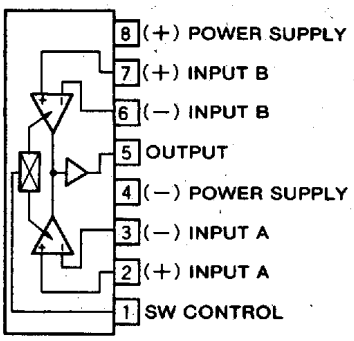
M5201L, P, FP

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

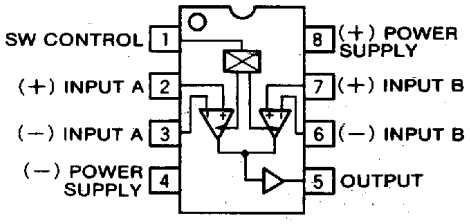
DESCRIPTION

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 convertional 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 $G_V = 0dB$, 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.

PIN CONFIGURATION (TOP VIEW)



Outline 8P5 (M5201L)



Outline 8P4 (M5201P)
8P2S (M5201FP)

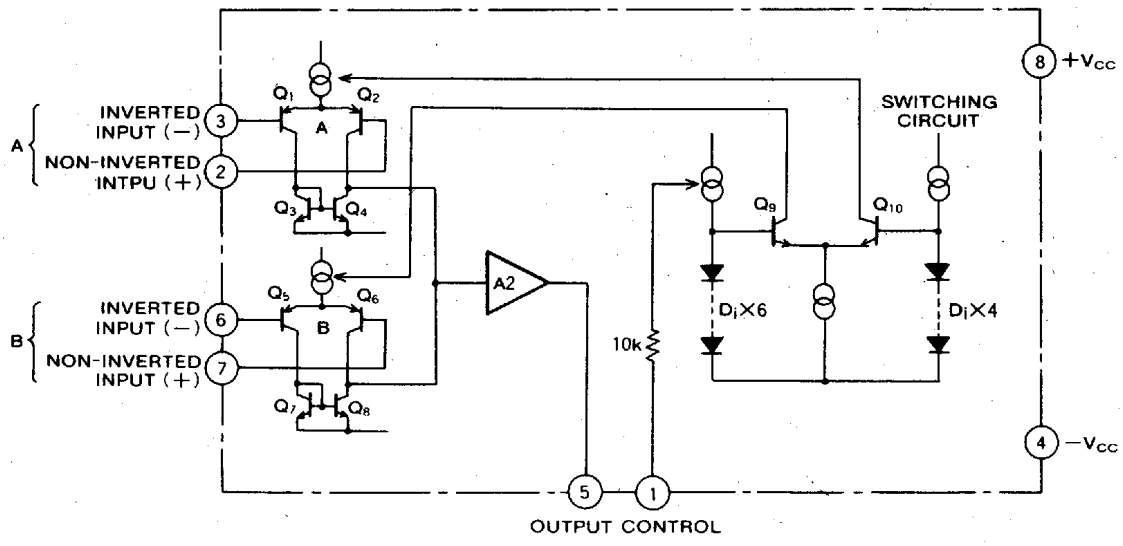
FEATURES

- 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 ..... $G_{VO}=100dB$, THD=0.002%(typ.)
- High slew rate, high f_T ..... SR=2.2V/μs, f_T=7MHz(typ.)
- Low noise ($R_S=1k\Omega$) FLAT ..... $V_{NI}=2\mu Vrms$(typ.)
- Small switching shock noise
- High load current, high power dissipation ..... $I_{LP}=\pm50mA$, P_d=800mW(SIP), P_d=625mW(DIP), P_d=440mW(FP)

