

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

HEF4511B **MSI** BCD to 7-segment latch/decoder/driver

Product specification
File under Integrated Circuits, IC04

January 1995

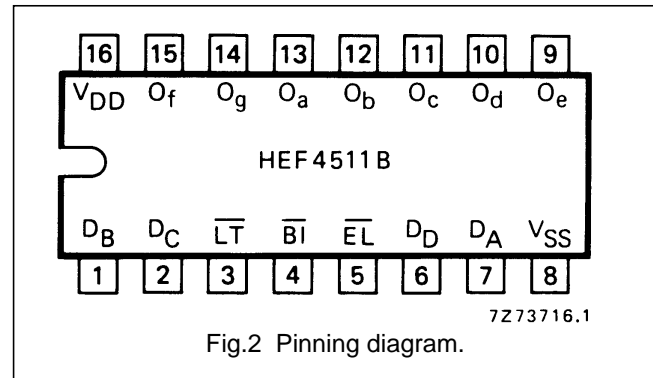
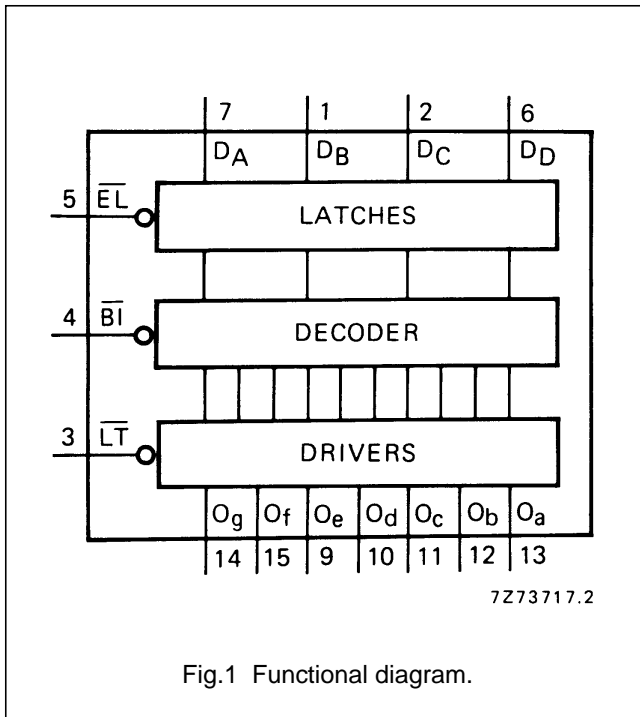
BCD to 7-segment latch/decoder/driver

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DESCRIPTION

The HEF4511B is a BCD to 7-segment latch/decoder/driver with four address inputs (D_A to D_D), an active LOW latch enable input (\overline{EL}), an active LOW ripple blanking input (\overline{BI}), an active LOW lamp test input (\overline{LT}), and seven active HIGH n-p-n bipolar transistor segment outputs (O_a to O_g).

