

# DATA SHEET

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- The IC04 LOCMOS HE4000B Logic Family Specifications HEF, HEC
- The IC04 LOCMOS HE4000B Logic Package Outlines/Information HEF, HEC

## HEF4052B

### MSI

Dual 4-channel analogue  
multiplexer/demultiplexer

Product specification  
File under Integrated Circuits, IC04

January 1995

# Dual 4-channel analogue multiplexer/demultiplexer

## HEF4052B MSI

### DESCRIPTION

The HEF4052B is a dual 4-channel analogue multiplexer/demultiplexer with common channel select logic. Each multiplexer/demultiplexer has four independent inputs/outputs ( $Y_0$  to  $Y_3$ ) and a common input/output ( $Z$ ). The common channel select logic includes two address inputs ( $A_0$  and  $A_1$ ) and an active LOW enable input ( $\bar{E}$ ).

Both multiplexers/demultiplexers contain four bidirectional analogue switches, each with one side connected to an independent input/output ( $Y_0$  to  $Y_3$ ) and the other side connected to a common input/output ( $Z$ ).

With  $\bar{E}$  LOW, one of the four switches is selected (low impedance ON-state) by  $A_0$  and  $A_1$ . With  $\bar{E}$  HIGH, all switches are in the high impedance OFF-state, independent of  $A_0$  and  $A_1$ .

$V_{DD}$  and  $V_{SS}$  are the supply voltage connections for the digital control inputs ( $A_0$ ,  $A_1$  and  $\bar{E}$ ). The  $V_{DD}$  to  $V_{SS}$  range is 3 to 15 V. The analogue inputs/outputs ( $Y_0$  to  $Y_3$ , and  $Z$ ) can swing between  $V_{DD}$  as a positive limit and  $V_{EE}$  as a negative limit.  $V_{DD} - V_{EE}$  may not exceed 15 V.

For operation as a digital multiplexer/demultiplexer,  $V_{EE}$  is connected to  $V_{SS}$  (typically ground).

