

# 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

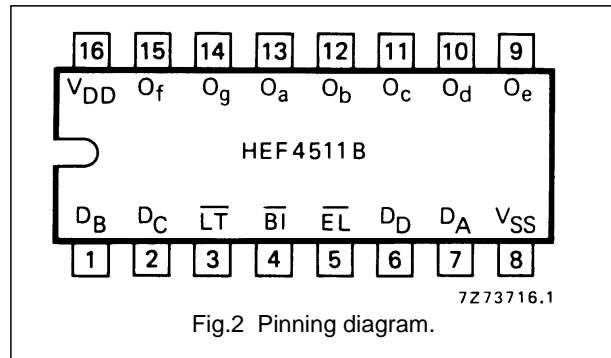
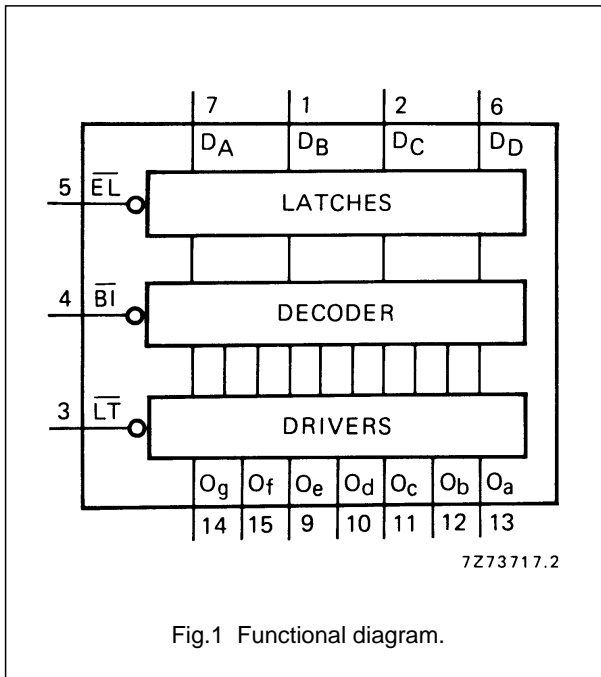
# BCD to 7-segment latch/decoder/driver

## HEF4511B MSI

### 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  $O_g$ ).

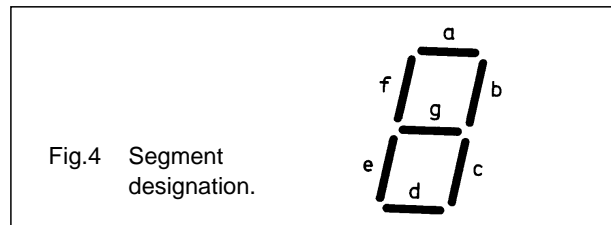
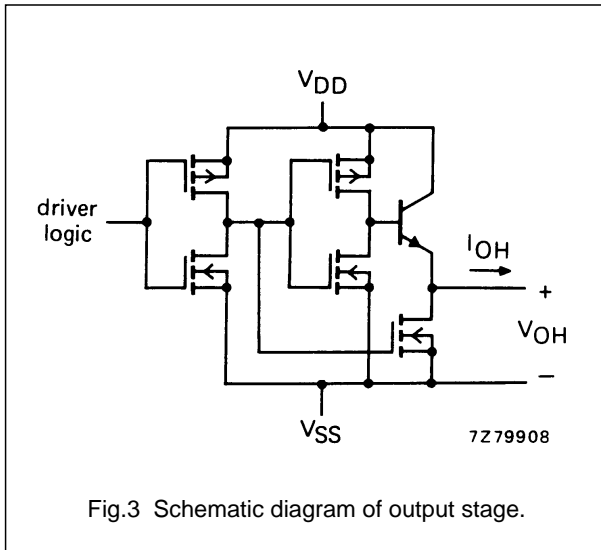
When  $\overline{EL}$  is LOW, the state of the segment outputs ( $O_a$  to  $O_g$ ) is determined by the data on  $D_A$  to  $D_D$ . When  $\overline{EL}$  goes HIGH, the last data present on  $D_A$  to  $D_D$  are stored in the latches and the segment outputs remain stable. When  $\overline{LT}$  is 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<sub>DD</sub> LIMITS category MSI

