M5201L, P, FP

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

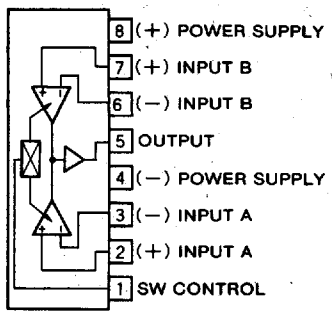
DESCRIPTION

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.

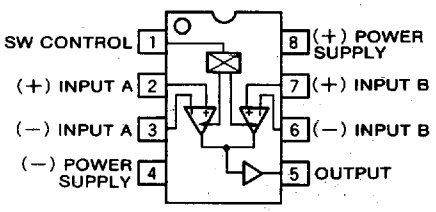
FEATURES

- 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=1kΩ) FLAT ..... $V_{NI}=2\mu Vrms$(typ.)
- Small switching shock noise
- High load current, high power dissipation ..... $I_{LP}=\pm 50mA$, P_d=800mW(SIP), P_d=625mW(DIP), P_d=440mW(FP)

PIN CONFIGURATION (TOP VIEW)



Outline 8P5 (M5201L)

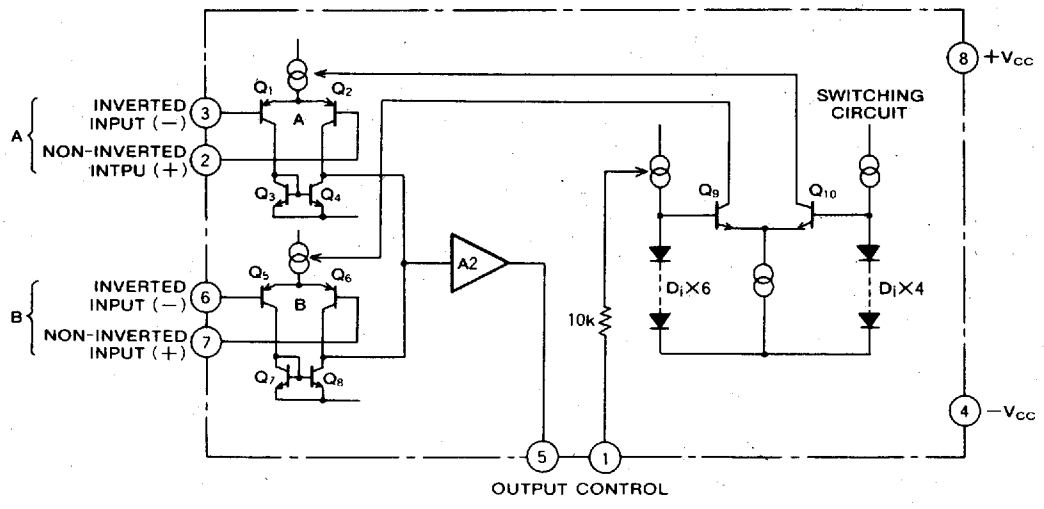


Outline 8P4 (M5201P)
8P2S (M5201FP)

RECOMMENDED OPERATING CONDITIONS

Supply voltage range ..... $\pm 2.5 \sim \pm 16V$
Rated supply voltage ..... $\pm 15V$

EQUIVALENT CIRCUIT



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

ABSOLUTE MAXIMUM RATINGS

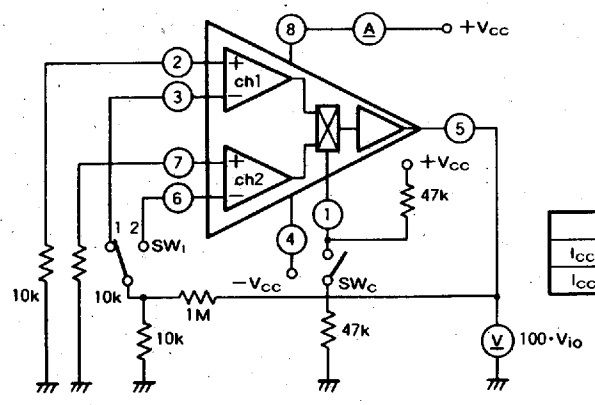
Symbol	Parameter	Ratings	Unit
V_{CC}	Supply voltage	±18(36)	V
V_{id}	Differential input voltage	±30	V
V_{ic}	Common phase input voltage	±15	V
I_{LP}	Load current	±50	mA
P_d	Power dissipation	800(SIP)/625(DIP)/440(FP)	mW
T_{opr}	Ambient temperature	−20～+75	℃
T_{stg}	Storage temperature	−55～+125	℃

