

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

HEF4737B

HEF4737V

LSI

Quadruple static decade counters

Product specification
File under Integrated Circuits, IC04

January 1995

Quadruple static decade counters

HEF4737B
HEF4737V

DESCRIPTION

The HEF4737B and HEF4737V are static quadruple decade counters for frequencies from 0 to 10 MHz. The counters are supplied with an extra overload flip-flop giving a total count capability of 19 999. The counter has the following inputs and outputs: a count input (CP), an asynchronous reset input (MR), an asynchronous preset input (PL), a transfer input (T), an output enable input (EO) (which controls the BCD outputs), the digit select inputs (S_A, S_B, S_C) (which perform selection of the contents of the latches to the 3-state BCD outputs (O_0 to O_3)), and the carry outputs (CO_2 to CO_5) (which give the carry signals of the decades except from the first decade).

The complementary MOS structure gives the devices very low stand-by and operating dissipation. Operating from a single supply voltage all outputs can drive one standard TTL input without interface circuitry under all specified operating conditions.

The BCD digit outputs are LOCMOS 3-state outputs. The high impedance off-state feature allows common bussing of the outputs. The counters are supplied with asynchronous reset and preset to 19 999 facilities making them suitable for counter and time base applications. All carry signals are available except from the first decade.

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

Recommended supply voltage range for HEF4737B is 3 to 15 V and for HEF4737V is 4,5 to 12,5 V.

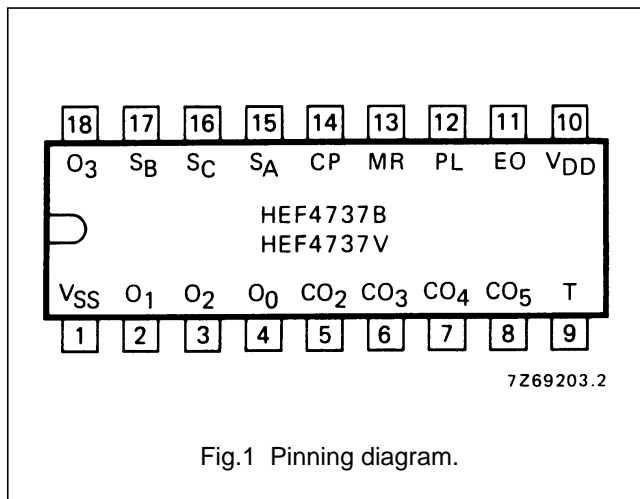


Fig.1 Pinning diagram.

HEF4737BP; HEF4737VP(N); 18-lead DIL plastic (SOT102-1)

HEF4737BD; HEF4737VD(F); 18-lead DIL ceramic (SOT133B)

(): Package Designator North America

SUPPLY VOLTAGE

| | RATING | RECOMMENDED OPERATING | |
|-----------------|------------|-----------------------|---|
| HEF4737B | -0,5 to 18 | 3,0 to 15,0 | V |
| HEF4737V | -0,5 to 18 | 4,5 to 12,5 | V |

PINNING

- CP count input
- MR asynchronous reset input
- PL asynchronous preset input
- T transfer input
- S_A, S_B, S_C digit select inputs
- EO output enable input
- O_0 to O_3 BCD outputs
- CO_2 to CO_5 carry outputs

