# DUAL OPERATIONAL AMPLIFIER WITH SWITCH

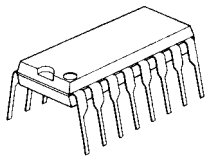
## ■ GENERAL DESCRIPTION

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.

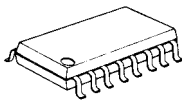
The NJM2123 has the same electrical characteristic of the NJM2112,and is low saturation output type.

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.

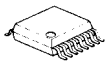
## ■ PACKAGE OUTLINE



NJM2123D



NJM2123M

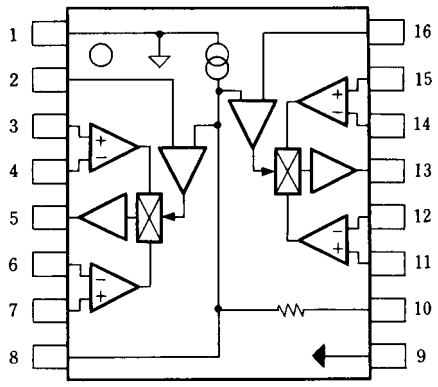


NJM2123V

## ■ 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

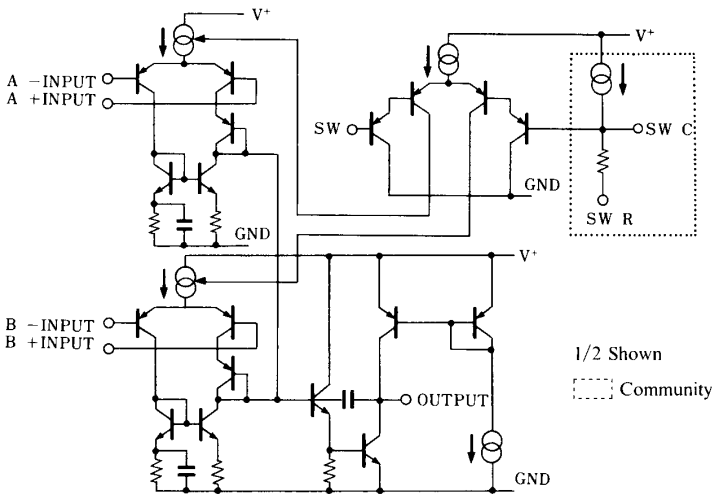
## ■ PIN CONFIGURATION




NJM2123D
NJM2123M
NJM2123V

| PIN FUNCTION | |
|---|---|
| 1.V+ | 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˚C )

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Current | $I_{CC}$ | $V_{IN}$=2.5V,$R_L$=∞ | - | 6.0 | 8.0 | mA |
| Input Offset Voltage | $V_{IO}$ | $R_S$≤10kΩ | - | 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 | $A_V$ | $R_L$≥10KΩ | 60 | 80 | - | dB |
| Maximum Output Voltage Swing 1 | $V_{OM1}$ | $V^+/V^-$=±2.5V,$R_L$≥2kΩ | ± 2.0 | ± 2.2 | - | V |
| Maximum Output Voltage Swing 2 | $V_{OM2}$ | $V^+/V^-$=±2.5V,$R_L$≥10kΩ | ± 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~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.

