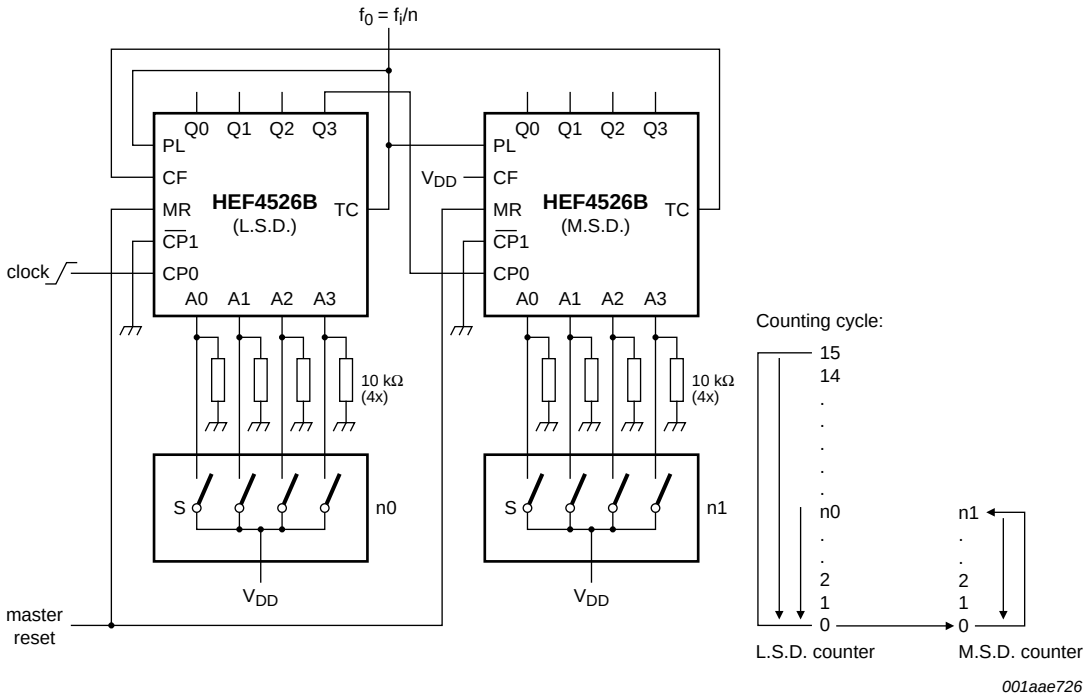


L.S.D. = Least Significant Digit; M.S.D. = Most Significant Digit.

Fig 8. Typical 2-stage programmable down counter (one cycle) application.



L.S.D. = Least Significant Digit; M.S.D. = Most Significant Digit.

Fig 9. Typical 2-stage programmable frequency divider application

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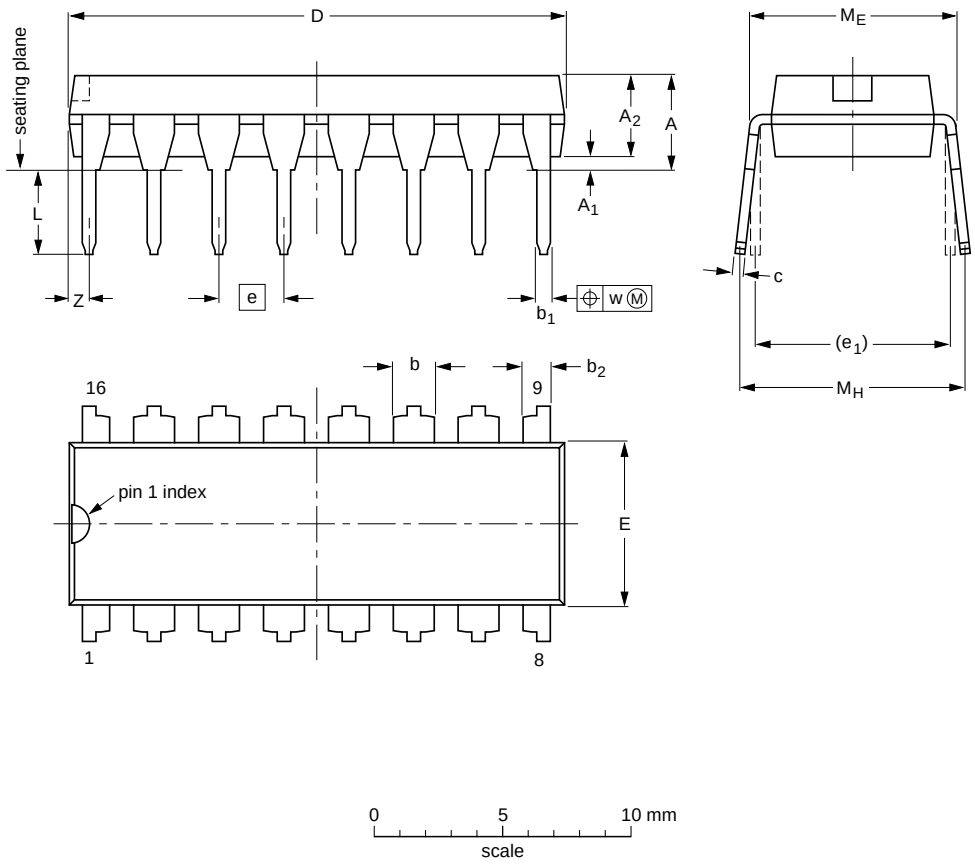
13. Package outline

