

## DUAL OPERATIONAL AMPLIFIER WITH SWITCH

### ■ GENERAL DESCRIPTION

The NJM2123 is a operational amplifier with analog switch ( 2 circuit of 2-input/1-output ). It is applicable to the audio part for Video ( VTR,LD...) and the Car-stereo.

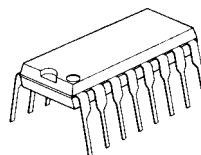
The NJM2123 has the same electrical characteristic of the NJM2112, and is low saturation output type.

The mode of switch is improved from the current control type ( NJM2120:1 circuit of 2-input/1-output ) to the voltage control type. So, it is easy to use.

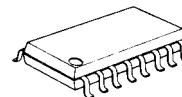
### ■ FEATURES

- Single Supply
- Operating Voltage ( +4V~+20V )
- Slew Rate ( 3V/μs typ. )
- Analog Switch Function
- Wide Unity Gain Bandwidth ( 10MHz typ. )
- Package Outline DIP16, DMP16, SSOP16
- Bipolar Technology

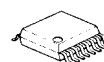
### ■ PACKAGE OUTLINE



NJM2123D

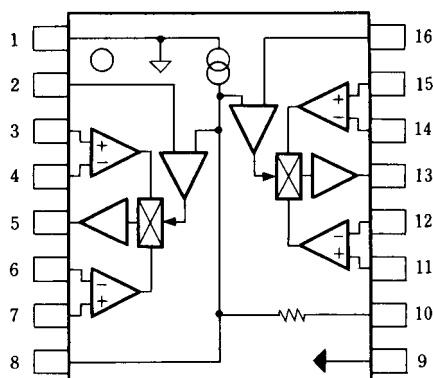


NJM2123M



NJM2123V

### ■ PIN CONFIGURATION

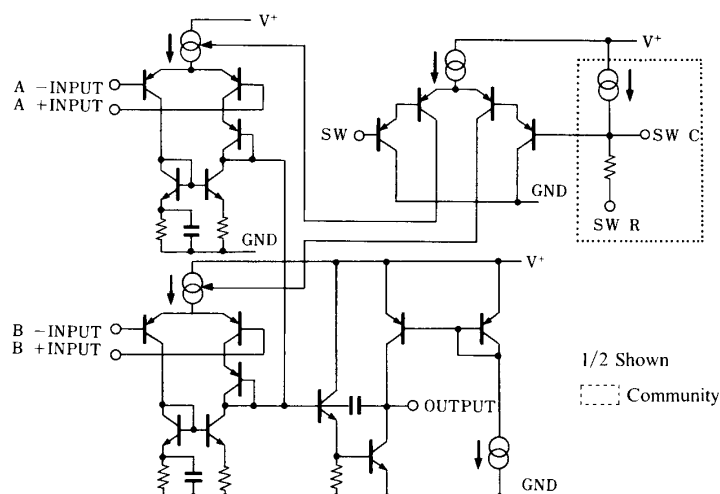


NJM2123D  
NJM2123M  
NJM2123V

#### PIN FUNCTION

|                  |                 |
|------------------|-----------------|
| 1.V <sup>+</sup> | 9.GND           |
| 2.SW1            | 10.SW R         |
| 3.IN1 A +INPUT   | 11.IN2 B +INPUT |
| 4.IN1 A -INPUT   | 12.IN2 B -INPUT |
| 5.OUT1           | 13.OUT2         |
| 6.IN1 B -INPUT   | 14.IN2 A -INPUT |
| 7.IN1 B +INPUT   | 15.IN2 A +INPUT |
| 8.SW C           | 16.SW2          |

### ■ EQUIVALENT CIRCUIT



## ■ ABSOLUTE MAXIMUM RATINGS

( Ta=25°C )

| PARAMETER                   | SYMBOL    | RATINGS                                       | UNIT |
|-----------------------------|-----------|-----------------------------------------------|------|
| Supply Voltage              | $V^+$     | 20 (± 10)                                     | V    |
| Differential Input Voltage  | $V_{ID}$  | ± 14                                          | V    |
| Input Voltage               | $V_{IC}$  | 20(±10)note:Less than $V^+$ (note)            | V    |
| Control Voltage             | $V_{CTR}$ | 20(±10)note:Less than $V^+$                   | V    |
| Power Dissipation           | $P_D$     | ( DIP8 ) 700<br>( DMP8 ) 300<br>( SSOP8 ) 300 | mW   |
| Operating Temperature Range | $T_{opr}$ | -30~+85                                       | °C   |
| Storage Temperature Range   | $T_{stg}$ | -40~+125                                      | °C   |

