

## 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.

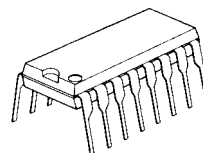
The NJM2123 has the same electrical characteristic of the NJM2112, and is low saturation output type.

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.

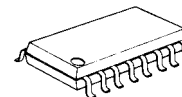
### ■ FEATURES

- 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

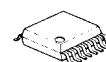
### ■ PACKAGE OUTLINE



NJM2123D

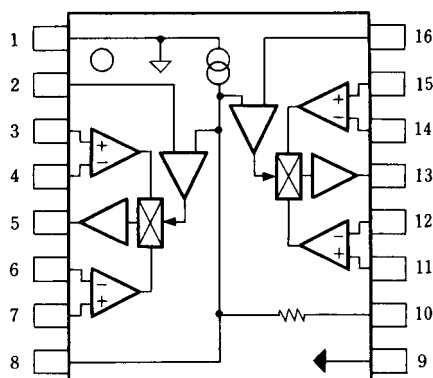


NJM2123M



NJM2123V

### ■ PIN CONFIGURATION

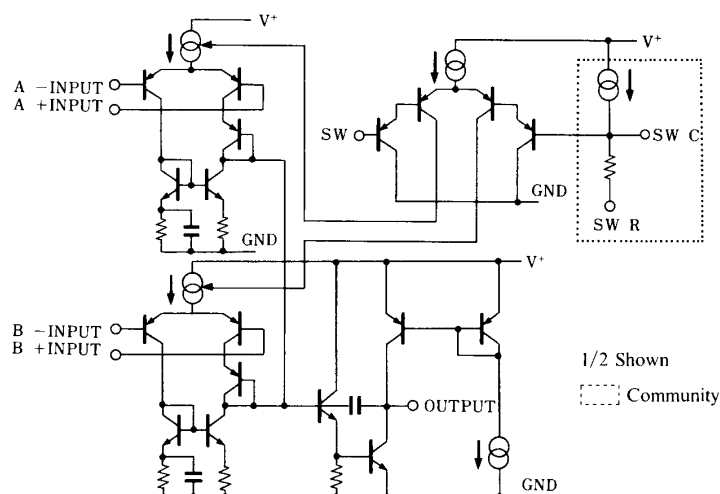


NJM2123D  
NJM2123M  
NJM2123V

#### 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 ( DMP8 ) 300 ( 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/ $\mu s$
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.

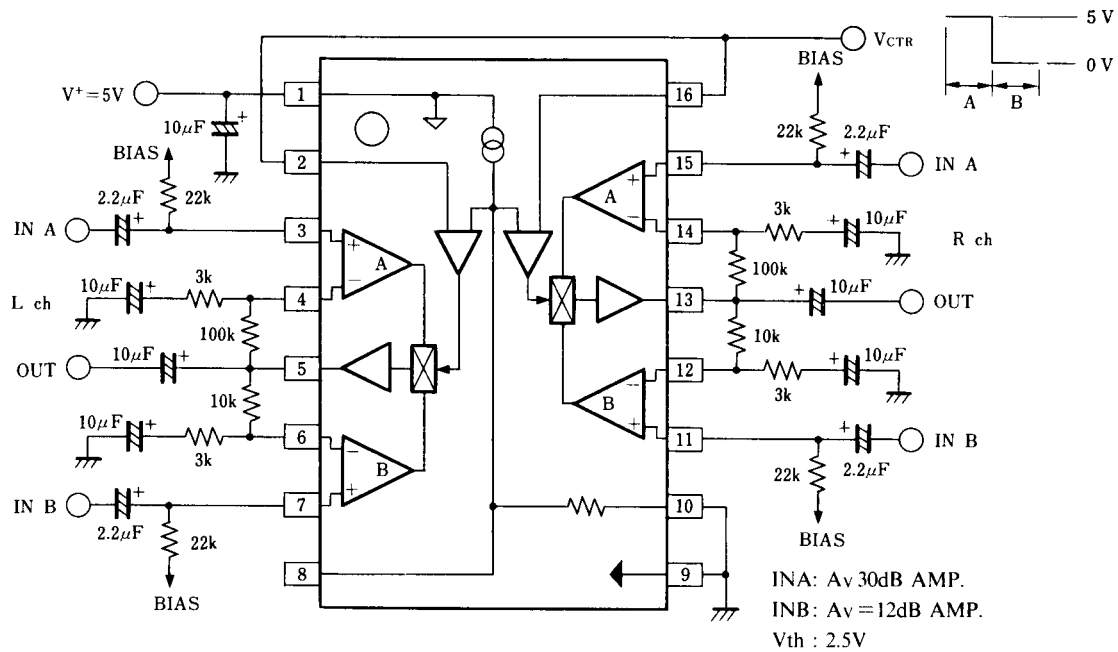
( note4 ) "Channel Separation" is defined about leak of signal between 2 circuits.