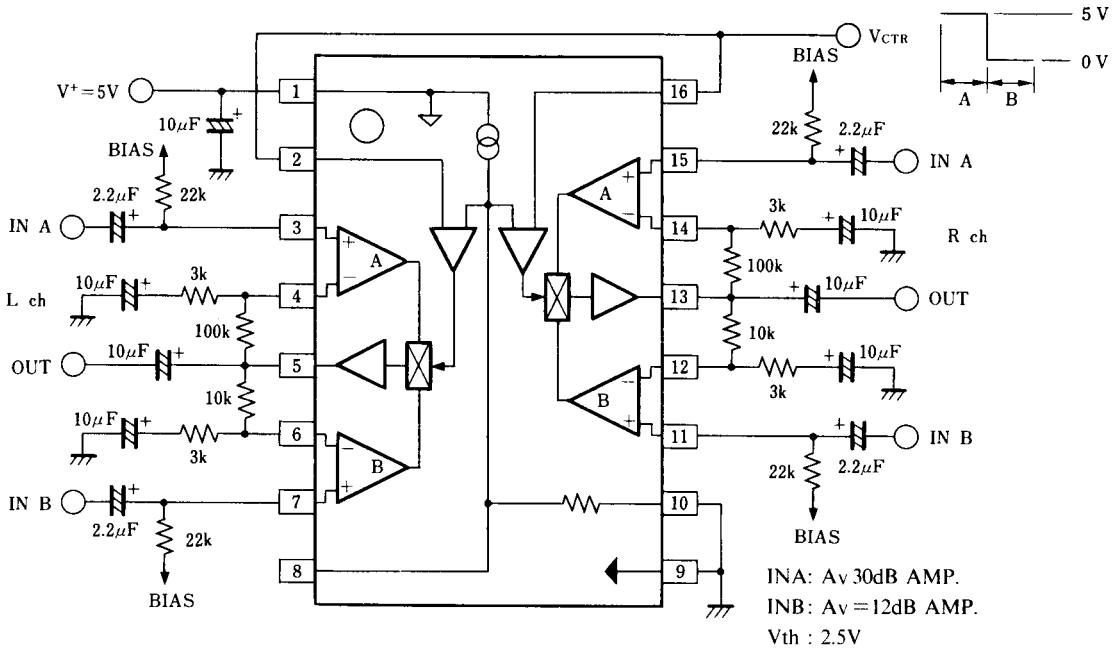
( note4 ) “Channel Separation” is defined about leak of signal between 2 circuits.

( note5 ) Vth is possible to adjust by external parts.

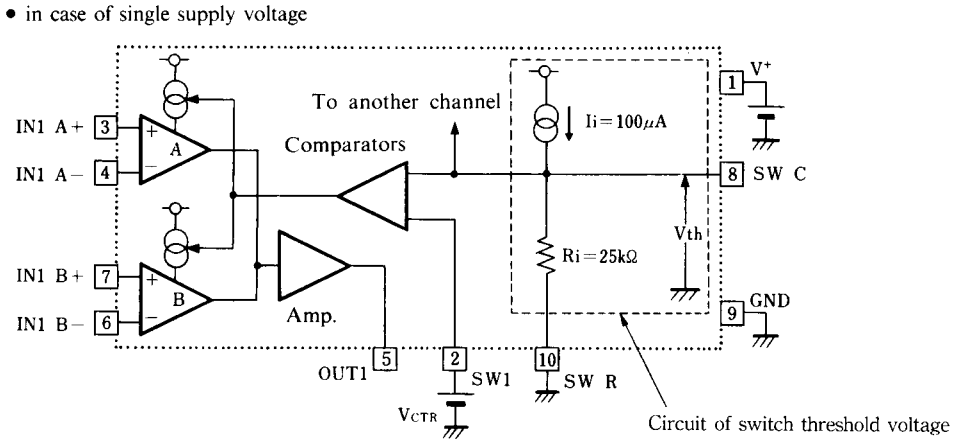
( note6 ) Voltage for $V^-$-PIN has to be supplied earlier than $V^+$-PIN in case of two supply voltage.

## ■ TYPICAL CHARACTERISTICS

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




## ■ SWITCHING MECHANISM




The switch circuit of NJM2123 consist of comparators for switch and circuit for switch threshold voltage ( Vth ) due to establish threshold of comparator.Vth=Ii x Ri=2.5V in case of above Figure.