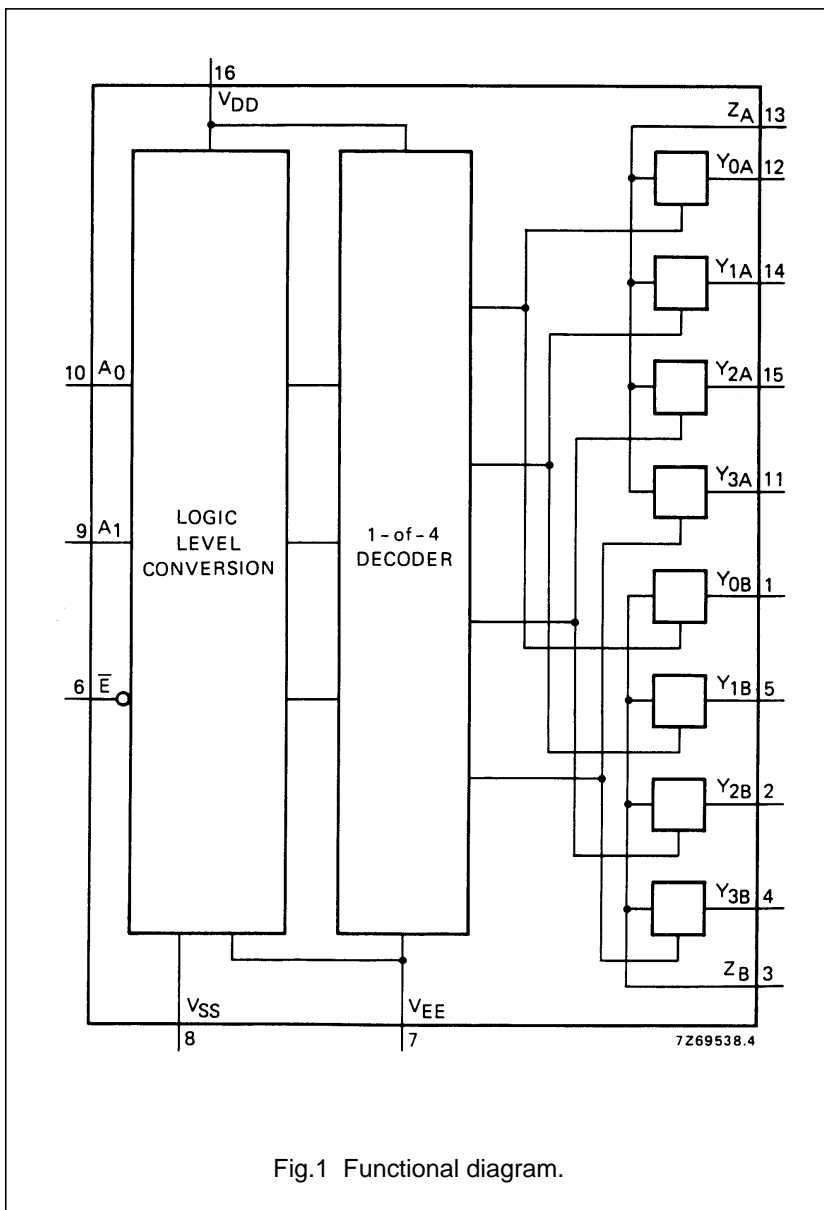


Fig.1 Functional diagram.

### PINNING

- $Y_{0A}$  to  $Y_{3A}$  independent inputs/outputs
- $Y_{0B}$  to  $Y_{3B}$  independent inputs/outputs
- $A_0$ ,  $A_1$  address inputs
- $\bar{E}$  enable input (active LOW)
- $Z_A$ ,  $Z_B$  common inputs/outputs

### FAMILY DATA, $I_{DD}$ LIMITS category MSI

See Family Specifications