## ■ ELECTRICAL CHARACTERISTICS

(  $V^+=5V, Ta=25^\circ C$  )

| PARAMETER                       | SYMBOL    | TEST CONDITION                         | MIN.  | TYP.  | MAX. | UNIT |
|---------------------------------|-----------|----------------------------------------|-------|-------|------|------|
| Operating Current               | $I_{CC}$  | $V_{IN}=2.5V, R_L=\infty$              | -     | 6.0   | 8.0  | mA   |
| Input Offset Voltage            | $V_{IO}$  | $R_S \leq 10k\Omega$                   | -     | 1.0   | 6.0  | mV   |
| Input Offset Current            | $I_{IO}$  |                                        | -     | 10    | 200  | nA   |
| Input Bias Current              | $I_B$     |                                        | -     | 100   | 300  | nA   |
| Large Signal Voltage Gain       | $A_V$     | $R_L \geq 10k\Omega$                   | 60    | 80    | -    | dB   |
| Maximum Output Voltage Swing 1  | $V_{OM1}$ | $V^+/V = \pm 2.5V, R_L \geq 2k\Omega$  | ± 2.0 | ± 2.2 | -    | V    |
| Maximum Output Voltage Swing 2  | $V_{OM2}$ | $V^+/V = \pm 2.5V, R_L \geq 10k\Omega$ | ± 2.3 | ± 2.4 | -    | V    |
| Input Common Mode Voltage Range | $V_{ICM}$ |                                        | 1.5   | -     | 4.0  | V    |
| Common Mode Rejection Ratio     | CMR       |                                        | 60    | 74    | -    | dB   |
| Supply Voltage Rejection Ratio  | SVR       |                                        | 60    | 80    | -    | dB   |
| Slew Rate                       | SR        | $A_V=1, V_{IN}=2V \sim 3V$             | -     | 3     | -    | V/μs |
| Gain Bandwidth Product          | GB        |                                        | -     | 10    | -    | MHz  |
| Crosstalk                       | CT        | $f=1kHz$                               | -     | 90    | -    | dB   |
| Channel Separation              | CS        | $f=1kHz$                               | -     | 120   | -    | dB   |
| Switch Threshold Voltage        | $V_{th}$  | Internal $V_{th}$                      | 2.0   | 2.5   | 3.0  | V    |

( note1 ) Applied circuit voltage gain is desired to be operated within the range of 3dB to 30 dB.

( note2 ) Special care being required for input common mode voltage range and the oscillation due to the capacitive load when operating on voltage follower.

( note3 ) "Crosstalk" is defined about leak of signal on the same circuit.

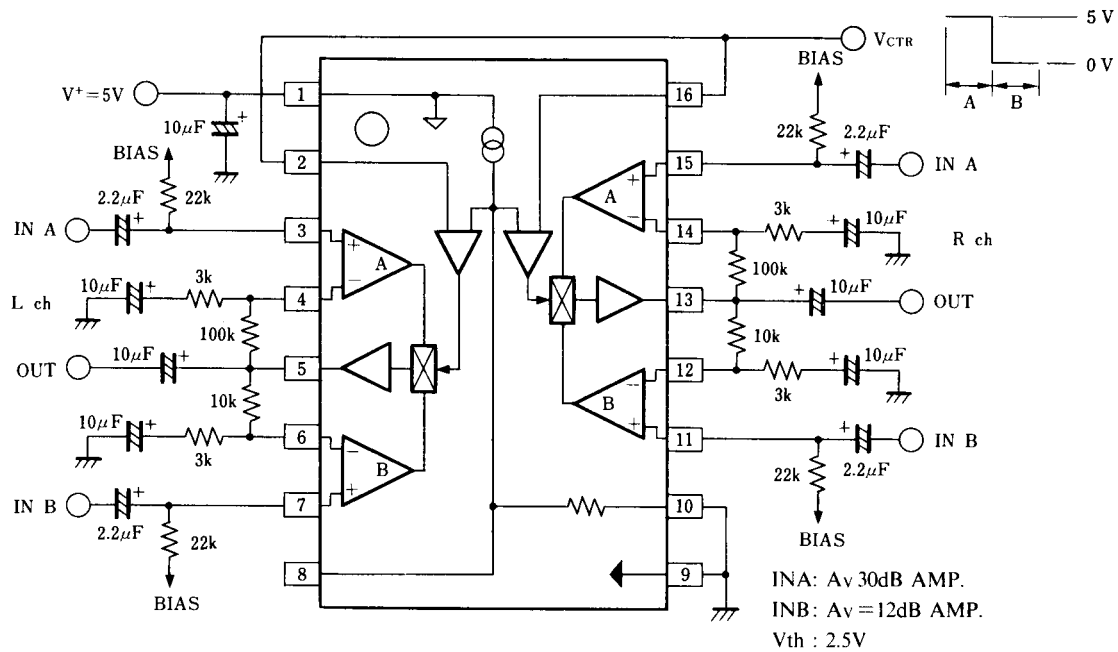
( note4 ) "Channel Separation" is defined about leak of signal between 2 circuits.

