

**M4052BP**  
**M4052BFP**

**DUAL 4-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER**

6249826 MITSUBISHI ELEK (LINEAR)

80C 09109 D 7-51-11

**DESCRIPTION**

The M4052BP is a semiconductor integrated circuit consisting of two multiplexer/demultiplexers which use 2-bit digital inputs to perform selection of four analog switches.

**FEATURES**

- Low ON resistance: 50Ω typ. ( $V_{DD}=15V$ )
- High OFF resistance:  $10^9\Omega$  or greater (typ)
- Small differences in ON resistance between each switch in the package: 10Ω typ. ( $V_{DD}=7.5V, V_{SS}=-7.5V$ )
- Linearized transfer characteristics: 0.07% distortion (typ)
- Signals with amplitude greater than the logic level amplitude of the control inputs may be switched.
- Provided with an inhibit input

**APPLICATION**

General purpose, for use in industrial and consumer digital equipment.

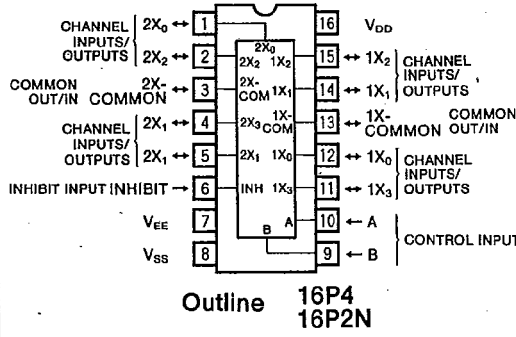
**FUNCTIONAL DESCRIPTION**

When a 2-bit binary input signal is applied to the control inputs (A and B), the channel number corresponding to the binary value input ( $X_0$  through  $X_3$ ) is set at low impedance with respect to the corresponding (X-COMMON). All other channels remain at high impedance.

In this operation, if the (INHIBIT) input is held high, all channels ( $X_0$  through  $X_3$ ) will be put in the high-impedance state, regardless of the state of the other inputs.

It is possible to switch an analog signal of amplitude  $V_{DD}-V_{EE}$  if this is greater than the logic level span  $V_{DD}-V_{SS}$  for inputs (A and B)

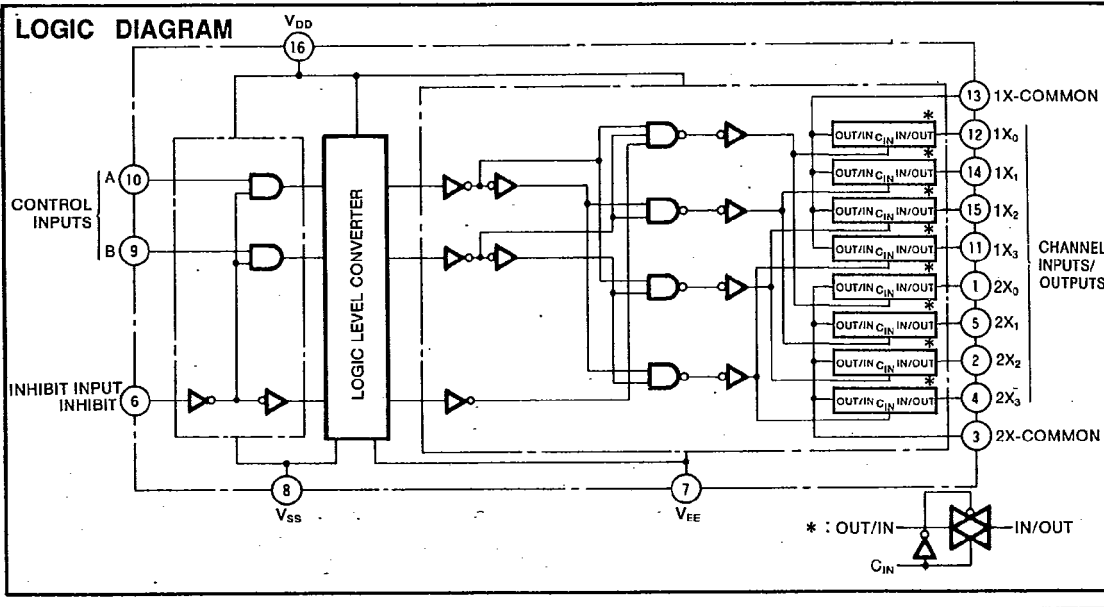
**PIN COFIGRATION (TOP VIEW)**



**FUNCTION TABLE (Note 1)**

Inhibit input	Control inputs		Channel INPUT/OUTPUT to COMMON switch selection			
	B	A	$X_0$	$X_1$	$X_2$	$X_3$
L	L	L	ON	OFF	OFF	OFF
L	L	H	OFF	ON	OFF	OFF
L	H	L	OFF	OFF	ON	OFF
L	H	H	OFF	OFF	OFF	ON
H	X	X	OFF	OFF	OFF	OFF