FAMILY DATA, I_{DD} LIMITS category LSI

See Family Specifications

Quadruple static decade counters

HEF4737B
HEF4737V

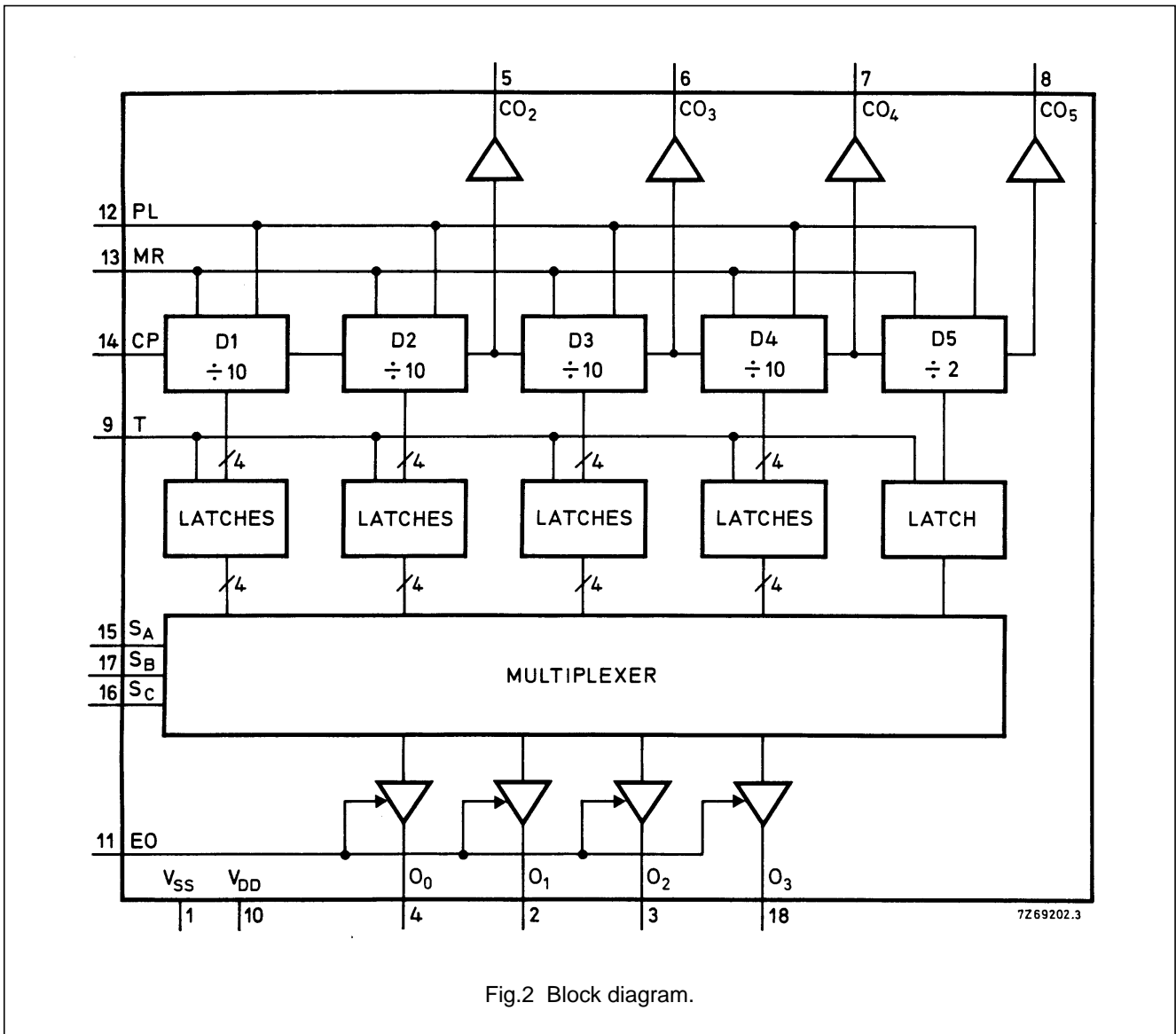


Fig.2 Block diagram.

FUNCTIONAL DESCRIPTION

Input signals

Count input (CP)

The signal to be counted is applied to this input. When PL and MR are LOW the contents of the counter increments by one at a LOW to HIGH transition of CP.

Reset input (MR)

This is an asynchronous reset. A HIGH level applied to this input will reset the counter to zero independent of the level at the count input and preset input.

Preset input (PL)

This is an asynchronous preset. When MR is LOW a HIGH at the PL input will preset the counter to 19 999 independent of the level at the count input.

Transfer input (T)

A HIGH level applied to this input allows the information held by the counter to pass to the latches.

Output enable input (EO)

A HIGH level at this input enables the BCD outputs and information can be read out of the latches using the

Quadruple static decade counters

HEF4737B
HEF4737V

multiplexer. A LOW level at this input disables the BCD outputs making them floating (high impedance off-state).

Digit select inputs (S_A , S_B , S_C)

| S_A | S_B | S_C | |
|-------|-------|-------|------------------|
| L | L | L | selects D1 (LSD) |
| H | L | L | selects D2 |
| L | H | L | selects D3 |
| H | H | L | selects D4 |
| X | X | H | selects D5 (MSD) |

Notes

1. H = HIGH state (the more positive voltage)
2. L = LOW state (the less positive voltage)
3. X = state is immaterial
4. When D5 is selected, the contents of D5 is available at O_0 and O_1 , O_2 and O_3 are LOW.
5. LSD = least significant divider
6. MSD = most significant divider

Output signals

The carry outputs are active LOW outputs.