( note5 )  $V_{th}$  is possible to adjust by external parts.

( note6 ) Voltage for  $V^-$ -PIN has to be supplied earlier than  $V^+$ -PIN in case of two supply voltage.

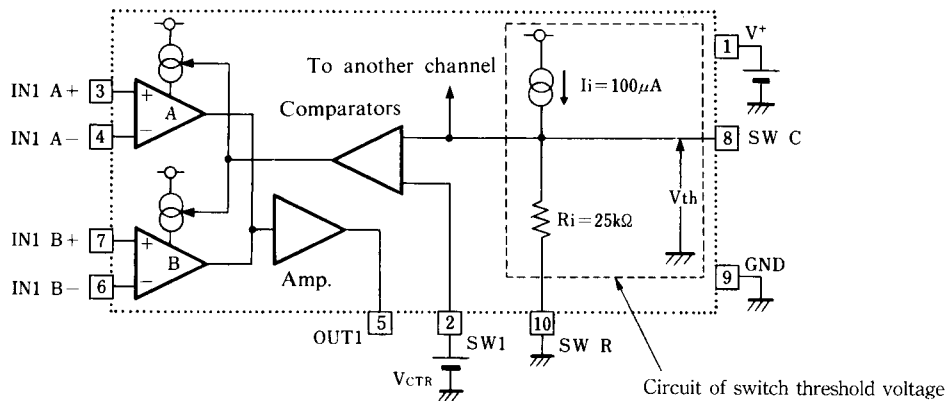
## ■ TYPICAL CHARACTERISTICS

In case of single supply voltage (  $V^+=5V$  )



## ■ SWITCHING MECHANISM

- in case of single supply voltage



The switch circuit of NJM2123 consist of comparators for switch and circuit for switch threshold voltage (  $V_{th}$  ) due to establish threshold of comparator.  $V_{th}=I_i \times R_i=2.5V$  in case of above Figure.

Comparator selects INPUT ( A or B ) by compare of control voltage (  $V_{CTR}$  ) and threshold voltage (  $V_{th}$  ) and control of operating current of Amp ( INPUT ).

INPUT A is selected in case of  $V_{CTR}>V_{th}$  and INPUT B is selected in case of  $V_{CTR}<V_{th}$ .

$V_{CTR}$  can not be used between  $V_{th}\pm 0.1V$  in order that signal of both INPUT A and INPUT B are mixed in case that  $V_{CTR}$  is near  $V_{th}$ .

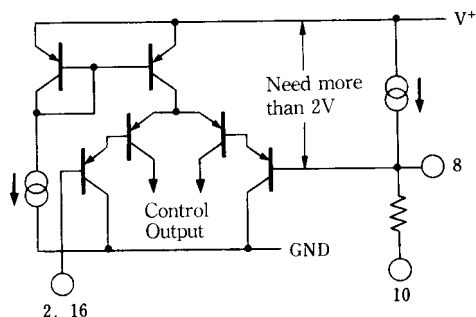
## ■ ABOUT ADJUSTMENT OF V<sub>th</sub>

The switch threshold voltage (  $V_{th}$  ) is possible to adjust by external parts to SW C/SW R. It needs to be satisfy with condition of  $V_{th} \leq V^+ - 2V$ .

This reason is caused by equivalent circuit of comparator for switch.

The  $V_{th}$  has to be adjust in case that supply voltage is less than 5V (  $\pm 2.5V$  ).

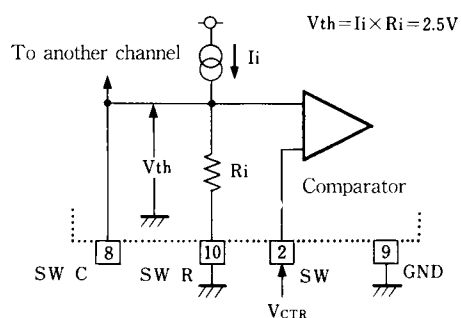
Adjustment method is as following.