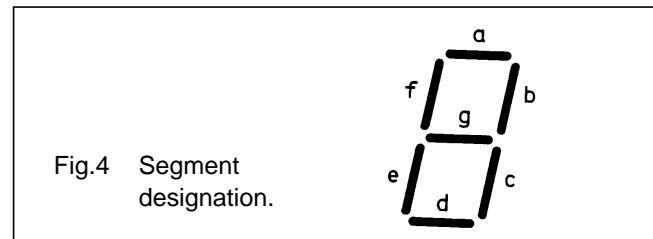
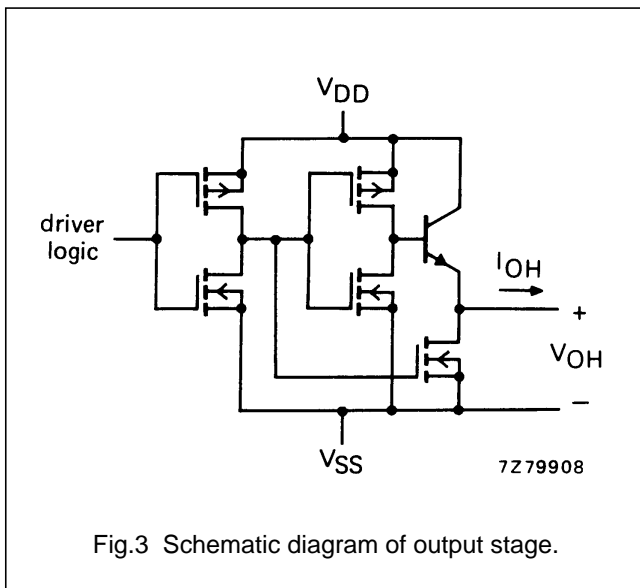
When \overline{EL} is LOW, the state of the segment outputs (O_a to O_g) is determined by the data on D_A to D_D . When \overline{EL} goes HIGH, the last data present on D_A to D_D are stored in the latches and the segment outputs remain stable. When \overline{LT} is LOW, all the segment outputs are HIGH independent of all other input conditions. With \overline{LT} HIGH, a LOW on \overline{BI} forces all segment outputs LOW. The inputs \overline{LT} and \overline{BI} do not affect the latch circuit.