Note 1 : X : Irrelevant  
ON : Low impedance between  $X_n$  and X-COMMON ( $n=0\sim3$ )  
OFF : High impedance between  $X_n$  and X-COMMON ( $n=0\sim3$ )



DUAL 4-CHANNEL ANALOG MULTIPLEXER/DEMULTIPLEXER

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ABSOLUTE MAXIMUM RATINGS (T<sub>a</sub> = -40 ~ +85°C, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V <sub>DD</sub> -V <sub>SS</sub>	Supply voltage		-0.5~20	V
V <sub>DD</sub> -V <sub>EE</sub>			-0.5~20	V
V <sub>I</sub>	Input voltage	Control and inhibit inputs	V <sub>SS</sub> -0.5~V <sub>DD</sub> +0.5	V
		Channel and common inputs	V <sub>EE</sub> -0.5~V <sub>DD</sub> +0.5	V
V <sub>IO</sub>	Input-to-output voltage		±0.5	V
I <sub>I</sub>	Input current	Control and inhibit inputs	±10	mA
I <sub>O</sub>	Output current	Switch-off	±10	mA
V <sub>O</sub>	Output voltage	Channel and common outputs	V <sub>EE</sub> -0.5~V <sub>DD</sub> +0.5	V
T <sub>opr</sub>	Operating temperature range		-40~+85	°C
T <sub>stg</sub>	Storage temperature range		-65~+150	°C

RECOMMENDED OPERATING CONDITNG CONDING CONDITIONS (T<sub>a</sub> = -40 ~ +85°C, unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min	Typ	Max	
V <sub>DD</sub> -V <sub>SS</sub>	Supply voltage	3		18	V
V <sub>DD</sub> -V <sub>EE</sub>		3		18	V
V <sub>I</sub>	Input voltage				V
	Control and inhibit inputs	V <sub>SS</sub>		V <sub>DD</sub>	
	Channel and common inputs	V <sub>EE</sub>		V <sub>DD</sub>	
V <sub>O</sub>	Output voltage	V <sub>EE</sub>		V <sub>DD</sub>	V

ELECTRICAL CHARACTERISTICS (V<sub>SS</sub>=0V)

Symbol	Parameter	Test conditions	Limits						Unit				
			-40°C		25°C		85°C						
			V <sub>EE</sub> (V)	V <sub>DD</sub> (V)	Min	Max	Min	Typ		Max	Min	Max	
V <sub>IH</sub>	"H" Input voltage (A, B, INHIBIT)	Input-to-output current=10μA	0	5	3.5		3.5			3.5		V	
			0	10	7.0		7.0			7.0			
			0	15	11.0		11.0			11.0			
V <sub>IL</sub>	"L" Input current (A, B, INHIBIT)	Input-to-output current=10μA	0	5		1.5			1.5		1.5	V	
			0	10		3.0			3.0		3.0		
			0	15		4.0			4.0		4.0		
R <sub>ON</sub>	ON resistance	Test circuit 1	V <sub>I</sub> =5V	0	5		500			600		800	Ω
			V <sub>I</sub> =2.5V	0	5		850			950		1300	
			V <sub>I</sub> =0.25V	0	5		500			600		800	
			V <sub>I</sub> =10V	0	10		210			250		300	
			V <sub>I</sub> =5V	0	10		210			250		300	
			V <sub>I</sub> =0.25V	0	10		210			250		300	
			V <sub>I</sub> =15V	0	15		140			160		200	
			V <sub>I</sub> =7.5V	0	15		140			160		200	
			V <sub>I</sub> =0.25V	0	15		140			160		200	
			V <sub>I</sub> =5V	-5	5		210			250		300	
			V <sub>I</sub> =±0.25V	-5	5		210			250		300	
			V <sub>I</sub> =-5V	-5	5		210			250		300	
ΔR <sub>ON</sub>	ON resistance variations between switches of the same package	Test circuit 1	V <sub>I</sub> =5V	-2.5	2.5				30			Ω	
			V <sub>I</sub> =7.5V	-5	5				15				
			V <sub>I</sub> =10V	-7.5	7.5				10				
I <sub>OFF</sub>	Input-to-output off-state leakage current (X <sub>0</sub> ~X <sub>3</sub> -X-COMMON)	V <sub>IO</sub> =10V, V <sub>ON</sub> =0V	0	10					125			nA	
			0	10					-125				
			0	18		250			250		1000		
			0	18		-250			-250		-1000		
I <sub>DD</sub>	Quiescent supply current	V <sub>I</sub> =V <sub>DD</sub> , V <sub>SS</sub>	0	5		20			20		150	μA	
			0	10		40			40		300		
			0	15		80			80		600		
I <sub>IH</sub>	"H" input current (A, B, INH)	V <sub>IH</sub> =18V	0	18		0.3			0.3		1.0	μA	
I <sub>IL</sub>	"L" input current (A, B, INH)	V <sub>IL</sub> =0V	0	18		-0.3			-0.3		-1.0	μA	

