

# M5201L, P, FP

## GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER (DUAL INPUT, SINGLE OUTPUT TYPE)

MITSUBISHI ELEK (LINEAR) 53E D

6249826 0014044 511 MIT2

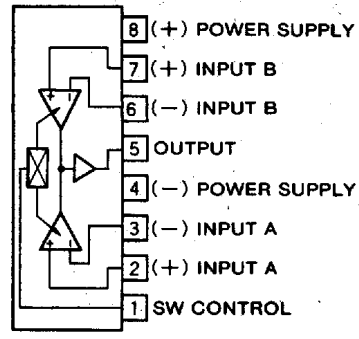
### DESCRIPTION

The M5201 is a semiconductor integrated circuit designed for an operational amplifier which adopts analog switch function, having dual inputs of A and B and a single output. The device comes in an 8-pin SIP, DIP or FP and contains input differential circuits of A and B type, single output circuit and a switching circuit of an operational amplifier, and can be used as a conventional operational amplifier, turning on A or B inputs by externally setting the control pin at high or low level. For a voltage follower condition where  $G_v = 0\text{dB}$ , the device functions merely as an analog switch, but, for an amplifier with a switching function, gain can be set independently for A and B inputs. The M5201 operational amplifier has basic characteristics similar to those of the M5218/M5R4558P and can be widely used as audio, video and musical instrument equipments.

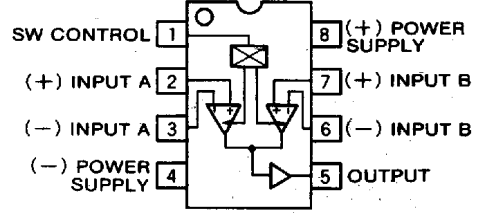
### FEATURES

- Operational amplifier inputs of A and B type and gain can be set independently
- Applicable to both single and dual power supplies
- High gain, low distortion  
.....  $G_{VO} = 100\text{dB}$ ,  $\text{THD} = 0.002\%$  (typ.)
- High slew rate, high  $f_T$  .....  $\text{SR} = 2.2\text{V}/\mu\text{s}$ ,  $f_T = 7\text{MHz}$  (typ.)
- Low noise ( $R_S = 1\text{k}\Omega$ ) FLAT .....  $V_{NI} = 2\mu\text{Vrms}$  (typ.)
- Small switching shock noise
- High load current, high power dissipation  
.....  $I_{LP} = \pm 50\text{mA}$ ,  $P_d = 800\text{mW}$  (SIP)  
 $P_d = 625\text{mW}$  (DIP)  
 $P_d = 440\text{mW}$  (FP)

### PIN CONFIGURATION (TOP VIEW)



Outline 8P5 (M5201L)

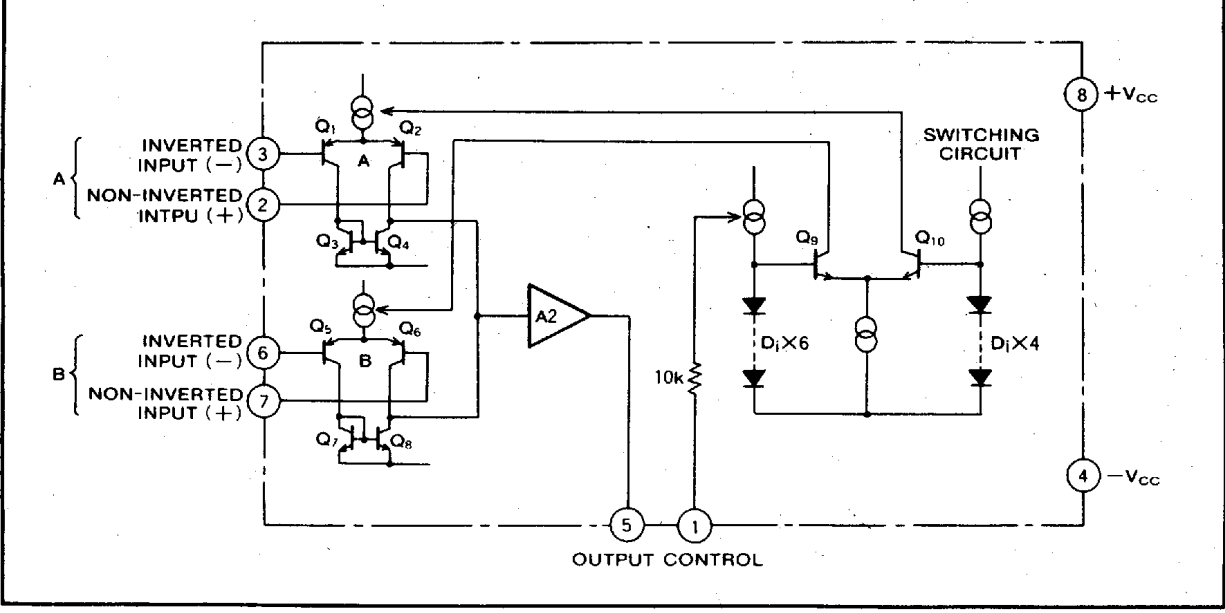


Outline 8P4 (M5201P)  
8P2S (M5201FP)

