

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

HEF4543B **MSI** BCD to 7-segment latch/decoder/driver

Product specification
File under Integrated Circuits, IC04

January 1995

BCD to 7-segment latch/decoder/driver

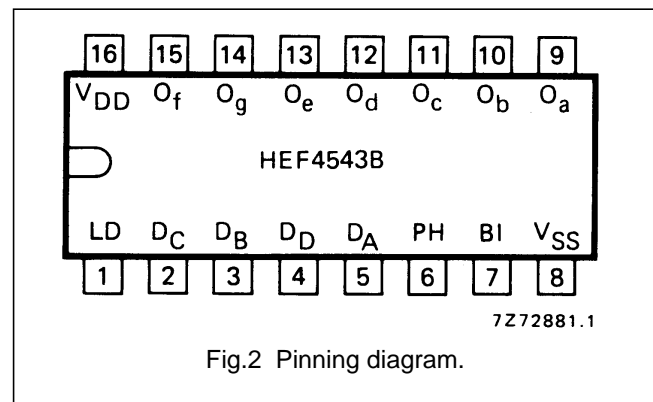
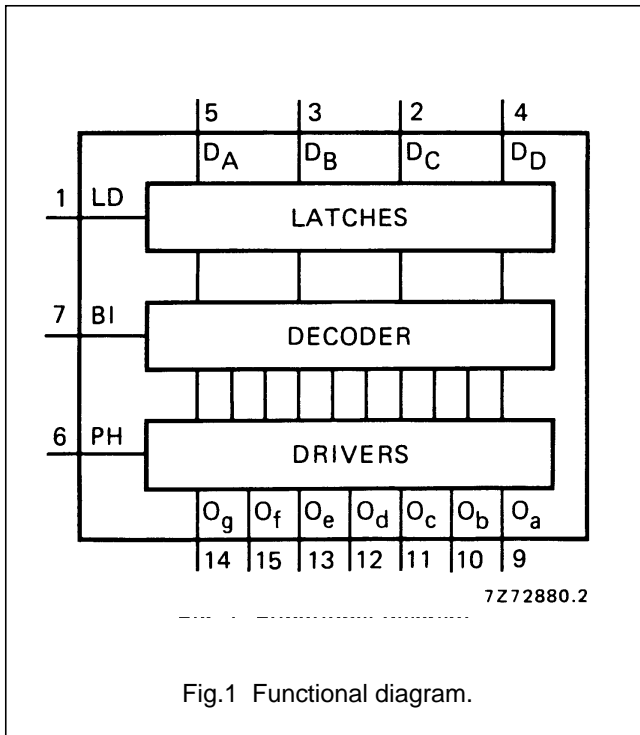
**HEF4543B
MSI**

DESCRIPTION

The HEF4543B is a BCD to 7-segment latch/decoder/driver for liquid crystal and LED displays. It has four address inputs (D_A to D_D), an active HIGH latch disable input (LD), an active HIGH blanking input (BI), an active HIGH phase input (PH) and seven buffered segment outputs (O_a to O_g).

The circuit provides the function of a 4-bit storage latch and an 8-4-2-1 BCD to 7-segment decoder/driver. It can invert the logic levels of the output combination. The phase (PH), blanking (BI) and latch disable (LD) inputs are used to reverse the function table phase, blank the display and store a BCD code, respectively.

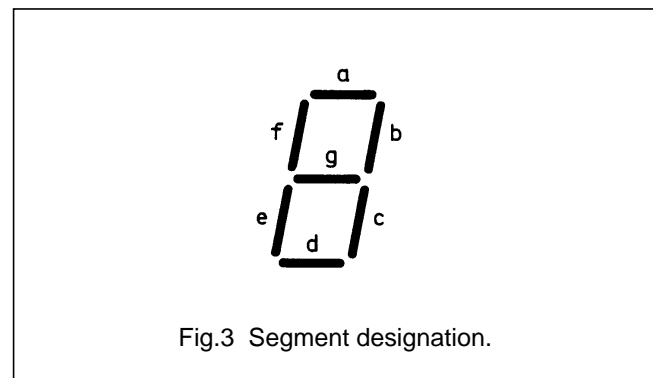
For liquid crystal displays a square-wave is applied to PH and the electrical common back-plane of the display. The outputs of the device are directly connected to the segments of the liquid crystal.