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

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

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

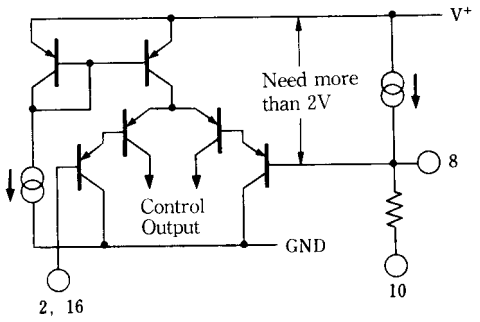
## ■ ABOUT ADJUSTMENT OF VTH

The switch threshold voltage ( Vth ) is possible to adjust by external parts to SW C/SW R.It needs to be satisfy with condition of Vth≤$V^+$-2V.

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

The Vth has to be adjust in case that supply voltage is less than 5V ( ±2.5V ).

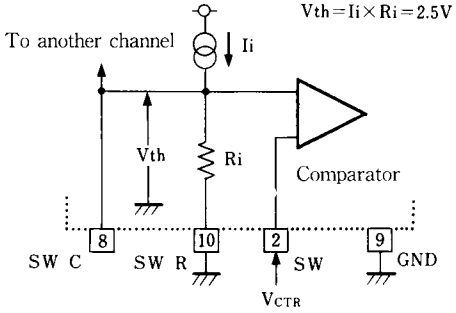
Adjustment method is as following.



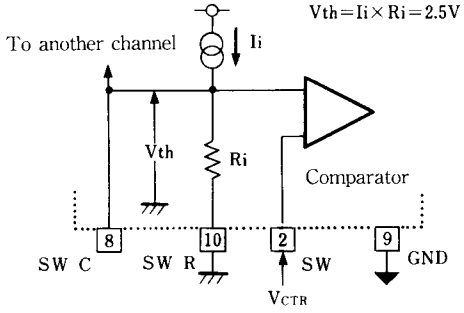

## ■ ADJUSTMENT OF VTH

In case of Ii=100μA,Ri=25kΩ,Re ( External Resistor )

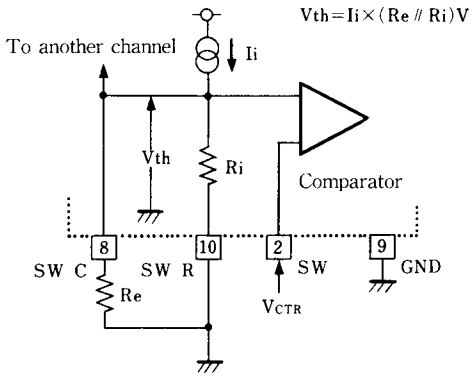
● Internal Vth ( Single supply )



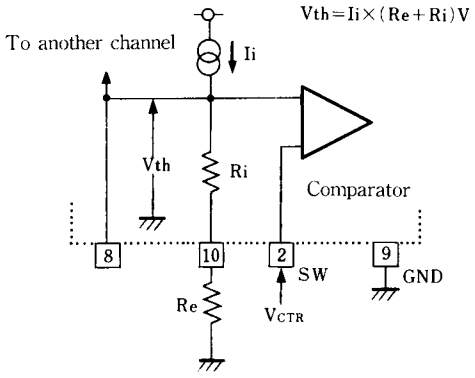

● Internal Vth ( Two supply )




● Vth,2.5V ( Single supply )

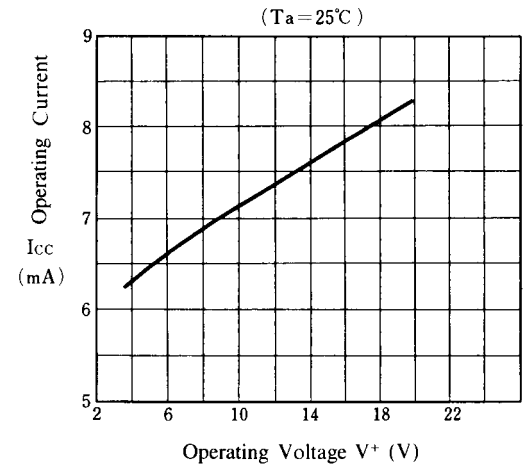



● Vth>2.5V ( Single supply )