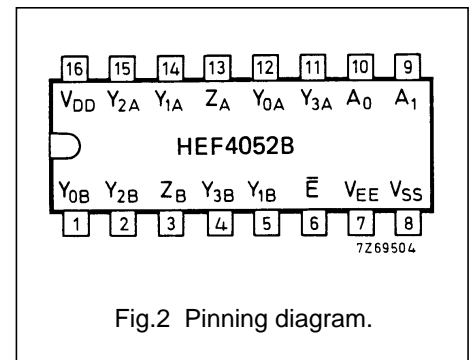


Fig.2 Pinning diagram.

- HEF4052BP(N): 16-lead DIL; plastic (SOT38-1)
  - HEF4052BD(F): 16-lead DIL; ceramic (cerdip) (SOT74)
  - HEF4052BT(D): 16-lead SO; plastic (SOT109-1)
- ( ): Package Designator North America

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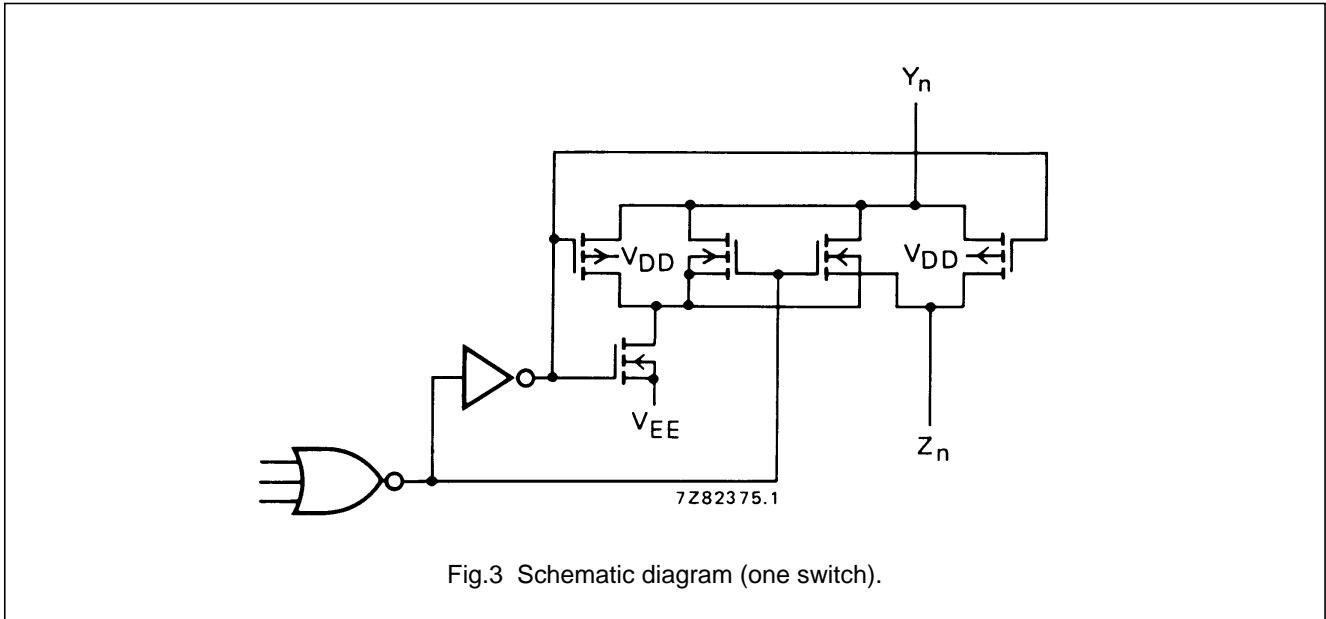