( 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.

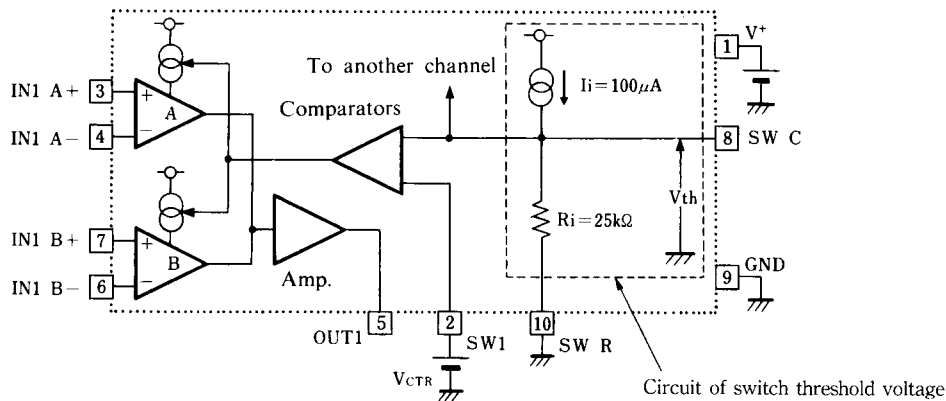
## ■ TYPICAL CHARACTERISTICS

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  $V_{th}$ .

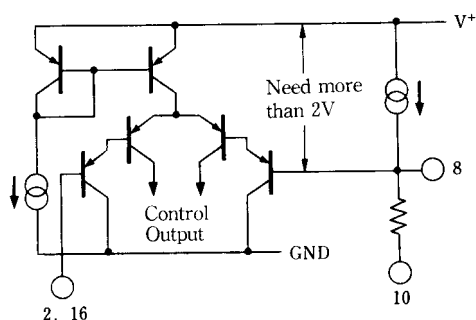
## ■ ABOUT ADJUSTMENT OF V<sub>th</sub>

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 (  $\pm 2.5V$  ).

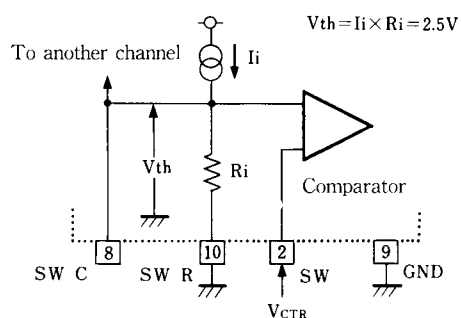
Adjustment method is as following.



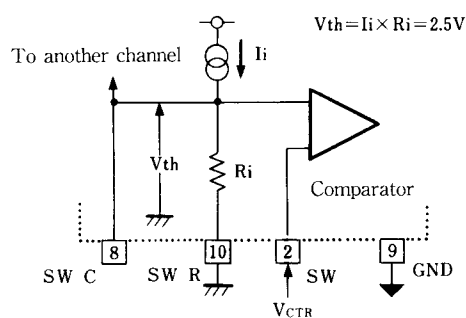
## ■ ADJUSTMENT OF V<sub>th</sub>

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

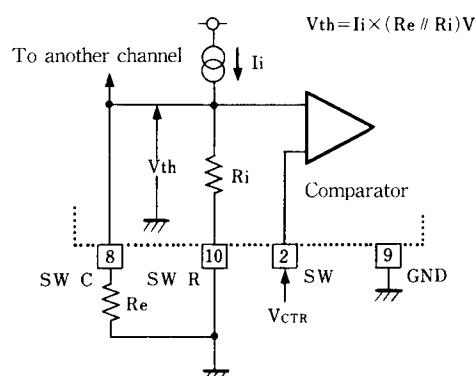
### ● Internal V<sub>th</sub> ( Single supply )



