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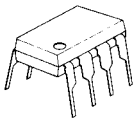
# OPERATIONAL AMPLIFIER WITH SWITCH

## ■ GENERAL DESCRIPTION

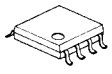
The NJM2120 is a dual operational amplifier of 2-INPUT and 1-OUTPUT with analog switch.The NJM2120 can be used as analog switch under the condition of $G_V$=0dB,as Switch + Amp in order that each gain (A or B) can be adjusted independently.Each amplifier of the NJM2120 has the same electrical characteristics as the NJM4558.

The NJM2120 is suitable for Audio,Video,Electrical musical instrument…etc.

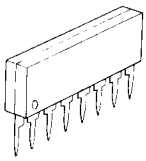
## ■ PACKAGE OUTLINE



NJM2120D



NJM2120M

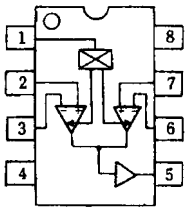


NJM2120L

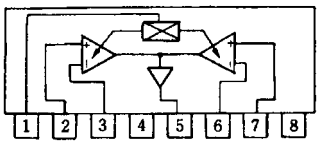
## ■ FEATURES

- Analog Switch Function
- Operating Voltage ( ±2.5V~±18V )
- Slew Rate ( 2.2V/μs typ. )
- Wide Unity Gain Bandwidth ( 7MHz typ. )
- Package Outline DIP8,DMP8,SIP8
- Bipolar Technology

## ■ PIN CONFIGURATION



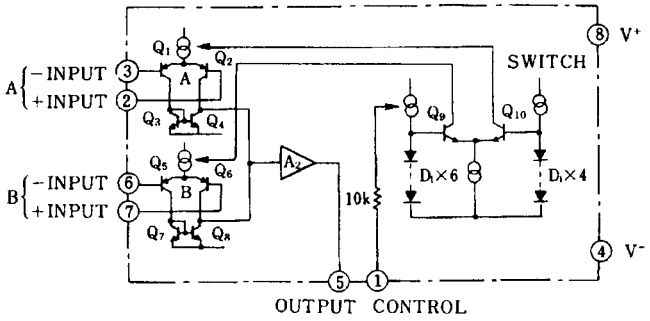

NJM2120D
NJM2120M




NJM2120L

**PIN FUNCTION**
**1.SW.CONTROL**
**2.A +INPUT**
**3.A -INPUT**
**4.$V^-$**
**5.OUTPUT**
**6.B –INPUT**
**7.B +INPUT**
**8.$V^+$**

## ■ EQUIVALENT CIRCUIT



## ■ ABSOLUTE MAXIMUM RATINGS

( Ta=25˚C )

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+/V^-$ | ± 18 | V |
| Differential Input Voltage | $V_{ID}$ | ± 30 | V |
| Input Voltage | $V_{IC}$ | ± 15 | V |
| Output Current | $I_O$ | ± 50 | mA |
| Power Dissipation | $P_D$ | ( DIP8 ) 500<br>( DMP8 ) 300<br>( SIP8 ) 800 | mW |
| Operating Temperature Range | $T_{opr}$ | -40~+85 | ˚C |
| Storage Temperature Range | $T_{stg}$ | -40~+125 | ˚C |

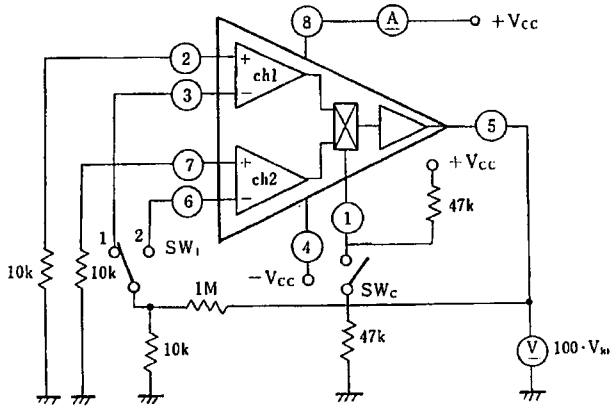
## ■ ELECTRICAL CHARACTERISTICS

( $V^+/V^-$=±15V,Ta=25˚C )