- HEF4511BP(N): 16-lead DIL; plastic (SOT38-1)
- HEF4511BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
- HEF4511BT(D): 16-lead SO; plastic (SOT109-1)
- (): Package Designator North America

PINNING

- D_A to D_D address (data) inputs
- \overline{EL} latch enable input (active LOW)
- \overline{BI} ripple blanking input (active LOW)
- \overline{LT} lamp test input (active LOW)
- O_a to O_g segment outputs



FAMILY DATA, I_{DD} LIMITS category MSI

See Family Specifications

BCD to 7-segment latch/decoder/driver

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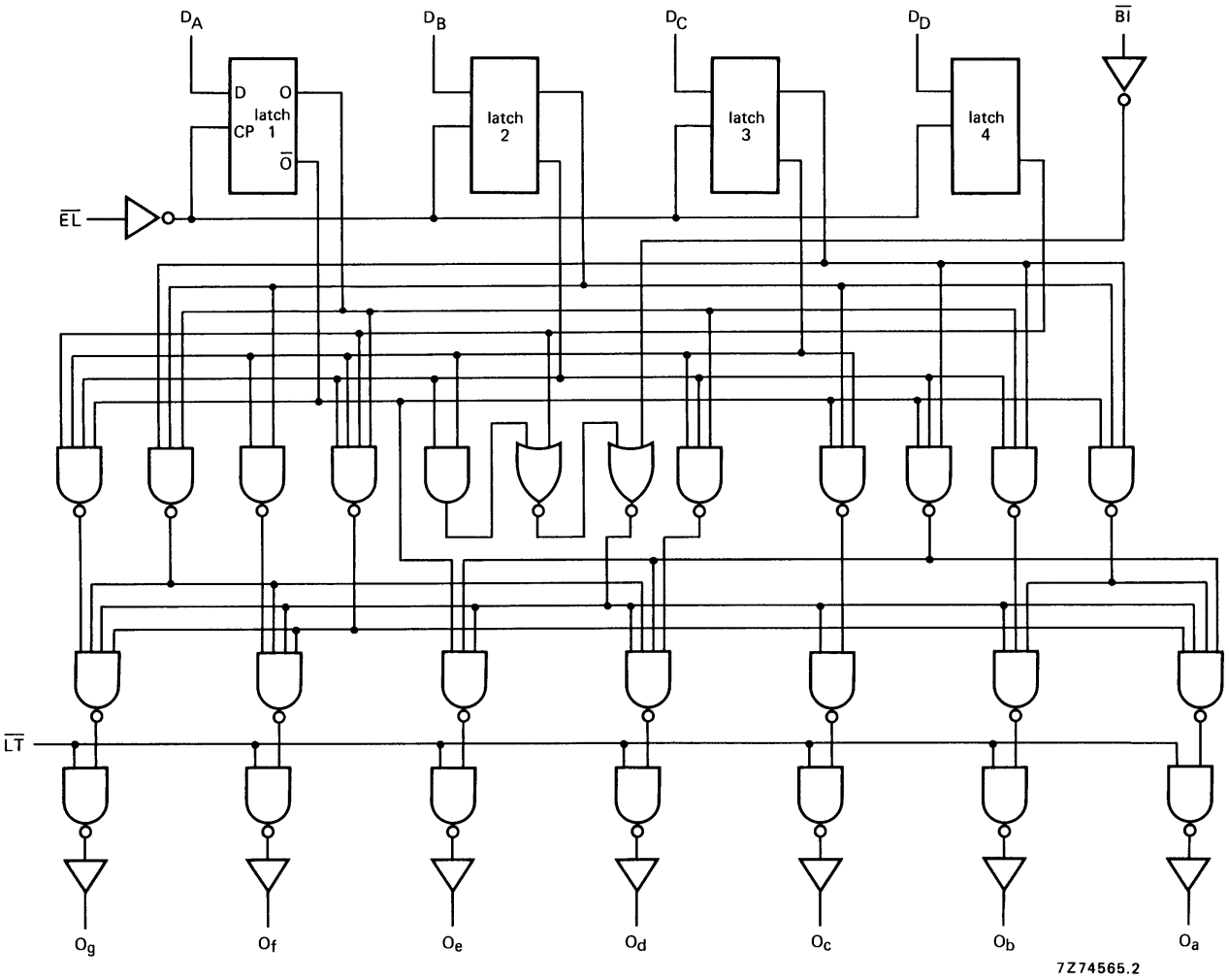