### RECOMMENDED OPERATING CONDITIONS

- Supply voltage range .....  $\pm 2.5 \sim \pm 16\text{V}$
- Rated supply voltage .....  $\pm 15\text{V}$

### EQUIVALENT CIRCUIT



**GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER  
(DUAL INPUT, SINGLE OUTPUT TYPE)**

**ABSOLUTE MAXIMUM RATINGS**

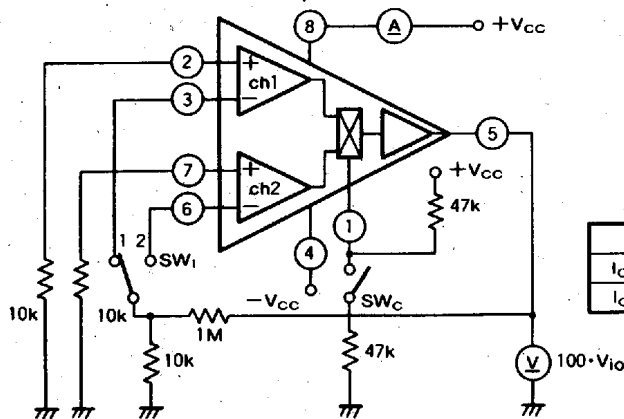
Symbol	Parameter	Ratings	Unit
$V_{CC}$	Supply voltage	$\pm 18(36)$	V
$V_{id}$	Differential input voltage	$\pm 30$	V
$V_{ic}$	Common phase input voltage	$\pm 15$	V
$I_{LP}$	Load current	$\pm 50$	mA
$P_d$	Power dissipation	800(SIP)/625(DIP)/440(FP)	mW
$T_{opr}$	Ambient temperature	$-20 \sim +75$	$^{\circ}C$
$T_{stg}$	Storage temperature	$-55 \sim +125$	$^{\circ}C$

**ELECTRICAL CHARACTERISTICS ( $V_{CC} = \pm 15V$ )**

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$I_{CC}$	Circuit current	$V_{in}$	SW ON	2.3	6.0	mA
			SW OFF	2.1	6.0	
$V_{IO}$	Input offset voltage	$R_S = 10k\Omega$		0.8	6.0	mV
$I_B$	Input bias current			80	500	nA
$G_{VO}$	Open loop voltage gain	$R_L = 2k\Omega$		100		dB
$V_{OM}$	Maximum output voltage	$R_L \geq 10k\Omega$	$\pm 12$	$\pm 14$		V
THD	Total harmonic distortion	$f = 1kHz, V_O = 5V_{rms}, G_V = 20dB$		0.002		%
SVR	Supply voltage rejection ratio			20	150	$\mu V/V$
C·S	Channel separation	$f = 1kHz$		82		dB
$f_T$	Gain bandwidth product	$G_V = 0dB$		7		MHz
SR	Slew rate	$G_V = 0dB, R_L = 2k\Omega // 100pF$		2.2		$V/\mu s$
$V_{NI}$	Input referred noise voltage	$R_S = 1k\Omega, BW = 10Hz \sim 30kHz, Flat$		2.0		$\mu V_{rms}$

**TEST CIRCUIT**

(1)  $I_{CC}, V_{IO}, SVR$



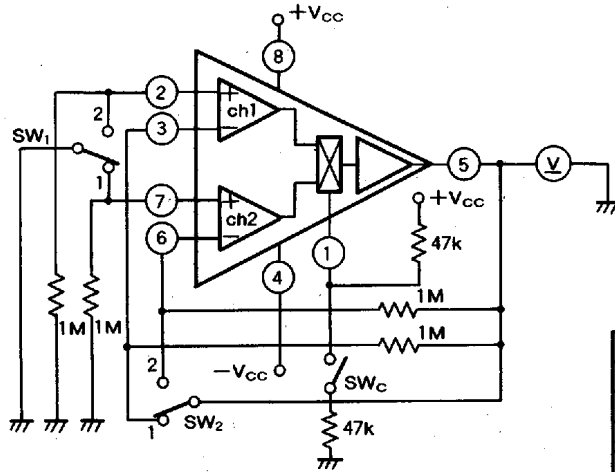
	SW <sub>C</sub>	SW <sub>I</sub>	Select ch
$I_{CC1}, V_{IO1}, SVR_1$	OFF	1	ch1
$I_{CC2}, V_{IO2}, SVR_2$	ON	2	ch2