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SWITCHING CHARACTERISTICS (T<sub>a</sub>=25°C, V<sub>ss</sub>=0V)

Symbol	Parameter	Tset conditions	Limits		Unit	
			V <sub>EE</sub> (V)	V <sub>DD</sub> (V)		
f <sub>max(I/O)</sub>	Maximum transfer frequency	R <sub>L</sub> =10kΩ C <sub>L</sub> =15pF Test circuit 2	-5	5	25	MHz
t <sub>PLH</sub>	"L-H" and "H-L" output propagation time (A, B-X <sub>0</sub> ~X <sub>3</sub> , X-COMMON)	R <sub>L</sub> =10kΩ C <sub>L</sub> =50pF Test circuit 3	0	5	1000	ns
			0	10	500	
			0	15	400	
			-5	5	700	
			-7.5	7.5	500	
t <sub>PHL</sub>	"L-H" and "H-L" output propagation time (A, B-X <sub>0</sub> ~X <sub>3</sub> , X-COMMON)	R <sub>L</sub> =10kΩ C <sub>L</sub> =50pF Test circuit 3	0	5	1000	ns
			0	10	500	
			0	15	400	
			-5	5	700	
			-7.5	7.5	500	
t <sub>PLH</sub>	"L-H" and "H-L" output propagation time (INHIBIT-X <sub>0</sub> ~X <sub>3</sub> , X-COMMON)	R <sub>L</sub> =10kΩ C <sub>L</sub> =50pF Test circuit 4	0	5	1400	ns
			0	10	700	
			0	15	500	
			-5	5	900	
			-7.5	7.5	500	
t <sub>PHL</sub>	"L-H" and "H-L" output propagation time (INHIBIT-X <sub>0</sub> ~X <sub>3</sub> , X-COMMON)	R <sub>L</sub> =10kΩ C <sub>L</sub> =50pF Test circuit 4	0	5	1400	ns
			0	10	700	
			0	15	500	
			-5	5	900	
			-7.5	7.5	500	
t <sub>PLH</sub>	"L-H" and "H-L" output propagation time (X <sub>0</sub> ~X <sub>3</sub> /X-COMMON-X-COMMON/X <sub>0</sub> ~X <sub>3</sub> )	R <sub>L</sub> =10kΩ C <sub>L</sub> =50pF Test circuit 5	0	5	45	ns
			0	10	30	
			0	15	20	
t <sub>PHL</sub>	"L-H" and "H-L" output propagation time (X <sub>0</sub> ~X <sub>3</sub> /X-COMMON-X-COMMON/X <sub>0</sub> ~X <sub>3</sub> )	R <sub>L</sub> =10kΩ C <sub>L</sub> =50pF Test circuit 5	0	5	45	ns
			0	10	30	
			0	15	20	
—	Sine-wave distortion	R <sub>L</sub> =10kΩ f <sub>i</sub> =1kHz Test circuit 2	-5	5	0.1	%
—	Feedthrough (switch off)	R <sub>L</sub> =1kΩ Test circuit 6	-5	5	500	kHz
—	Crosstalk (A, B, INHIBIT-X <sub>0</sub> ~X <sub>3</sub> , X-COMMON)	R <sub>i</sub> =1kΩ R <sub>L</sub> =10kΩ C <sub>L</sub> =15pF Test circuit 7	0	5	200	mV
			0	10	300	
			0	15	400	
C <sub>i</sub>	Input capacitance	Control and inhibit inputs			7.5	pF
		Channel and common inputs			10	

TEST CIRCUITS (V<sub>ss</sub>=0V, capacitance C<sub>L</sub> includes stray wiring capacitance and probe input capacitance)

**1** ON resistance (R<sub>ON</sub>)

$$R_{ON} = 10 \times \frac{(V_I - V_O)}{V_O} \text{ (k}\Omega\text{)}$$

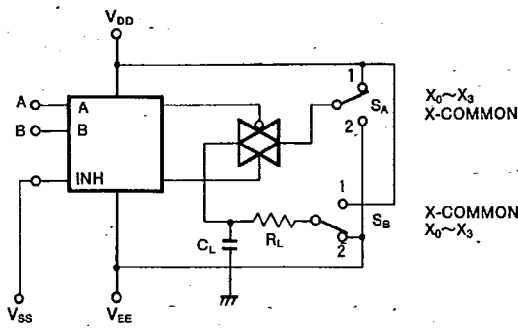
Refer to the function table for conditions of control inputs A and B.