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Current | $I_{CC}$ | $V_{IN}$ SW ON | - | 2.3 | 6.0 | mA |
| | | SW OFF | - | 2.1 | 6.0 | mA |
| Input Offset Voltage | $V_{IO}$ | $R_S$=10kΩ | - | 0.8 | 6.0 | mV |
| Input Bias Current | $I_B$ | | - | 80 | 500 | nA |
| Large Signal Voltage Gain | $A_V$ | $R_L$=2kΩ | - | 100 | - | dB |
| Maximum Output Voltage Swing | $V_{OM}$ | $R_L$=10kΩ | ± 12 | ± 14 | - | V |
| Total Harmonic Distortion | THD | f=1kHz,$V_O$=5Vrms,$G_V$=20dB | - | 0.002 | - | % |
| Supply Voltage Rejection Ratio | SVR | | - | 20 | 150 | μV/V |
| Channel Separation | CS | f=1kHz | - | 82 | - | dB |
| Unity Gain Bandwidth | $f_T$ | $G_V$=0dB | - | 7 | - | MHz |
| Slew Rate | SR | $G_V$=0dB,$R_L$=2kΩ//100pF | - | 2.2 | - | V/μs |
| Equivalent Input Noise Voltage | $V_{NI}$ | $R_S$=1kΩ,BW=10Hz~30kHz,Flat | - | 2.0 | - | μVrms |

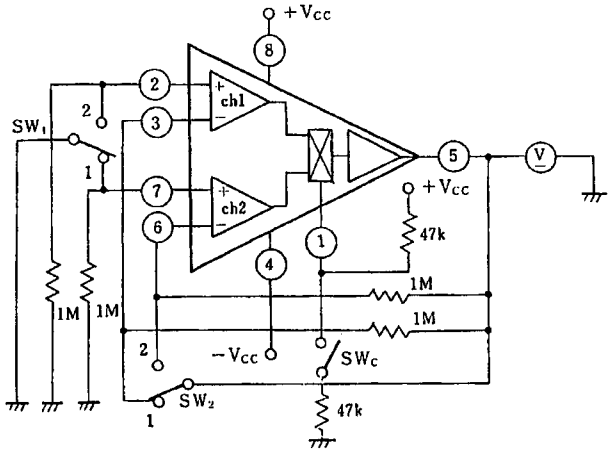
## ■ TEST CIRCUIT

(1) $I_{cc}$, $V_{io}$, SVR




| | SWc | SW1 | Select ch |
|---|---|---|---|
| $I_{CC1}$, $V_{IO1}$, $SVR_1$ | OFF | 1 | ch 1 |
| $I_{CC2}$, $V_{IO2}$, $SVR_2$ | ON | 2 | ch 2 |

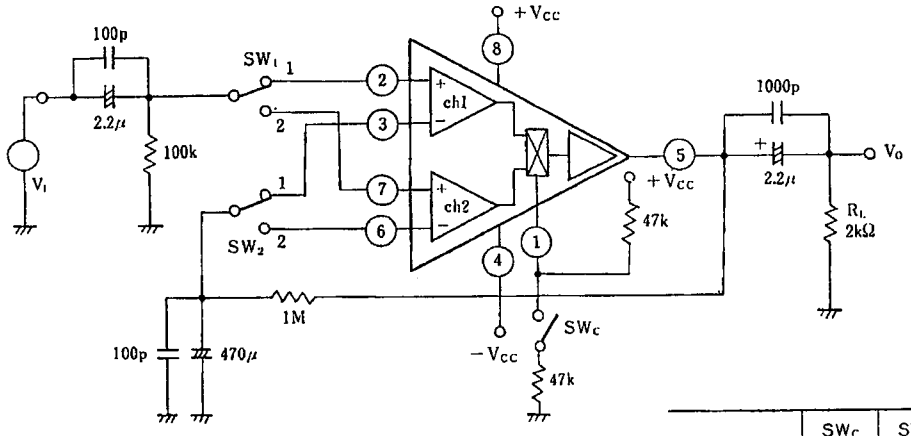
(2) $I_b$, $I_{io}$




$I_b{}' = V_0{}^+/1M\Omega$
$I_b{}^- = V_0{}^-/1M\Omega$
$I_{IO} = |I_b{}^+ - I_b{}^-|$

| | SWc | SW1 | SW2 | Select ch |
|---|---|---|---|---|
| $V_{O1}$ | OFF | 1 | 1 | ch 1 |
| $V_{O1}$ | OFF | 2 | 2 | ch 1 |
| $V_{O2}$ | ON | 2 | 2 | ch 2 |
| $V_{O2}$ | ON | 1 | 1 | ch 2 |