Fig.3 Schematic diagram (one switch).

FUNCTION TABLE

INPUTS			CHANNEL ON
$\bar{E}$	$A_1$	$A_0$	
L	L	L	$Y_{0A}-Z_A; Y_{0B}-Z_B$
L	L	H	$Y_{1A}-Z_A; Y_{1B}-Z_B$
L	H	L	$Y_{2A}-Z_A; Y_{2B}-Z_B$
L	H	H	$Y_{3A}-Z_A; Y_{3B}-Z_B$
H	X	X	none

Notes

- H = HIGH state (the more positive voltage)  
L = LOW state (the less positive voltage)  
X = state is immaterial

RATINGS

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

Supply voltage (with reference to  $V_{DD}$ )  $V_{EE}$  -18 to +0,5 V

Note

- To avoid drawing  $V_{DD}$  current out of terminal Z, when switch current flows into terminals Y, the voltage drop across the bidirectional switch must not exceed 0,4 V. If the switch current flows into terminal Z, no  $V_{DD}$  current will flow out of terminals Y, in this case there is no limit for the voltage drop across the switch, but the voltages at Y and Z may not exceed  $V_{DD}$  or  $V_{EE}$ .

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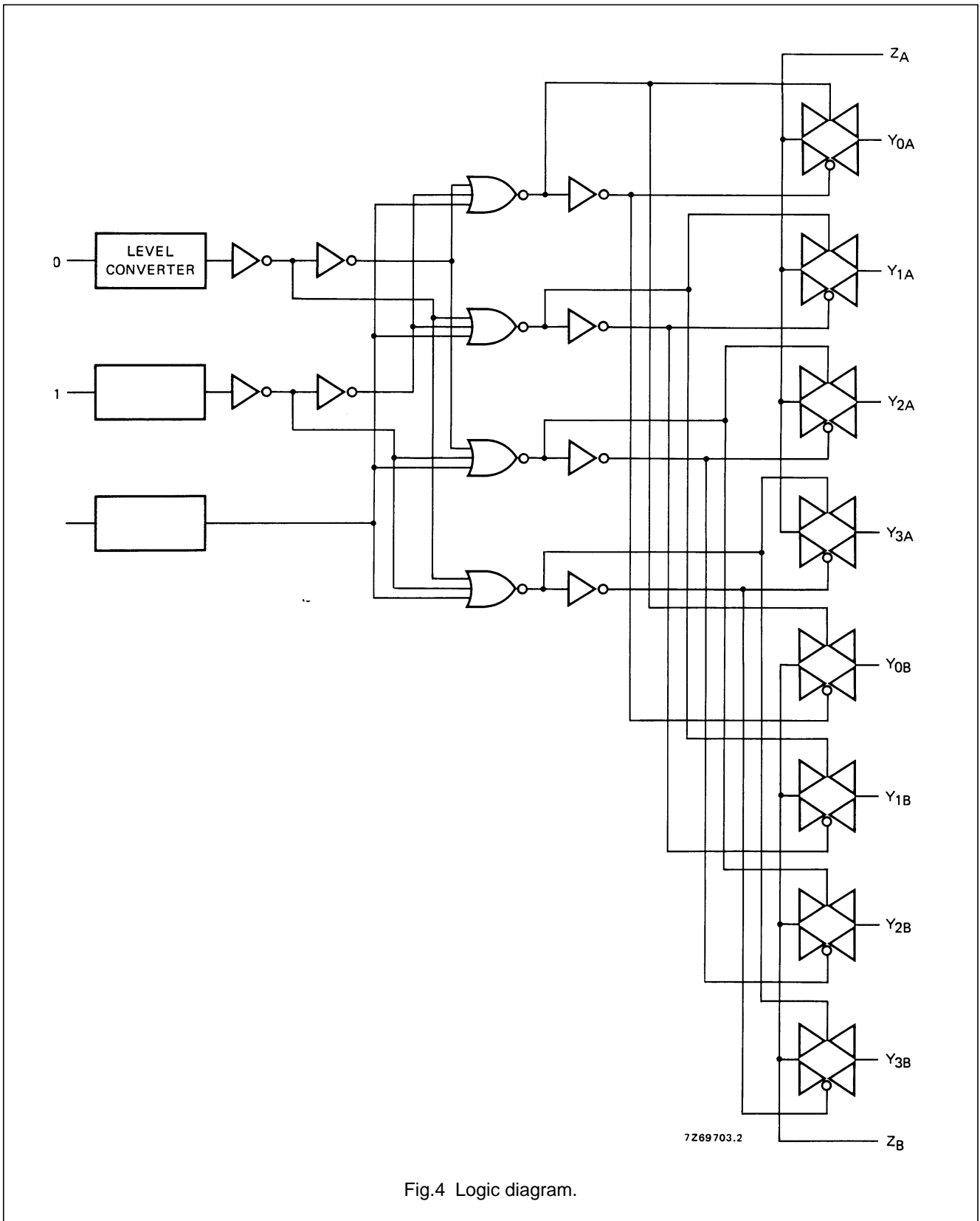


Fig.4 Logic diagram.

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DC CHARACTERISTICS

T<sub>amb</sub> = 25 °C

	V <sub>DD</sub> -V <sub>EE</sub> V	SYMBOL	TYP.	MAX.		CONDITIONS
ON resistance	5	R <sub>ON</sub>	350	2500	Ω	V <sub>is</sub> = 0 to V <sub>DD</sub> -V <sub>EE</sub> see Fig.6
	10		80	245	Ω	
	15		60	175	Ω	
ON resistance	5	R <sub>ON</sub>	115	340	Ω	V <sub>is</sub> = 0 see Fig.6
	10		50	160	Ω	
	15		40	115	Ω	
ON resistance	5	R <sub>ON</sub>	120	365	Ω	V <sub>is</sub> = V <sub>DD</sub> -V <sub>EE</sub> see Fig.6
	10		65	200	Ω	
	15		50	155	Ω	
'Δ' ON resistance between any two channels	5	ΔR <sub>ON</sub>	25	-	Ω	V <sub>is</sub> = 0 to V <sub>DD</sub> -V <sub>EE</sub> see Fig.6
	10		10	-	Ω	
	15		5	-	Ω	
OFF-state leakage current, all channels OFF	5	I <sub>oZZ</sub>	-	-	nA	$\bar{E}$ at V <sub>DD</sub>
	10		-	-	nA	
	15		-	1000	nA	
OFF-state leakage current, any channel	5	I <sub>oZY</sub>	-	-	nA	$\bar{E}$ at V <sub>SS</sub>
	10		-	-	nA	
	15		-	200	nA	