Unit Resistance :  $\Omega$   
capacitance : F

**GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER  
 (DUAL INPUT, SINGLE OUTPUT TYPE)**

MITSUBISHI ELEK (LINEAR) 53E D ■ 6249826 0014046 394 ■ MIT2

(2)  $I_b, I_{io}$



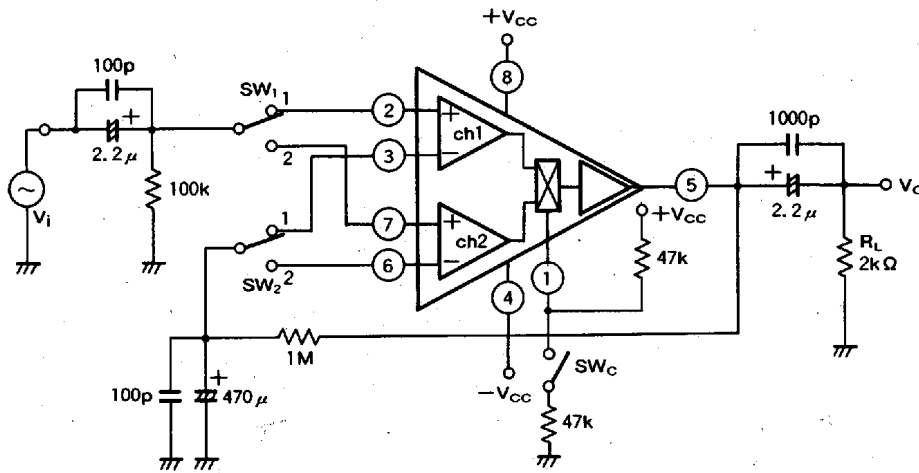
$$I_b^+ = V_{o1} / 1M\Omega$$

$$I_b^- = V_{o2} / 1M\Omega$$

$$I_{io} = |I_b^+ - I_b^-|$$

	SW <sub>C</sub>	SW <sub>1</sub>	SW <sub>2</sub>	Select ch
V <sub>o1</sub>	OFF	1	1	ch1
V <sub>o1</sub>	OFF	2	2	ch1
V <sub>o2</sub>	ON	2	2	ch2
V <sub>o2</sub>	ON	1	1	ch2

(3)  $f_t, G_v$



	SW <sub>C</sub>	SW <sub>1</sub>	SW <sub>2</sub>	Select ch
$f_{t1}, G_{v1}$	OFF	1	1	ch1
$f_{t2}, G_{v2}$	ON	2	2	ch2

Unit Resistance: Ω  
 Capacitance: F

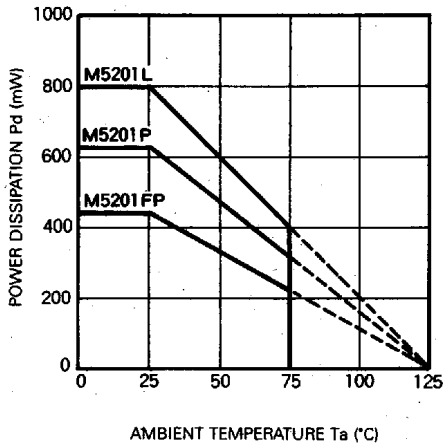
# M5201L, P, FP

## GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER (DUAL INPUT, SINGLE OUTPUT TYPE)

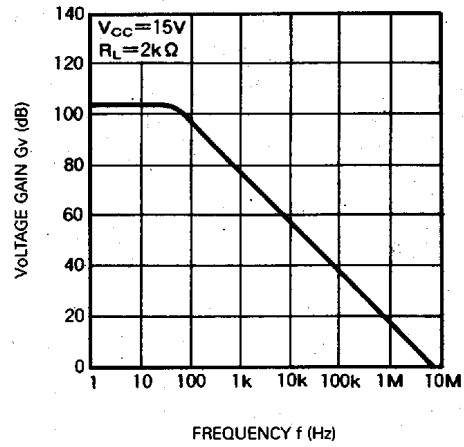
MITSUBISHI ELEK (LINEAR) 53E D ■ 6249826 0014047 220 ■ MIT2