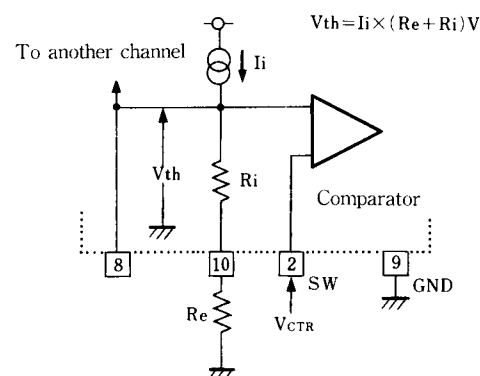
### ● Internal V<sub>th</sub> ( Two supply )



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

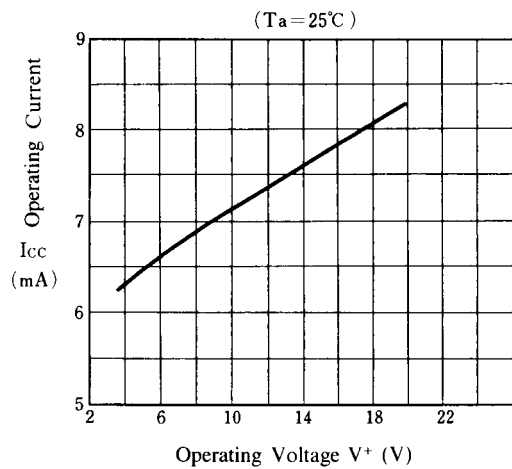


### ● V<sub>th</sub> > 2.5V ( Single supply )

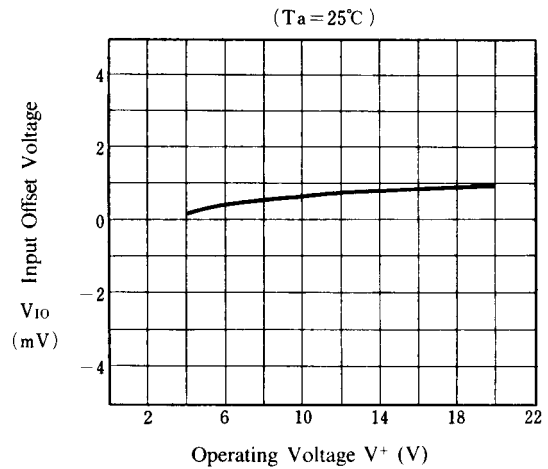


## ■ TYPICAL CHARACTERISTICS

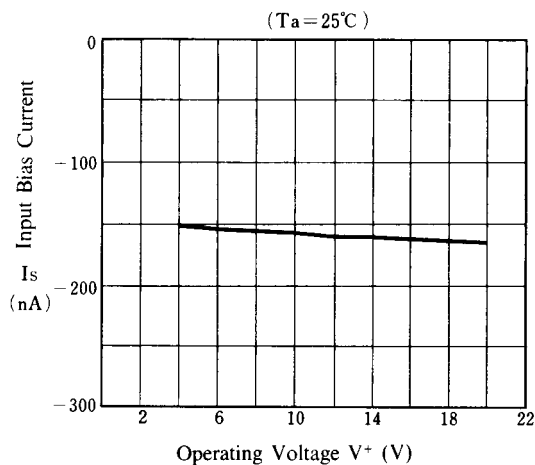
**Operating Current vs. Operating Voltage**



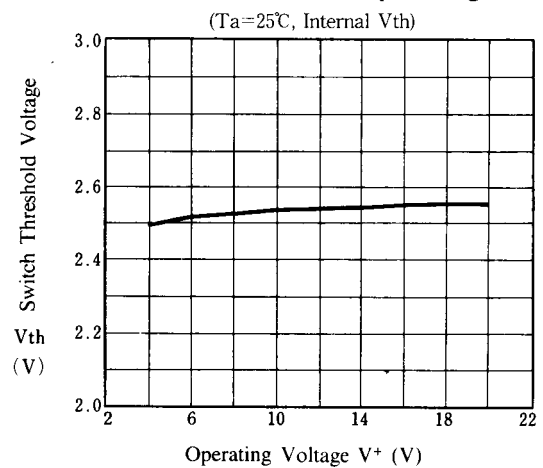
**Input Offset Voltage vs. Operating Voltage**



