# Designated client product

This product will be discontinued its production in the near term.
And it is provided for customers currently in use only, with a time limit.
It can not be available for your new project. Please select other new or existing products.
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New Japan Radio Co.,Ltd.

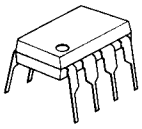
www.njr.com

# DUAL LOW VOLTAGE POWER AMPLIFIER

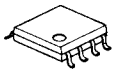
## ■ GENERAL DESCRIPTION

The NJM2073 is a monolithic integrated circuit in 8 lead dual-in-line package,which is designed for dual audio power amplifier in portable radio and handy cassette player.

## ■ PACKAGE OUTLINE



NJM2073D

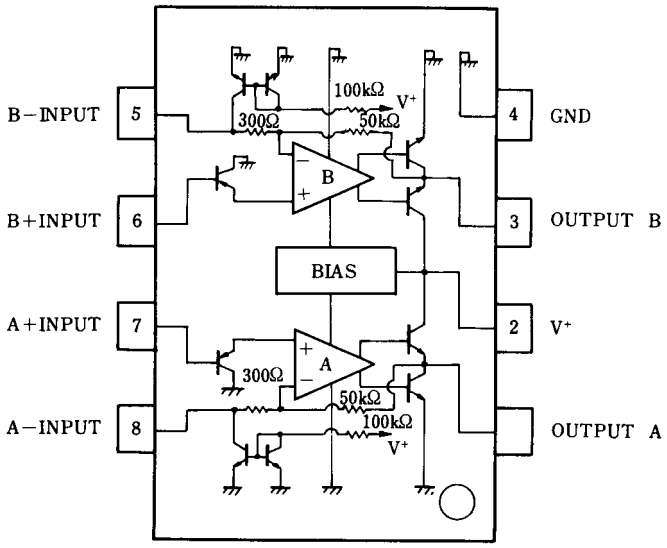


NJM2073M

## ■ FEATURES

- Operating Voltage ( $V^+$=1.8V~15V )
- Low Crossover Distortion
- Low Operating Current
- Bridge or Stereo Configuration
- No Turn-on Noise
- Package Outline DIP8,DMP8
- Bipolar Technology

## ■ PIN CONFIGURATION




NJM2073D
NJM2073M

## ■ ABSOLUTE MAXIMUM RATINGS

( Ta=25˚C )

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---|---|---|---|
| Supply Voltage | $V^+$ | 15 | V |
| Output Peak Current | $I_{OP}$ | 1 | A |
| Power Dissipation | $P_D$ | ( DIP8 ) 700<br>( DMP8 ) 300 | mW |
| Input Voltage Range | $V_{IN}$ | ± 0.4 | V |
| Operating Temperature Range | $T_{opr}$ | -40~+85 | ˚C |
| Storage Temperature Range | $T_{stg}$ | -40~+125 | ˚C |

## ■ ELECTRICAL CHARACTERISTICS D-Type

(1) BTL Configuration ( Test Circuit Fig.1 ) ( $V^+$=6V,Ta=25˚C )

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Voltage | $V^+$ | | 1.8 | - | 15 | V |
| Operating Current | $I_{CC}$ | $R_L$=∞ | - | 6 | 9 | mA |
| Output Offset Voltage | $\Delta V_O$ | $R_L$=8Ω | - | 10 | 50 | mV |
| ( Between the Outputs ) | | | | | | |
| Input Bias Current | $I_B$ | | - | 100 | - | nA |
| Output Power | | THD=10%,f=1kHz | | | | |
| | $P_O$ | $V^+$=9V,$R_L$=16Ω ( Note ) | - | 2.0 | - | W |
| | $P_O$ | $V^+$=6V,$R_L$=8Ω ( Note ) | 0.9 | 1.2 | - | W |
| | $P_O$ | $V^+$=4.5V,$R_L$=8Ω | - | 0.6 | - | W |
| | $P_O$ | $V^+$=4.5V,$R_L$=4Ω ( Note ) | - | 0.8 | - | W |
| | $P_O$ | $V^+$=3V,$R_L$=4Ω | 200 | 300 | - | mW |
| | $P_O$ | $V^+$=2V,$R_L$=4Ω | - | 80 | - | mW |
| | | THD=1%,f=40Hz~15kHz | | | | |
| | $P_O$ | $V^+$=6V,$R_L$=8Ω | - | 1.0 | - | W |
| | $P_O$ | $V^+$=4.5V,$R_L$=4Ω | - | 0.6 | - | W |
| Total Harmonic Distortion | THD | $P_O$=0.5W,$R_L$=8Ω,f=1kHz | - | 0.2 | - | % |
| Close Loop Voltage Gain | $A_V$ | f=1kHz | 41 | 44 | 47 | dB |
| Input Impedance | $Z_{IN}$ | f=1kHz | 100 | - | - | kΩ |
| Equivalent Input Noise Voltage | $V_{NI1}$ | $R_S$=10kΩ,A Curve | - | 2 | - | μV |
| | $V_{NI2}$ | $R_S$=10kΩ,B=22Hz~22kHz | - | 2.5 | - | μV |
| Ripple Rejection | RR | f=100Hz | - | 40 | - | dB |
| Cutoff Frequency | $f_H$ | $A_V$=-3dB from f=1kHz,$R_L$=8Ω,$P_O$=1W | - | 130 | - | kHz |