ELECTRICAL CHARACTERISTICS (V_{CC}=±15V)

Symbol	Parameter	Test conditions		Limits Min	Limits Typ	Limits Max	Unit
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

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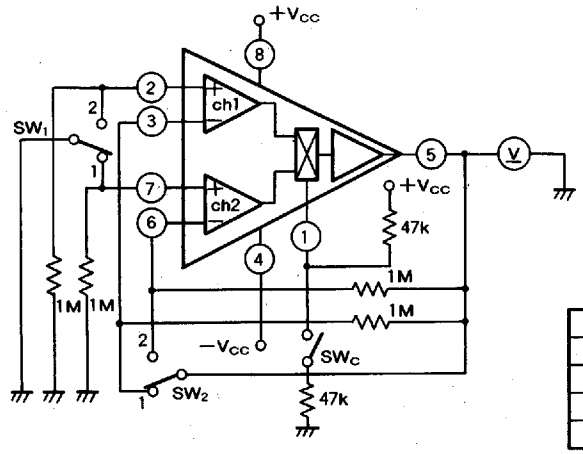
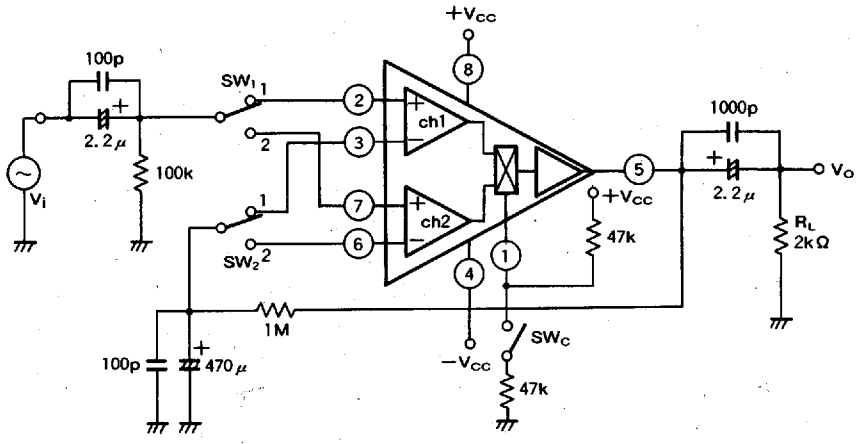
(2) I_b, I_{io}



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

	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



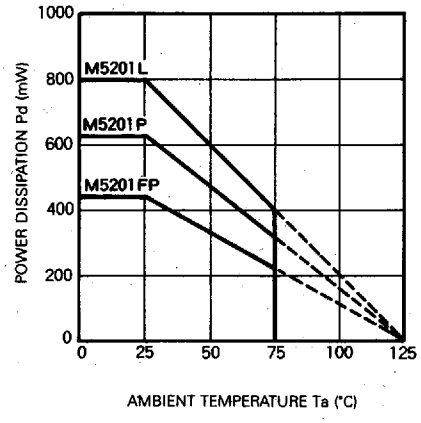
	SW_C	SW_1	SW_2	Select ch
f_{t1}, G_{V1}	OFF	1	1	ch1
f_{t2}, G_{V2}	ON	2	2	ch2