### TYPICAL CHARACTERISTICS

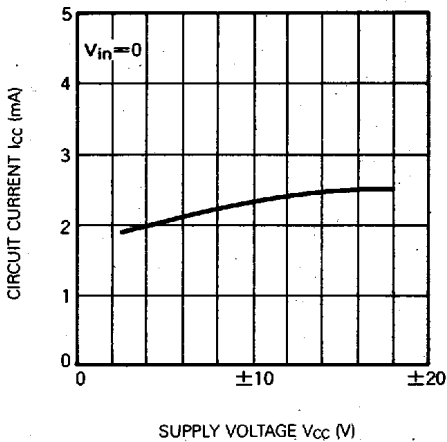
**THERMAL DERATING (MAXIMUM RATING)**



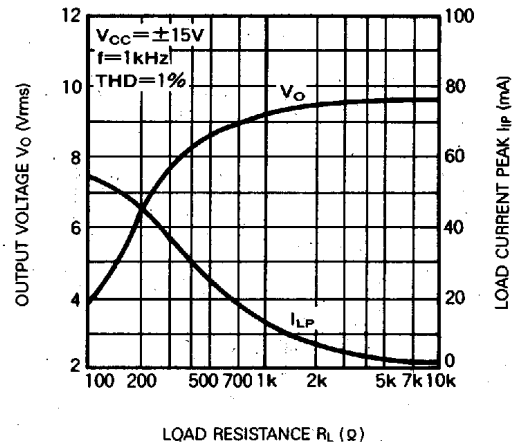
**VOLTAGE GAIN VS. FREQUENCY RESPONSE**



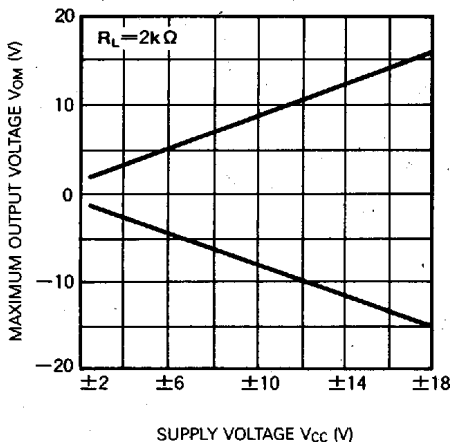
**CIRCUIT CURRENT VS. SUPPLY VOLTAGE**



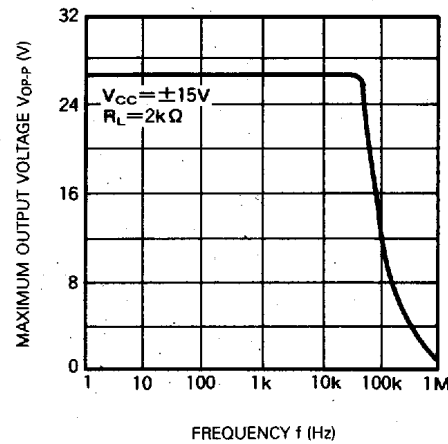
**OUTPUT VOLTAGE/LOAD CURRENT PEAK VS. LOAD RESISTANCE**



**MAXIMUM OUTPUT VOLTAGE VS. SUPPLY VOLTAGE**



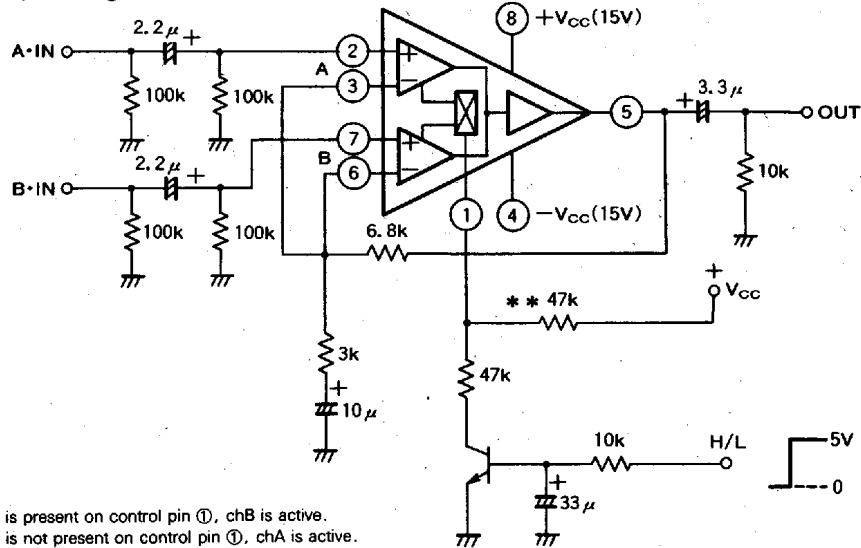
**MAXIMUM OUTPUT VOLTAGE VS. FREQUENCY RESPONSE**



**GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER  
 (DUAL INPUT, SINGLE OUTPUT TYPE)**

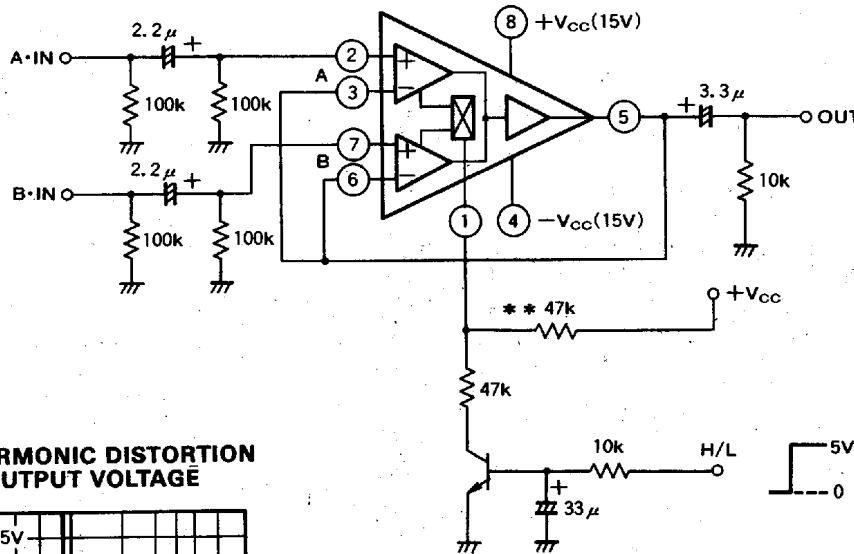