( Note ) At on PC Board

(2) Stereo Configuration ( Test Circuit Fig.2 )

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Voltage | $V^+$ | | 1.8 | - | 15 | V |
| Output Voltage | $V_O$ | | - | 2.7 | - | V |
| Operating Current | $I_{CC}$ | $R_L$=∞ | - | 6 | 9 | mA |
| Input Bias Current | $I_B$ | | - | 100 | - | nA |
| Output Power ( Each Channel ) | | THD=10%,f=1kHz | | | | |
| | $P_O$ | $V^+$=6V,$R_L$=4Ω ( Note ) | 0.5 | 0.65 | - | W |
| | $P_O$ | $V^+$=4.5V,$R_L$=4Ω | - | 0.32 | - | W |
| | $P_O$ | $V^+$=3V,$R_L$=4Ω | - | 120 | - | mW |
| | $P_O$ | $V^+$=2V,$R_L$=4Ω | - | 30 | - | mW |
| | | THD=1%,f=1kHz | | | | |
| | $P_O$ | $V^+$=6V,$R_L$=4Ω | - | 500 | - | mW |
| | $P_O$ | $V^+$=4.5V,$R_L$=4Ω | - | 250 | - | mW |
| Total Harmonic Distortion | THD | $P_O$=0.4W,$R_L$=4Ω,f=1kHz | - | 0.25 | - | % |
| Voltage Gain | $A_V$ | f=1kHz | 41 | 44 | 47 | dB |
| Channel Balance | $\Delta A_V$ | | - | - | ± 1 | dB |
| Input Impedance | $Z_{IN}$ | f=1kHz | 100 | - | - | kΩ |
| Equivalent Input Noise Voltage | $V_{NI1}$ | $R_S$=10kΩ,A Curve | - | 2.5 | - | μV |
| | $V_{NI2}$ | $R_S$=10kΩ,B=22Hz~22kHz | - | 3 | - | μV |
| Ripple Rejection | RR | f=100Hz,$C_X$=100μF | 24 | 30 | - | dB |
| Cutoff Frequency | $f_H$ | $A_V$=-3dB from f=1kHz,$R_L$=8Ω,$P_O$=250mW | - | 200 | - | kHz |

( Note ) At on PC Board

## ■ ELECTRICAL CHARACTERISTICS M-Type

(1) BTL Configuration ( Test Circuit Fig.1 ) ( $V^+$=6V,Ta=25°C )

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Voltage | $V^+$ | | 1.8 | - | 15 | V |
| Operating Current | $I_{CC}$ | $R_L$=∞ | - | 6 | 9 | mA |
| Output Offset Voltage | $\Delta V_O$ | $R_L$=8Ω | - | 10 | 50 | mV |
| ( Between the Outputs ) | | | | | | |
| Input Bias Current | $I_B$ | | - | 100 | - | nA |
| Output Power | | THD=10%,f=1kHz | | | | |
| | $P_O$ | $V^+$=6V,$R_L$=16Ω ( Note ) | - | 0.8 | - | W |
| | $P_O$ | $V^+$=4V,$R_L$=8Ω ( Note ) | 350 | 460 | - | mW |
| | $P_O$ | $V^+$=3V,$R_L$=4Ω ( Note ) | 200 | 300 | - | mW |
| | $P_O$ | $V^+$=2V,$R_L$=4Ω | - | 80 | - | mW |
| | | THD=1%,f=40Hz~15kHz | | | | |
| | $P_O$ | $V^+$=4V,$R_L$=8Ω | - | 380 | - | mW |
| Total Harmonic Distortion | THD | $V^+$=4V,$R_L$=8Ω,$P_O$=200mW,f=1kHz | - | 0.2 | - | % |
| Close Loop Voltage Gain | $A_V$ | f=1kHz | 41 | 44 | 47 | dB |
| Input Impedance | $Z_{IN}$ | f=1kHz | 100 | - | - | kΩ |
| Equivalent Input Noise Voltage | $V_{NI1}$ | $R_S$=10kΩ,A Curve | - | 2 | - | μV |
| | $V_{NI2}$ | $R_S$=10kΩ,B=22Hz~22kHz | - | 2.5 | - | μV |
| Ripple Rejection | RR | f=100Hz | - | 40 | - | dB |
| Cutoff Frequency | $f_H$ | $A_V$=-3dB from f=1kHz,$R_L$=16Ω,$P_O$=0.5W | - | 130 | - | kHz |