Unit Resistance: Ω
Capacitance: F

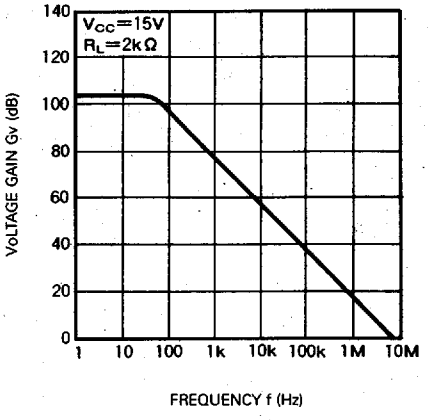
GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER (DUAL INPUT, SINGLE OUTPUT TYPE)

TYPICAL CHARACTERISTICS

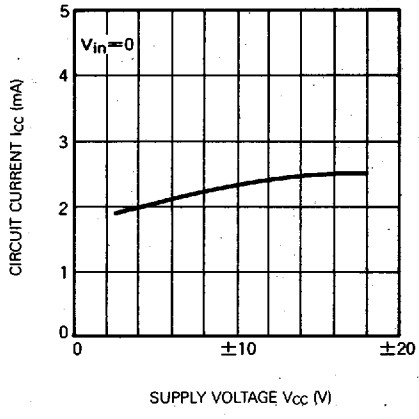
THERMAL DERATING (MAXIMUM RATING)