Fig.5 Logic diagram; for one latch see Fig.6.

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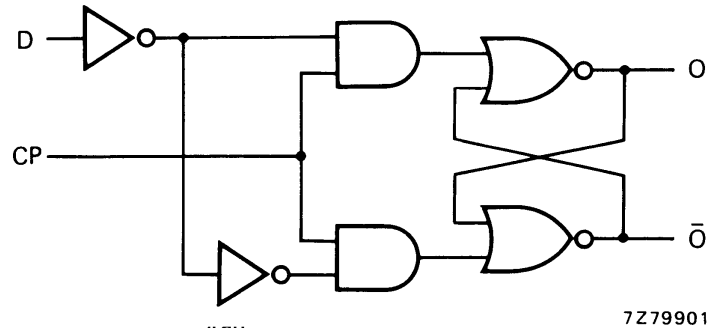


Fig.6 Logic diagram (one latch); see also Fig.5.

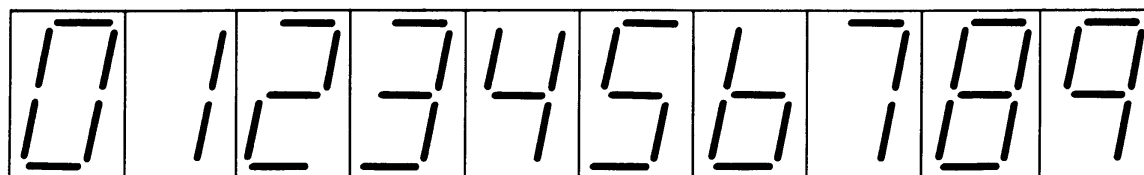
FUNCTION TABLE

| INPUTS | | | | | | | OUTPUTS | | | | | | | |
|-----------------|-----------------|-----------------|-------|-------|-------|-------|---------|-------|-------|-------|-------|-------|-------|---------|
| \overline{EL} | \overline{BI} | \overline{LT} | D_D | D_C | D_B | D_A | O_a | O_b | O_c | O_d | O_e | O_f | O_g | DISPLAY |
| X | X | L | X | X | X | X | H | H | H | H | H | H | H | 8 |
| X | L | H | X | X | X | X | L | L | L | L | L | L | L | blank |
| L | H | H | L | L | L | L | H | H | H | H | H | H | L | 0 |
| L | H | H | L | L | L | H | L | H | H | L | L | L | L | 1 |
| L | H | H | L | L | H | L | H | H | L | H | H | L | H | 2 |
| L | H | H | L | L | H | H | H | H | H | H | L | L | H | 3 |
| L | H | H | L | H | L | L | L | H | H | L | L | H | H | 4 |
| L | H | H | L | H | L | H | H | L | H | H | L | H | H | 5 |
| L | H | H | L | H | H | L | L | L | H | H | H | H | H | 6 |
| L | H | H | L | H | H | H | H | H | H | L | L | L | L | 7 |
| L | H | H | H | L | L | L | H | H | H | H | H | H | H | 8 |
| L | H | H | H | L | L | H | H | H | H | L | L | H | H | 9 |
| L | H | H | H | L | H | L | L | L | L | L | L | L | L | blank |
| L | H | H | H | L | H | H | L | L | L | L | L | L | L | blank |
| L | H | H | H | H | L | L | L | L | L | L | L | L | L | blank |
| L | H | H | H | H | H | L | L | L | L | L | L | L | L | blank |
| L | H | H | H | H | H | H | L | L | L | L | L | L | L | blank |
| H | H | H | X | X | X | X | | | | * | | | | * |

Note

- H = HIGH state (the more positive voltage)
L = LOW state (the less positive voltage)
X = state is immaterial
* Depends upon the BCD code applied during the LOW to HIGH transition of \overline{EL} .

BCD to 7-segment latch/decoder/driver

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Fig.7 Display.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134).

Output (source) current HIGH $-I_{OH}$ max. 25 mA

For other RATINGS see Family Specifications.

Note

1. A destructive high current mode may occur if V_I and V_O are not constrained to the range $V_{SS} \leq V_I$ or $V_O \leq V_{DD}$.

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DC CHARACTERISTICS

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

| HEF | V_{DD} V | I_{OH} mA | SYMBOL | T_{amb} (°C) | | | | | |
|------------------------|---------------|----------------|----------|----------------|------|-------|-------|-------|------|
| | | | | -40 | | + 25 | | + 85 | |
| | | | | MIN. | MAX. | MIN. | TYP. | MIN. | MAX. |
| Output voltage HIGH | 5 | 0 | V_{OH} | 4,10 | | 4,10 | 4,40 | 4,10 | V |
| | 10 | 0 | | 9,10 | | 9,10 | 9,40 | 9,10 | V |
| | 15 | 0 | | 14,10 | | 14,10 | 14,40 | 14,10 | V |
| Output voltage HIGH | 5 | 5 | V_{OH} | | | | 4,20 | | V |
| | 10 | 5 | | | | | 9,20 | | V |
| | 15 | 5 | | | | | 14,20 | | V |
| Output voltage HIGH | 5 | 10 | V_{OH} | 3,60 | | 3,60 | 4,05 | 3,30 | V |
| | 10 | 10 | | 8,75 | | 8,75 | 9,10 | 8,45 | V |
| | 15 | 10 | | 13,75 | | 13,75 | 14,10 | 13,45 | V |
| Output voltage HIGH | 5 | 15 | V_{OH} | | | | 4,00 | | V |
| | 10 | 15 | | | | | 9,00 | | V |
| | 15 | 15 | | | | | 14,00 | | V |
| Output voltage HIGH | 5 | 20 | V_{OH} | 2,80 | | 2,80 | 3,80 | 2,50 | V |
| | 10 | 20 | | 8,10 | | 8,10 | 9,00 | 7,80 | V |
| | 15 | 20 | | 13,10 | | 13,10 | 14,00 | 12,80 | V |
| Output voltage HIGH | 5 | 25 | V_{OH} | | | | 3,70 | | V |
| | 10 | 25 | | | | | 8,90 | | V |
| | 15 | 25 | | | | | 14,00 | | V |