Carry output CO_2

When the contents of the first two decades of the counter are both 9 then the CO_2 output becomes LOW. It remains LOW until the next LOW to HIGH transition of the count input, i.e. until the contents of the first two decades are zero. CO_2 is LOW when the contents of the counter are: 00 099, 00 199, 00 299 etc.

Carry output CO_3

When the contents of the first three decades of the counter are all 9 then the CO_3 output becomes LOW. It remains LOW until the next LOW to HIGH transition of the count input, i.e. until the contents of the first three decades are zero. CO_3 is LOW when the contents of the counter are 00 999, 01 999, 02 999 etc.

Carry output CO_4

When the contents of the first four decades of the counter are all 9 then the CO_4 output becomes LOW. It remains LOW until the next LOW to HIGH transition of the count input, i.e. until the contents of the first four decades are zero. CO_4 is LOW when the contents of the counter are 09 999 and 19 999.

The carry signals CO_2 , CO_3 and CO_4 are suppressed while the preset is active. A HIGH to the preset input sets the counter to 19 999 but the carry signals remain HIGH until preset input returns to LOW, then the carry outputs will also become LOW.

Carry output CO_5

When the content of the counter is 10 000 the CO_5 output becomes LOW. It returns to HIGH when the content of the counter is zero.

Digit outputs (O_0 to O_3)

The digit outputs give the contents of the selected latch. The output is in the form of BCD, positive logic.