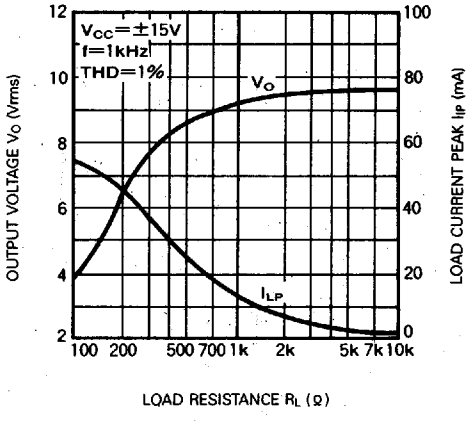
VOLTAGE GAIN VS. FREQUENCY RESPONSE



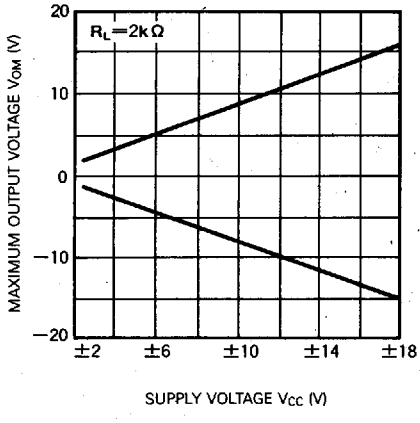
CIRCUIT CURRENT VS. SUPPLY VOLTAGE



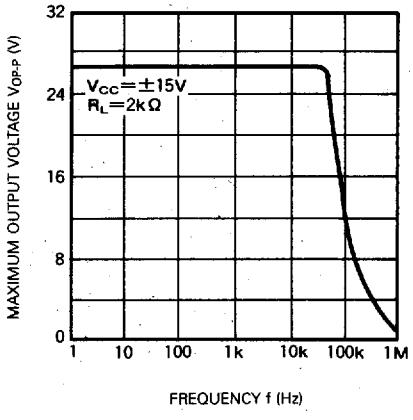
OUTPUT VOLTAGE/LOAD CURRENT PEAK VS. LOAD RESISTANCE



MAXIMUM OUTPUT VOLTAGE VS. SUPPLY VOLTAGE



MAXIMUM OUTPUT VOLTAGE VS. FREQUENCY RESPONSE



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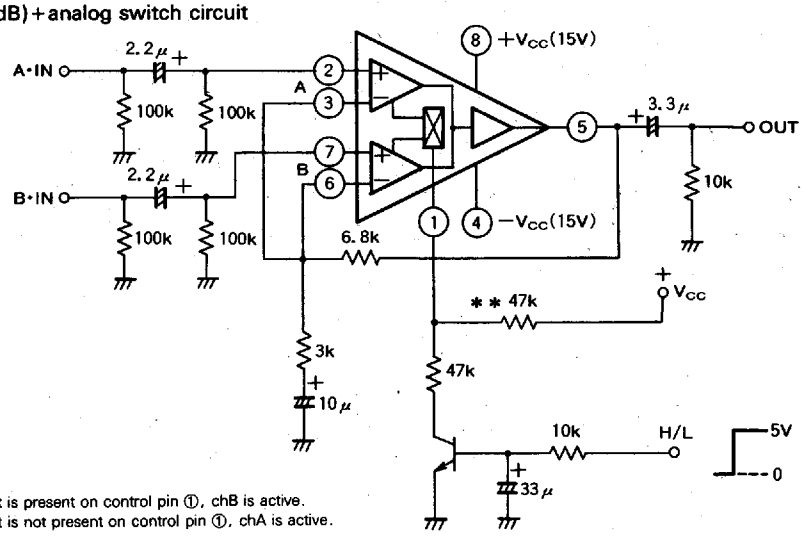
GENERAL PURPOSE SWITCHING OPERATIONAL AMPLIFIER (DUAL INPUT, SINGLE OUTPUT TYPE)

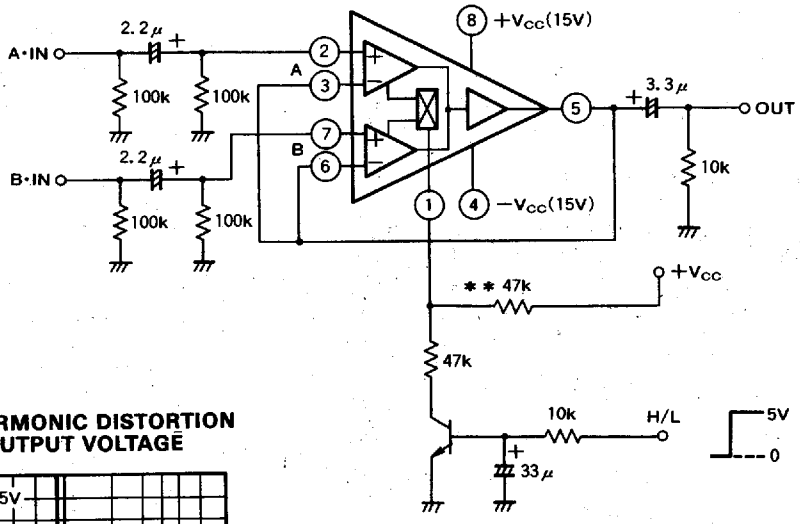
APPLICATION CIRCUIT

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

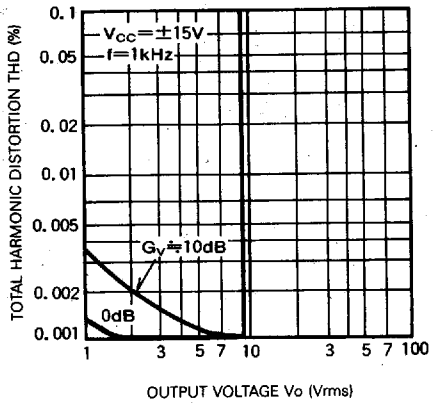


*When the current is present on control pin ①, chB is active.
When the current is not present on control pin ①, chA is active.

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



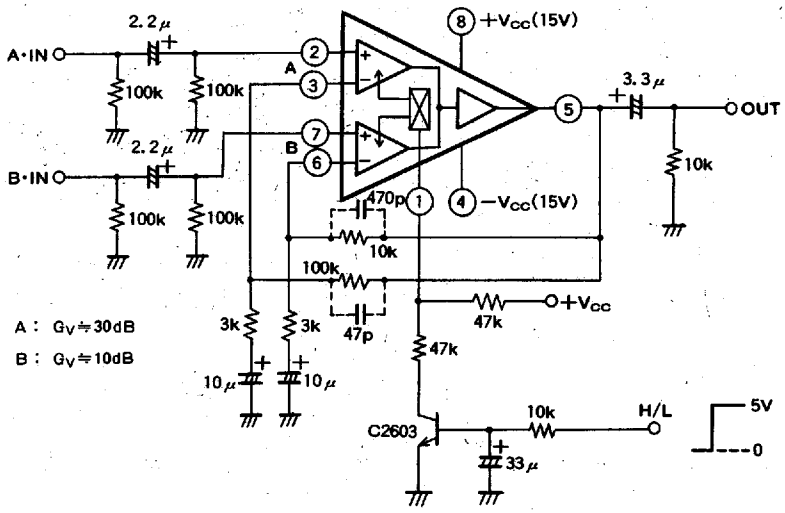
TOTAL HARMONIC DISTORTION VS. OUTPUT VOLTAGE