(3) ft, $A_V$



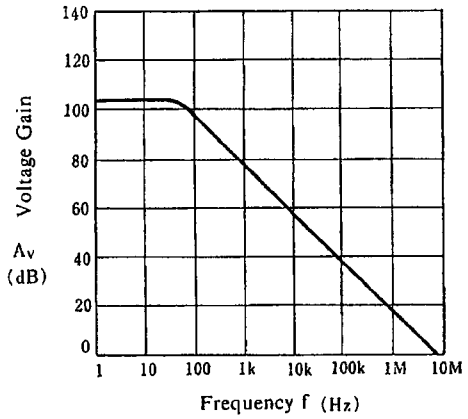

| | SWc | SW1 | SW2 | Selection |
|---|---|---|---|---|
| $f_{t1}$, $A_{V1}$ | OFF | 1 | 1 | ch 1 |
| $f_{t2}$, $A_{V2}$ | ON | 2 | 2 | ch 2 |

Unit Resistance: Ω
Capacity : F

## ■ TYPICAL CHARACTERISTICS

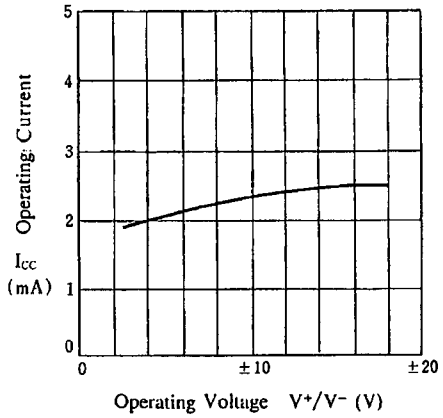
**Voatage Gain vs. Frequency**

($V^+/V^-=\pm15V$, $R_L=2k\Omega$)



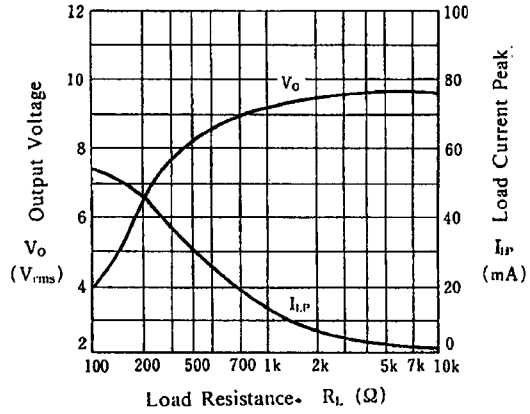

**Operating Current vs. Operating Voltage**

($V_{in}=0$)



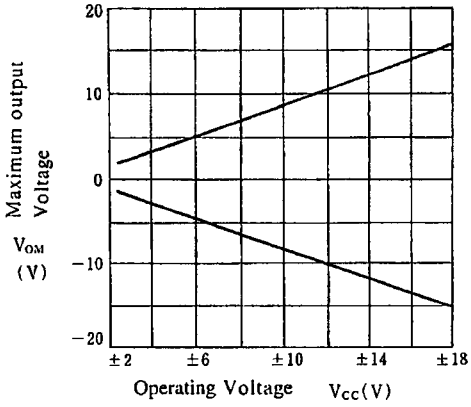

**Output Voltage, Load Current Peak vs. Load Resistance**

($V_{CC}=\pm15V$, f=1KHz, THD=1%)



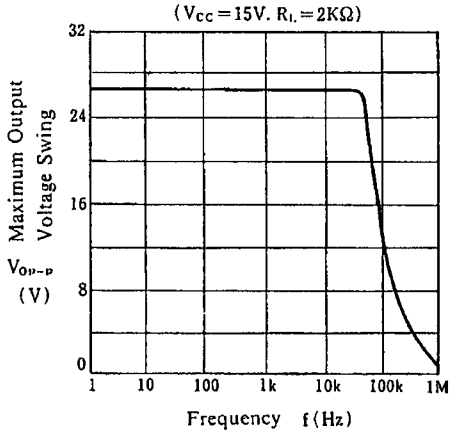

**Maximum Output Voltage vs. Operating Voltage**

($R_L=2k\Omega$)