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| HEC | V _{DD} V | I _{OH} mA | SYMBOL | T _{amb} (°C) | | | | | |
|------------------------|----------------------|-----------------------|-----------------|-----------------------|------|-------|-------|-------|------|
| | | | | -55 | | + 25 | | + 125 | |
| | | | | MIN. | MAX. | MIN. | TYP. | MIN. | MAX. |
| Output voltage HIGH | 5 | 0 | V _{OH} | 4,10 | | 4,10 | 4,40 | 4,10 | V |
| | 10 | 0 | | 9,10 | | 9,10 | 9,90 | 9,10 | V |
| | 15 | 0 | | 14,10 | | 14,10 | 14,40 | 14,40 | V |
| Output voltage HIGH | 5 | 5 | V _{OH} | | | | 4,30 | | V |
| | 10 | 5 | | | | | 9,30 | | V |
| | 15 | 5 | | | | | 14,30 | | V |
| Output voltage HIGH | 5 | 10 | V _{OH} | 3,60 | | 3,60 | 4,25 | 3,20 | V |
| | 10 | 10 | | 8,75 | | 8,75 | 9,25 | 8,35 | V |
| | 15 | 10 | | 13,75 | | 13,75 | 14,25 | 13,35 | V |
| Output voltage HIGH | 5 | 15 | V _{OH} | | | | 4,20 | | V |
| | 10 | 15 | | | | | 9,20 | | V |
| | 15 | 15 | | | | | 14,20 | | V |
| Output voltage HIGH | 5 | 20 | V _{OH} | 2,80 | | 2,80 | 4,20 | 2,30 | V |
| | 10 | 20 | | 8,10 | | 8,10 | 9,20 | 7,60 | V |
| | 15 | 20 | | 13,10 | | 13,10 | 14,20 | 12,60 | V |
| Output voltage HIGH | 5 | 25 | V _{OH} | | | | 4,15 | | V |
| | 10 | 25 | | | | | 9,20 | | V |
| | 15 | 25 | | | | | 14,20 | | V |

AC CHARACTERISTICS

V_{SS} = 0 V; T_{amb} = 25 °C; input transition times ≤ 20 ns

| | V _{DD} V | TYPICAL FORMULA FOR P (μW) | |
|---|----------------------|---|---|
| Dynamic power dissipation per package (P) | 5 10 15 | 1 000 f _i + ∑ (f _o C _L) × V _{DD} ² 4 000 f _i + ∑ (f _o C _L) × V _{DD} ² 10 000 f _i + ∑ (f _o C _L) × V _{DD} ² | where f _i = input freq. (MHz) f _o = output freq. (MHz) C _L = load capacitance (pF) ∑ (f _o C _L) = sum of outputs V _{DD} = supply voltage (V) |

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AC CHARACTERISTICS

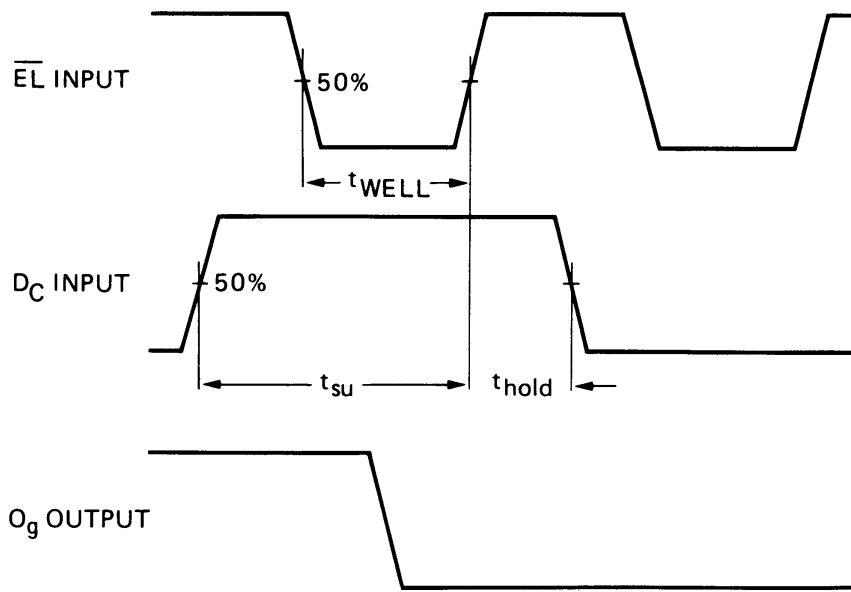
 $V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ °C}$; $C_L = 50\text{ pF}$; input transition times $\leq 20\text{ ns}$