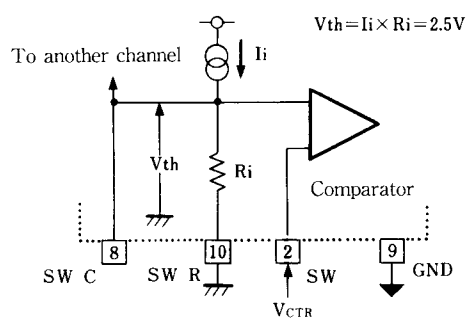
## ■ ADJUSTMENT OF V<sub>th</sub>

In case of  $I_i = 100\mu A$ ,  $R_i = 25k\Omega$ ,  $R_e$  ( External Resistor )

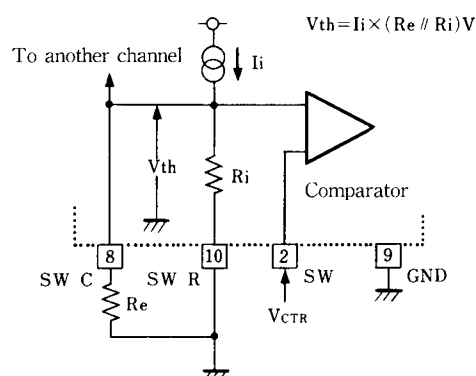
### ● Internal V<sub>th</sub> ( Single supply )



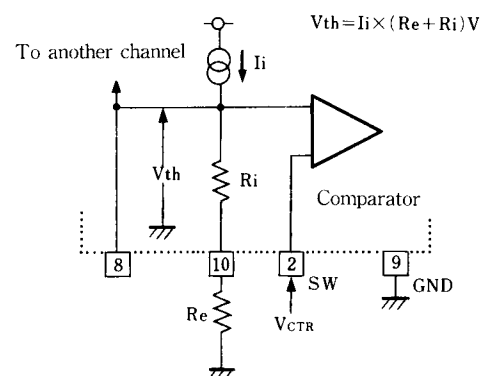
### ● Internal V<sub>th</sub> ( Two supply )



### ● V<sub>th</sub>, 2.5V ( Single supply )

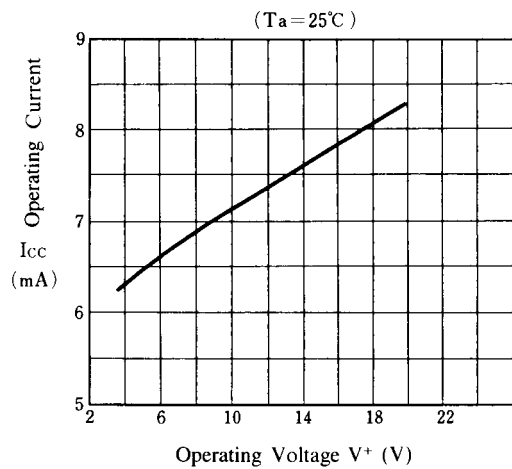


### ● V<sub>th</sub> > 2.5V ( Single supply )

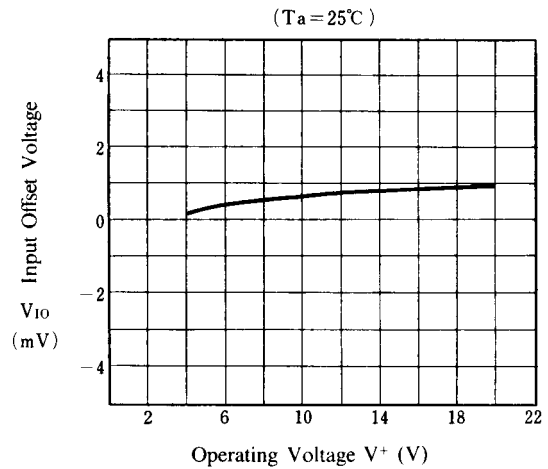


## ■ TYPICAL CHARACTERISTICS

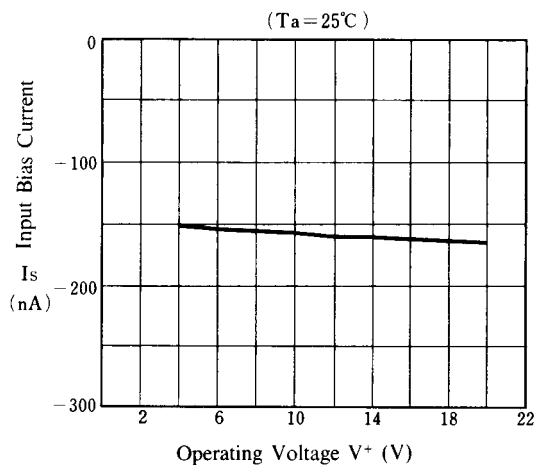
**Operating Current vs. Operating Voltage**