DIP16: plastic dual in-line package; 16 leads (300 mil) **SOT38-4**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.02	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.03

Note

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT38-4						~~95-01-14~~ 03-02-13

Fig 10. Package outline SOT38-4 (DIP16)

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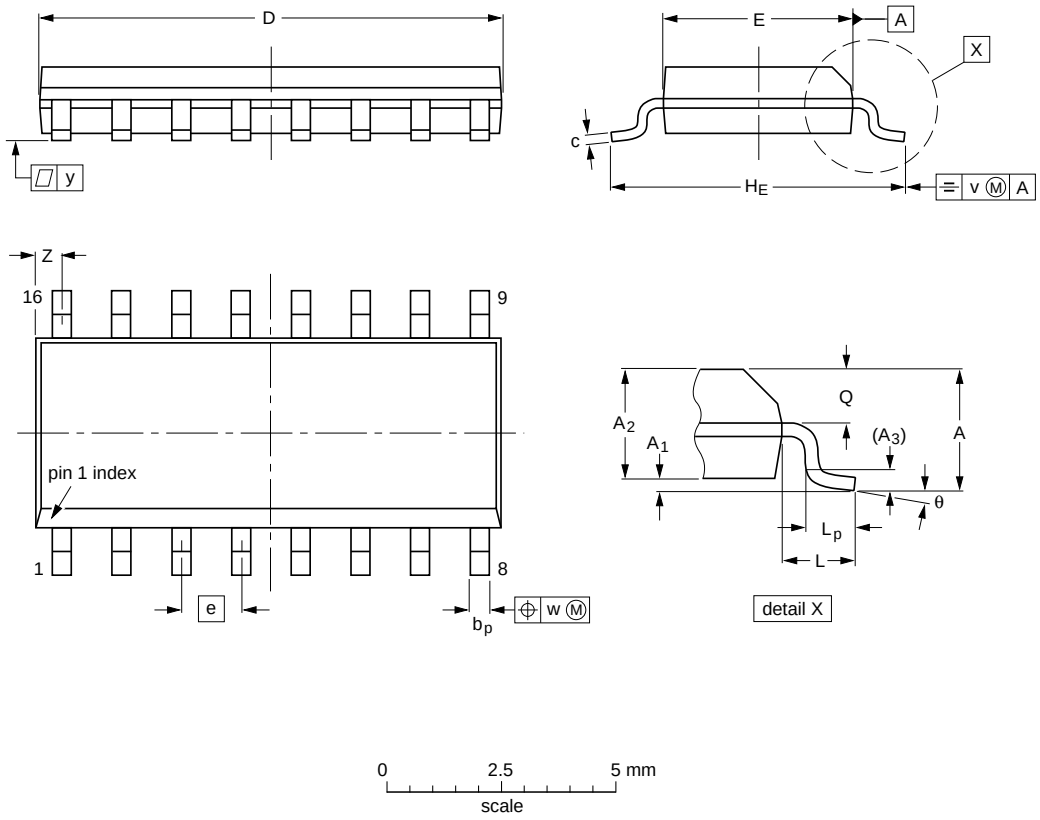
SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8^o 0^o
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT109-1	076E07	MS-012				~~99-12-27~~ 03-02-19

Fig 11. Package outline SOT109-1 (SO16)

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14. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4526B v.5	20111122	Product data sheet	-	HEF4526B v.4
Modifications:	• Section Applications removed • Table 8: I_{OH} minimum values changed to maximum			
HEF4526B v.4	20090921	Product data sheet	-	HEF4526B_CNV v.3
HEF4526B_CNV v.3	19950101	Product specification	-	HEF4526B_CNV v.2
HEF4526B_CNV v.2	19950101	Product specification	-	-

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15.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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