Quaduple static decade counters

HEF4737B
HEF4737V

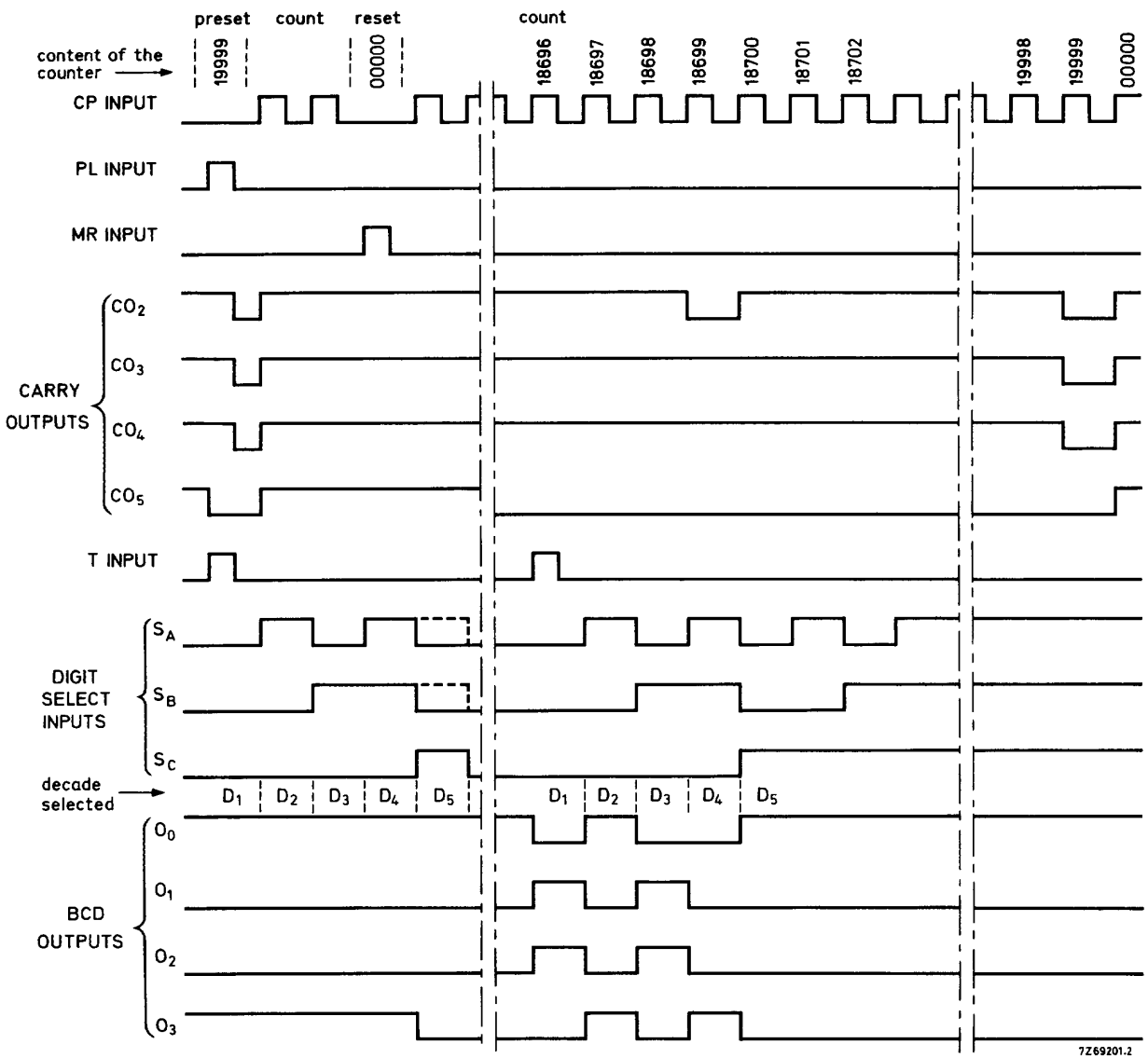


Fig.3 Timing diagram.

Quadruple static decade counters

HEF4737B
HEF4737V

The values given at $V_{DD} = 15\text{ V}$ in the following d.c. and a.c. characteristics, are not applicable to the HEF4737V, because of its reduced supply voltage range.

DC CHARACTERISTICS

$V_{SS} = 0\text{ V}$

| | V_{DD} V | V_{OH} V | V_{OL} V | SYMBOL | T_{amb} (°C) | | | | | | |
|--|---------------|---------------|---------------|--------------|----------------|------|------|------|------|------|---------------|
| | | | | | -40 | | + 25 | | + 85 | | |
| | | | | | MIN. | MAX. | MIN. | MAX. | MIN. | MAX. | |
| Input leakage current at $V_I = 0$ or V_{DD} | 10 | | | $\pm I_{IN}$ | - | - | - | 0,3 | - | 1 | μA |
| | 15 | | | | - | - | - | 0,3 | - | 1 | μA |
| Output (sink) current LOW | 4,75 | | 0,4 | I_{OL} | 1,6 | - | 1,6 | - | 1,4 | - | mA |
| | 10 | | 0,5 | | 2,5 | - | 2,3 | - | 1,7 | - | mA |
| | 15 | | 1,5 | | 7,0 | - | 6,0 | - | 4,0 | - | mA |
| Output (source) current HIGH | 5 | 4,6 | | $-I_{OH}$ | 0,96 | - | 0,80 | - | 0,65 | - | mA |
| | 10 | 9,5 | | | 2,4 | - | 2,0 | - | 1,6 | - | mA |
| | 15 | 13,5 | | | 7,0 | - | 6,0 | - | 4,5 | - | mA |
| Output (source) current HIGH | 5 | 2,5 | | $-I_{OH}$ | 3,0 | - | 2,5 | - | 2,0 | - | mA |
| 3-state output leakage current $V_O = 0$ or V_{DD} | 10 | | | $\pm I_{OZ}$ | - | 1,6 | - | 1,6 | - | 12 | μA |
| | 15 | | | | - | 1,6 | - | 1,6 | - | 12 | μA |

AC CHARACTERISTICS

$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ °C}$; $C_L = 15\text{ pF}$; input transition times $\leq 20\text{ ns}$

| | V_{DD} V | SYMBOL | MIN. | TYP. | MAX. | TYPICAL EXTRAPOLATION FORMULA | | |
|--|---------------|-----------|-----------|------|------|----------------------------------|-----------------------------|-----------------------------|
| Propagation delays CP \rightarrow O_n (D1 selected) HIGH to LOW | 5 | t_{PHL} | | 320 | 640 | ns | 308 ns + (0,24 ns/pF) C_L | |
| | 10 | | 120 | 240 | ns | 125 ns + (0,10 ns/pF) C_L | | |
| | 15 | | 90 | 180 | ns | 86 ns + (0,07 ns/pF) C_L | | |
| | LOW to HIGH | 5 | t_{PLH} | | 320 | 640 | ns | 296 ns + (0,48 ns/pF) C_L |
| | | 10 | | 120 | 240 | ns | 110 ns + (0,20 ns/pF) C_L | |
| | | 15 | | 90 | 180 | ns | 82 ns + (0,15 ns/pF) C_L | |
| CP \rightarrow O_n (D5 selected) HIGH to LOW | 5 | t_{PHL} | | 620 | 1240 | ns | 608 ns + (0,24 ns/pF) C_L | |
| | 10 | | 330 | 660 | ns | 325 ns + (0,10 ns/pF) C_L | | |
| | 15 | | 250 | 500 | ns | 246 ns + (0,07 ns/pF) C_L | | |
| | LOW to HIGH | 5 | t_{PLH} | | 620 | 1240 | ns | 596 ns + (0,48 ns/pF) C_L |
| | | 10 | | 330 | 660 | ns | 320 ns + (0,20 ns/pF) C_L | |
| | | 15 | | 250 | 500 | ns | 242 ns + (0,15 ns/pF) C_L | |