MITSUBISHI ELEK (LINEAR) 53E D ■ 6249826 0014048 167 ■ MIT2  
**APPLICATION CIRCUIT**

(1) FLAT amplifier ( $G_v \approx 10\text{dB}$ ) + analog switch circuit

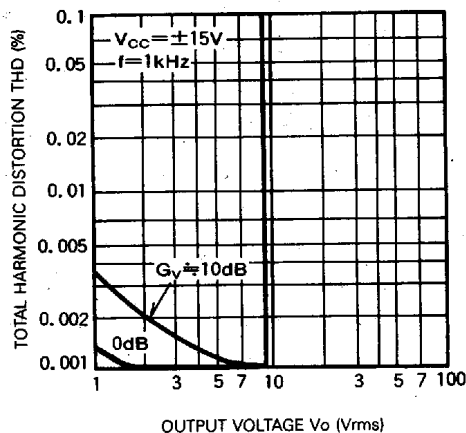


\* When the current is present on control pin ①, chB is active.  
 When the current is not present on control pin ①, chA is active.

(2) Analog switch circuit ( $D_v = 0\text{dB}$ , voltage follower amplifier)



**TOTAL HARMONIC DISTORTION  
 VS. OUTPUT VOLTAGE**

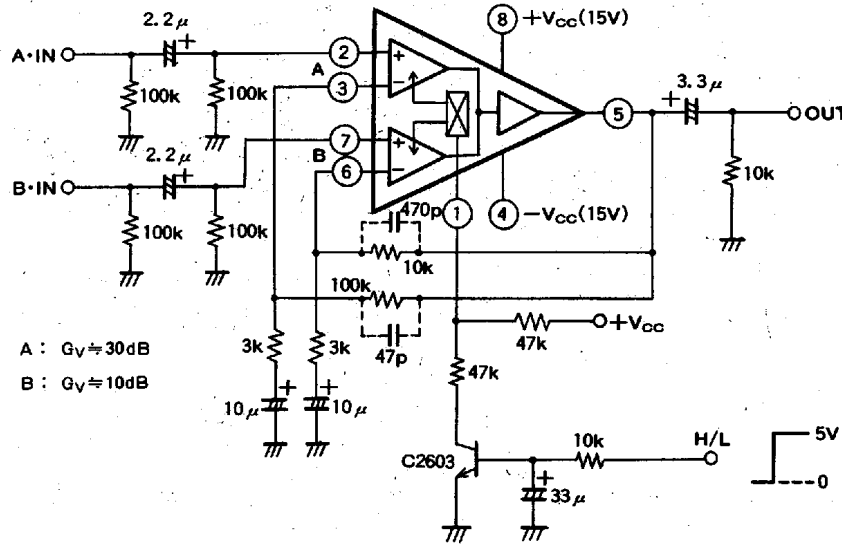


A resistor indicated by \*\* is a pull-up resistor to prevent switching pin ① from being activated by the leak current from an external circuit (i.e. TR).

**GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER  
(DUAL INPUT, SINGLE OUTPUT TYPE)**

MITSUBISHI ELEK (LINEAR)  
TYPICAL APPLICATION CIRCUIT

53E D ■ 6249826 0014049 0T3 ■ MIT2



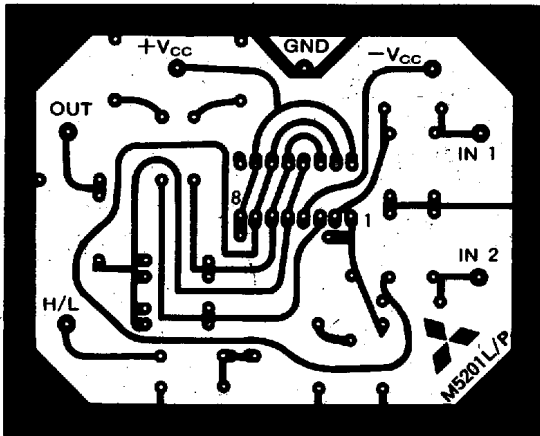
※When the current is present on control pin ①, chB is active. When the current is not present on control pin ①, chA is active.

Unit Resistance: Ω  
Capacitance: F

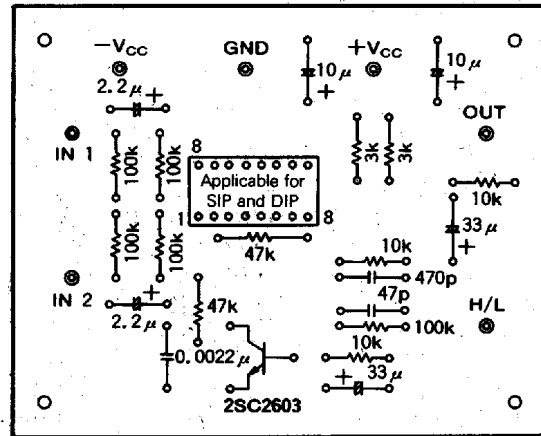
A :  $G_V \approx 30\text{dB}$   
B :  $G_V \approx 10\text{dB}$