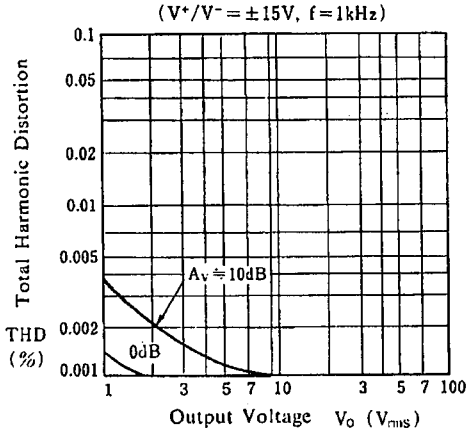

**Maximum Output Voltage Swing vs. Frequency**

($V_{CC}=15V$, $R_L=2K\Omega$)



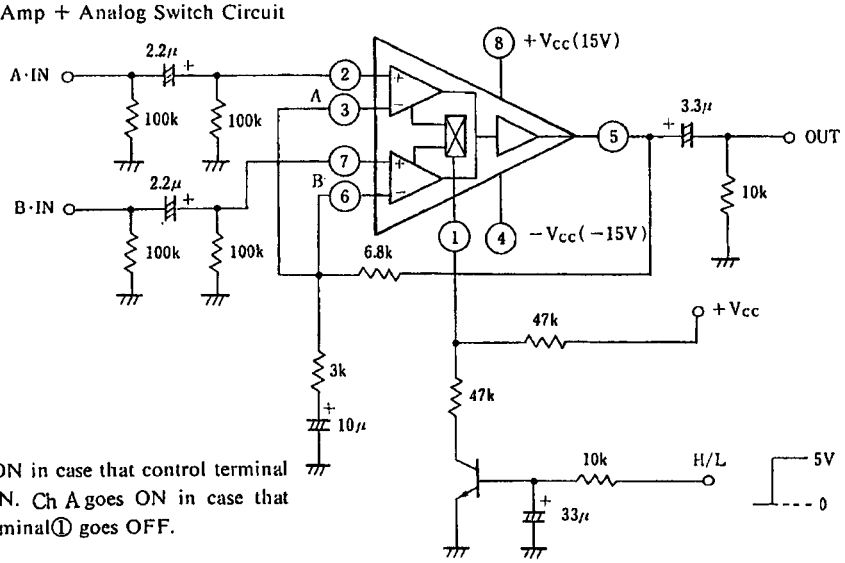

**Total Harmonic Distortion vs. Output Voltage**

($V^+/V^-=\pm15V$, f=1kHz)