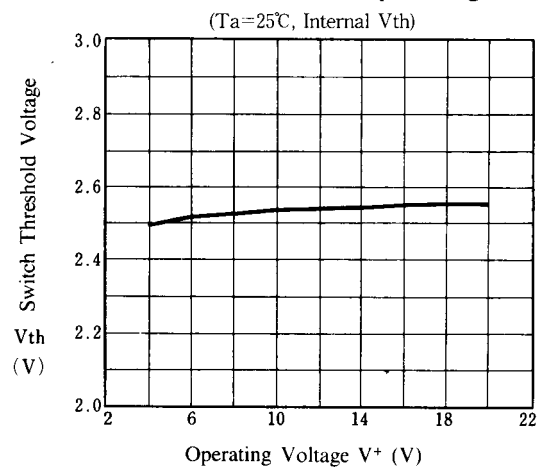
**Input Offset Voltage vs. Operating Voltage**



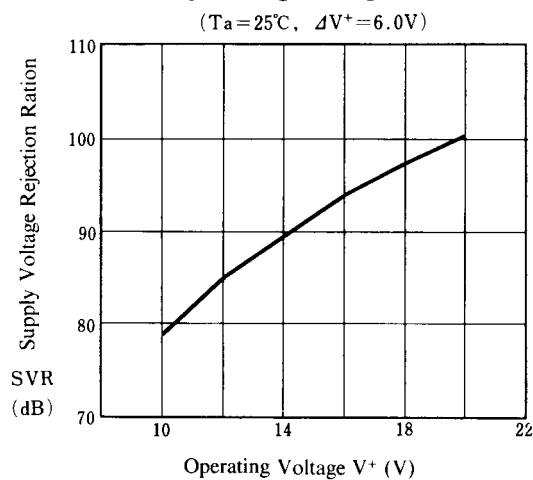
**Input Bias Current vs. Operating Voltage**



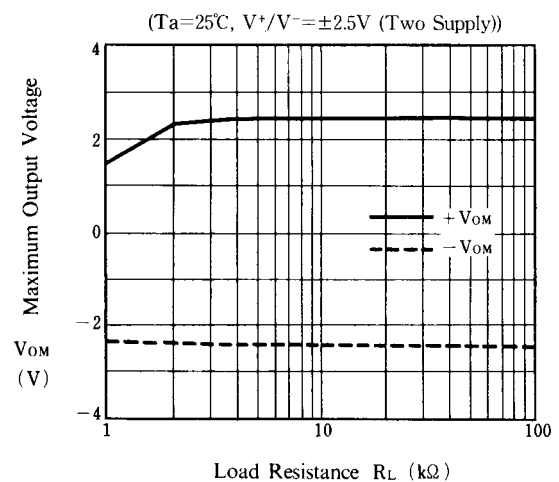
**Switch Threshold Voltage vs. Operating Voltage**



**Supply Voltage Rejection Ratio vs. Operating Voltage**



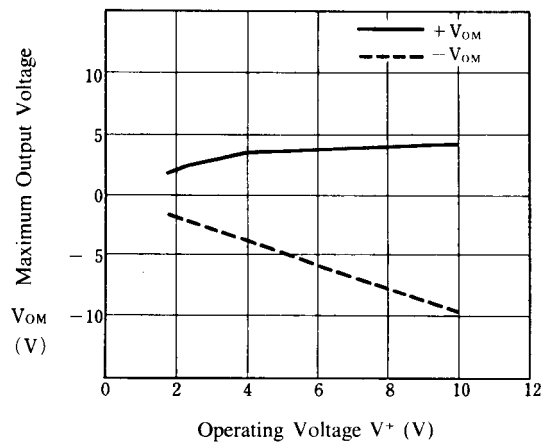
**Maximum Output Voltage vs. Load Resistance**



## ■ TYPICAL CHARACTERISTICS

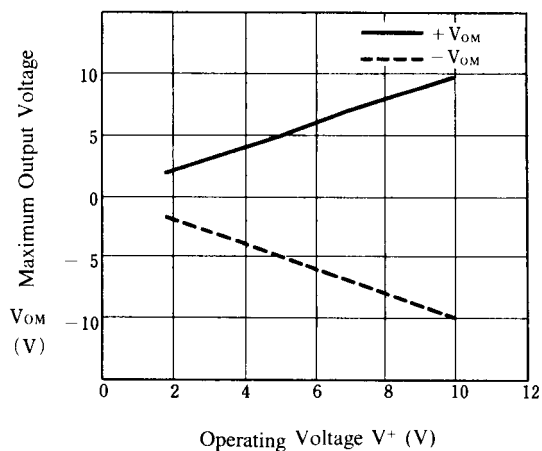
Maximum Output Voltage vs. Operating Voltage