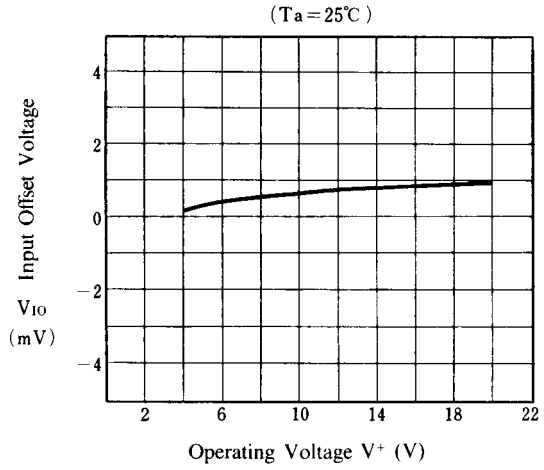


## ■ TYPICAL CHARACTERISTICS

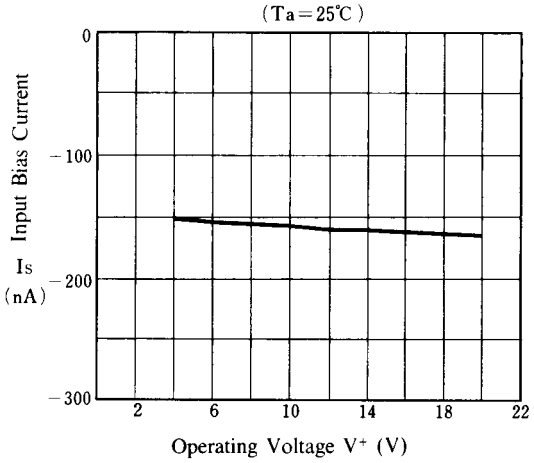
### Operating Current vs. Operating Voltage