RECOMMENDED OPERATING CONDITIONS

Supply voltage range ..... ±2.5~±16V
Rated supply voltage ..... ±15V

EQUIVALENT CIRCUIT



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

ABSOLUTE MAXIMUM RATINGS

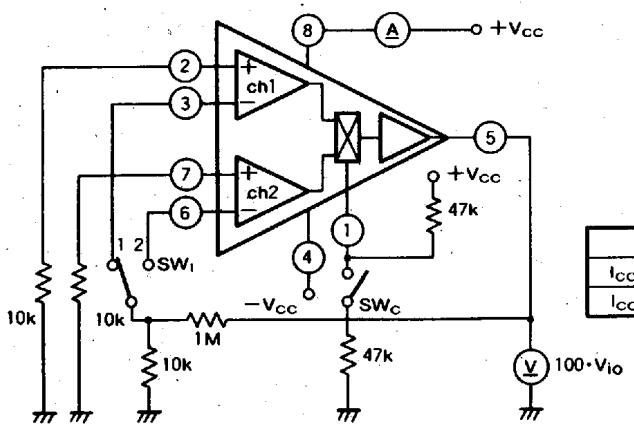
Symbol	Parameter	Ratings	Unit
V_{CC}	Supply voltage	±18(36)	V
V_{id}	Differential input voltage	±30	V
V_{ic}	Common phase input voltage	±15	V
I_{LP}	Load current	±50	mA
P_d	Power dissipation	800(SIP)/625(DIP)/440(FP)	mW
T_{opr}	Ambient temperature	−20～+75	℃
T_{stg}	Storage temperature	−55～+125	℃

ELECTRICAL CHARACTERISTICS (V_{CC}=±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=10kΩ			0.8	6.0	mV
I_B	Input bias current				80	500	nA
G_{VO}	Open loop voltage gain	R_L=2kΩ			100		dB
V_{OM}	Maximum output voltage	R_L≧10kΩ		±12	±14		V
THD	Total harmonic distortion	f=1kHz, V_O=5Vrms, G_V=20dB			0.002		%
SVR	Supply voltage rejection ratio				20	150	μV/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=2kΩ//100pF			2.2		V/μs
V_{NI}	Input refferred noise voltage	R_S=1kΩ, BW=10Hz～30kHz, Flat			2.0		μVrms

TEST CIRCUIT

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

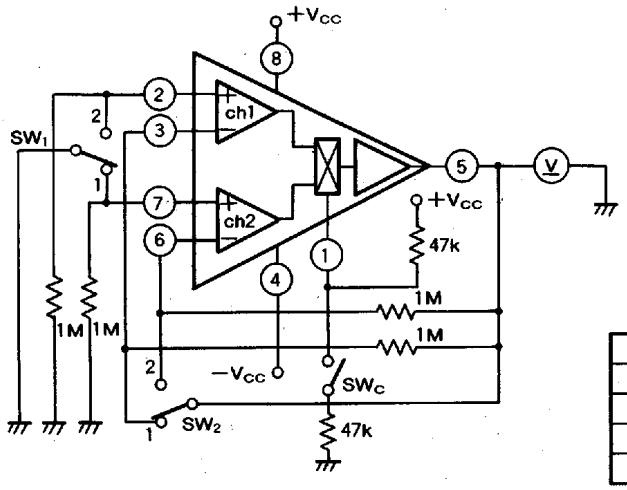


	SW_C	SW_1	Select ch
I_{CC1}, V_{IO1}, SVR_1	OFF	1	ch1
I_{CC2}, V_{IO2}, SVR_2	ON	2	ch2