( $T_a = 25^\circ\text{C}$ ,  $R_L = 2\text{ k}\Omega$ )



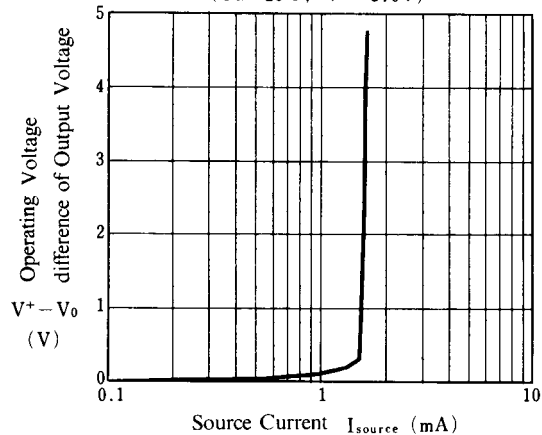
Maximum Output Voltage vs. Operating Voltage

( $T_a = 25^\circ\text{C}$ ,  $R_L = 10\text{ k}\Omega$ )

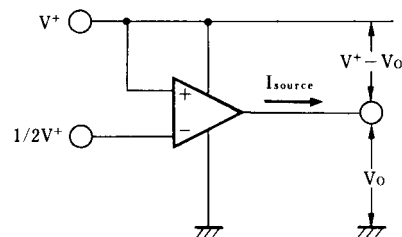


Output Source Current

( $T_a = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{ V}$ )

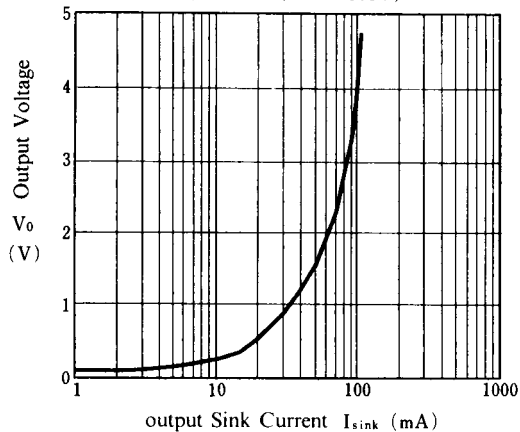


Test Circuit (Output Source Current)

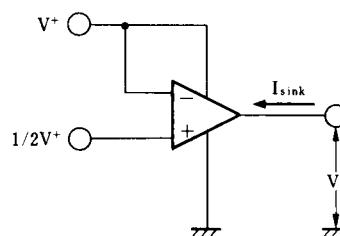


Output Voltage vs. Output Sink Current

( $T_a = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{ V}$ )



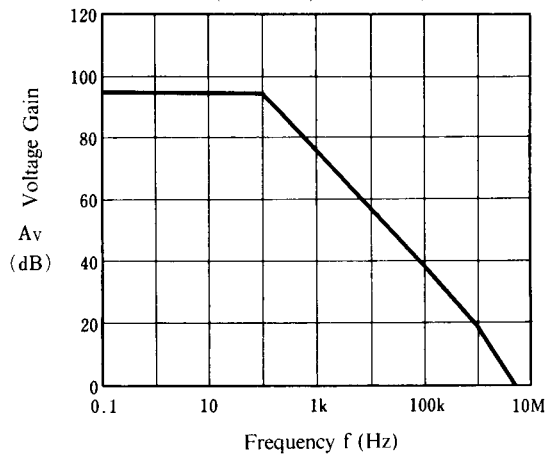
Test Circuit (Output Sink Current)



## ■ TYPICAL CHARACTERISTICS

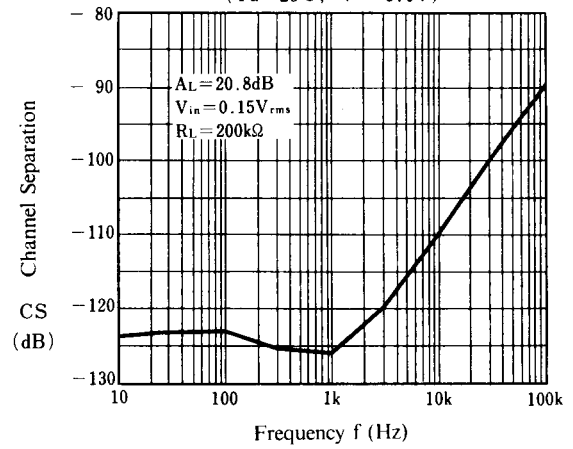
**Voltage Gain vs. Frequency**

( $T_a = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{V}$ )