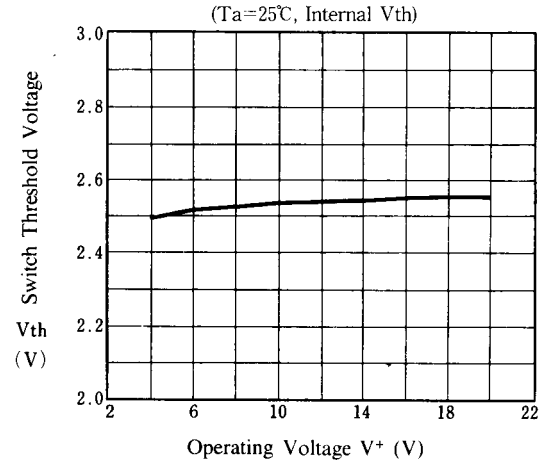

### Input Offset Voltage vs. Operating Voltage



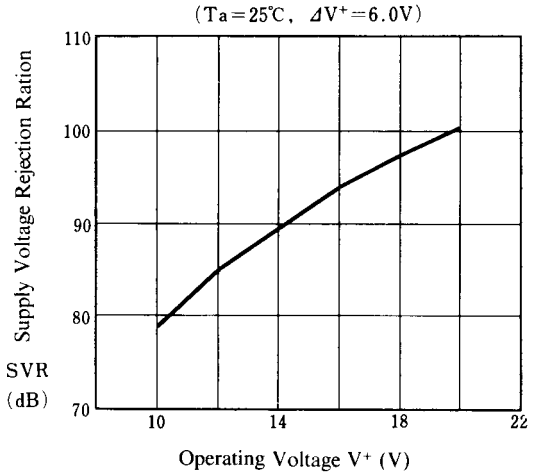

### Input Bias Current vs. Operating Voltage



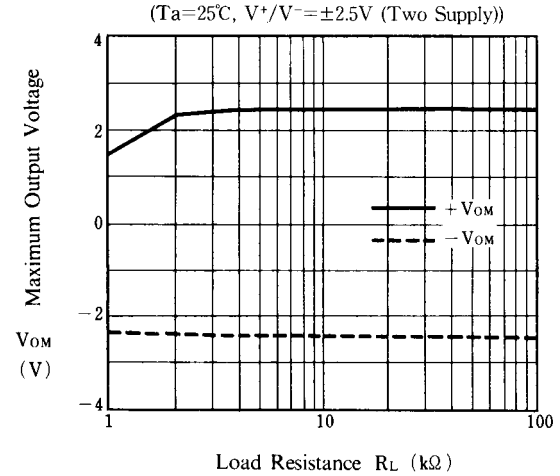

### Switch Threshold Voltage vs. Operating Voltage




### Supply Voltage Rejection Ratio vs. Operating Voltage



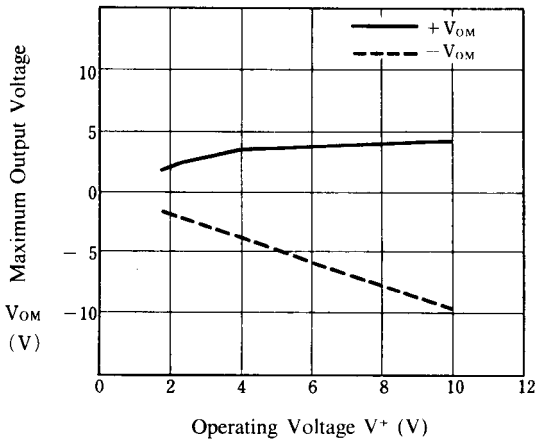

### Maximum Output Voltage vs. Load Resistance



## ■ TYPICAL CHARACTERISTICS

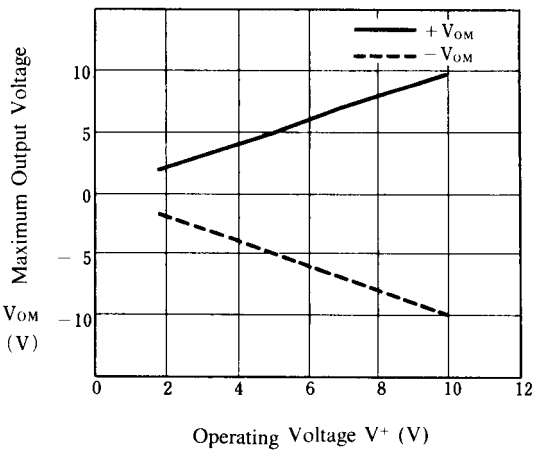
**Maximum Output Voltage vs. Operating Voltage**

(Ta=25℃, $R_L$= 2 kΩ)



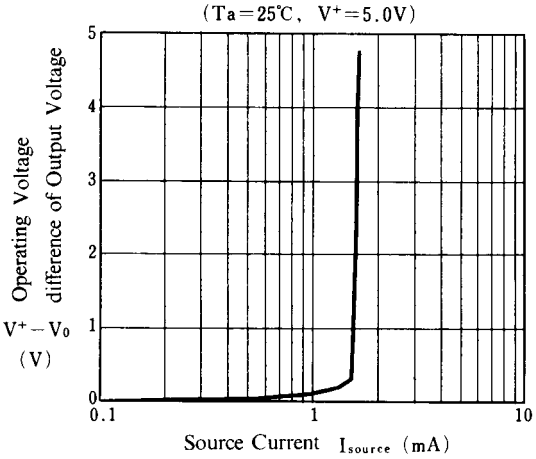

**Maximum Output Voltage vs. Operating Voltage**

(Ta=25℃, $R_L$=10kΩ)

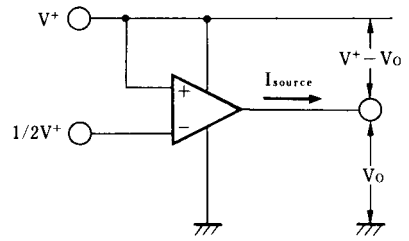



**Output Source Current**

(Ta=25℃, V+=5.0V)