Unit Resistance : Ω
capacitance : F

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

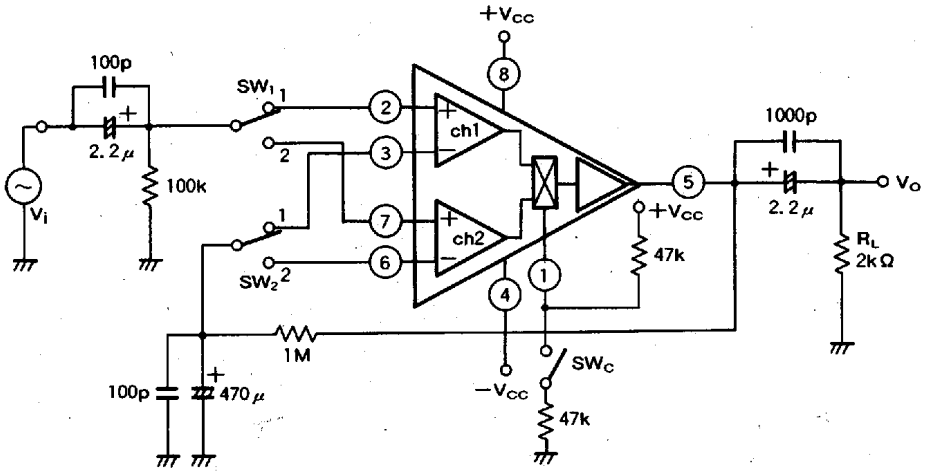
(2) I_b, I_{io}



$I_b^+ = V_o^+ / 1M\Omega$
$I_b^- = V_o^- / 1M\Omega$
$I_{io} = | I_b^+ - I_b^- |$

	SW_C	SW_1	SW_2	Select ch
V_{O1}	OFF	1	1	ch1
V_{O1}	OFF	2	2	ch1
V_{O2}	ON	2	2	ch2
V_{O2}	ON	1	1	ch2

(3) f_t, G_V



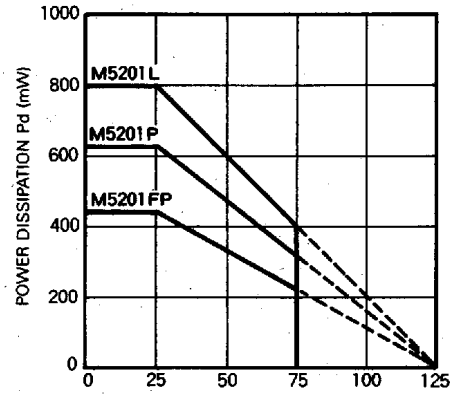
	SW_C	SW_1	SW_2	Select ch
f_{t1}, G_{V1}	OFF	1	1	ch1
f_{t2}, G_{V2}	ON	2	2	ch2

Unit Resistance: Ω
Capacitance: F

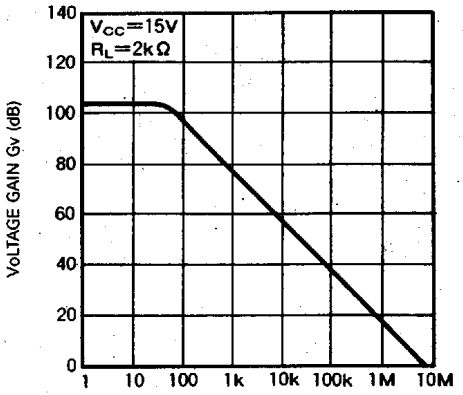
GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER (DUAL INPUT, SINGLE OUTPUT TYPE)

TYPICAL CHARACTERISTICS

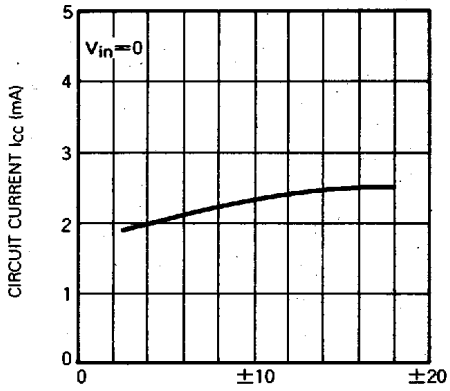
THERMAL DERATING (MAXIMUM RATING)