( Note ) At on PC Board

(2) Stereo Configuration ( Test Circuit Fig.2 )

| PARAMETER | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Operating Voltage | $V^+$ | | 1.8 | - | 15 | V |
| Output Voltage | $V_O$ | | - | 2.7 | - | V |
| Operating Current | $I_{CC}$ | $R_L$=∞ | - | 6 | 9 | mA |
| Input Bias Current | $I_B$ | | - | 100 | - | nA |
| Output Power ( Each Channel ) | | THD=10%,f=1kHz | | | | |
| | $P_O$ | $V^+$=6V,$R_L$=16Ω | - | 240 | - | mW |
| | $P_O$ | $V^+$=5V,$R_L$=8Ω ( Note ) | - | 270 | - | mW |
| | $P_O$ | $V^+$=4V,$R_L$=4Ω ( Note ) | 180 | 250 | - | mW |
| | $P_O$ | $V^+$=3V,$R_L$=4Ω | - | 120 | - | mW |
| | $P_O$ | $V^+$=2V,$R_L$=4Ω | - | 30 | - | mW |
| | | THD=1%,f=1kHz | | | | |
| | $P_O$ | $V^+$=4V,$R_L$=4Ω | - | 180 | - | mW |
| Total Harmonic Distortion | THD | $V^+$=4V,$R_L$=4Ω,$P_O$=150mW,f=1kHz | - | 0.25 | - | % |
| Voltage Gain | $A_V$ | f=1kHz | 41 | 44 | 47 | dB |
| Channel Balance | $\Delta A_V$ | | - | - | ± 1 | dB |
| Input Impedance | $Z_{IN}$ | f=1kHz | 100 | - | - | kΩ |
| Equivalent Input Noise Voltage | $V_{NI1}$ | $R_S$=10kΩ,A Curve | - | 2.5 | - | μV |
| | $V_{NI2}$ | $R_S$=10kΩ,B=22Hz~22kHz | - | 3 | - | μV |
| Ripple Rejection | RR | f=100Hz,$C_X$=100μF | 24 | 30 | - | dB |
| Cutoff Frequency | $f_H$ | $A_V$=-3dB from f=1kHz,$R_L$=16Ω,$P_O$=125mW | - | 200 | - | kHz |

( Note ) At on PC Board

## ■ TYPICAL APPLICATION & TEST CIRCUIT

**Fig.1 BTL Configuration**

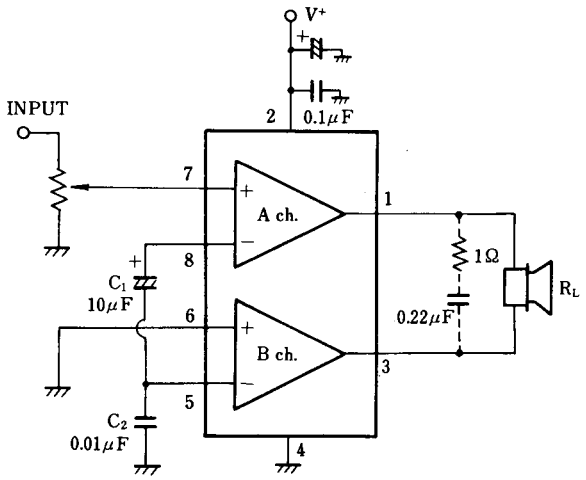
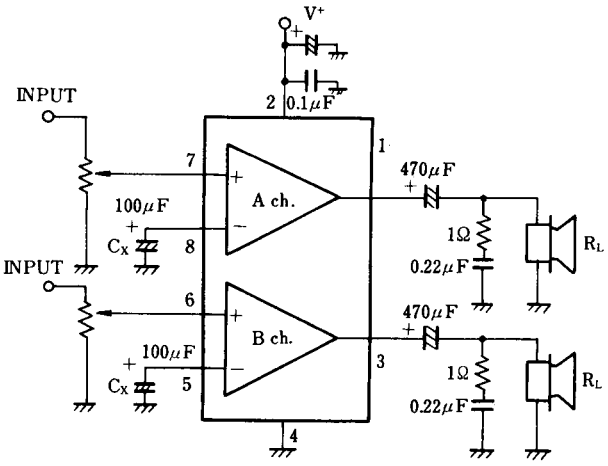



**Fig.2 Stereo Configuration**

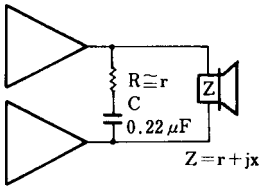



note:pin No.to D,M-Type

## ■ PARASTIC OSCILLATION PREVEMTING CIRCUIT

Put 1Ω+0.22μF on parallel to load,if the load is speaker.Recommend putting 0.1μF and more than 100μF capacitors with good high frequency characteristics in to near ground and supply voltage pins.

In BTL operation of less than 2V supply voltage,parastic oscillation may be occurred with R=1Ω.And so recommended R to be the same value of pure resistance(r) when it is lower than 3V.




## ■ MUTING CIRCUIT

When Mute ON.OUTPUT level saturates to GND side.