Quadruple static decade counters

HEF4737B HEF4737V

| | V _{DD} V | SYMBOL | MIN. | TYP. | MAX. | TYPICAL EXTRAPOLATION FORMULA | |
|---------------------------------|----------------------|------------------|------|------|------|----------------------------------|--------------------------------------|
| CP → CO ₂ | 5 | | | 220 | 440 | ns | 208 ns + (0,24 ns/pF) C _L |
| HIGH to LOW | 10 | t _{PHL} | | 110 | 220 | ns | 105 ns + (0,10 ns/pF) C _L |
| | 15 | | | 85 | 170 | ns | 81 ns + (0,07 ns/pF) C _L |
| LOW to HIGH | 5 | t _{PLH} | | 220 | 400 | ns | 196 ns + (0,48 ns/pF) C _L |
| | 10 | | | 110 | 220 | ns | 100 ns + (0,20 ns/pF) C _L |
| | 15 | | | 85 | 170 | ns | 77 ns + (0,15 ns/pF) C _L |
| Propagation delays | | | | | | | |
| CP → CO ₅ | 5 | | | 350 | 700 | ns | 338 ns + (0,24 ns/pF) C _L |
| HIGH to LOW | 10 | t _{PHL} | | 160 | 320 | ns | 155 ns + (0,10 ns/pF) C _L |
| | 15 | | | 120 | 240 | ns | 116 ns + (0,07 ns/pF) C _L |
| LOW to HIGH | 5 | t _{PLH} | | 350 | 700 | ns | 326 ns + (0,48 ns/pF) C _L |
| | 10 | | | 160 | 320 | ns | 150 ns + (0,20 ns/pF) C _L |
| | 15 | | | 120 | 240 | ns | 112 ns + (0,15 ns/pF) C _L |
| S _n → O _n | 5 | | | 200 | 400 | ns | 188 ns + (0,24 ns/pF) C _L |
| HIGH to LOW | 10 | t _{PHL} | | 80 | 160 | ns | 75 ns + (0,10 ns/pF) C _L |
| | 15 | | | 55 | 110 | ns | 51 ns + (0,07 ns/pF) C _L |
| LOW to HIGH | 5 | t _{PLH} | | 200 | 400 | ns | 176 ns + (0,48 ns/pF) C _L |
| | 10 | | | 80 | 160 | ns | 70 ns + (0,20 ns/pF) C _L |
| | 15 | | | 55 | 110 | ns | 47 ns + (0,15 ns/pF) C _L |
| T → O _n | 5 | | | 220 | 440 | ns | 208 ns + (0,24 ns/pF) C _L |
| HIGH to LOW | 10 | t _{PHL} | | 90 | 180 | ns | 85 ns + (0,10 ns/pF) C _L |
| | 15 | | | 60 | 120 | ns | 56 ns + (0,07 ns/pF) C _L |
| LOW to HIGH | 5 | t _{PLH} | | 220 | 440 | ns | 196 ns + (0,48 ns/pF) C _L |
| | 10 | | | 90 | 180 | ns | 80 ns + (0,20 ns/pF) C _L |
| | 15 | | | 60 | 120 | ns | 52 ns + (0,15 ns/pF) C _L |
| MR → O _n | 5 | | | 490 | 980 | ns | 478 ns + (0,24 ns/pF) C _L |
| HIGH to LOW | 10 | t _{PHL} | | 200 | 400 | ns | 195 ns + (0,10 ns/pF) C _L |
| | 15 | | | 60 | 120 | ns | 56 ns + (0,07 ns/pF) C _L |
| PL → O _n | 5 | | | 260 | 520 | ns | 236 ns + (0,48 ns/pF) C _L |
| LOW to HIGH | 10 | t _{PLH} | | 110 | 220 | ns | 100 ns + (0,20 ns/pF) C _L |
| | 15 | | | 85 | 170 | ns | 77 ns + (0,15 ns/pF) C _L |
| MR → CO _n | 5 | | | 350 | 700 | ns | 326 ns + (0,48 ns/pF) C _L |
| LOW to HIGH | 10 | t _{PLH} | | 160 | 320 | ns | 150 ns + (0,20 ns/pF) C _L |
| | 15 | | | 120 | 240 | ns | 112 ns + (0,15 ns/pF) C _L |
| PL → CO _n | 5 | | | 350 | 700 | ns | 338 ns + (0,24 ns/pF) C _L |
| HIGH to LOW | 10 | t _{PHL} | | 160 | 320 | ns | 155 ns + (0,10 ns/pF) C _L |
| | 15 | | | 120 | 240 | ns | 116 ns + (0,07 ns/pF) C _L |