**PCB FOR CIRCUIT TESTING**

**WIRING ON THE PCB**



**(PARTS INSERTION SIDE)**



**GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER  
 (DUAL INPUT, SINGLE OUTPUT TYPE)**

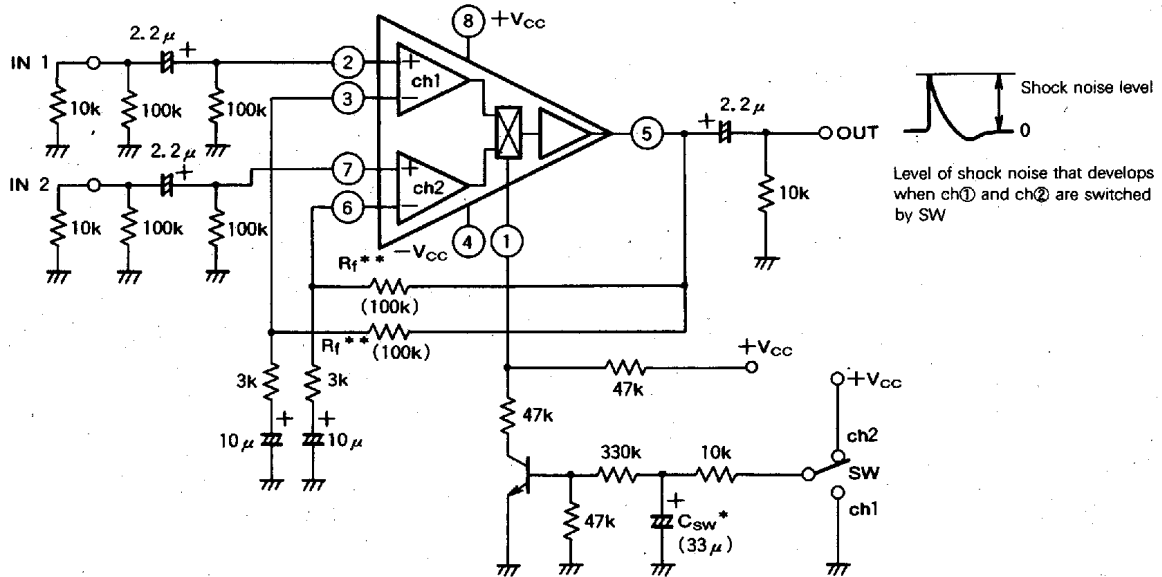
MITSUBISHI ELEK (LINEAR) 53E D

53E D

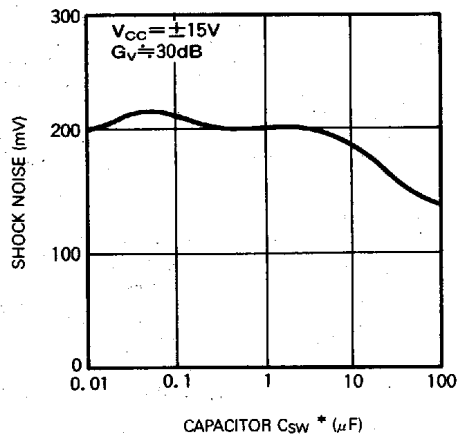
6249826 0014050 815 MIT2

**SHOCK NOISE MEASUREMENT**

**TEST CIRCUIT**

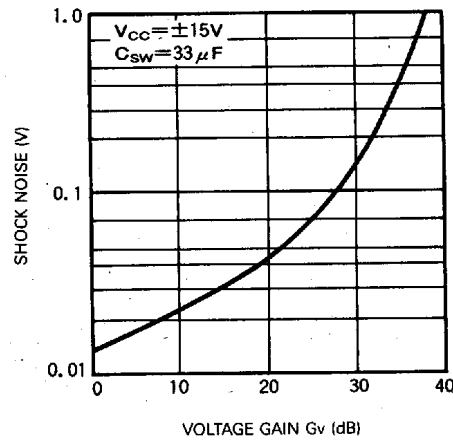


**SHOCK NOISE VS. CAPACITOR  $C_{sw}$**



\* Characteristic of shock noise with respect to change of  $C_{sw}$

**SHOCK NOISE VS. VOLTAGE GAIN**

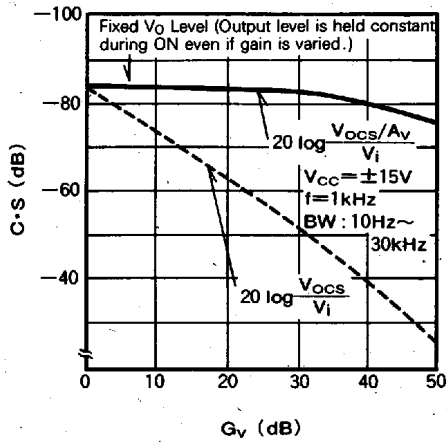


\*\* Characteristic of shock noise with respect to voltage gain varied by  $R_1$ .

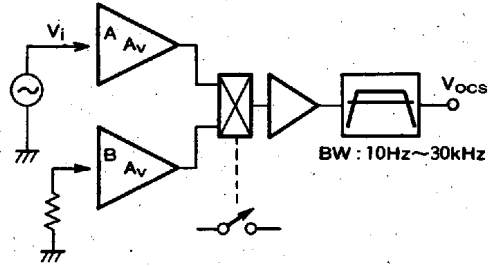
**GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER  
(DUAL INPUT, SINGLE OUTPUT TYPE)**

MITSUBISHI ELEK (LINEAR) 53E D ■ 6249826 0014051 751 ■ MIT2

**CHANNEL SEPARATION (C-S)**



(A: OFF/B: IN ON MODE)



$$C-S = 20 \log \left[ \frac{\text{INPUT LEAK LEVEL}}{\text{SIGNAL LEVEL}} \right] \text{ (dB)}$$