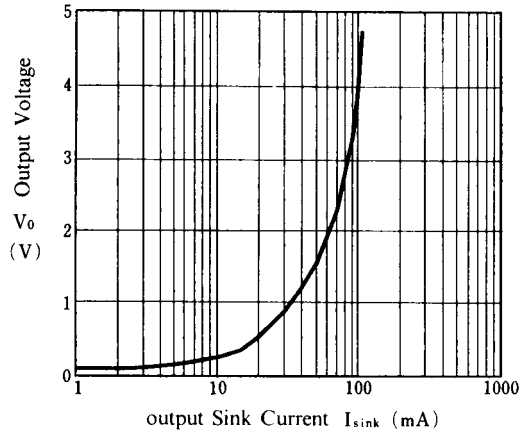



Test Circuit (Output Source Current)

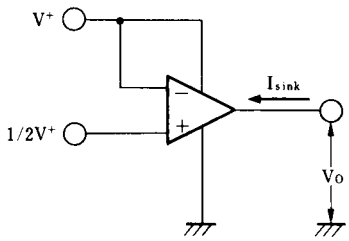



**Output Voltage vs. Output Sink Current**

(Ta=25℃, V+=5.0V)



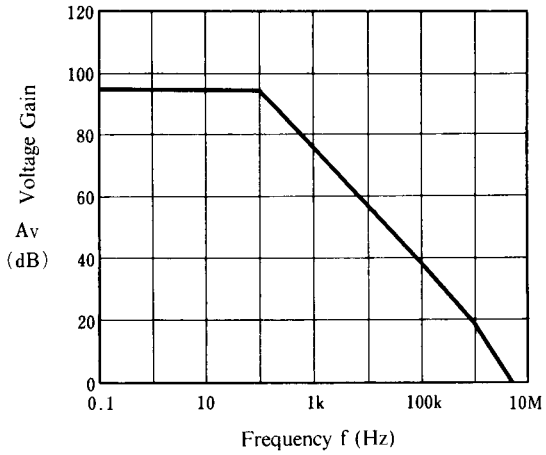

Test Circuit (Output Sink Current)



## ■ TYPICAL CHARACTERISTICS

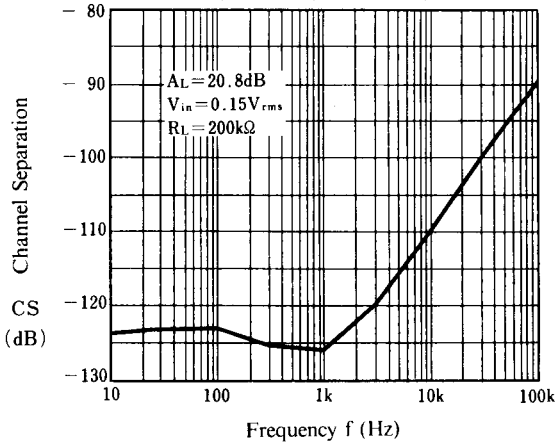
**Voltage Gain vs. Frequency**

(Ta=25℃, V⁺=5.0V)



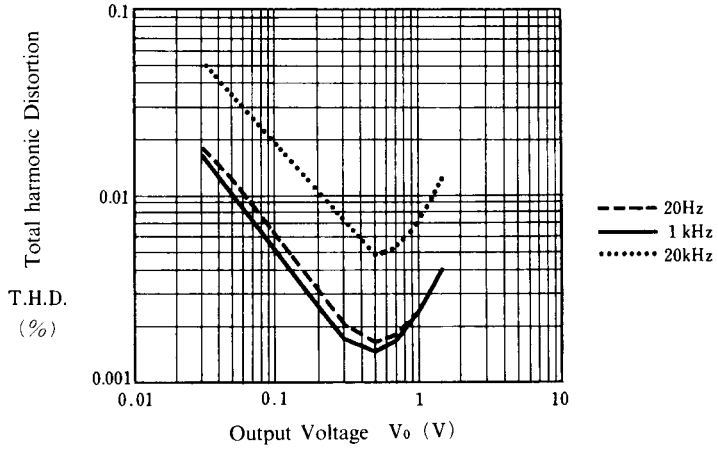

**Channel Separation vs. Frequency**

(Ta=25℃, V⁺=5.0V)