Quadruple static decade counters

HEF4737B
HEF4737V

| | V _{DD} V | SYMBOL | MIN. | TYP. | MAX. | TYPICAL EXTRAPOLATION FORMULA | |
|--|----------------------|-------------------|------|------|------|----------------------------------|-------------------------------------|
| Output transition times; any output HIGH to LOW LOW to HIGH | 5 | t _{THL} | | 35 | 70 | ns | 15 ns + (0,40 ns/pF) C _L |
| | 10 | | | 18 | 36 | ns | 9 ns + (0,18 ns/pF) C _L |
| | 15 | | | 15 | 30 | ns | 8 ns + (0,13 ns/pF) C _L |
| | 5 | t _{TLH} | | 50 | 100 | ns | 15 ns + (0,70 ns/pF) C _L |
| | 10 | | | 30 | 60 | ns | 13 ns + (0,33 ns/pF) C _L |
| | 15 | | | 25 | 50 | ns | 13 ns + (0,23 ns/pF) C _L |
| 3-state propagation delays Output disable times EO → O _n HIGH LOW | 5 | t _{PHZ} | | 60 | 120 | ns | |
| | 10 | | | 35 | 70 | ns | |
| | 15 | | | 25 | 50 | ns | |
| | 5 | t _{PLZ} | | 60 | 120 | ns | |
| | 10 | | | 35 | 70 | ns | |
| | 15 | | | 25 | 50 | ns | |
| Output enable times EO → O _n HIGH LOW | 5 | t _{PZH} | | 90 | 180 | ns | |
| | 10 | | | 40 | 80 | ns | |
| | 15 | | | 30 | 60 | ns | |
| | 5 | t _{PZL} | | 90 | 180 | ns | |
| | 10 | | | 40 | 80 | ns | |
| | 15 | | | 30 | 60 | ns | |
| Maximum CP pulse width; LOW | 5 | t _{WCPL} | 160 | 80 | | ns | |
| | 10 | | 60 | 30 | | ns | |
| | 15 | | 50 | 25 | | ns | |
| Minimum MR pulse width; HIGH | 5 | t _{WMRH} | 100 | 50 | | ns | |
| | 10 | | 50 | 25 | | ns | |
| | 15 | | 40 | 20 | | ns | |
| Minimum PL pulse width; HIGH | 5 | t _{WPLH} | 120 | 60 | | ns | |
| | 10 | | 60 | 30 | | ns | |
| | 15 | | 50 | 25 | | ns | |
| Minimum T pulse width; HIGH | 5 | t _{WTH} | 100 | 50 | | ns | |
| | 10 | | 40 | 20 | | ns | |
| | 15 | | 36 | 18 | | ns | |
| Maximum clock pulse frequency | 5 | f _{max} | 3 | 6 | | MHz | |
| | 10 | | 8 | 16 | | MHz | |
| | 15 | | 10 | 20 | | MHz | |

 Quadruple static decade counters

 HEF4737B
 HEF4737V

| | V_{DD} V | TYPICAL FORMULA FOR P (μ W) | |
|---|---------------|--|--|
| Dynamic power dissipation per package (P) | 5 | $950 f_i + \sum (f_o C_L) \times V_{DD}^2$ | 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 | $4\ 200 f_i + \sum (f_o C_L) \times V_{DD}^2$ | |
| | 15 | $11\ 200 f_i + \sum (f_o C_L) \times V_{DD}^2$ | |



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