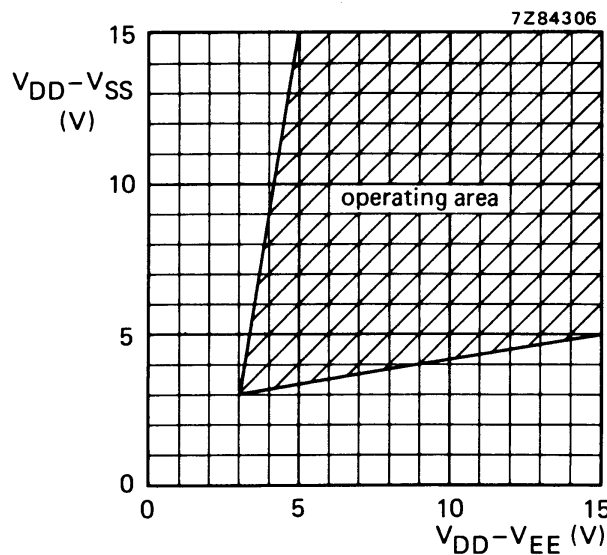


Fig.5 Operating area as a function of the supply voltages.

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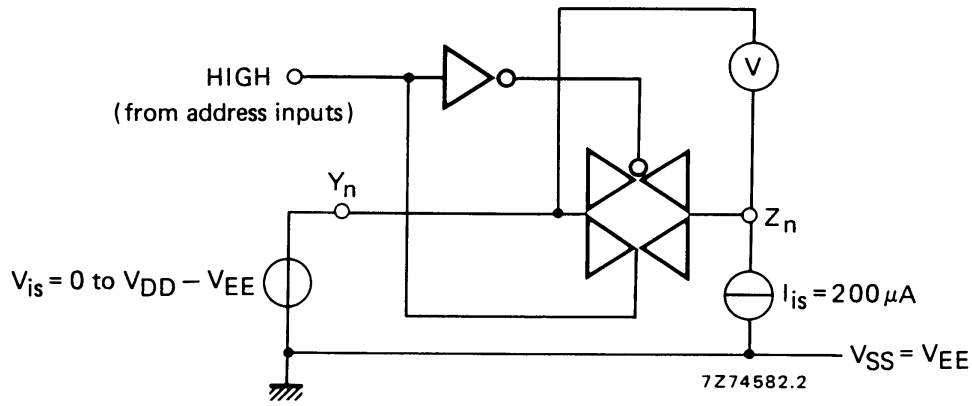
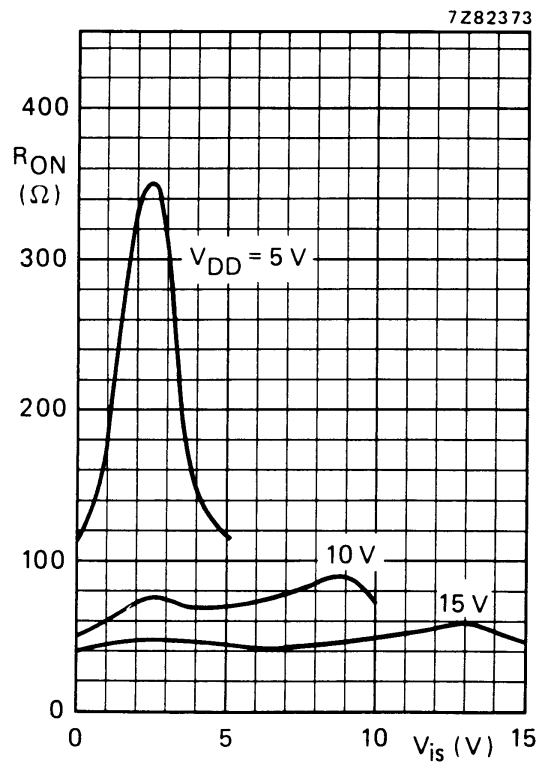


Fig.6 Test set-up for measuring  $R_{ON}$ .