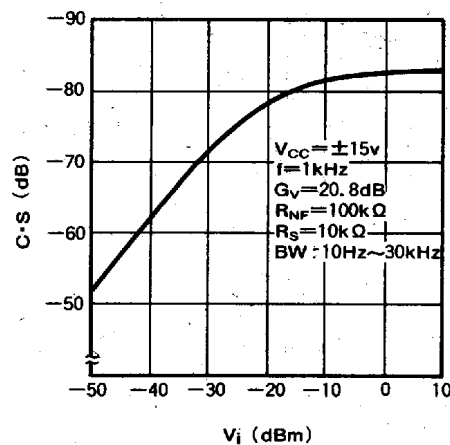
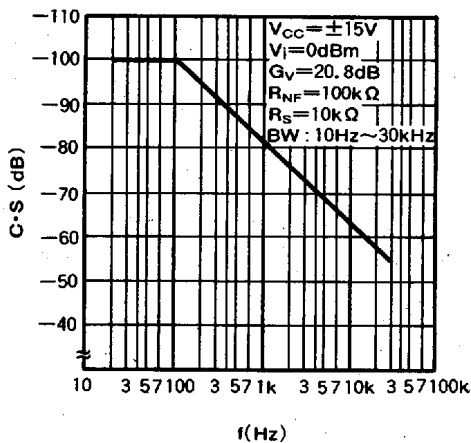
$$= 20 \log \frac{V_{ocs}/A_v}{V_i} \text{ (dB)}$$

Channel separation is defined as the ratio of the leak signal (that is scaled on the assumption it is present in the input) to the input signal.

$$\left( 20 \log \frac{V_{ocs}/A_v}{V_i} \right)$$

However, as indicated by the above broken line, if gain ( $A_v$ ) is not scaled, channel separation appears to be deteriorated by as much as the amplified amount.

$$\left( 20 \log \frac{V_{ocs}}{V_i} \right)$$

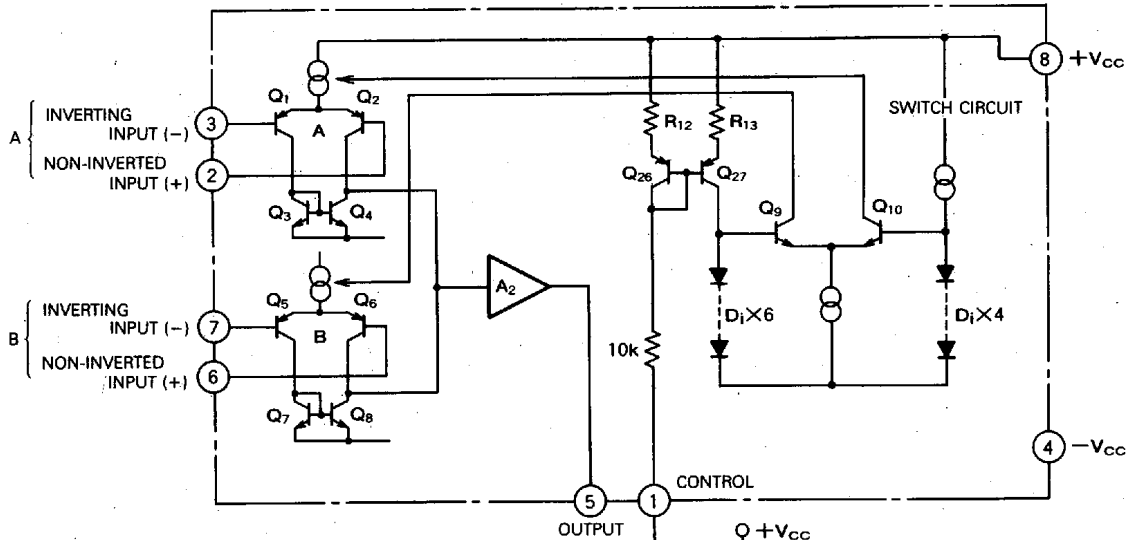




**GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER  
 (DUAL INPUT, SINGLE OUTPUT TYPE)**

MITSUBISHI ELEK (LINEAR) 53E D ■ 6249826 0014052 698 ■ MIT2

**SWITCHING MECHANISM**



As shown in the above figure, the M5201 transfers switching signals by externally feeding the current to the  $V_F$  on the  $Q_{26}$  side of the current mirror transistor circuit (which consists of transistors  $Q_{26}$  and  $Q_{27}$ ). That is, when no current is fed to pin ①,  $Q_{10}$  is turned on by four diodes connected to  $Q_{10}$  to activate the amplifier for channel A. When current is fed to pin ①, the collector current to  $Q_9$  flows to turn on the six diodes connected to  $Q_9$  and channel B is activated. Thus, applying and removing current to/from pin ① switches an active channel, therefore, M5203 can arbitrarily control the driving method regardless of the type of power supply (single or dual).

It is recommended to connect a pull-up resistor  $R_p$  to pin ① to reduce the current sensitivity of transistor  $Q_{26}$  because a very small current may turn on the  $V_F$ .