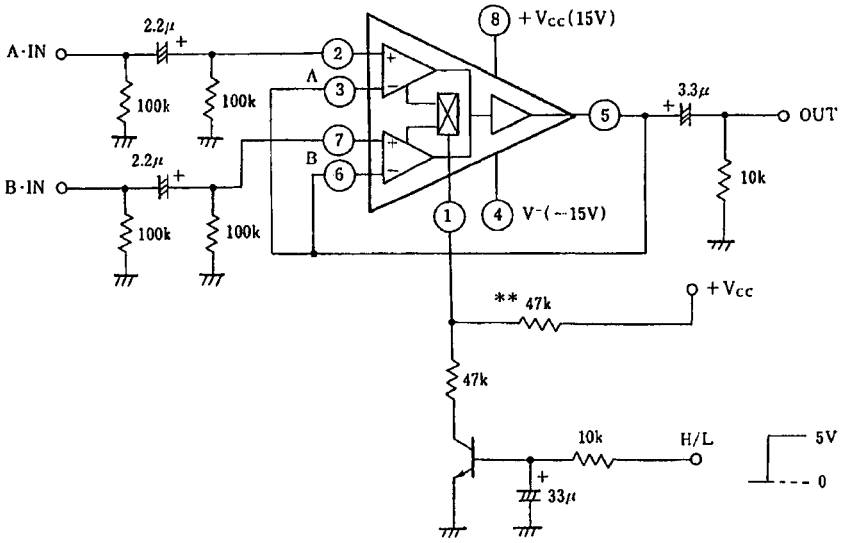
## ■ APPLICATION CIRCUIT

(1) Gv ≒10dB FLAT Amp + Analog Switch Circuit



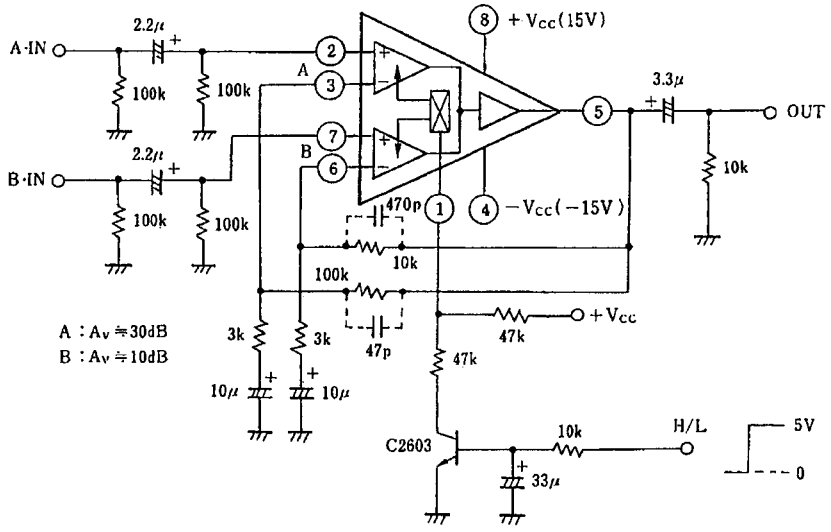

*Ch B goes ON in case that control terminal ① goes ON. Ch A goes ON in case that control terminal① goes OFF.

(2) Analog Switch Circuit (GV=0dB Voltage Follower Amp)




*:*Resistanc(**) is Pull-up-resistance for prevent from switching terminal① going ON by reakage of external circuit (TR...etc).

## ■ TYPICAL APPLICATION CIRCUIT

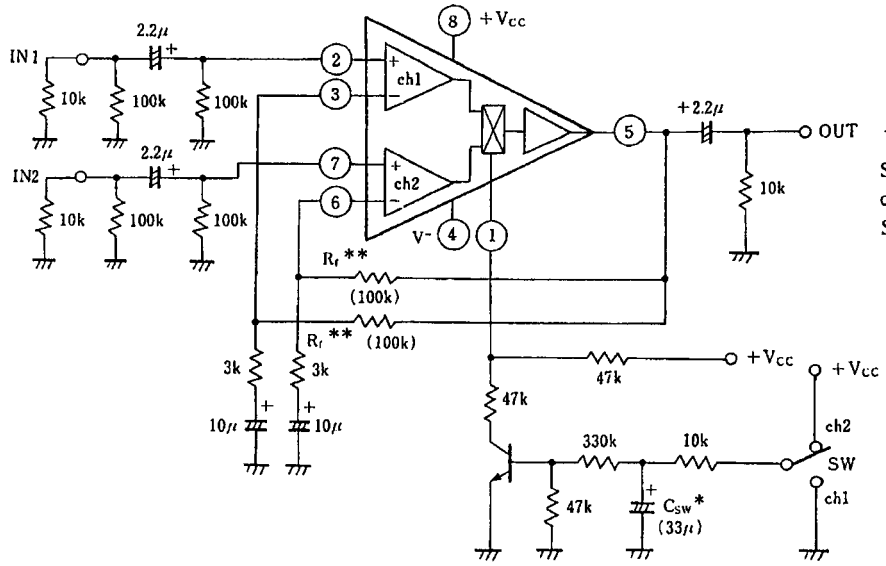


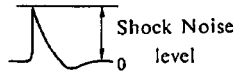

*Ch B goes ON in case that control terminal ① goes ON. Ch A goes ON in case that control terminal① goes OFF.

Unit Resistance: Ω
Capacity : F

## ■ SHOCK NOISE TEST

Test Curcuit

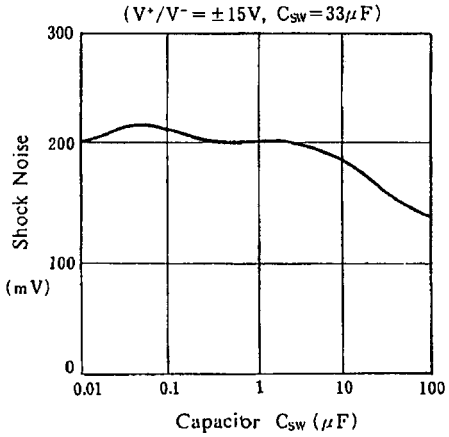



Shock noise level by changeover (ch1 or 2) of SW.