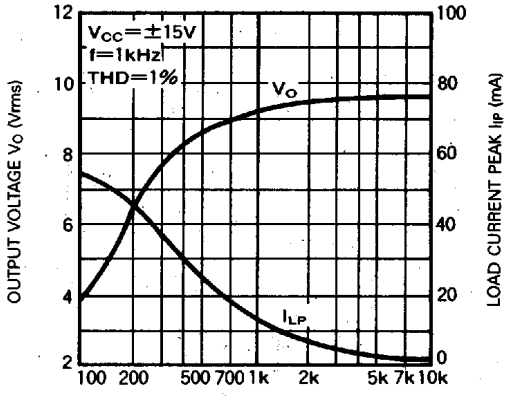
VOLTAGE GAIN VS. FREQUENCY RESPONSE



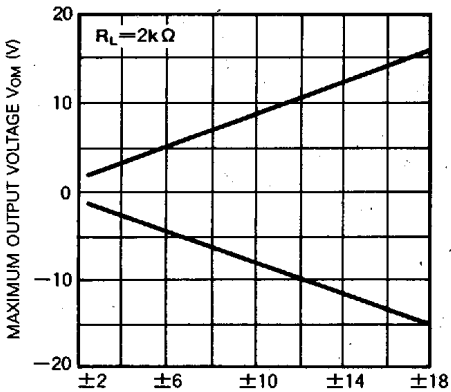
CIRCUIT CURRENT VS. SUPPLY VOLTAGE



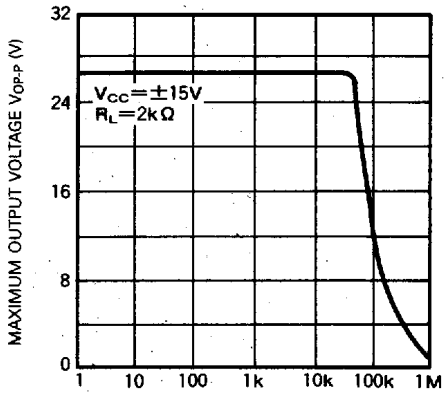
OUTPUT VOLTAGE/LOAD CURRENT PEAK VS. LOAD RESISTANCE



MAXIMUM OUTPUT VOLTAGE VS. SUPPLY VOLTAGE



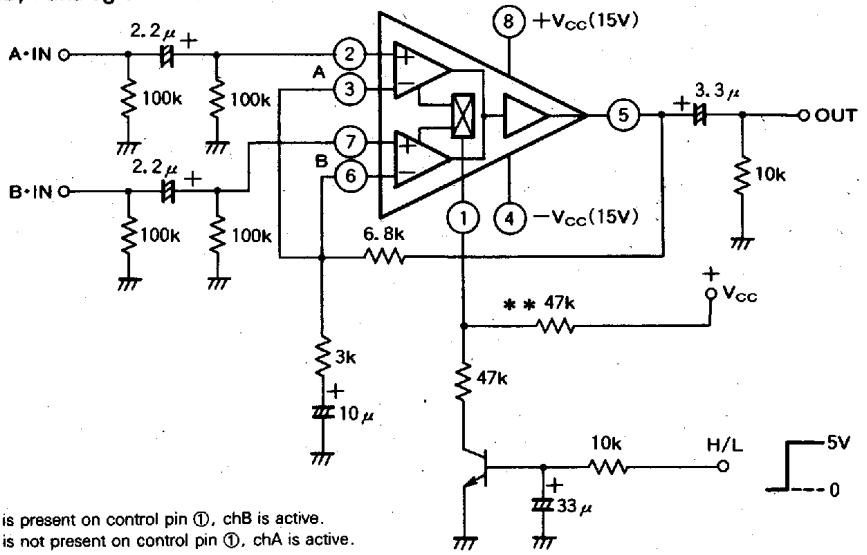
MAXIMUM OUTPUT VOLTAGE VS. FREQUENCY RESPONSE