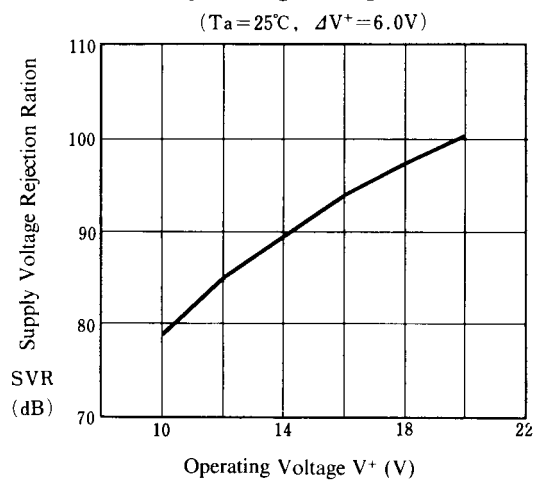
**Input Bias Current vs. Operating Voltage**



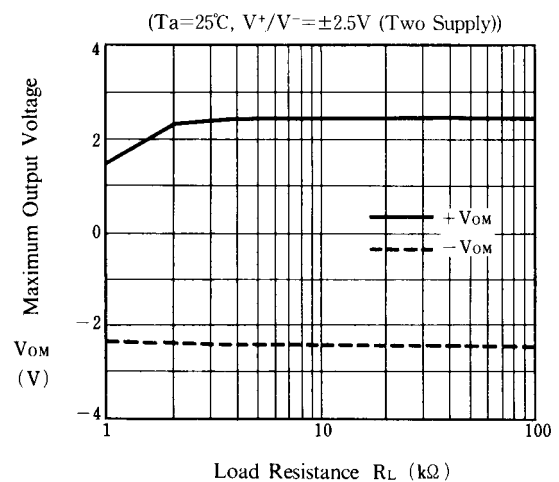
**Switch Threshold Voltage vs. Operating Voltage**



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



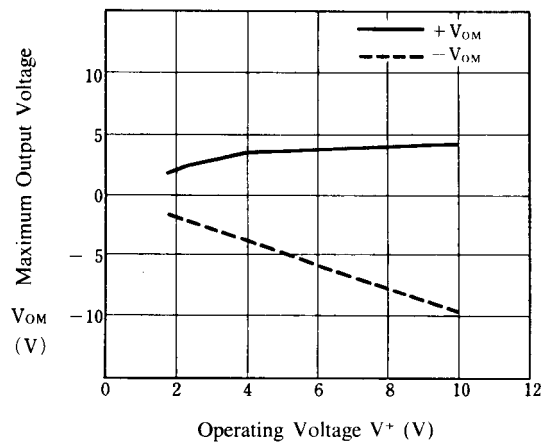
**Maximum Output Voltage vs. Load Resistance**



## ■ TYPICAL CHARACTERISTICS

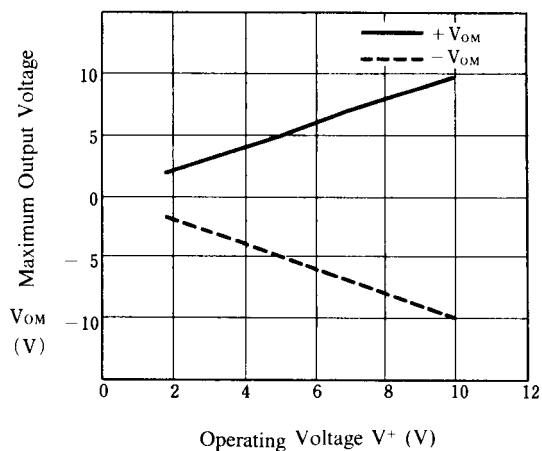
Maximum Output Voltage vs. Operating Voltage