See Family Specifications

BCD to 7-segment latch/decoder/driver

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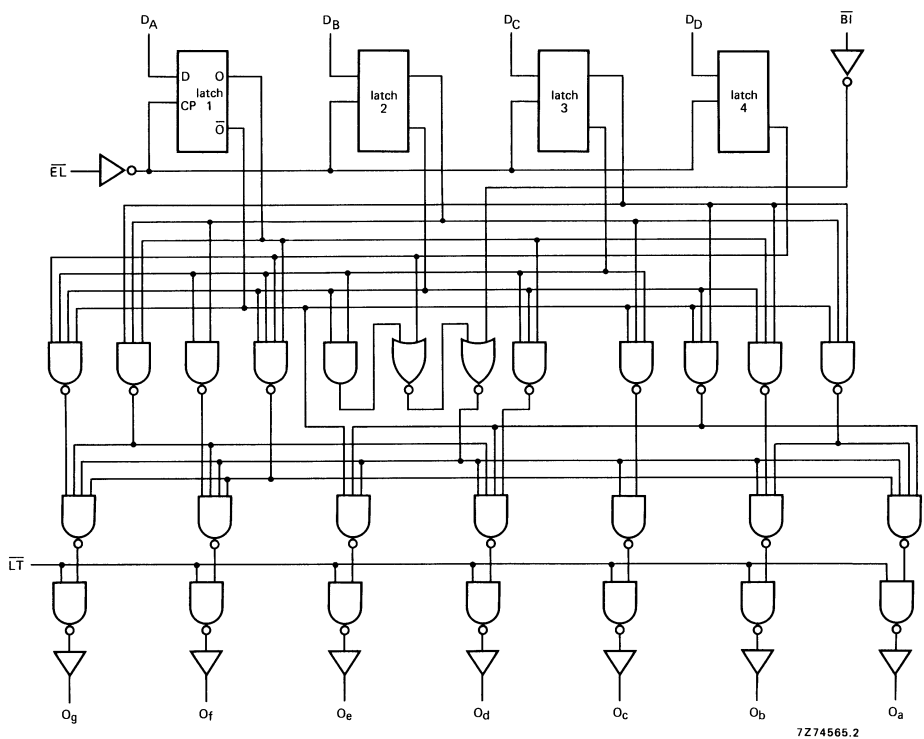
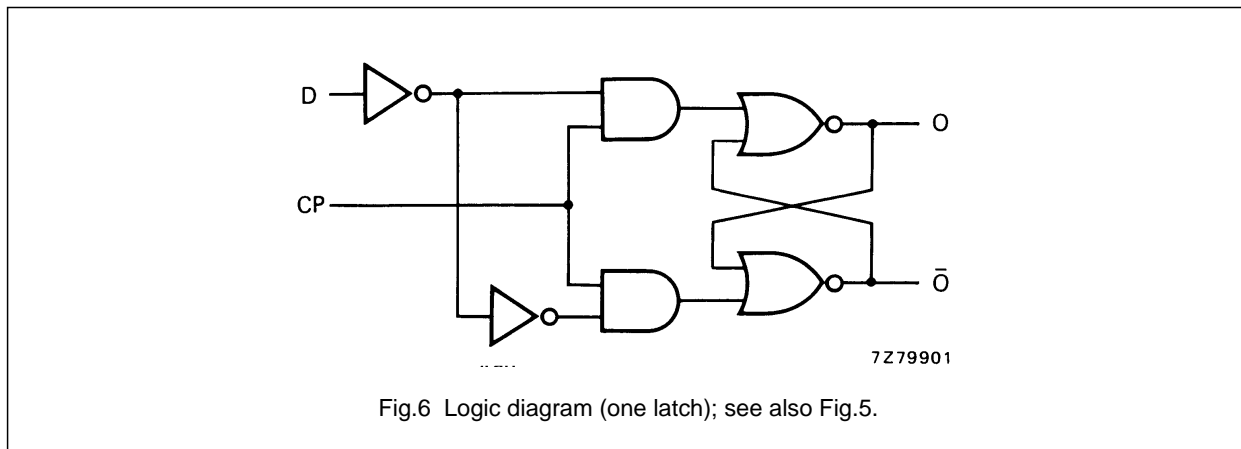