$I_{is} = 200 \mu A$   
 $V_{SS} = V_{EE} = 0 V$

Fig.7 Typical  $R_{ON}$  as a function of input voltage.

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**AC CHARACTERISTICS**

$V_{EE} = V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ ; input transition times  $\leq 20\text{ ns}$

	$V_{DD}$ V	TYPICAL FORMULA FOR P ( $\mu\text{W}$ )	
Dynamic power dissipation per package (P)	5	$1\ 300 f_i + \sum(f_o C_L) \times V_{DD}^2$	where $f_i$ = input freq. (MHz) $f_o$ = output freq. (MHz) $C_L$ = load capacitance (pF) $\sum(f_o C_L)$ = sum of outputs $V_{DD}$ = supply voltage (V)
	10	$6\ 100 f_i + \sum(f_o C_L) \times V_{DD}^2$	
	15	$15\ 600 f_i + \sum(f_o C_L) \times V_{DD}^2$	

**AC CHARACTERISTICS**

$V_{EE} = V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ ; input transition times  $\leq 20\text{ ns}$

	$V_{DD}$ V	SYMBOL	TYP.	MAX.			
Propagation delays $V_{is} \rightarrow V_{os}$ HIGH to LOW	5	$t_{PHL}$	10	20	ns	note 1	
	10		5	10	ns		
	15		5	10	ns		
	LOW to HIGH	5	$t_{PLH}$	10	20	ns	note 1
		10		5	10	ns	
		15		5	10	ns	
$A_n \rightarrow V_{os}$ HIGH to LOW	5	$t_{PHL}$	150	305	ns	note 2	
	10		65	135	ns		
	15		50	100	ns		
	LOW to HIGH	5	$t_{PLH}$	150	300	ns	note 2
		10		75	150	ns	
		15		50	100	ns	
Output disable times $\bar{E} \rightarrow V_{os}$ HIGH	5	$t_{PHZ}$	95	190	ns	note 3	
	10		90	180	ns		
	15		90	180	ns		
	LOW	5	$t_{PLZ}$	100	205	ns	note 3
		10		90	180	ns	
		15		90	180	ns	
Output enable times $\bar{E} \rightarrow V_{os}$ HIGH	5	$t_{PZH}$	130	260	ns	note 3	
	10		55	115	ns		
	15		45	85	ns		
	LOW	5	$t_{PZL}$	120	240	ns	note 3
		10		50	100	ns	
		15		35	75	ns	

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	V <sub>DD</sub> V	SYMBOL	TYP.	MAX.	
Distortion, sine-wave response	5		0,25	%	note 4
	10		0,04	%	
	15		0,04	%	
Crosstalk between any two channels	5		–	MHz	note 5
	10		1	MHz	
	15		–	MHz	
Crosstalk; enable or address input to output	5		–	mV	note 6
	10		50	mV	
	15		–	mV	
OFF-state feed-through	5		–	MHz	note 7
	10		1	MHz	
	15		–	MHz	
ON-state frequency response	5		13	MHz	note 8
	10		40	MHz	
	15		70	MHz	

**Notes**

V<sub>is</sub> is the input voltage at a Y or Z terminal, whichever is assigned as input.

V<sub>os</sub> is the output voltage at a Y or Z terminal, whichever is assigned as output.