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

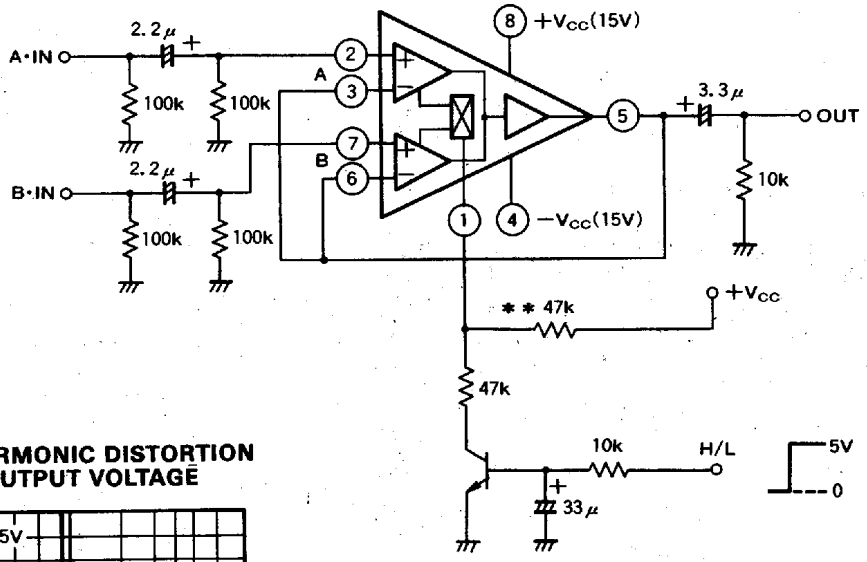
APPLICATION CIRCUIT

(1) FLAT amplifier (Gv≒10dB)+analog switch circuit



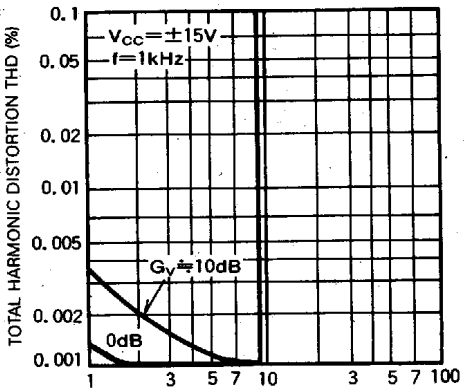
*When the current is present on control pin ①, chB is active.
When the current is not present on control pin ①, chA is active.

(2) Analog switch circuit (Dv=0dB, voltage follower amplifier)



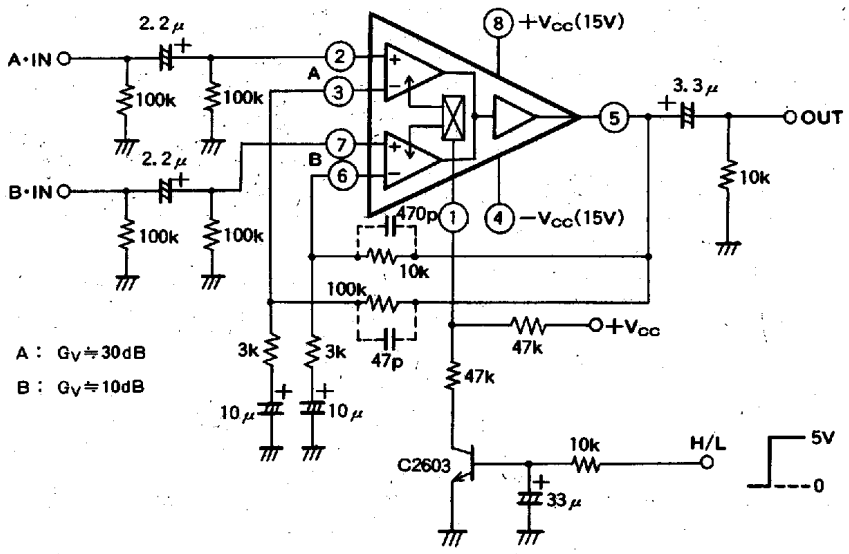
A resistor indicated by ** is a pull-up resistor to prevent switching pin ① from being activated by the leak current from an external circuit (i.e. TR).