- HEF4543BP(N): 16-lead DIL; plastic (SOT38-1)
- HEF4543BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
- HEF4543BT(D): 16-lead SO; plastic (SOT109-1)
- (): Package Designator North America

PINNING

- D_A to D_D address (data) inputs
- PH phase input (active HIGH)
- BI blanking input (active HIGH)
- LD latch disable input (active HIGH)
- 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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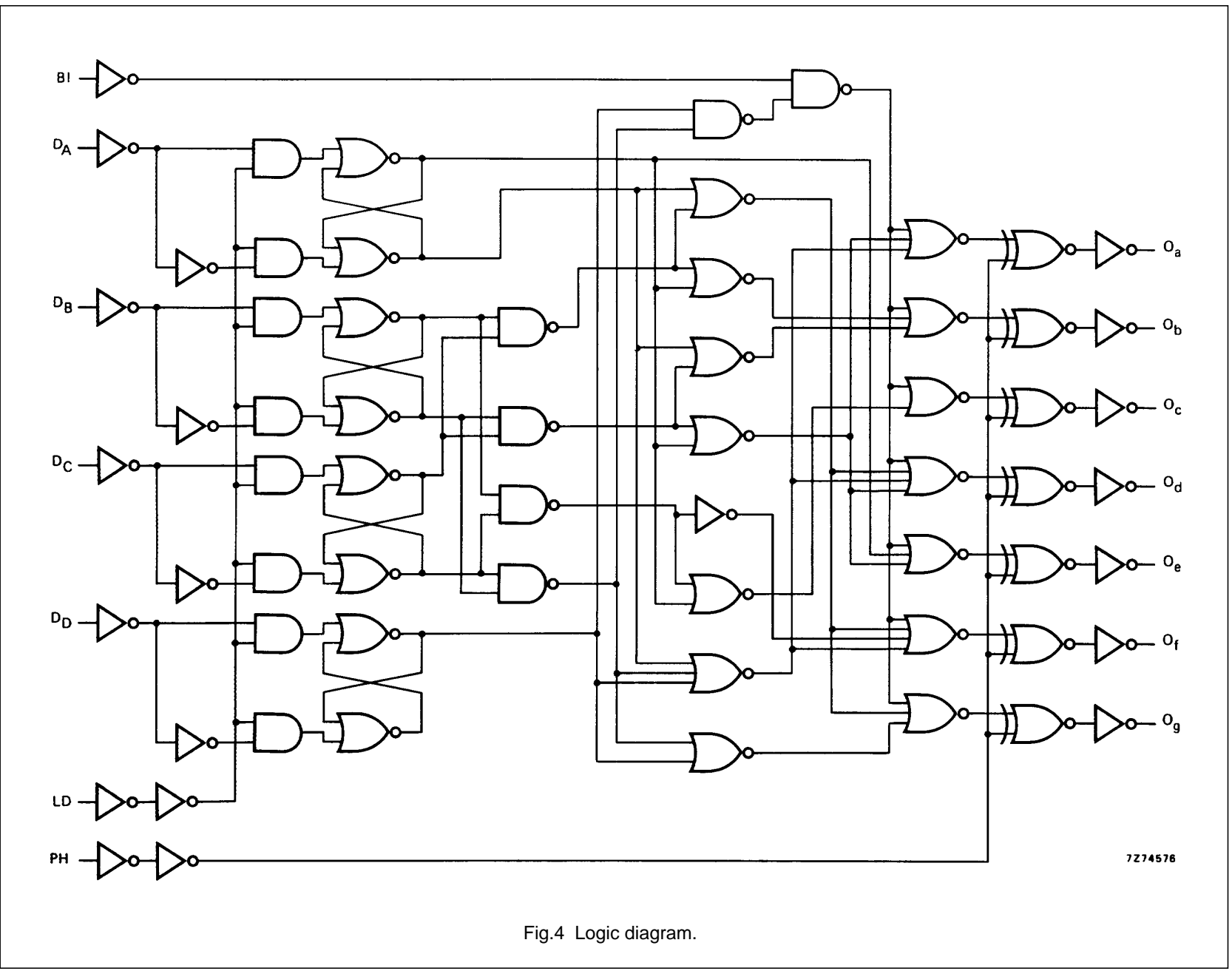


Fig.4 Logic diagram.