Fig.5 Logic diagram; for one latch see Fig.6.

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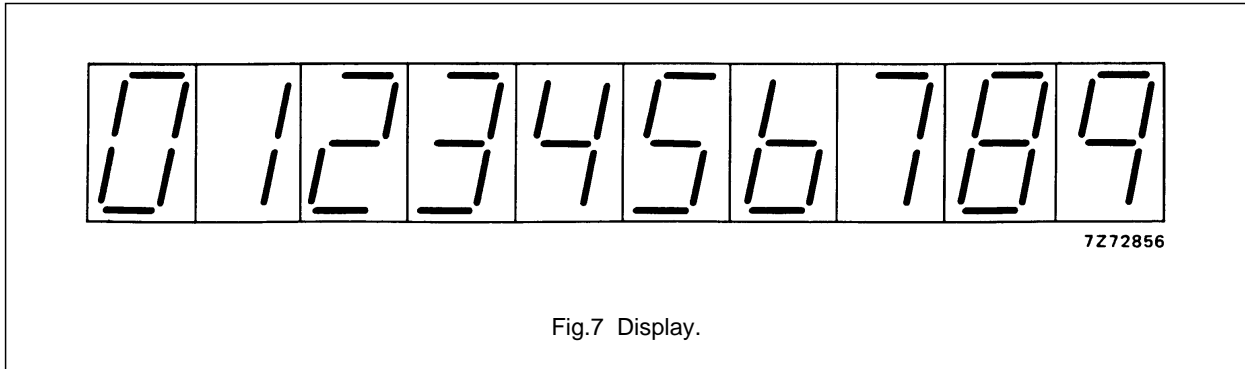
FUNCTION TABLE

INPUTS							OUTPUTS							DISPLAY
$\overline{EL}$	$\overline{BI}$	$\overline{LT}$	$D_D$	$D_C$	$D_B$	$D_A$	$O_a$	$O_b$	$O_c$	$O_d$	$O_e$	$O_f$	$O_g$	
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	L	H	H	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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MSI**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  $V_O \leq V_{DD}$ .

## BCD to 7-segment latch/decoder/driver

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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

## BCD to 7-segment latch/decoder/driver

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HEC	V <sub>DD</sub> V	I <sub>OH</sub> mA	SYMBOL	T <sub>amb</sub> (°C)					
				-55		+25		+125	
				MIN.	MAX.	MIN.	TYP.	MIN.	MAX.
Output voltage HIGH	5	0	V <sub>OH</sub>	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 <sub>OH</sub>				4,30		V
	10	5					9,30		V
	15	5					14,30		V
Output voltage HIGH	5	10	V <sub>OH</sub>	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 <sub>OH</sub>				4,20		V
	10	15					9,20		V
	15	15					14,20		V
Output voltage HIGH	5	20	V <sub>OH</sub>	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 <sub>OH</sub>				4,15		V
	10	25					9,20		V
	15	25					14,20		V

## AC CHARACTERISTICS

V<sub>SS</sub> = 0 V; T<sub>amb</sub> = 25 °C; input transition times ≤ 20 ns

	V <sub>DD</sub> V	TYPICAL FORMULA FOR P (μW)	
Dynamic power dissipation per package (P)	5	$1\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$	where f <sub>i</sub> = input freq. (MHz) f <sub>o</sub> = output freq. (MHz) C <sub>L</sub> = load capacitance (pF) ∑ (f <sub>o</sub> C <sub>L</sub> ) = sum of outputs V <sub>DD</sub> = supply voltage (V)
	10	$4\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$	
	15	$10\,000 f_i + \sum (f_o C_L) \times V_{DD}^2$	