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



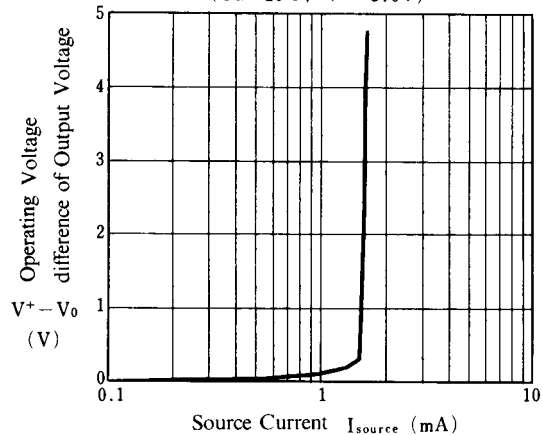
Maximum Output Voltage vs. Operating Voltage

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

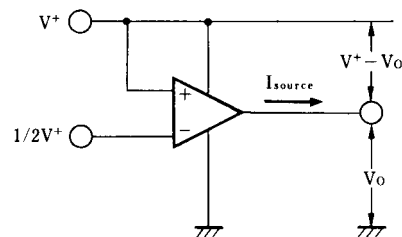


Output Source Current

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

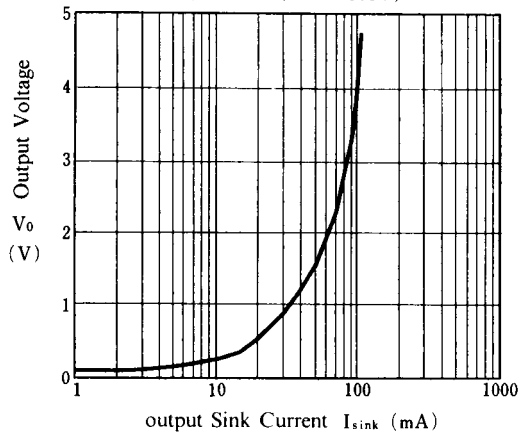


Test Circuit (Output Source Current)

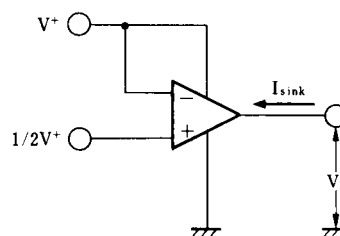


Output Voltage vs. Output Sink Current

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



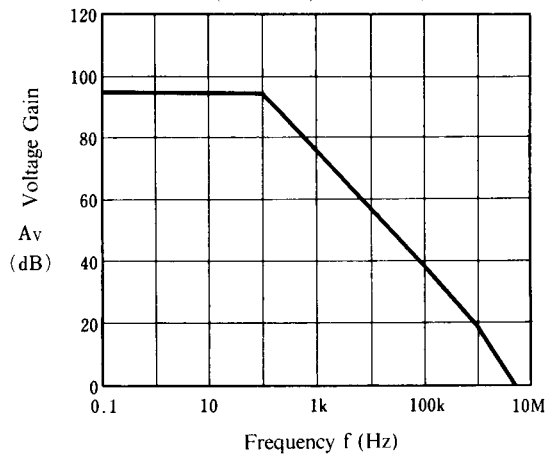
Test Circuit (Output Sink Current)