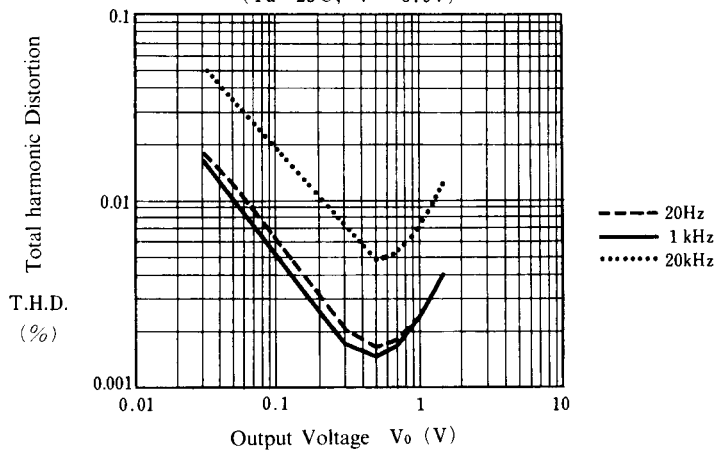
**Channel Separation vs. Frequency**

( $T_a = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{V}$ )

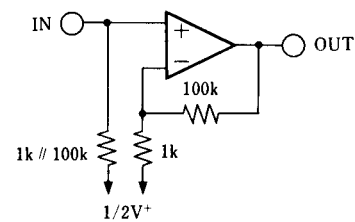


**Total Harmonic Distortion vs. Output Voltage**

( $T_a = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{V}$ )