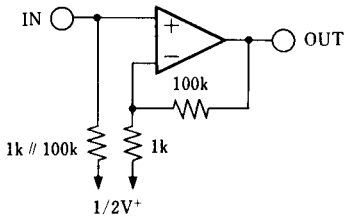



**Total Harmonic Distortion vs. Output Voltage**

(Ta=25℃, V⁺=5.0V)

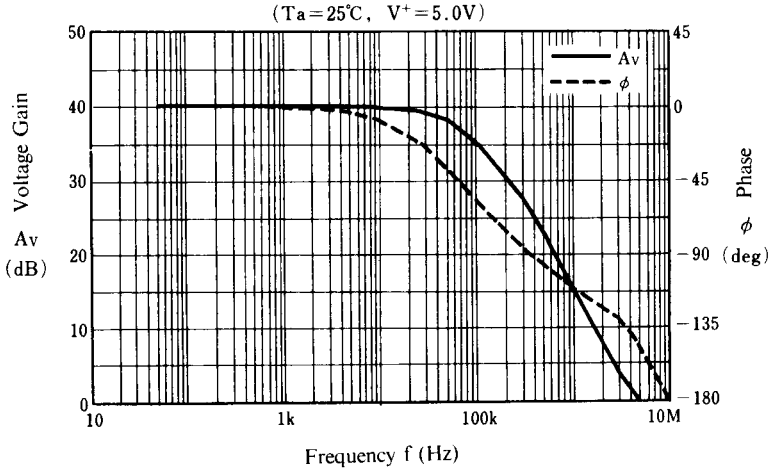



Test Circuit (Voltage Gain/Phase)

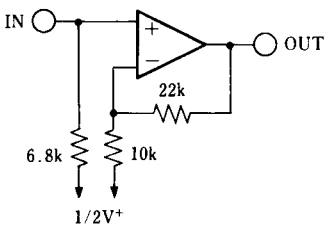



**Voltage Gain/Phase vs. Frequency**

(Ta=25℃, V⁺=5.0V)

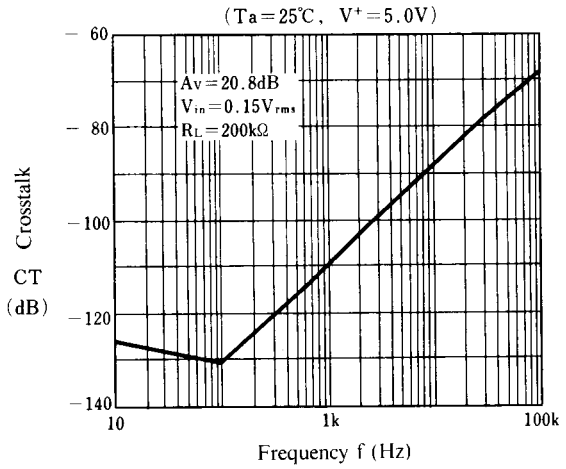



Test Circuit (THD)