TOTAL HARMONIC DISTORTION VS. OUTPUT VOLTAGE



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

TYPICAL APPLICATION CIRCUIT

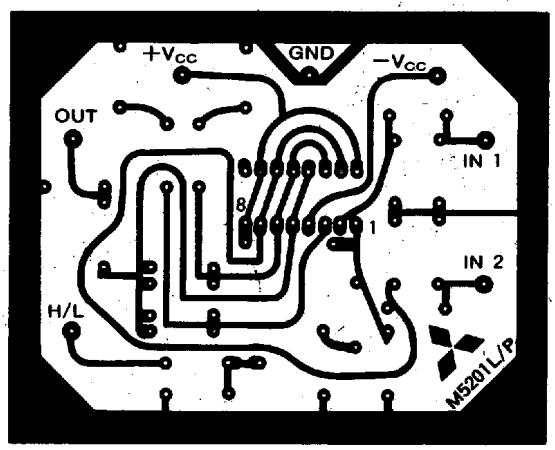


*When the current is present on control pin ①, chB is active. When the current is not present on control pin ①, chA is active.

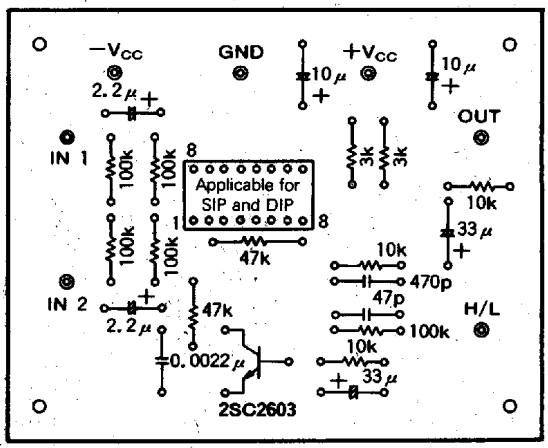
Unit Resistance: Ω
Capacitance: F

PCB FOR CIRCUIT TESTING

WIRING ON THE PCB



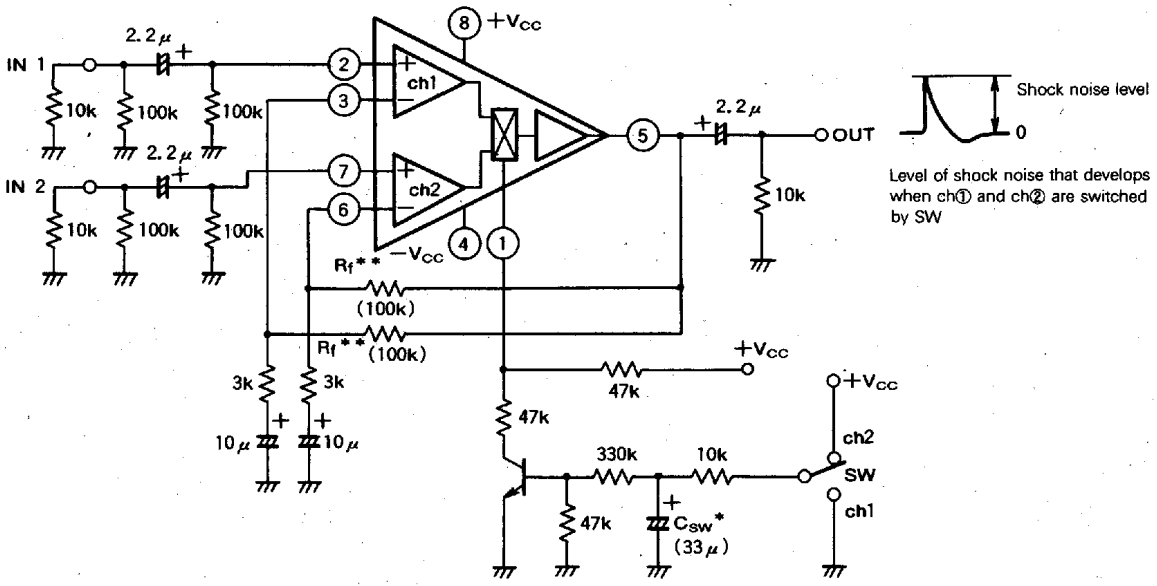
(PARTS INSERTION SIDE)