**Fig.3 BTL Configuration**

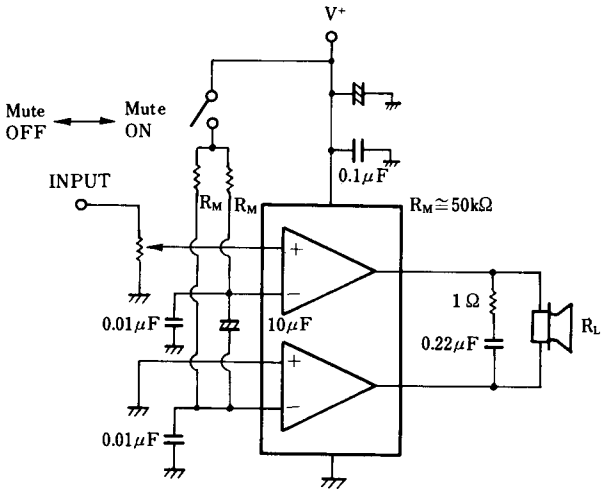
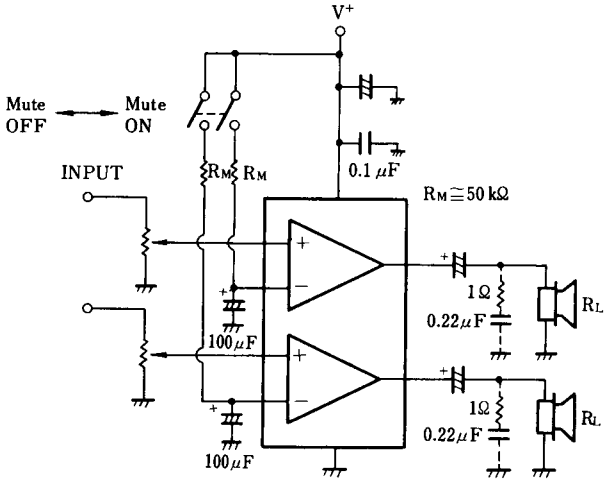



**Fig.4 Stereo Configuration**



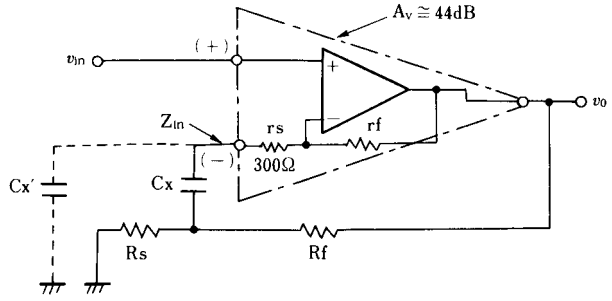

## ■ VOLTAGE GAIN REDUCTION APPLICATION EXAMPLE

(1) Outline of way to further Reduction

NJM2073 by taking in assamption,as one of OP-AMP ( Gain 44dB,minus input impedance about 300Ω ),to feedback from output to minus input helps to get reduction of stabilized Voltage Gain.Fig.5 indicates the model example.

Here is the point to be noticed that,in order to get the appropriate output Bias Voltage,it is important to keep the minus input floating as DC condition,(inserting $C_X$),and also that when extended too much reduction of Gain might cause Oscillation due to high band phase margin.The reduction of voltage gain is limited at around 26dB (20 times),and when oscillation,it in necessary to attach the oscillation stopper.Please examine the $C_X$ value accordingly to the application requirement.

**Fig.5 Model of Voltage Gain Reduction**




$$Av=\frac{v_o}{v_{in}}\cong\frac{Rs+Rf}{Rs+\frac{Rs+Rf}{160/(A_v)}+\frac{Rs\times Rf}{160\times 300/(A_v)(Zin)}}$$

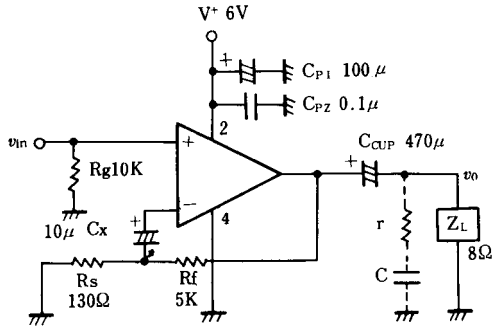
(2) The Application Example of Voltage Gain Reduction. ( STEREO )

Fig.6 indicates the application example and Table1 indicates the recommendable value of parts to be attached externally.

Table1,Applicating purpose and Recommended Value of Externally parts to be attached.

| EXTERNAL PARTS | APPLICATION PURPOSE | RECOMMENDED VALUE | REMARKS |
|---|---|---|---|
| $R_g$ | Plus input to be grounded by fixed DC | Under about 100kΩ | Catch the noise when much higher. |
| $R_s$ | AV shall be decided with $R_f$ | - | |
| $R_f$ | AV shall be decided with $R_s$ | About 5kΩ | The co-temperature of AV becomes higher in case when $R_S$ is higher resistance.The current from output pin to GND becomes higher,in case when $R_S$ is lower resistance.(The current sinks in vain.) |
| $C_X$ | Minus input to be grounded by fixed DC | - | Low-band Cut off frequency (fL) is to be decided.<br>The rise time becomes longer in case that $C_X$ is big. |
| $C_{CUP}$ | Output DC Decoupling | When $R_L$=8Ω,More than 220μF | fL shall be decided by $C_{CUP}$ and $Z_L$. |
| $C_{P1}$ | Stabilization of $V^+$ | More than about $C_{CUP}$ | Inserting near around $V^+$ pin and GND pin. |
| $C_{P2}$ | Prevention of Oscillation | More than 0.1μF | |
| r | Prevention of Oscillation | About $R_L$ | Inserting near around $V^+$ pin and GND pin. |
| C | Prevention of Oscillation | 0.22μF | To be examined by about the resistor volume of the speaker load. |