- R<sub>L</sub> = 10 kΩ to V<sub>EE</sub>; C<sub>L</sub> = 50 pF to V<sub>EE</sub>;  $\bar{E} = V_{SS}$ ; V<sub>is</sub> = V<sub>DD</sub> (square-wave); see Fig.8.
- R<sub>L</sub> = 10 kΩ; C<sub>L</sub> = 50 pF to V<sub>EE</sub>;  $\bar{E} = V_{SS}$ ; A<sub>n</sub> = V<sub>DD</sub> (square-wave); V<sub>is</sub> = V<sub>DD</sub> and R<sub>L</sub> to V<sub>EE</sub> for t<sub>PLH</sub>; V<sub>is</sub> = V<sub>EE</sub> and R<sub>L</sub> to V<sub>DD</sub> for t<sub>PHL</sub>; see Fig.8.
- R<sub>L</sub> = 10 kΩ; C<sub>L</sub> = 50 pF to V<sub>EE</sub>;  $\bar{E} = V_{DD}$  (square-wave);  
V<sub>is</sub> = V<sub>DD</sub> and R<sub>L</sub> to V<sub>EE</sub> for t<sub>PHZ</sub> and t<sub>PZH</sub>;  
V<sub>is</sub> = V<sub>EE</sub> and R<sub>L</sub> to V<sub>DD</sub> for t<sub>PLZ</sub> and t<sub>PZL</sub>; see Fig.8.
- R<sub>L</sub> = 10 kΩ; C<sub>L</sub> = 15 pF; channel ON; V<sub>is</sub> = 1/2 V<sub>DD (p-p)</sub> (sine-wave, symmetrical about 1/2 V<sub>DD</sub>);  
f<sub>is</sub> = 1 kHz; see Fig.9.
- R<sub>L</sub> = 1 kΩ; V<sub>is</sub> = 1/2 V<sub>DD (p-p)</sub> (sine-wave, symmetrical about 1/2 V<sub>DD</sub>);

$$20 \log \frac{V_{os}}{V_{is}} = -50 \text{ dB}; \text{ see Fig. 10.}$$

- R<sub>L</sub> = 10 kΩ to V<sub>EE</sub>; C<sub>L</sub> = 15 pF to V<sub>EE</sub>;  $\bar{E}$  or A<sub>n</sub> = V<sub>DD</sub> (square-wave); crosstalk is |V<sub>os</sub>| (peak value); see Fig.8.

- R<sub>L</sub> = 1 kΩ; C<sub>L</sub> = 5 pF; channel OFF; V<sub>is</sub> = 1/2 V<sub>DD (p-p)</sub> (sine-wave, symmetrical about 1/2 V<sub>DD</sub>);

$$20 \log \frac{V_{os}}{V_{is}} = -50 \text{ dB}; \text{ see Fig. 9.}$$

- R<sub>L</sub> = 1 kΩ; C<sub>L</sub> = 5 pF; channel ON; V<sub>is</sub> = 1/2 V<sub>DD (p-p)</sub> (sine-wave, symmetrical about 1/2 V<sub>DD</sub>);

$$20 \log \frac{V_{os}}{V_{is}} = -3 \text{ dB}; \text{ see Fig. 9.}$$



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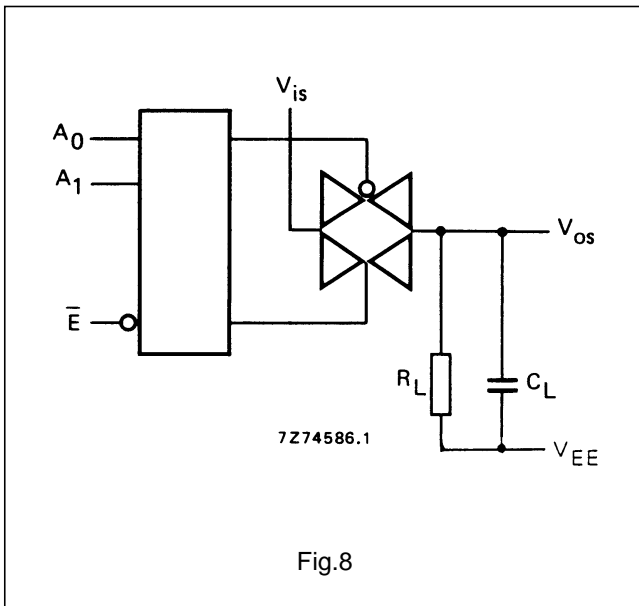