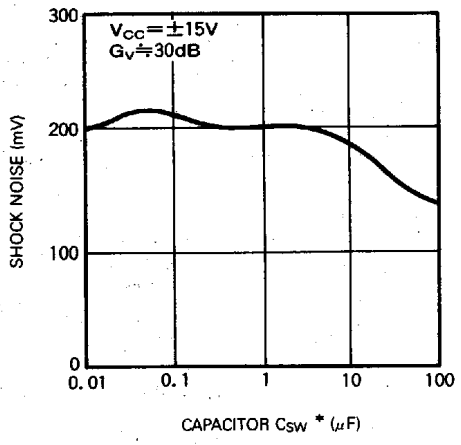
GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER (DUAL INPUT, SINGLE OUTPUT TYPE)

SHOCK NOISE MEASUREMENT

TEST CIRCUIT

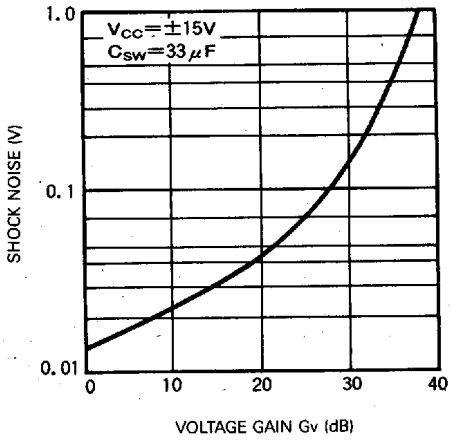


SHOCK NOISE VS. CAPACITOR Csw



*Characteristic of shock noise with respect to change of Csw

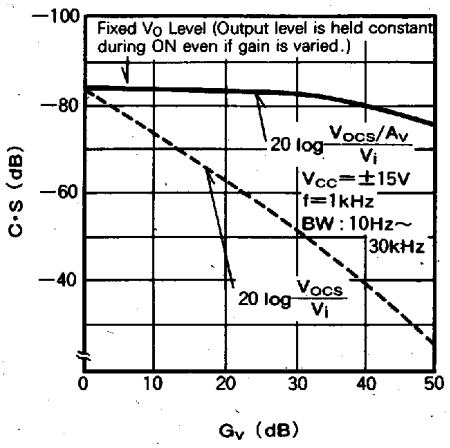
SHOCK NOISE VS. VOLTAGE GAIN



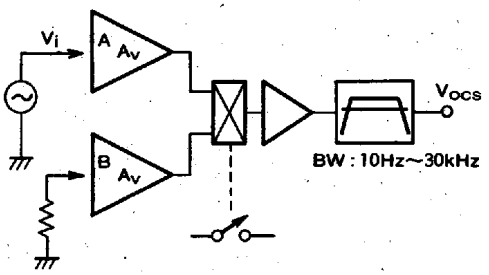
**Characteristic of shock noise with respect to voltage gain varied by R1.

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

CHANNEL SEPARATION (C·S)



(A:OFF/B:IN ON MODE)



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

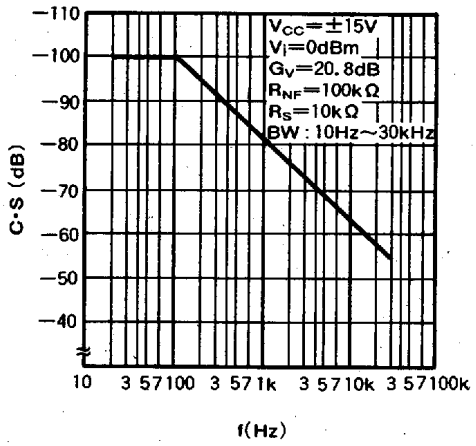
$$= 20 \log \frac{V_{OCS}/A_V}{V_i} \text{(dB)}$$

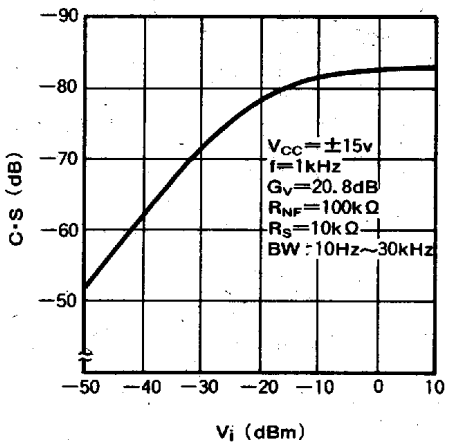
Channel separation is defined as the ratio of the leak signal (that is scaled on the assumption it is present in the input) to the input signal.