BCD to 7-segment latch/decoder/driver

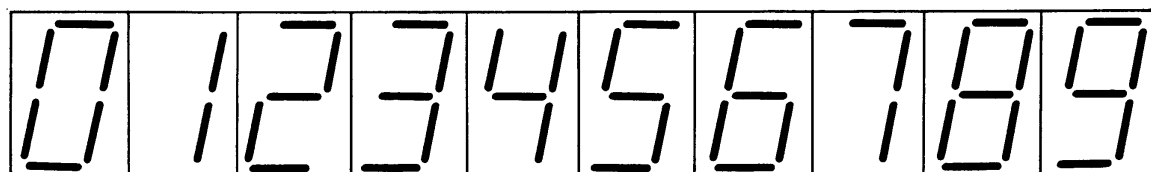
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FUNCTION TABLE

| INPUTS | | | | | | | OUTPUTS | | | | | | | |
|----------|----|-------------------|----------------|----------------|----------------|----------------|------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------|
| LD | BI | PH ⁽⁴⁾ | D _D | D _C | D _B | D _A | O _a | O _b | O _c | O _d | O _e | O _f | O _g | DISPLAY |
| X | H | L | X | X | X | X | L | L | L | L | L | L | L | blank |
| H | L | L | L | L | L | L | H | H | H | H | H | H | L | 0 |
| H | L | L | L | L | L | H | L | H | H | L | L | L | L | 1 |
| H | L | L | L | L | H | L | H | H | L | H | H | L | H | 2 |
| H | L | L | L | L | H | H | H | H | H | H | L | L | H | 3 |
| H | L | L | L | H | L | L | L | H | H | L | L | H | H | 4 |
| H | L | L | L | H | L | H | H | L | H | H | L | H | H | 5 |
| H | L | L | L | H | H | L | H | L | H | H | H | H | H | 6 |
| H | L | L | L | H | H | H | H | H | H | L | L | L | L | 7 |
| H | L | L | H | L | L | L | H | H | H | H | H | H | H | 8 |
| H | L | L | H | L | L | H | H | H | H | H | L | H | H | 9 |
| H | L | L | H | L | H | L | L | L | L | L | L | L | L | blank |
| H | L | L | H | L | H | H | L | L | L | L | L | L | L | blank |
| H | L | L | H | H | L | L | L | L | L | L | L | L | L | blank |
| H | L | L | H | H | H | H | L | L | L | L | L | L | L | blank |
| H | L | L | H | H | H | H | L | L | L | L | L | L | L | blank |
| L | L | L | X | X | X | X | (5) | | | | | | | (5) |
| as above | | H | as above | | | | inverse of above | | | | | | | as above |

Notes

1. H = HIGH state (the more positive voltage)
2. L = LOW state (the less positive voltage)
3. X = state is immaterial
4. For liquid crystal displays, apply a square-wave to PH.
For common cathode LED displays, select PH = LOW.
For common anode LED displays, select PH = HIGH.
5. Depends upon the BCD-code previously applied when LD = HIGH.



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Fig.5 Display.