## ■ TYPICAL CHARACTERISTICS

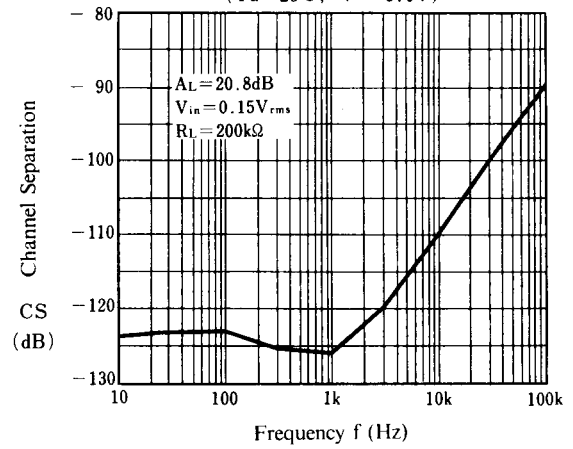
**Voltage Gain vs. Frequency**

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



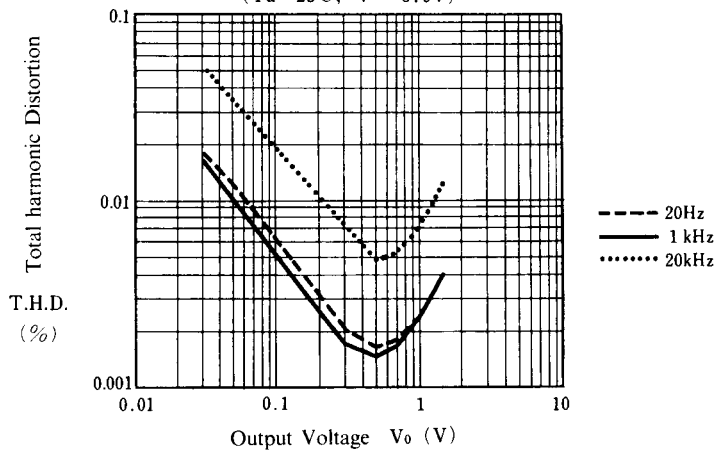
**Channel Separation vs. Frequency**

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

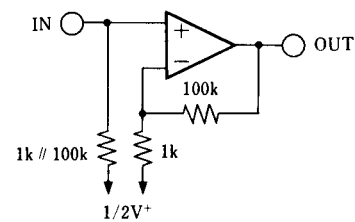


**Total Harmonic Distortion vs. Output Voltage**

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

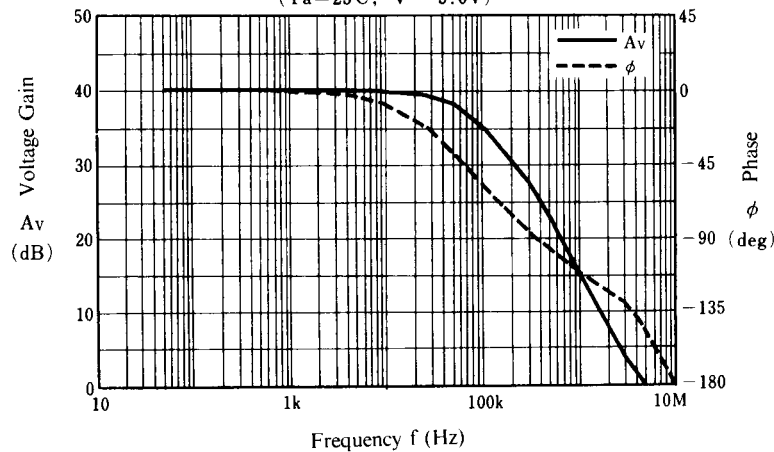