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)

TYPICAL APPLICATION CIRCUIT

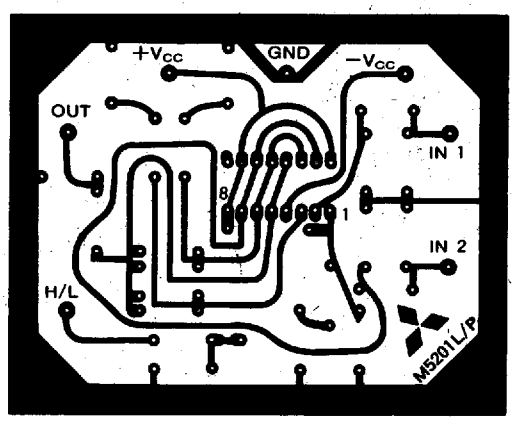


*When the current is present on control pin ①, chB is active. When the current is not present on control pin ①, chA is active.

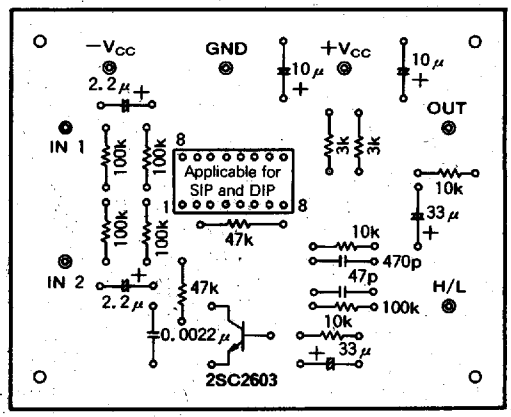
Unit Resistance: Ω
Capacitance: F

PCB FOR CIRCUIT TESTING

WIRING ON THE PCB



(PARTS INSERTION SIDE)



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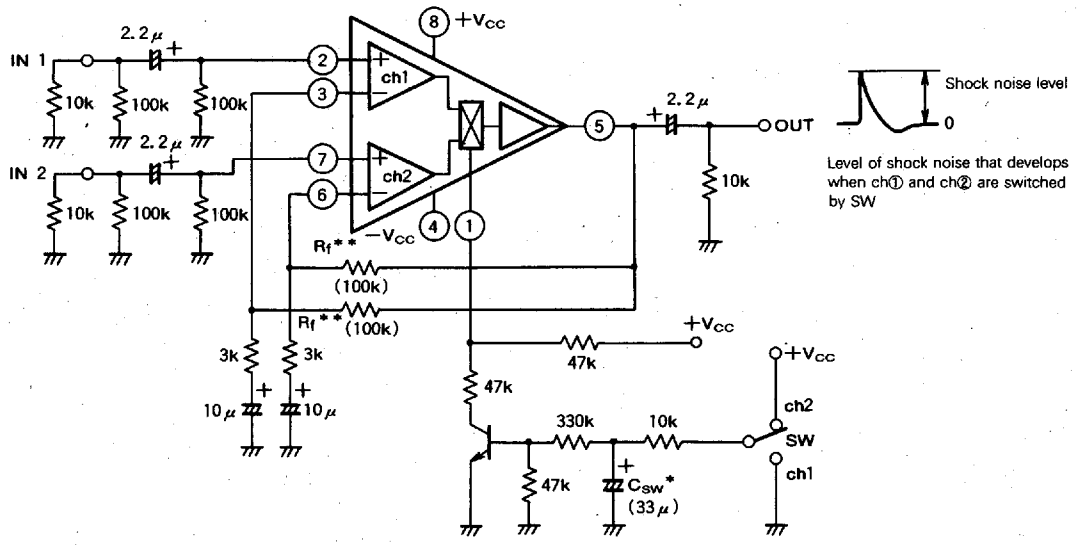
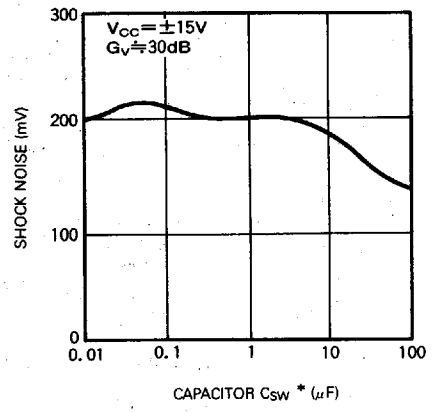
SHOCK NOISE MEASUREMENT