**2** Maximum transfer frequency (f<sub>max(I/O)</sub>). Sine-wave distortion

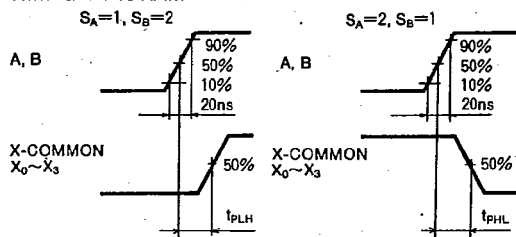
f<sub>max(I/O)</sub> is taken as that frequency f<sub>i</sub> at which, using a sine-wave input of 2.5V<sub>P-P</sub>, 20 log<sub>10</sub>(V<sub>O</sub>/V<sub>I</sub>) = -3dB. Refer to the function table for conditions of control inputs A and B.

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**3 "L-H" and "H-L" output propagation time**  
(A, B-X<sub>0</sub>-X<sub>3</sub>, COMMON)

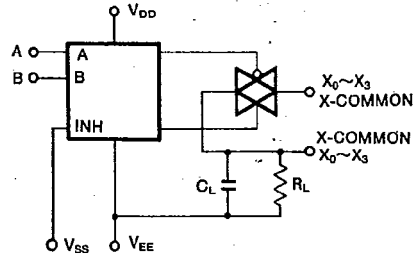


**TIMNG DIAGRAM**

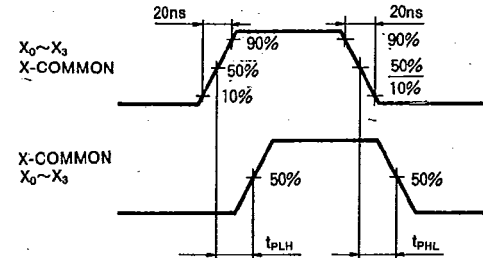


Refer to the function table for conditions of control inputs A and B.

**5 "L-H" and "H-L" output propagation time**  
(X<sub>0</sub>-X<sub>3</sub>/X-COMMON-X-COMMON/X<sub>0</sub>-X<sub>3</sub>)

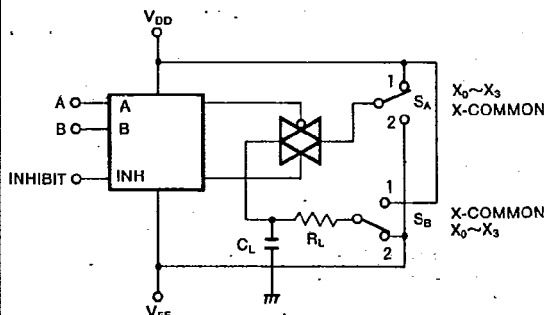


**TIMNG DIAGRAM**

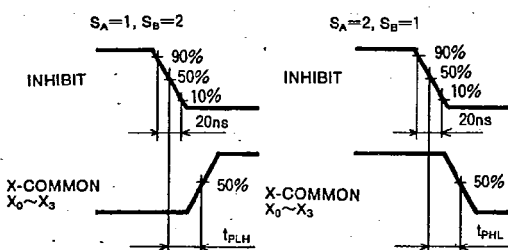


Refer to the function table for conditions of control inputs A and B.

**4 "L-H" and "H-L" output propagation time**  
(INHIBIT-X<sub>0</sub>-X<sub>3</sub>, X-COMMON)

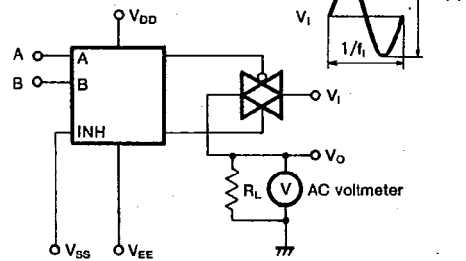


**TIMNG DIAGRAM**



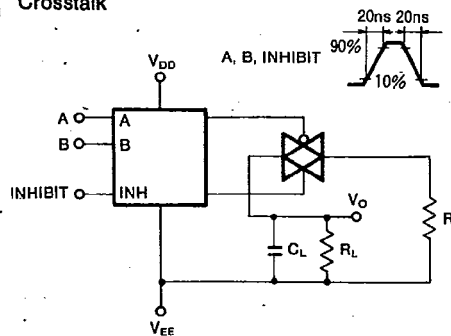
Refer to the function table for conditions of control inputs A and B.

**6 Feedthrough**



The feedthrough is taken as that frequency  $f_i$  at which, using a sine-wave input of  $2.5V_{P-P}$ ,  $20 \log_{10}(V_O/V_I) = -50\text{dB}$ . Refer to the function table for conditions of control inputs A and B.

**7 Crosstalk**



Refer to the function table for conditions of control inputs A and B.