**Test Circuit (Voltage Gain/Phase)**

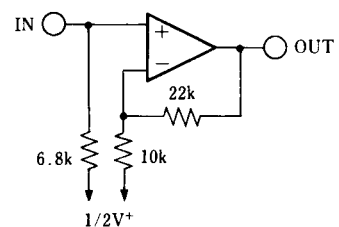


**Voltage Gain/Phase vs. Frequency**

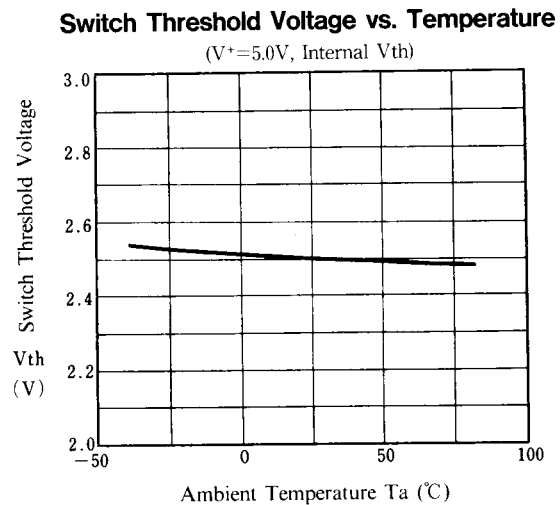
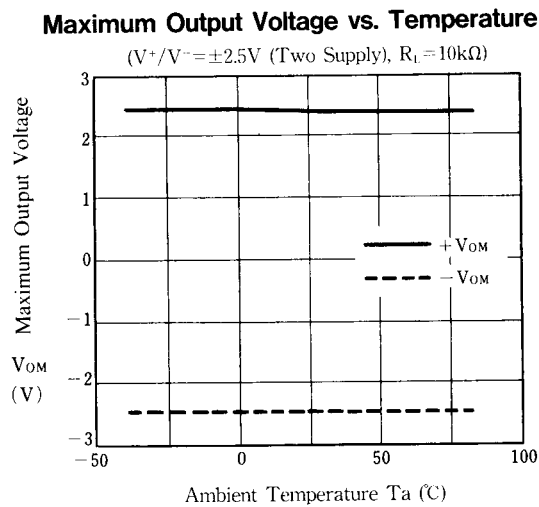
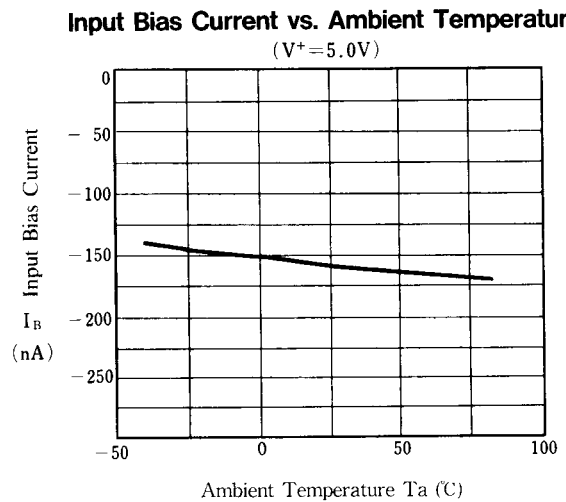
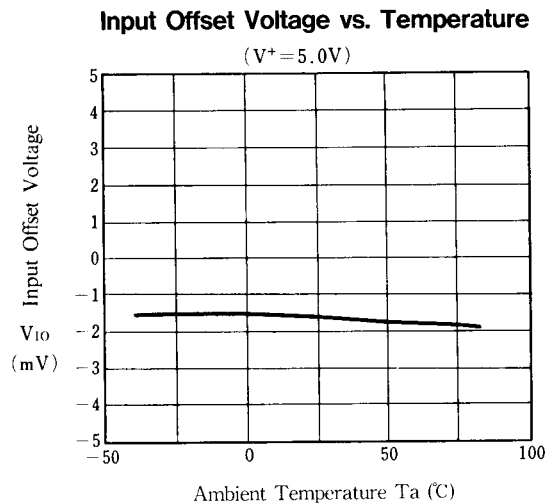
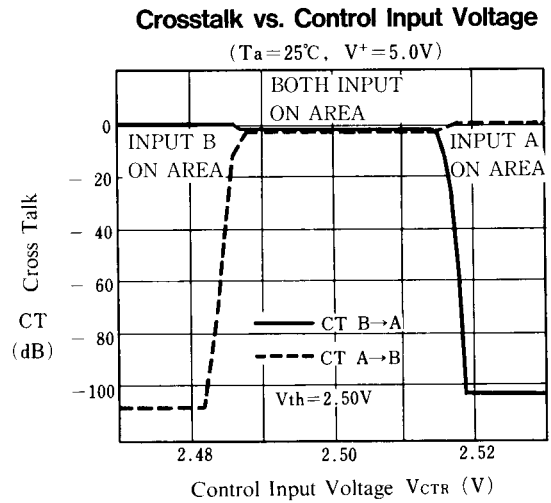
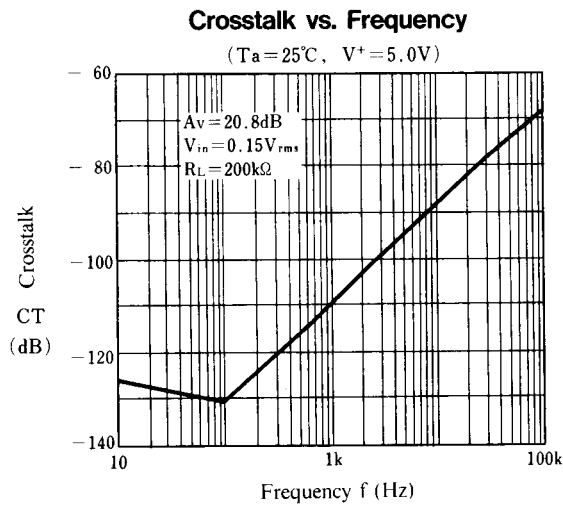
( $T_a = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{V}$ )



**Test Circuit (THD)**



## ■ TYPICAL CHARACTERISTICS





**[CAUTION]**

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