TEST CIRCUIT

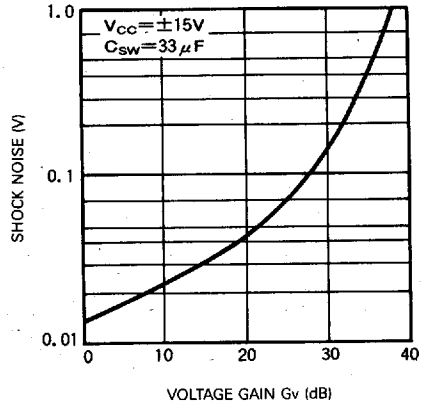


SHOCK NOISE VS. CAPACITOR Csw



* Characteristic of shock noise with respect to change of Csw

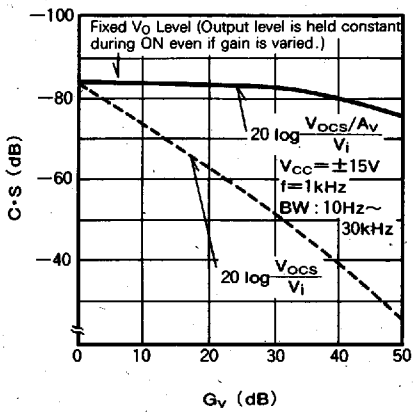
SHOCK NOISE VS. VOLTAGE GAIN



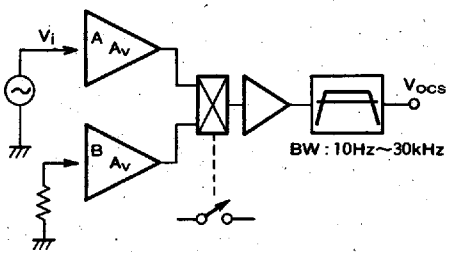
** Characteristic of shock noise with respect to voltage gain varied by R1.

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

CHANNEL SEPARATION (C·S)



(A:OFF/B:IN ON MODE)



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

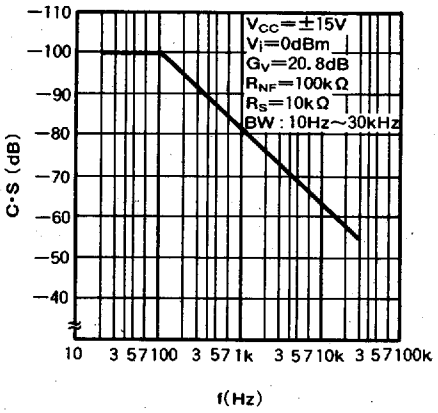
$$= 20 \log \frac{V_{OCS}/A_V}{V_i} \text{(dB)}$$

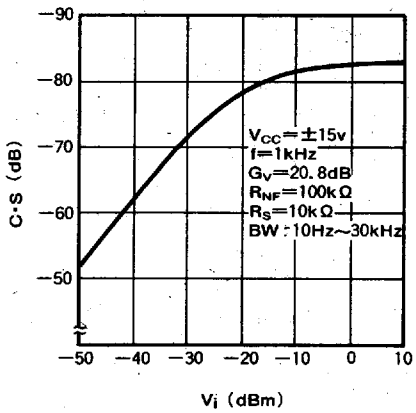
Channel separation is defined as the ratio of the leak signal (that is scaled on the assumption it is present in the input) to the input signal.