Fig.8

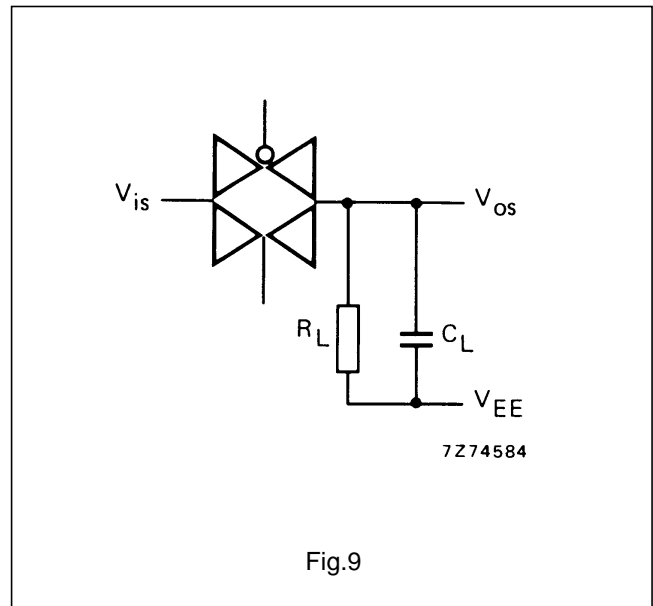


Fig.9

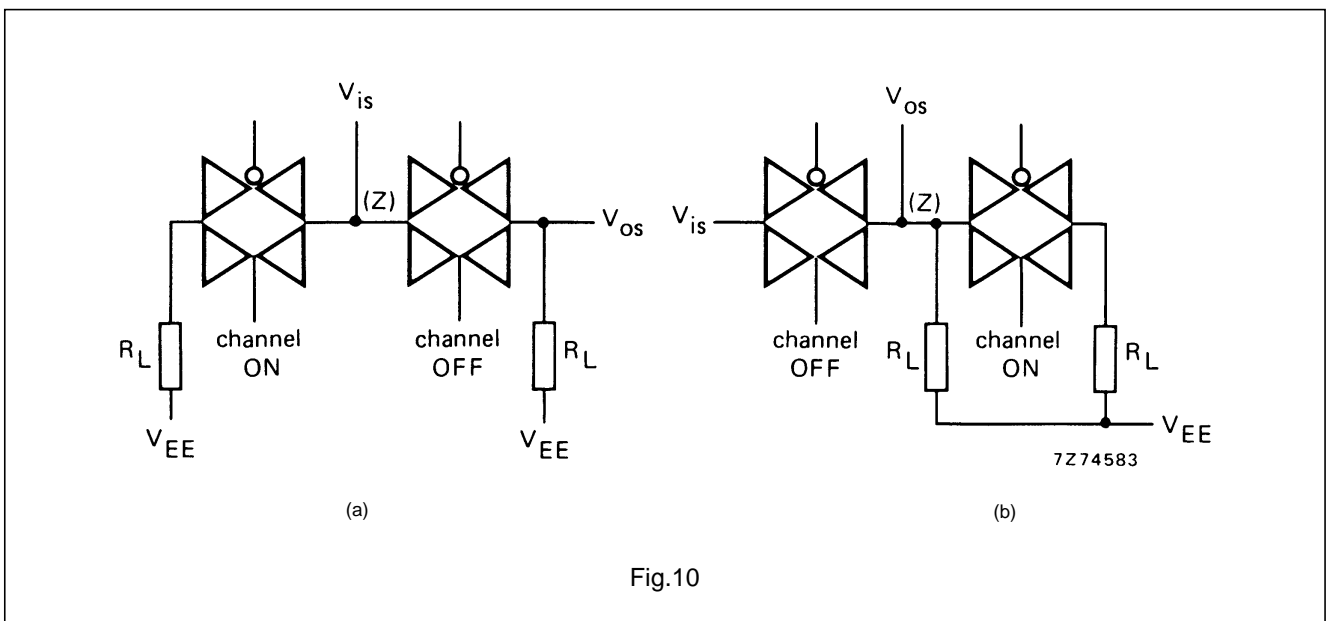


Fig.10

**APPLICATION INFORMATION**

Some examples of applications for the HEF4052B are:

- Analogue multiplexing and demultiplexing.
- Digital multiplexing and demultiplexing.
- Signal gating.

**NOTE**

If break before make is needed, then it is necessary to use the enable input.