**Fig.6 STEREO Application Example.**



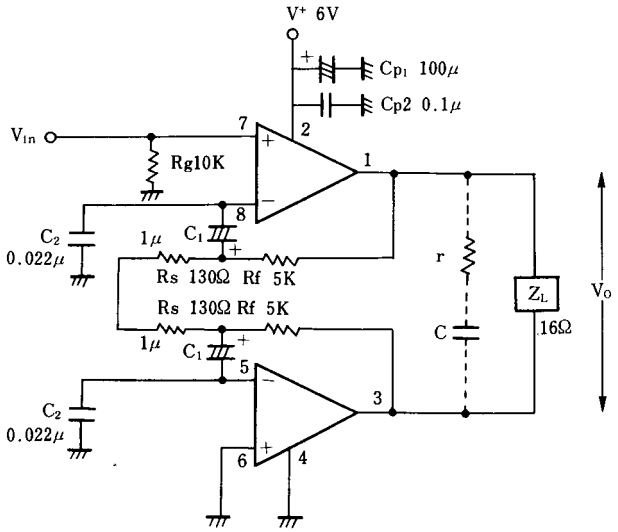
● Application for Voltage Gain Reduction ( BTL )

Fig.7 indicates the application example,Table2 shows recommended value of externally attaching parts.

Table2 Applicating purpose and Recommended Value of External Part

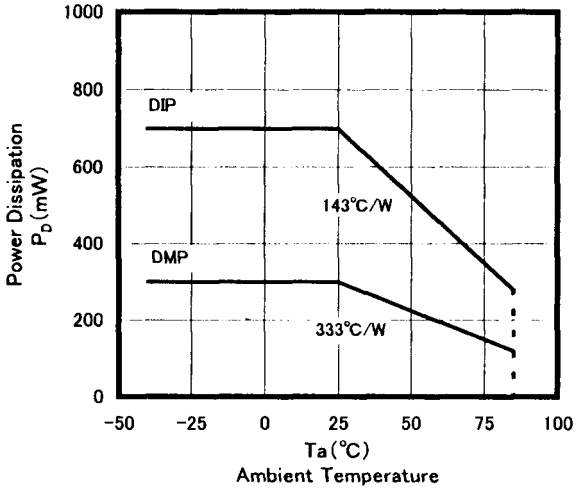
| EXTERNAL PARTS | APPLICATION PURPOSE | RECOMMENDED VALUE | REMARKS |
|---|---|---|---|
| $R_g$ | DC condition ground of plus input | Below about 10kΩ | Making noise when higher. |
| $R_s$ | AV shall be decided with $R_f$ | - | |
| $R_f$ | AV shall be decided with $R_s$ | About 5kΩ | Temperature feature to be increased accordingly as in higher AV value.<br>When lower,to be trended of Oscillation. |
| $C_1$ | Releasing minus input in to DC condition | - | Setting up low band Cut-off frequency (fL).<br>More higher,the rise time become longer. |
| $C_2$ | Preventing Oscillation | About 0.02μF | The more higher in value,the high band THD,due to phase slipping to be deteriorated.<br>When lower,to be trended of oscillation. |
| $C_{P1}$ | Stability of $V^+$<br>Preventing Oscillation | More than about 100μF | Inserting near around at $V^+$ and the GND pin. |
| $C_{P2}$ | Preventing Oscillation | More than 0.1μF | Inserting near around at $V^+$ and the GND pin. |
| r | Preventing Oscillation | About $R_L$ | To be examined at around pure resister Value of speaker load. |
| C | Preventing Oscillation | 0.22μF | |