## BCD to 7-segment latch/decoder/driver

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

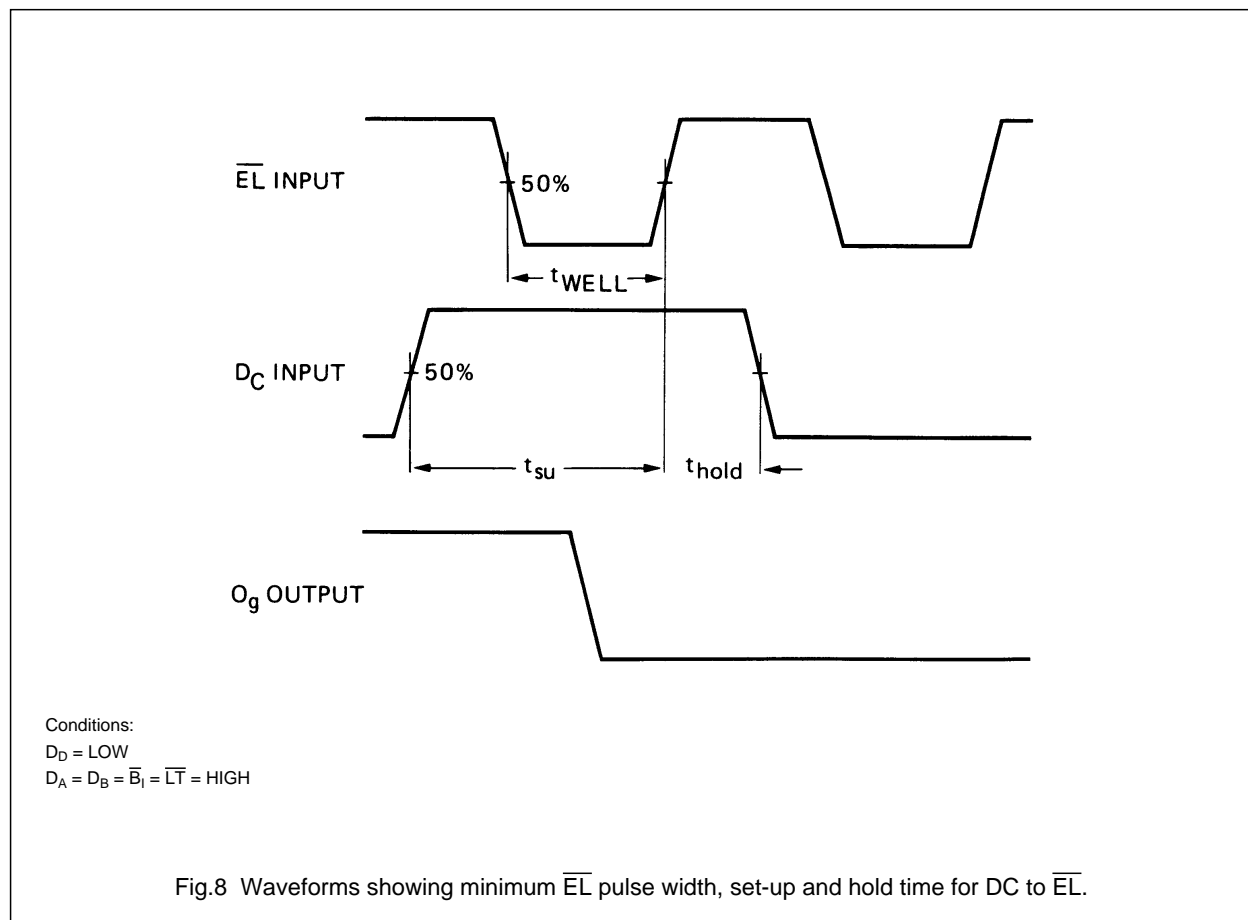
	$V_{DD}$ V	SYMBOL	MIN.	TYP.	MAX.	TYPICAL EXTRAPOLATION FORMULA			
Propagation delays	5	$t_{PHL}$		155	310	ns	128 ns + (0,55 ns/pF) $C_L$		
				$D_n \rightarrow O_n$ HIGH to LOW	10	60	120	ns	49 ns + (0,23 ns/pF) $C_L$
				15	40	80	ns	32 ns + (0,16 ns/pF) $C_L$	
	5	$t_{PLH}$		135	270	ns	108 ns + (0,55 ns/pF) $C_L$		
				$LOW\ to\ HIGH$	10	55	110	ns	44 ns + (0,23 ns/pF) $C_L$
				15	40	80	ns	32 ns + (0,16 ns/pF) $C_L$	
	$\overline{EL} \rightarrow O_n$ HIGH to LOW	5	$t_{PHL}$		160	320	ns	133 ns + (0,55 ns/pF) $C_L$	
					10	60	120	ns	49 ns + (0,23 ns/pF) $C_L$
					15	45	90	ns	37 ns + (0,16 ns/pF) $C_L$
	$LOW\ to\ HIGH$	5	$t_{PLH}$		160	320	ns	133 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) $C_L$