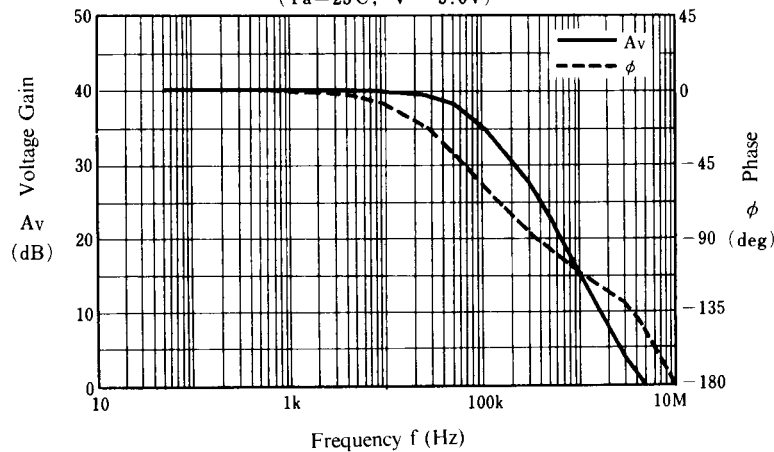


**Test Circuit (Voltage Gain/Phase)**

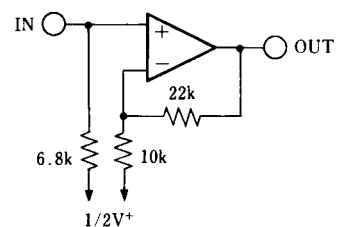


**Voltage Gain/Phase vs. Frequency**

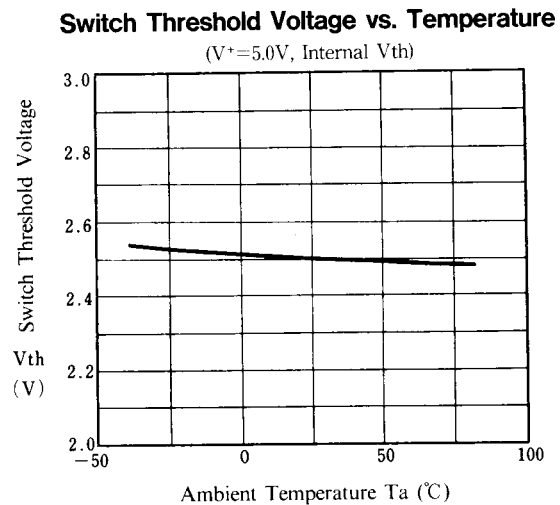
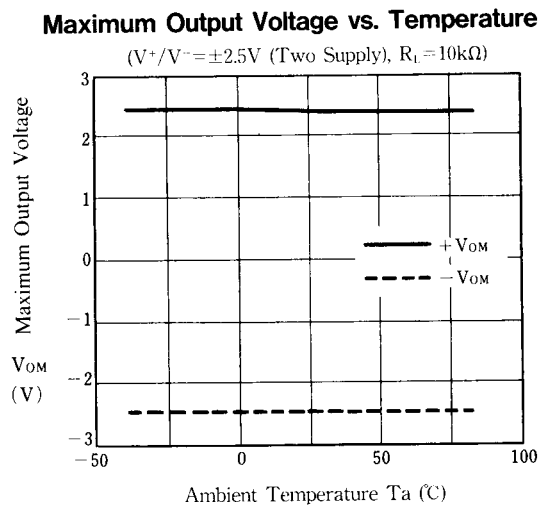
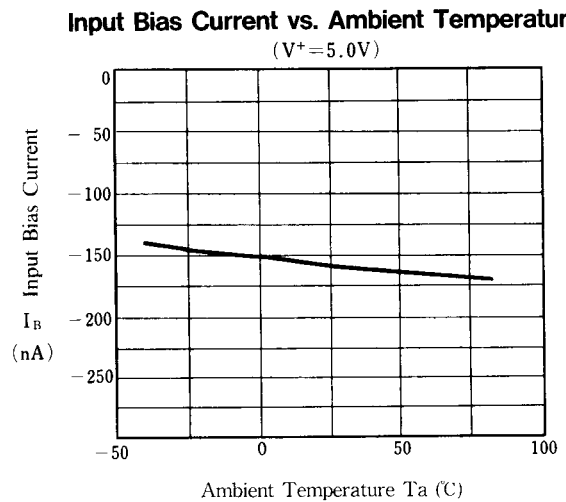
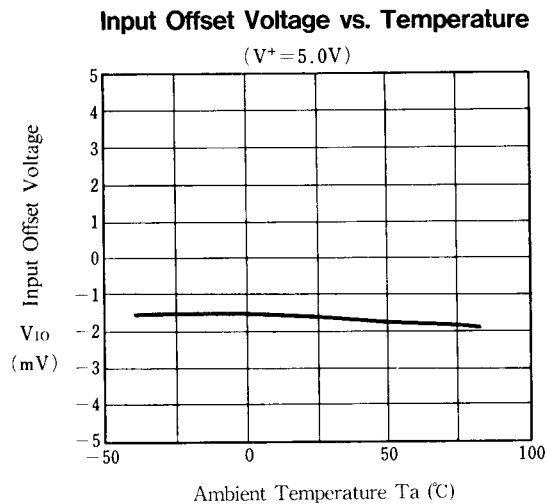
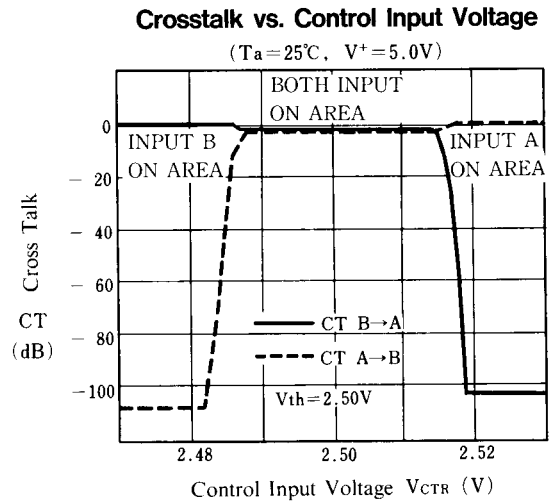
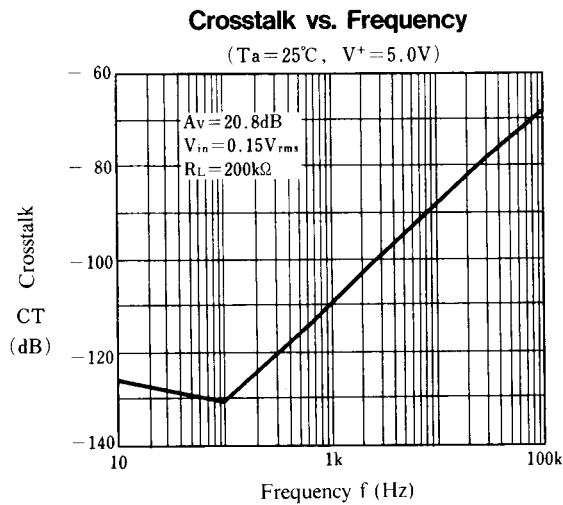
( $T_a = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{V}$ )



**Test Circuit (THD)**



## ■ TYPICAL CHARACTERISTICS



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