**Fig.7 BTL Application**

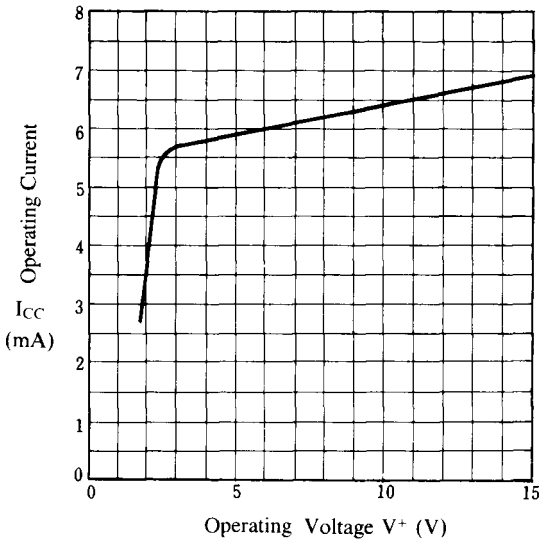


## ■ TYPICAL CHARACTERISTICS

**Power Dissipation**

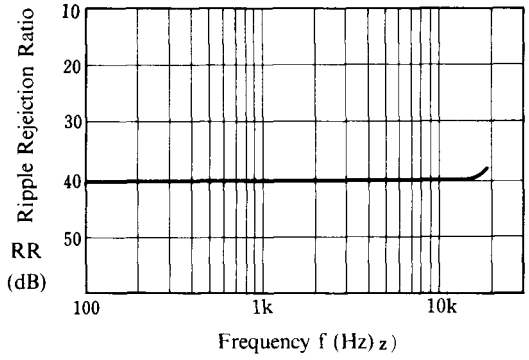



**Operating Current**



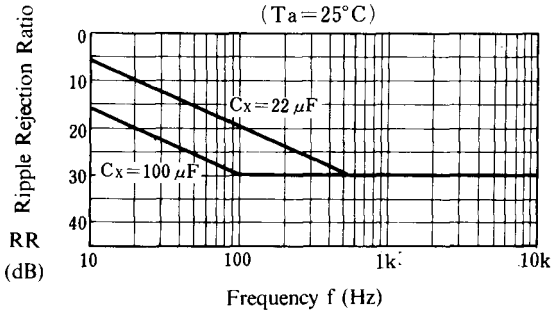

**Ripple Rejection Ratio (BTL)**

(Ta=25°C)



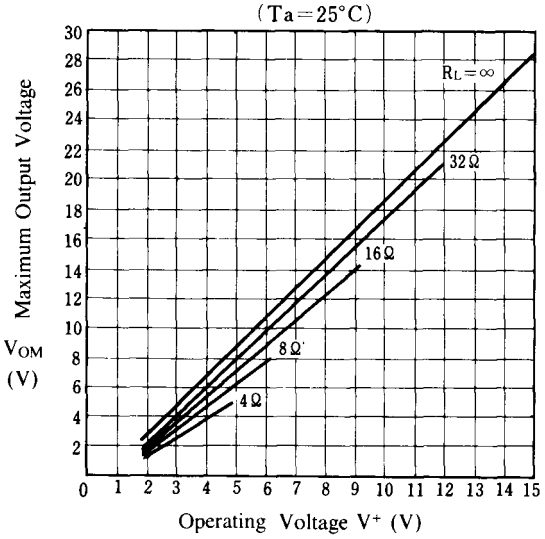

**Ripple Rejection Ratio (Stereo)**

(Ta=25°C)



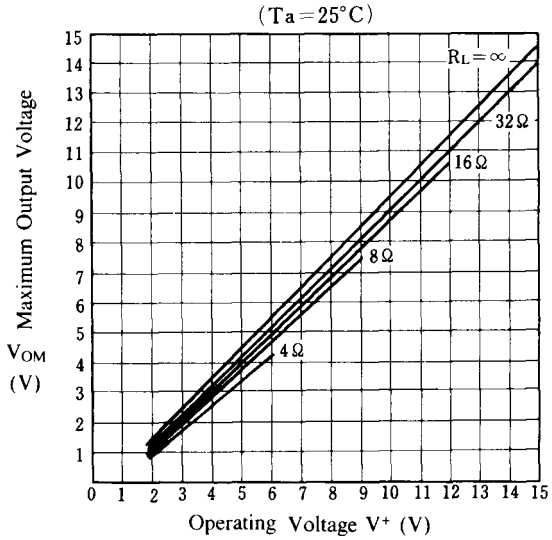

**Maximum Output Voltage (BTL)**

(Ta=25°C)




**Maximum Output Voltage (Stereo)**

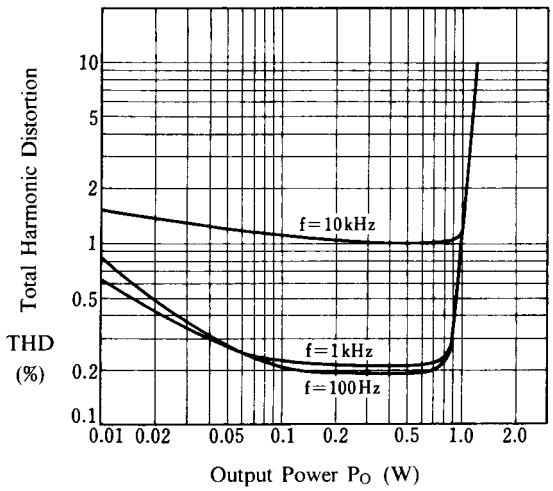
(Ta=25°C)



## ■ TYPICAL CHARACTERISTICS

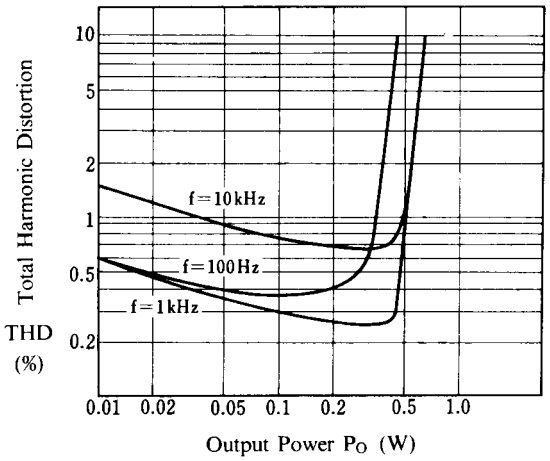
**Total Harmonic Distortion (BTL)**

($V^+$=6V, $R_L$=8Ω)