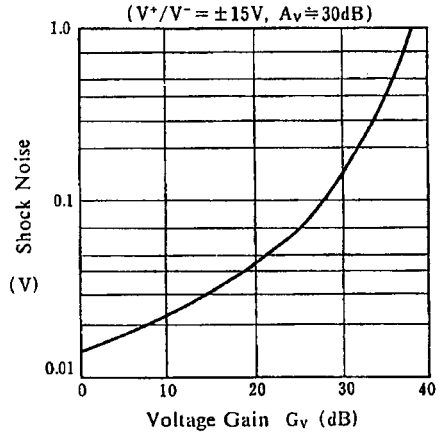
**Shock Noise vs. Capacior Csw**

(V⁺/V⁻ = ±15V, $C_{SW}$ = 33μF)

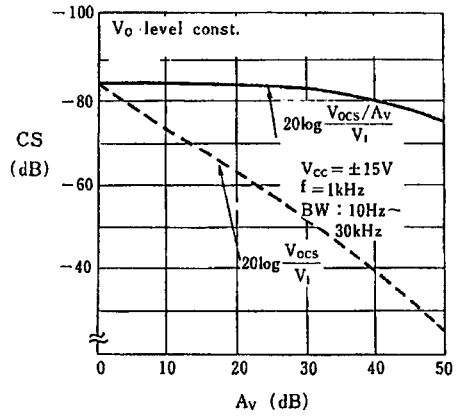



**Shock Noise vs. Voltage Gain**

(V⁺/V⁻ = ±15V, $A_V$ ≒ 30dB)



## ■ CHANNEL SEPARATION

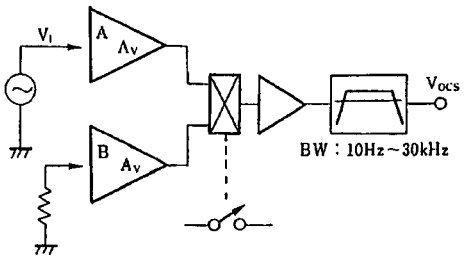



C·S is defined on ratio of reakage signal which occur on input side and input signal.

$(20\log\frac{Vocs\ /\ Av}{Vi})$

But, C·S seem to be inferior apparently in case that Gain(Av) is left out of consideration.

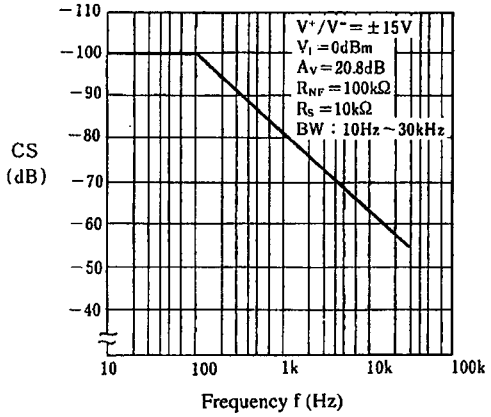
[In case of A:OFF/B:ON]



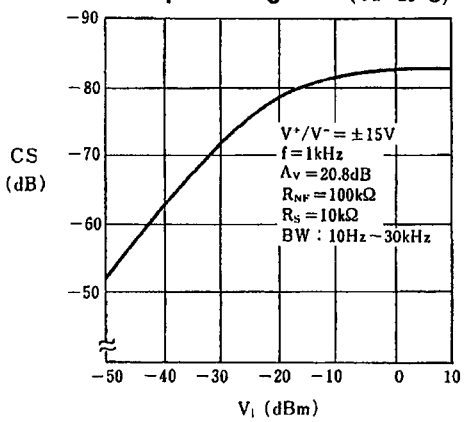

$$CS = 20\log\left[\frac{\text{Input Reakage Level}}{\text{Signal Level}}\right](dB)$$