BCD to 7-segment latch/decoder/driver

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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} | | 180 | 360 | ns | $153\text{ ns} + (0,55\text{ ns/pF}) C_L$ | | |
| | | | | HIGH to LOW | 75 | 150 | ns | $64\text{ ns} + (0,23\text{ ns/pF}) C_L$ | |
| | | | | | 55 | 110 | ns | $47\text{ ns} + (0,16\text{ ns/pF}) C_L$ | |
| | 5 | t_{PLH} | | 180 | 360 | ns | $153\text{ ns} + (0,55\text{ ns/pF}) C_L$ | | |
| | | | | LOW to HIGH | 75 | 150 | ns | $64\text{ ns} + (0,23\text{ ns/pF}) C_L$ | |
| | | | | | 55 | 110 | ns | $47\text{ ns} + (0,16\text{ ns/pF}) C_L$ | |
| | LD \rightarrow O_n | 5 | t_{PHL} | | 170 | 340 | ns | $143\text{ ns} + (0,55\text{ ns/pF}) C_L$ | |
| | | | | | HIGH to LOW | 80 | 160 | ns | $69\text{ ns} + (0,23\text{ ns/pF}) C_L$ |
| | | | | | | 60 | 120 | ns | $52\text{ ns} + (0,16\text{ ns/pF}) C_L$ |
| | | 5 | t_{PLH} | | 190 | 380 | ns | $163\text{ ns} + (0,55\text{ ns/pF}) C_L$ | |
| | | | | | LOW to HIGH | 80 | 160 | ns | $69\text{ ns} + (0,23\text{ ns/pF}) C_L$ |
| | | | | | | 60 | 120 | ns | $52\text{ ns} + (0,16\text{ ns/pF}) C_L$ |
| BI \rightarrow O_n | 5 | t_{PHL} | | 145 | 290 | ns | $118\text{ ns} + (0,55\text{ ns/pF}) C_L$ | | |
| | | | | HIGH to LOW | 65 | 130 | ns | $54\text{ ns} + (0,23\text{ ns/pF}) C_L$ | |
| | | | | | 45 | 90 | ns | $37\text{ ns} + (0,16\text{ ns/pF}) C_L$ | |
| | 5 | t_{PLH} | | 125 | 250 | ns | $98\text{ ns} + (0,55\text{ ns/pF}) C_L$ | | |
| | | | | LOW to HIGH | 55 | 110 | ns | $54\text{ ns} + (0,23\text{ ns/pF}) C_L$ | |
| | | | | | 40 | 80 | ns | $32\text{ ns} + (0,16\text{ ns/pF}) C_L$ | |
| Output transition times | 5 | t_{THL} | | 60 | 120 | ns | $10\text{ ns} + (1,0\text{ ns/pF}) C_L$ | | |
| | | | | HIGH to LOW | 30 | 60 | ns | $9\text{ ns} + (0,42\text{ ns/pF}) C_L$ | |
| | | | | | 20 | 40 | ns | $6\text{ ns} + (0,28\text{ ns/pF}) C_L$ | |
| | 5 | t_{TLH} | | 60 | 120 | ns | $10\text{ ns} + (1,0\text{ ns/pF}) C_L$ | | |
| | | | | LOW to HIGH | 30 | 60 | ns | $9\text{ ns} + (0,42\text{ ns/pF}) C_L$ | |
| | | | | | 20 | 40 | ns | $6\text{ ns} + (0,28\text{ ns/pF}) C_L$ | |
| Minimum LD pulse width; HIGH | 5 | t_{WLDH} | | 60 | 30 | ns | | | |
| | 10 | | | 30 | 15 | ns | | | |
| | 15 | | | 20 | 10 | ns | | | |
| Set-up time $D_n \rightarrow$ LD | 5 | t_{su} | | 40 | 20 | ns | | | |
| | 10 | | | 20 | 5 | ns | | | |
| | 15 | | | 15 | 0 | ns | | | |
| Hold time $D_n \rightarrow$ LD | 5 | t_{hold} | | 0 | -15 | ns | | | |
| | 10 | | | 15 | 0 | ns | | | |
| | 15 | | | 20 | 5 | ns | | | |

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| | V _{DD} V | TYPICAL FORMULA FOR P (μW) | |
|---|----------------------|---|---|
| Dynamic power dissipation per package (P) | 5 | $2\ 200\ f_i + \sum (f_o C_L) \times V_{DD}^2$ | where f _i = input freq. (MHz) f _o = output freq. (MHz) C _L = load capacitance (pF) ∑ (f _o C _L) = sum of outputs V _{DD} = supply voltage (V) |
| | 10 | $10\ 400\ f_i + \sum (f_o C_L) \times V_{DD}^2$ | |
| | 15 | $33\ 000\ f_i + \sum (f_o C_L) \times V_{DD}^2$ | |

APPLICATION INFORMATION

Some examples of applications for the HEF4543B are:

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

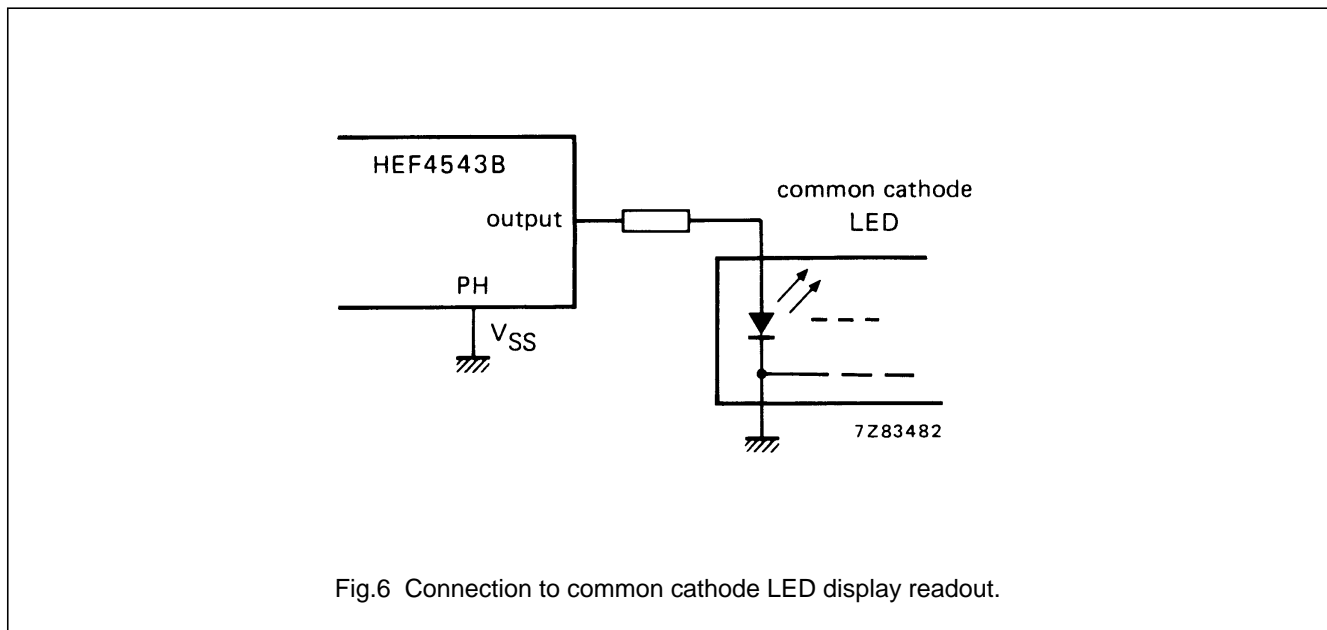
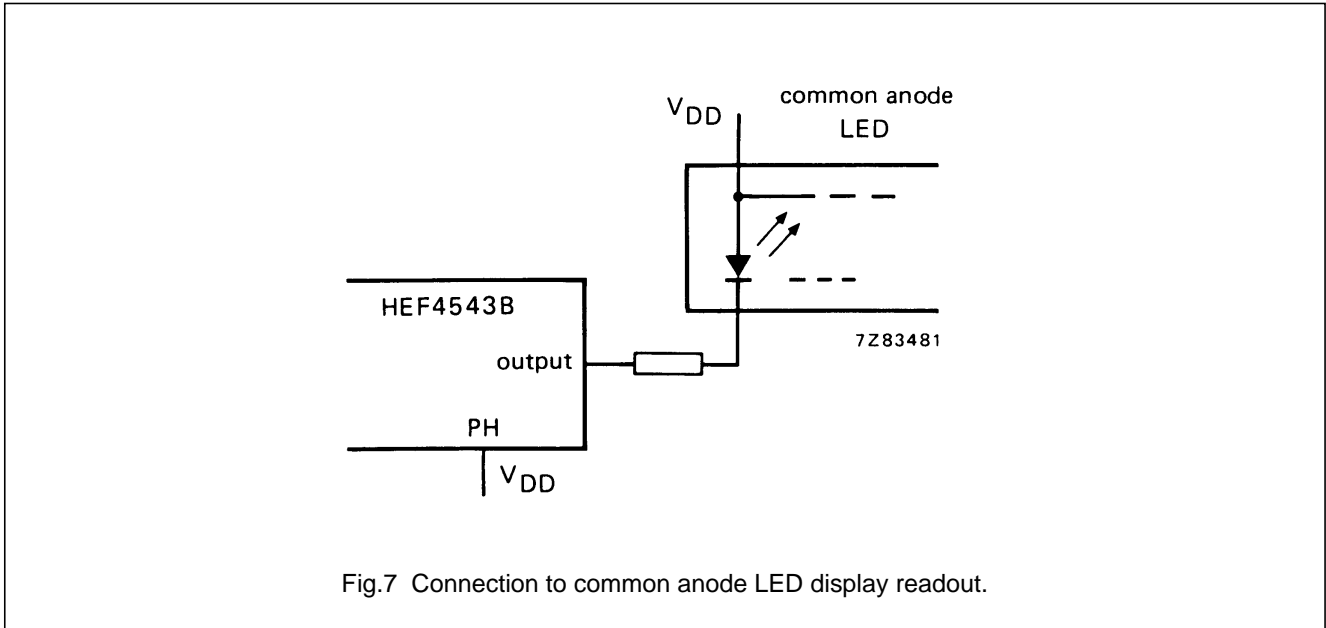