	$\overline{BI} \rightarrow O_n$ HIGH to LOW	5	$t_{PHL}$		120	240	ns	93 ns + (0,55 ns/pF) $C_L$	
					10	50	100	ns	39 ns + (0,23 ns/pF) $C_L$
					15	35	70	ns	27 ns + (0,16 ns/pF) $C_L$
	$\overline{BI} \rightarrow O_n$ LOW to HIGH	5	$t_{PLH}$		105	210	ns	78 ns + (0,55 ns/pF) $C_L$	
					10	40	80	ns	29 ns + (0,23 ns/pF) $C_L$
					15	30	60	ns	22 ns + (0,16 ns/pF) $C_L$
$\overline{LT} \rightarrow O_n$ HIGH to LOW	5	$t_{PHL}$		80	160	ns	52 ns + (0,55 ns/pF) $C_L$		
				10	30	60	ns	19 ns + (0,23 ns/pF) $C_L$	
				15	20	40	ns	12 ns + (0,16 ns/pF) $C_L$	
$LOW\ to\ HIGH$	5	$t_{PLH}$		60	120	ns	33 ns + (0,55 ns/pF) $C_L$		
				10	30	60	ns	19 ns + (0,23 ns/pF) $C_L$	
				15	25	50	ns	17 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) $C_L$	
	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	10 ns + (0,06 ns/pF) $C_L$	