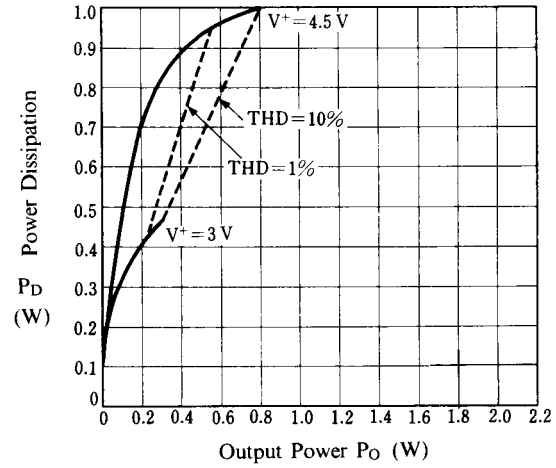

**Total Harmonic Distortion (Stereo)**

($V^+$=6V, $R_L$=4Ω)



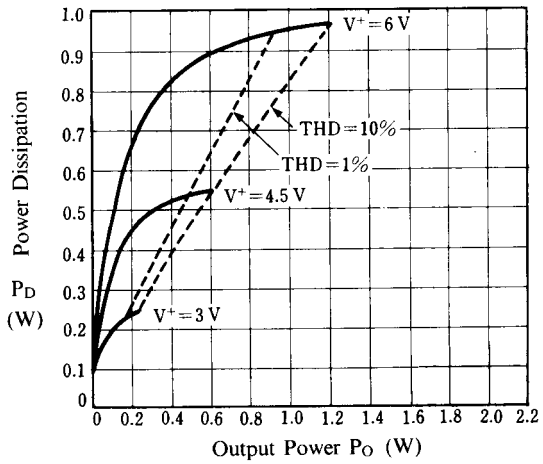

**Power Dissipation vs. Output Power (BTL)**

($R_L$=4Ω, f=1kHz, Ta=25°C)



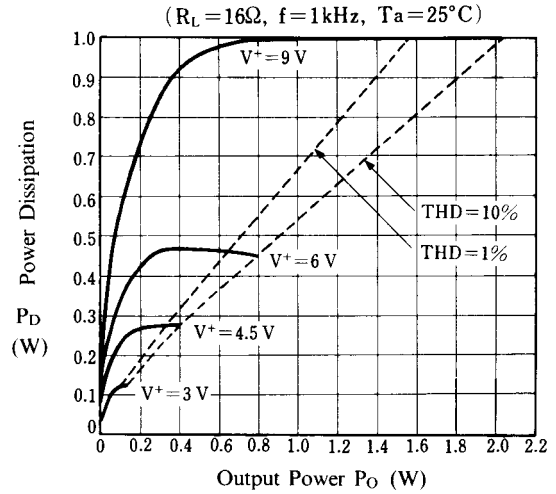

**Power Dissipation vs. Output Power (BTL)**

($R_L$=8Ω, f=1kHz, Ta=25°C)



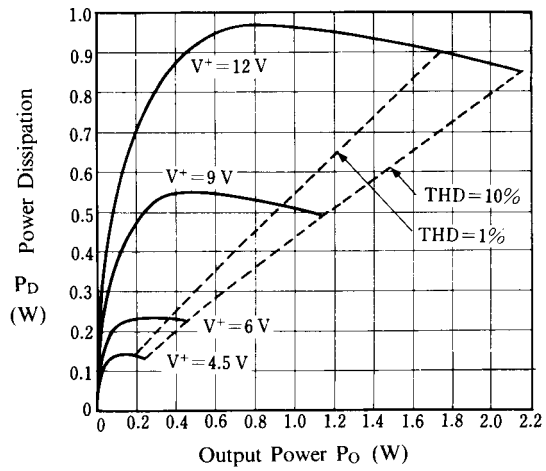

**Power Dissipation vs. Output Power (BTL)**

($R_L$=16Ω, f=1kHz, Ta=25°C)




**Power Dissipation vs. Output Power (BTL)**

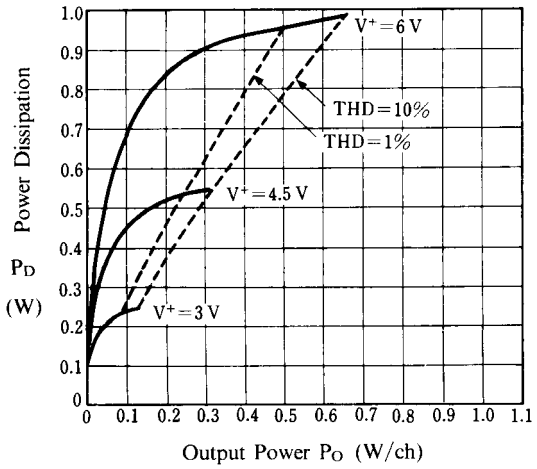
($R_L$=32Ω, f=1kHz)