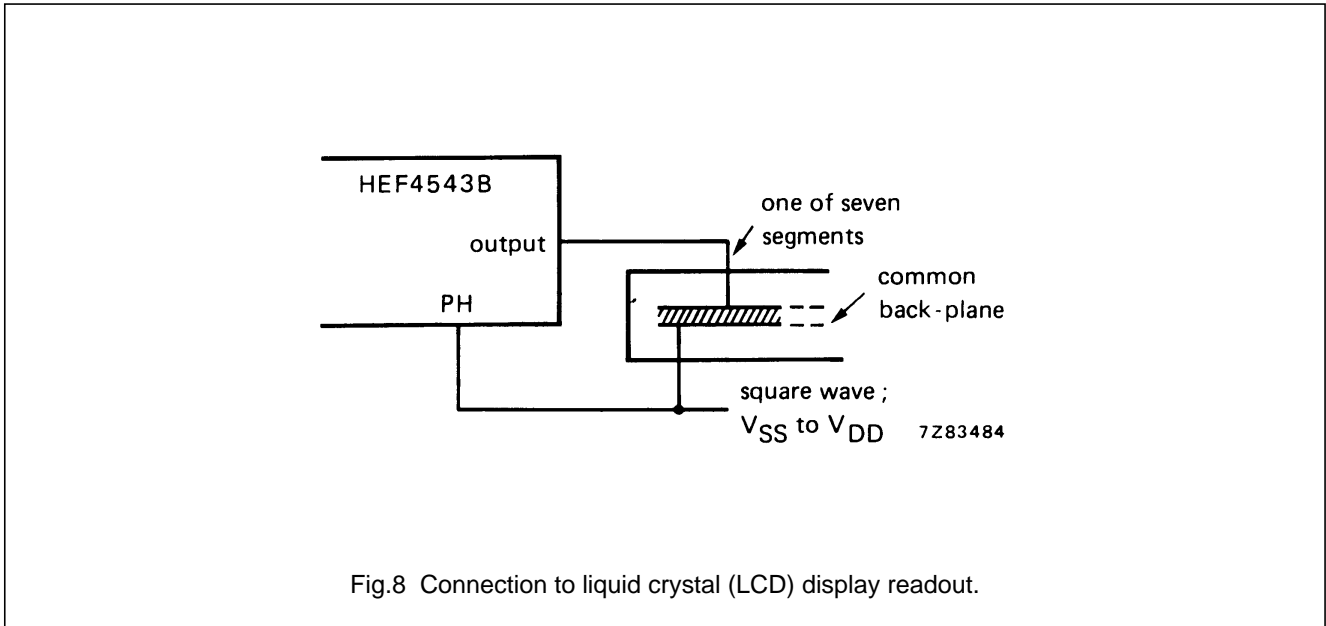
Fig.6 Connection to common cathode LED display readout.

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Note to Figs 6 and 7: bipolar transistors may be added for gain where $V_{DD} \leq 10\text{ V}$ or $I_{out} \geq 10\text{ mA}$.



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