| | V_{DD} V | SYMBOL | MIN. | TYP. | MAX. | TYPICAL EXTRAPOLATION FORMULA | | | | | | | | | | |
|--------------------|---------------|-----------|------|-----------|------|----------------------------------|---------------------------------|---------------------------------|-------------|----|-----|----------------------------|----------------------------|----|----|-----|
| Propagation delays | 5 | t_{PHL} | | 155 | 310 | ns | 128 ns + (0,55 ns/pF) C_L | | | | | | | | | |
| | | | | | | | | HIGH to LOW | 10 | 60 | 120 | ns | 49 ns + (0,23 ns/pF) C_L | | | |
| | | | | | | | | | | | | | | 15 | 40 | 80 |
| | 5 | | | t_{PLH} | | 135 | 270 | | | | | | | | | |
| | | | | | | | | LOW to HIGH | 10 | 55 | 110 | ns | 44 ns + (0,23 ns/pF) C_L | | | |
| | | | | | | | | | | | | | | 15 | 40 | 80 |
| | 5 | | | t_{PHL} | | 160 | 320 | | | | | | | | | |
| | | | | | | | | $\overline{EL} \rightarrow O_n$ | HIGH to LOW | 10 | 60 | 120 | ns | | | |
| | | | | | | | | | | | | | | 15 | 45 | 90 |
| | 5 | t_{PLH} | | 160 | 320 | ns | 133 ns + (0,55 ns/pF) C_L | | | | | | | | | |
| | | | | | | | | LOW to HIGH | 10 | 70 | 140 | ns | 59 ns + (0,23 ns/pF) C_L | | | |
| | | | | | | | | | | | | | | 15 | 50 | 100 |
| | 5 | t_{PHL} | | 120 | 240 | ns | 93 ns + (0,55 ns/pF) C_L | | | | | | | | | |
| | | | | | | | | $\overline{BI} \rightarrow O_n$ | HIGH to LOW | 10 | 50 | 100 | ns | | | |
| | | | | | | | | | | | | | | 15 | 35 | 70 |
| | 5 | t_{PLH} | | 105 | 210 | ns | 78 ns + (0,55 ns/pF) C_L | | | | | | | | | |
| | | | | | | | | $\overline{BI} \rightarrow O_n$ | LOW to HIGH | 10 | 40 | 80 | ns | | | |
| | | | | | | | | | | | | | | 15 | 30 | 60 |
| 5 | t_{PHL} | | 80 | 160 | ns | 52 ns + (0,55 ns/pF) C_L | | | | | | | | | | |
| | | | | | | | $\overline{LT} \rightarrow O_n$ | HIGH to LOW | 10 | 30 | 60 | ns | 19 ns + (0,23 ns/pF) C_L | | | |
| | | | | | | | | | | | | | | 15 | 20 | 40 |
| 5 | t_{PLH} | | 60 | 120 | ns | 33 ns + (0,55 ns/pF) C_L | | | | | | | | | | |
| | | | | | | | LOW to HIGH | 10 | 30 | 60 | ns | 19 ns + (0,23 ns/pF) C_L | | | | |
| | | | | | | | | | | | | | 15 | 25 | 50 | ns |
| 5 | t_{THL} | | 60 | 120 | ns | 10 ns + (1,0 ns/pF) C_L | | | | | | | | | | |
| | | | | | | | Output transition times | HIGH to LOW | 10 | 30 | 60 | ns | | | | |
| | | | | | | | | | | | | | 15 | 20 | 40 | ns |
| 5 | t_{TLH} | | 25 | 50 | ns | 20 ns + (1,0 ns/pF) C_L | | | | | | | | | | |
| | | | | | | | LOW to HIGH | 10 | 16 | 32 | ns | 13 ns + (0,06 ns/pF) C_L | | | | |
| | | | | | | | | | | | | | 15 | 13 | 26 | ns |