## ■ TYPICAL CHARACTERISTICS

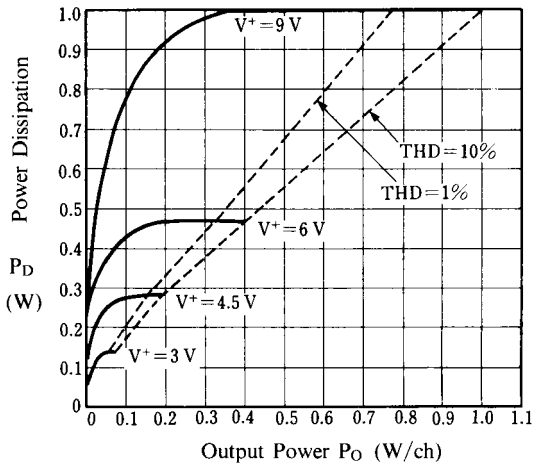
**Power Dissipation vs. Output Power (Stereo)**

($R_L$ = 4Ω, f = 1kHz)



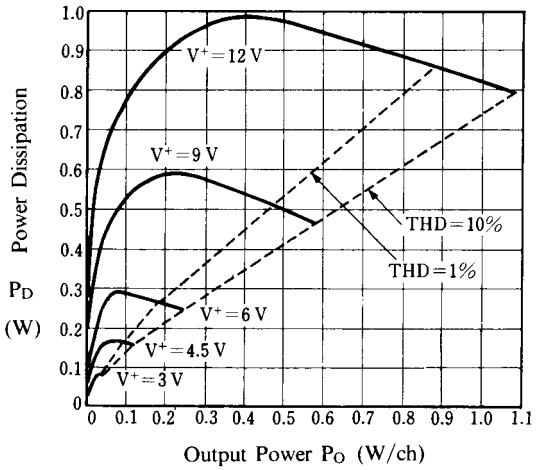

**Power Dissipation vs. Output Power (Stereo)**

($R_L$ = 8Ω, f = 1kHz)



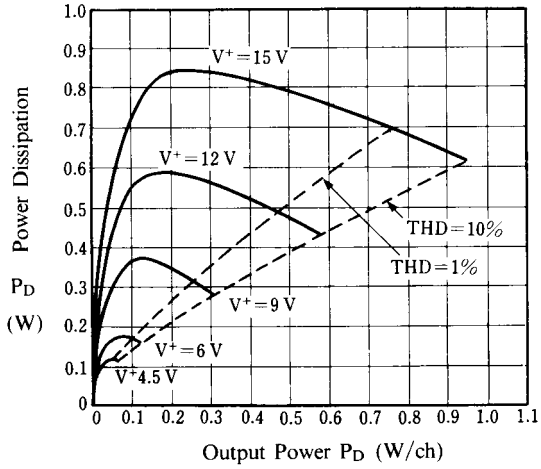

**Power Dissipation vs. Output Power (Stereo)**

($R_L$ = 16Ω, f = 1kHz)



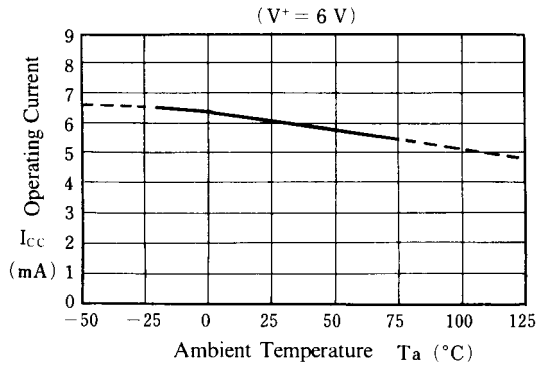

**Power Dissipation vs. Output Power (Stereo)**

($R_L$ = 32Ω, f = 1kHz)

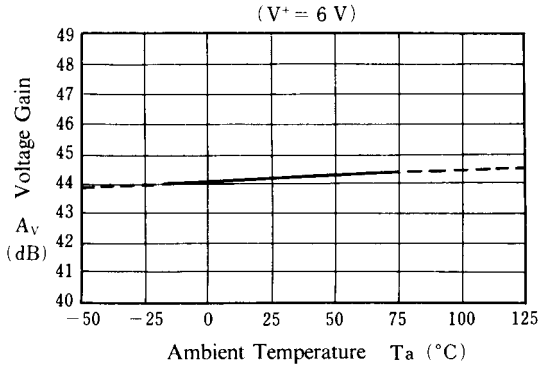


## ■ TYPICAL CHARACTERISTICS

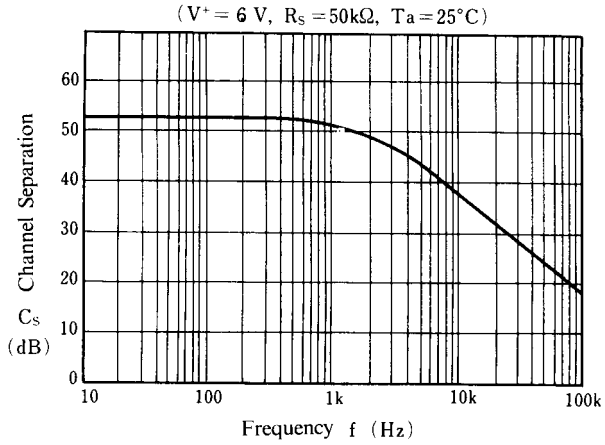
**Operating Current vs. Temperature**




**Voltage Gain vs. Temperature**




**Channel Separation vs. Frequency**

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