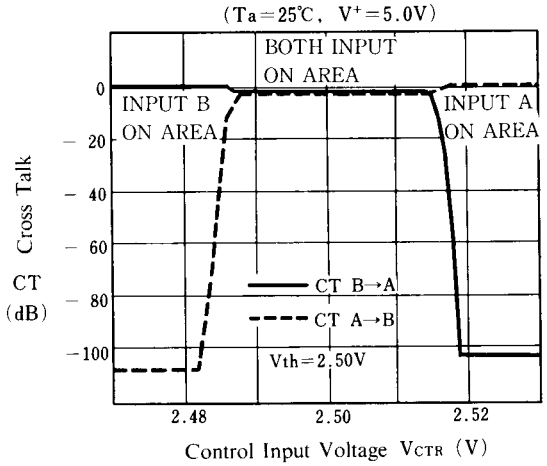


## ■ TYPICAL CHARACTERISTICS

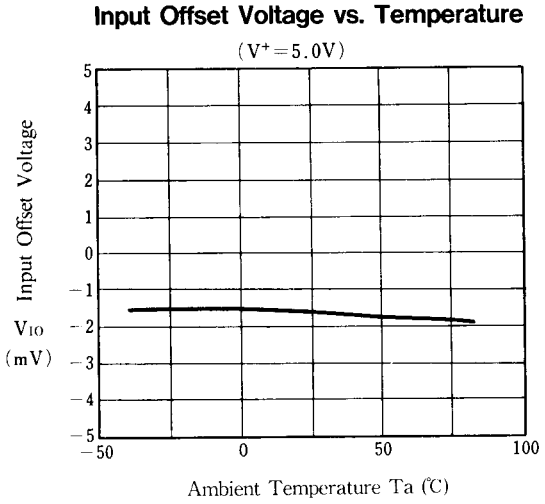
**Crosstalk vs. Frequency**



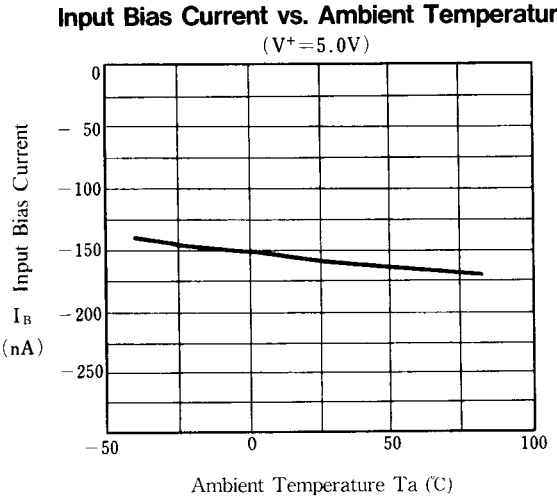

**Crosstalk vs. Control Input Voltage**



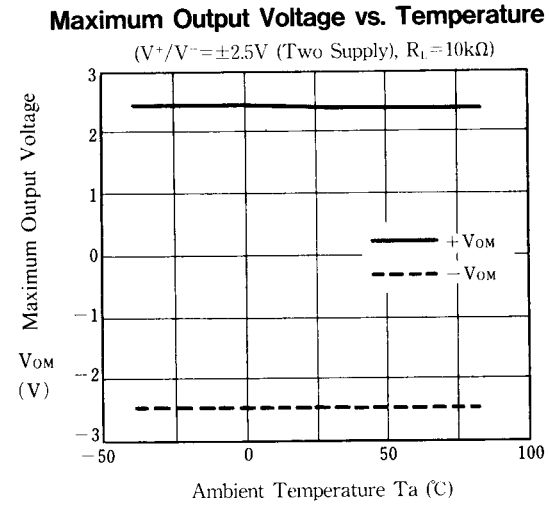

**Input Offset Voltage vs. Temperature**



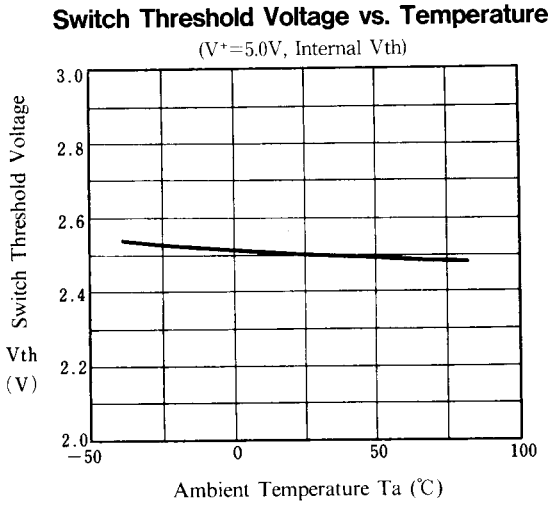

**Input Bias Current vs. Ambient Temperature**




**Maximum Output Voltage vs. Temperature**




**Switch Threshold Voltage vs. Temperature**



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