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| | V _{DD} V | SYMBOL | MIN. | TYP. | MAX. | TYPICAL EXTRAPOLATION FORMULA |
|--|----------------------|------------|------|------|------|----------------------------------|
| Minimum \overline{EL} pulse width; LOW | 5 | t_{WELL} | 80 | 40 | ns | see also waveforms Fig.8 |
| | 10 | | 40 | 20 | ns | |
| | 15 | | 35 | 17 | ns | |
| Set-up time $D_n \rightarrow \overline{EL}$ | 5 | t_{su} | 50 | 25 | ns | |
| | 10 | | 25 | 12 | ns | |
| | 15 | | 20 | 9 | ns | |
| Hold-time $D_n \rightarrow \overline{EL}$ | 5 | t_{hold} | 60 | 30 | ns | |
| | 10 | | 30 | 15 | ns | |
| | 15 | | 25 | 12 | ns | |



Conditions:
 $D_D = \text{LOW}$
 $D_A = D_B = \overline{B}_1 = \overline{LT} = \text{HIGH}$

Fig.8 Waveforms showing minimum \overline{EL} pulse width, set-up and hold time for D_C to \overline{EL} .

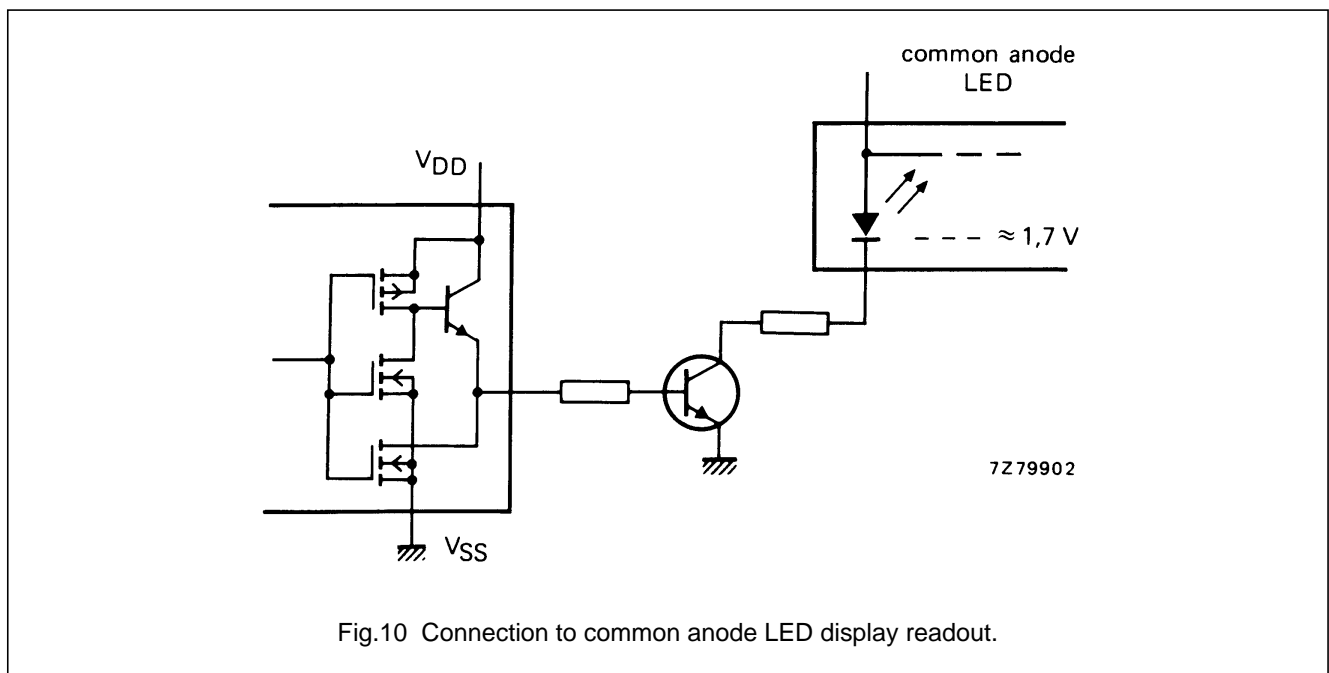
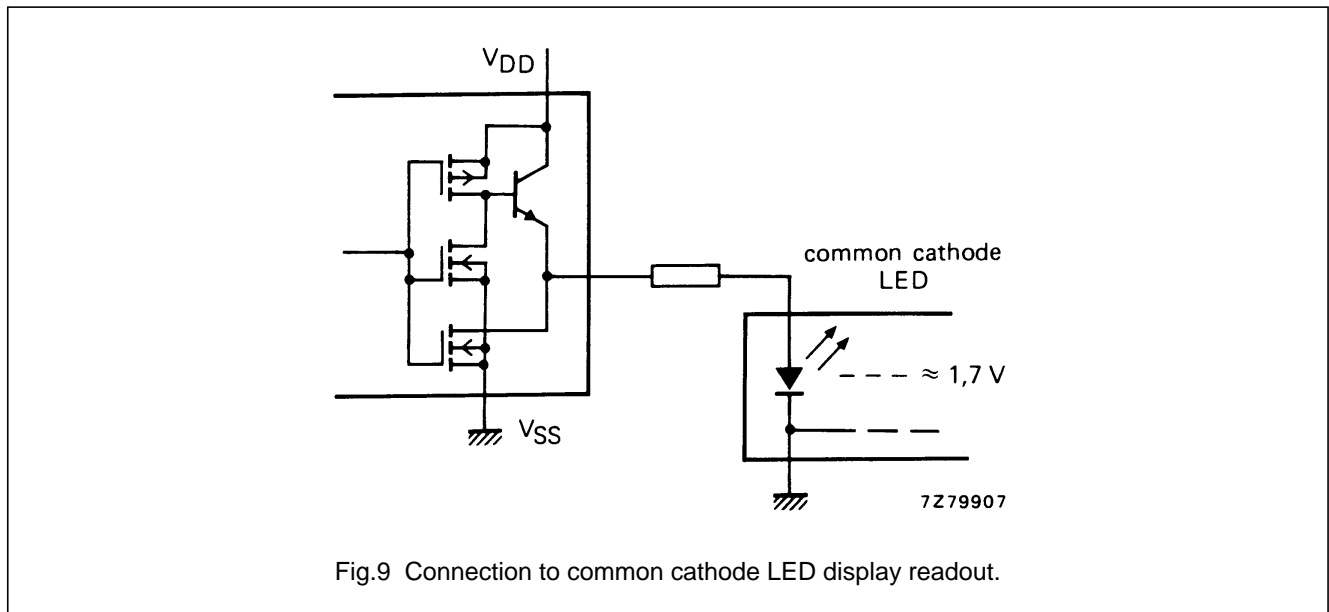
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APPLICATION INFORMATION

Some examples of applications for the HEF4511B are:

- Driving LED displays.
- Driving incandescent displays.
- Driving fluorescent displays.
- Driving LCD displays.
- Driving gas discharge displays.



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