$(20 \log \frac{V_{OCS}/A_V}{V_i})$

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

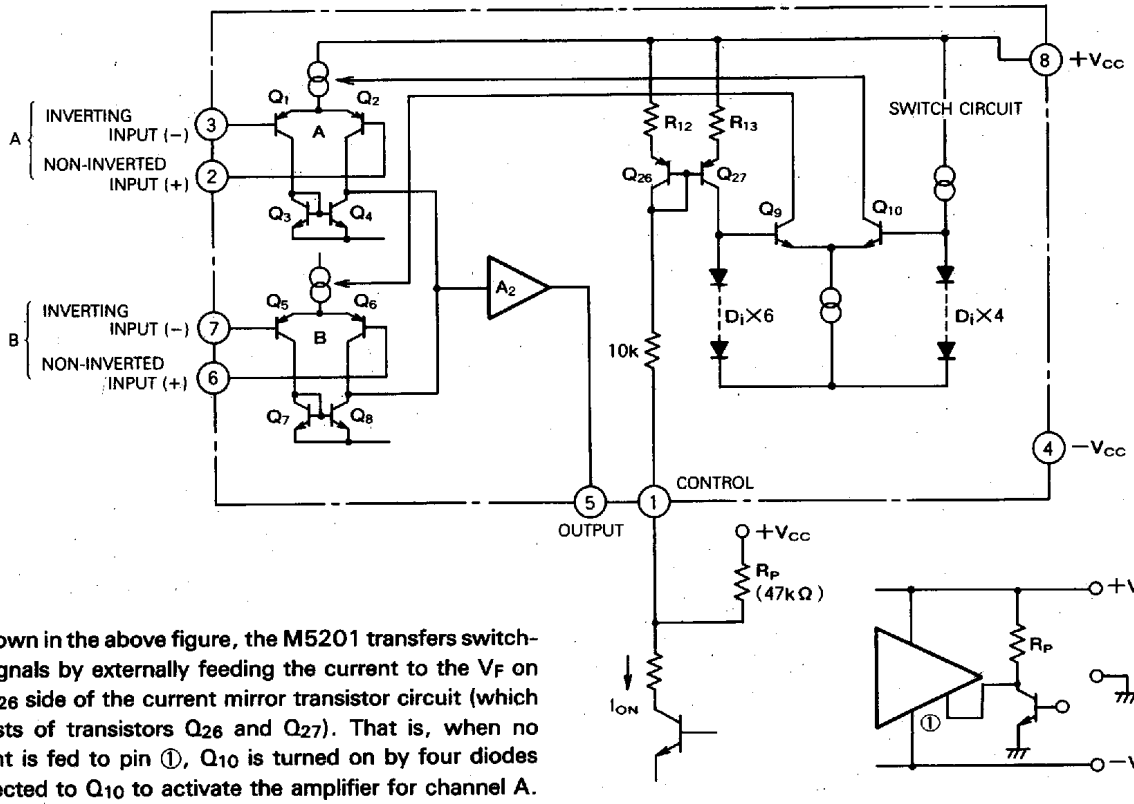
$(20 \log \frac{V_{OCS}}{V_i})$

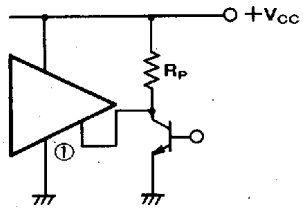




GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER (DUAL INPUT, SINGLE OUTPUT TYPE)

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 are removing current to/from pin ① switches an active channel, therefore, M5203 can arbituraly 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 the reduce current sensitivity of transistor Q_{26} because a very small current may turn on the V_F.