$$= 20\log\frac{Vocs/Av}{Vi}\ (dB)$$

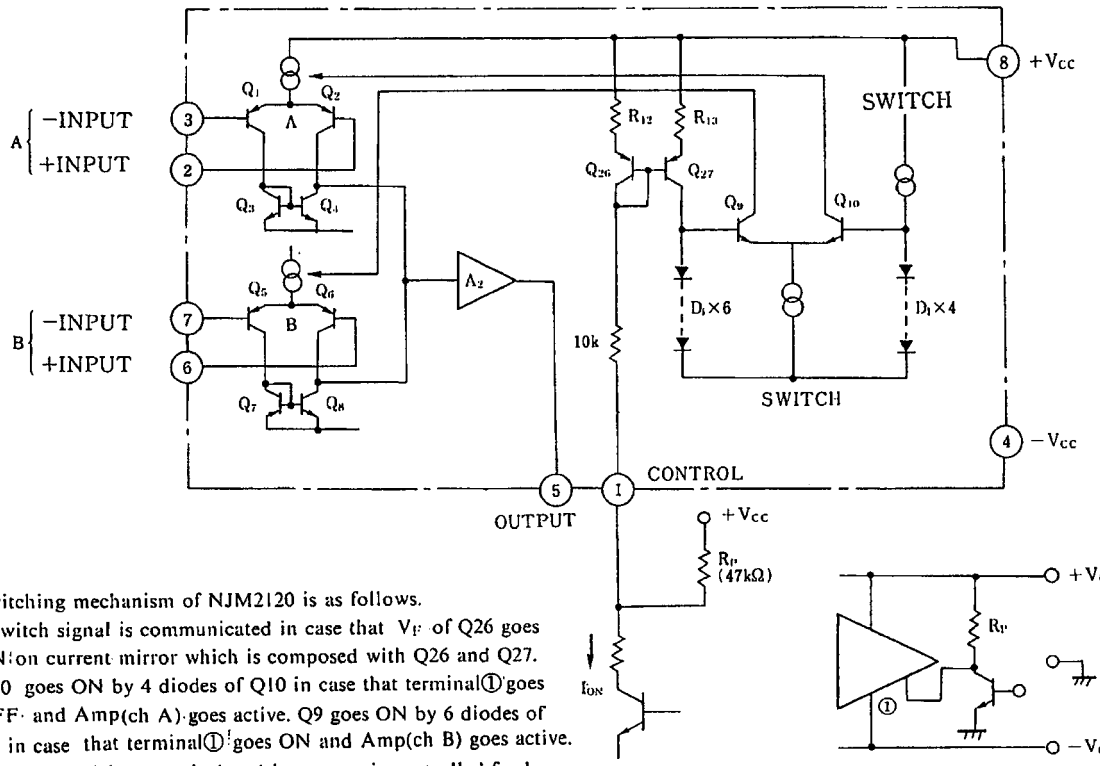
**Channel Separation vs. Frequeny** (Ta=25°C)




**Channel Separation vs. Input Voltage** (Ta=25°C)



## ■ SWITCHING MECHANISM

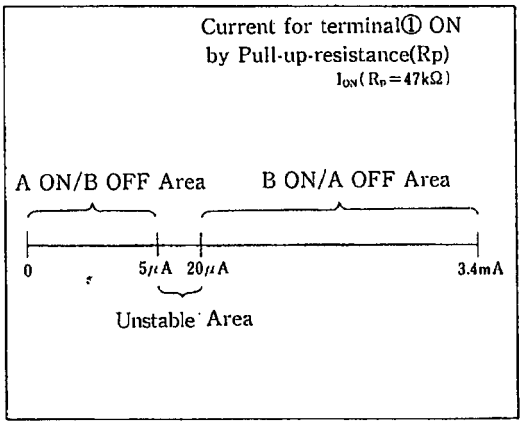



Switching mechanism of NJM2120 is as follows.

Switch signal is communicated in case that $V_F$ of Q26 goes ON:on current mirror which is composed with Q26 and Q27. Q10 goes ON by 4 diodes of Q10 in case that terminal① goes OFF, and Amp(ch A) goes active. Q9 goes ON by 6 diodes of Q9 in case that terminal① goes ON and Amp(ch B) goes active. So, NJM2120 have merit that drive system is controlled freely. Because drive system is not related to supply voltage system (Single supply type/Two supply type) in order that switch change by current ON/OFF.

But this switch goes ON by very little current because of signal communicate system which depend on ON of $V_F$

So, please use NJM2120 under the conditon of lowerring sensitivity for current ON/OFF by external Pull-up-resistance(Rp)



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