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	V <sub>DD</sub> 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	



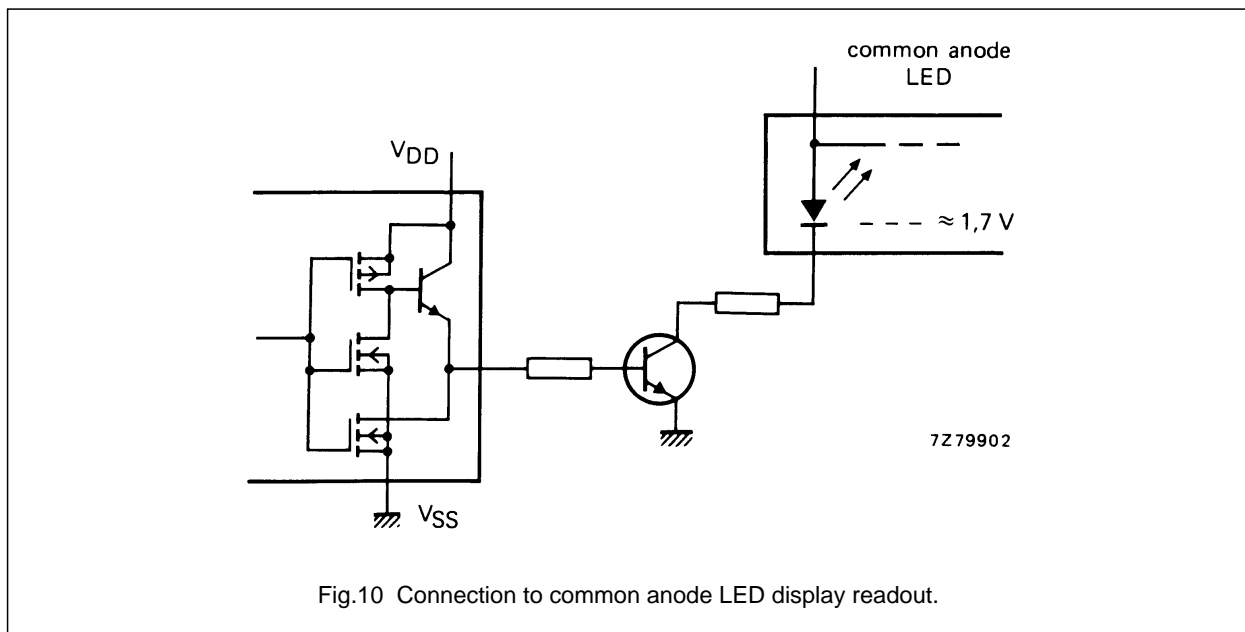
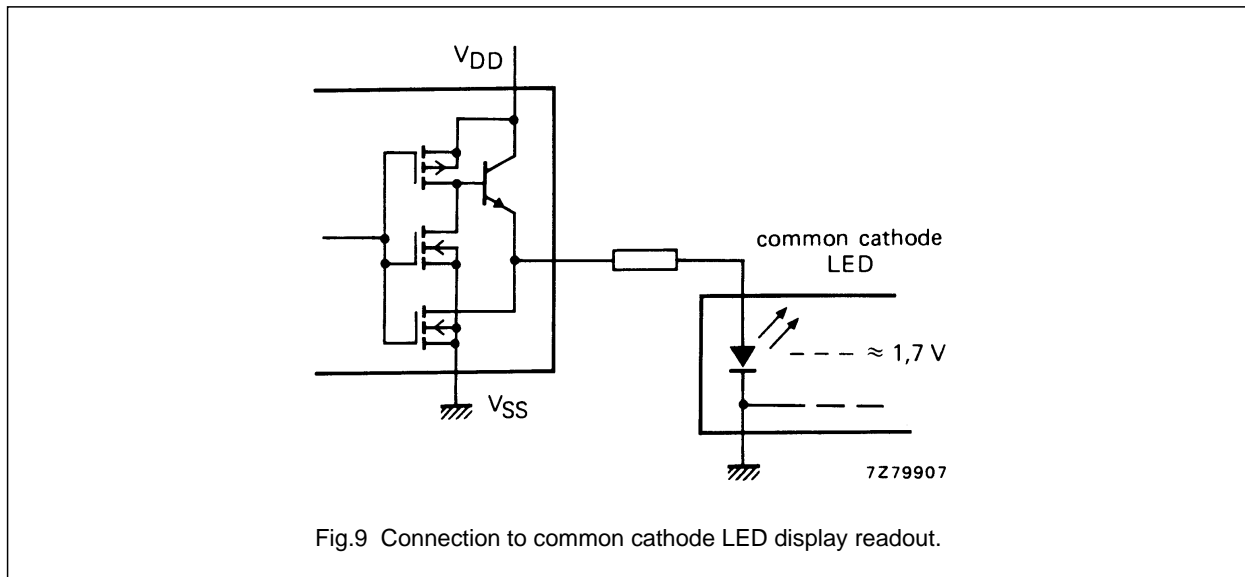
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## APPLICATION INFORMATION

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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