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

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.

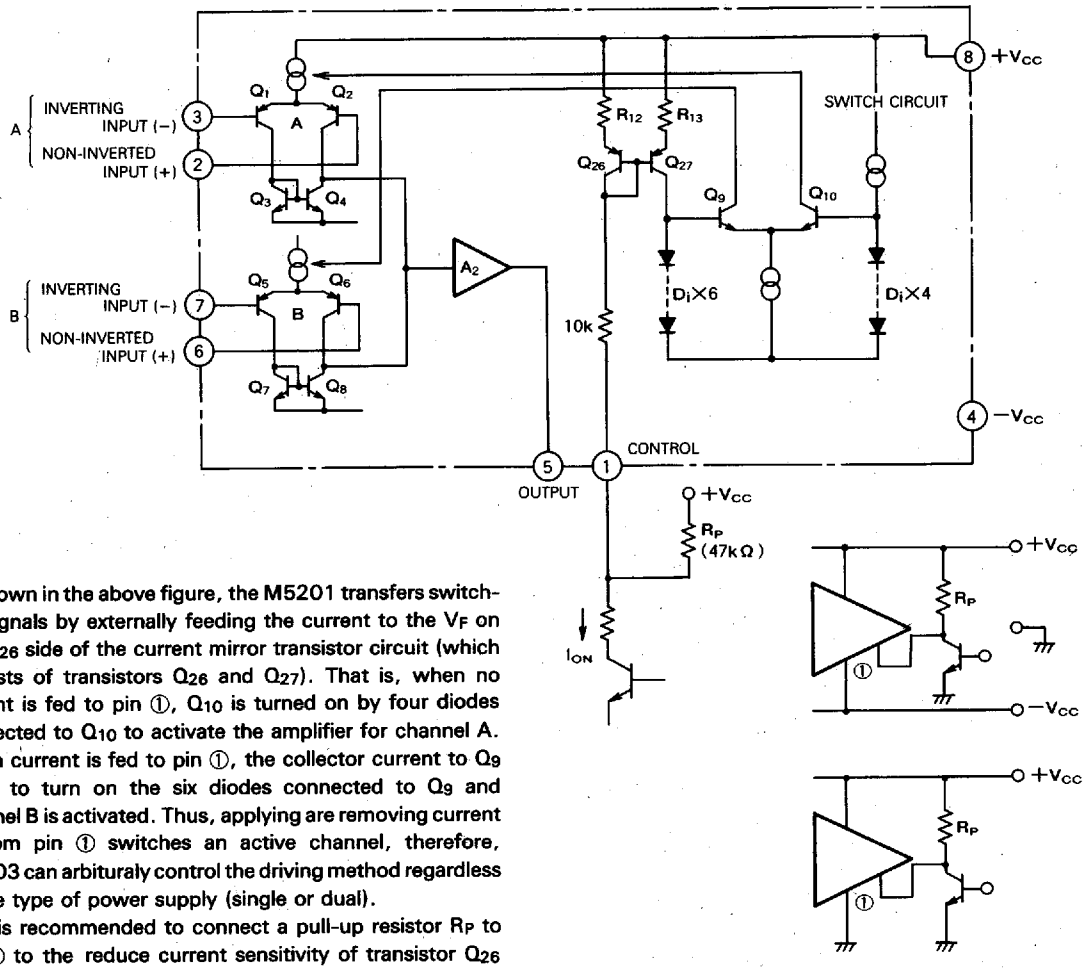
$(20 \log \frac{V_{OCS}}{V_i})$





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.