Ordering number:ENN1697B

Monolithic Linear IC

LA4555

2-Channel AF Power Amplifier for Radio, Tape Recorder Use

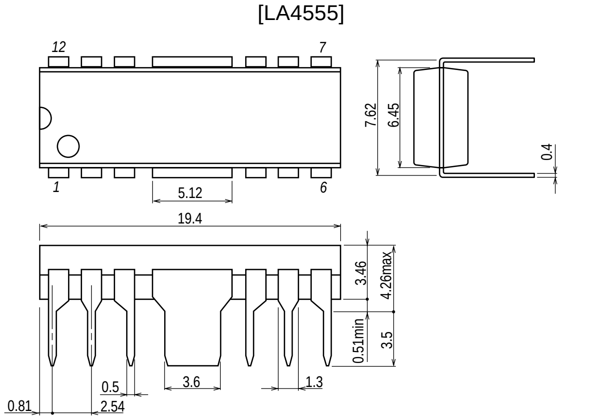
Features

- Low quiescent current.
- On-chip 2 channels permitting use in stereo and bridge amplifier applications.
- High output.
- Minimum number of external parts required. (9 pcs. munimum)
- Good ripple rejection (at steady state).
- Soft tone at the output saturation mode.
- Good channel separation.
- Easy thermal design.
- Small pop noise at the time of power supply ON/OFF.

Package Dimensions

unit:mm

3022A-DIP12F



SANYO : DIP12F

Specifications

Absolute Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		13	V
Allowable power dissipation	Pd max	With recommended PCB (See sample printed circuit pattern.)	4	W
Operating temperature	Topr		–20 to +75	˚C
Storage temperature	Tstg		–55 to +150	˚C

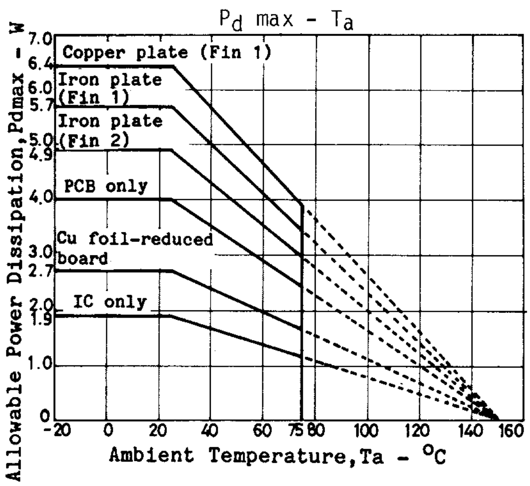
Operating Conditions at Ta = 25˚C

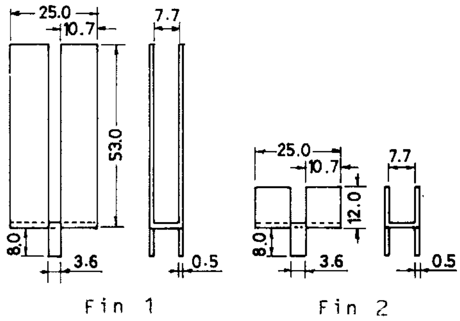
Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		6, 9	V
Load resistance	R_L	Stereo 6V	2 to 8	Ω
		BTL 6V	4 to 8	Ω
		Stereo 9V	4 to 8	Ω
		BTL 9V	8	Ω
Operating voltage range	V_{CC}op		3.6 to 12	V

SANYO Electric Co.,Ltd. Semiconductor Company
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

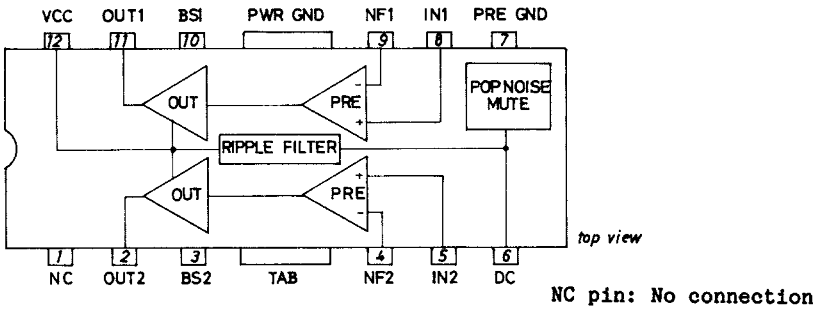
Operating Characteristics at Ta = 25˚C, V_{CC}=9V, f=1kHz, Rg=600Ω, R_L=4Ω, ( ) : R_L=8Ω,
See specified Test Circuit.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent current	Icco	Stereo 9V		15	30	mA
		Stereo 6V		13		mA
Voltage gain	VG	Rf=0, V_{IN}=–51dBm	49	51	53	dB
Voltage gain difference	ΔVG	Rf=0, V_{IN}=–51dBm			±1	dB
Output power	P_O	THD=10%, 6V, Stereo	0.7	1.0		W
		THD=10%, BTL		2.8		W
		THD=10%, 9V, Stereo	1.7	2.3		W
		THD=10%, BTL		(4.5)		W
Total harmonic distortion	THD	P_O=250mW		0.3	1.5	%
Input resistance	ri		21	30		kΩ
Output noise voltage	V_{NO}	Rg=0		0.5	1.0	mV
		Rg=10kΩ		0.8	2.0	mV
Ripple rejection	Rr	Rg=0, f=100Hz, V_R=150mV	40	48		dB
Crosstalk	CT	Rg=10kΩ, f=1kHz, Vo=0dBm	40	58		dB

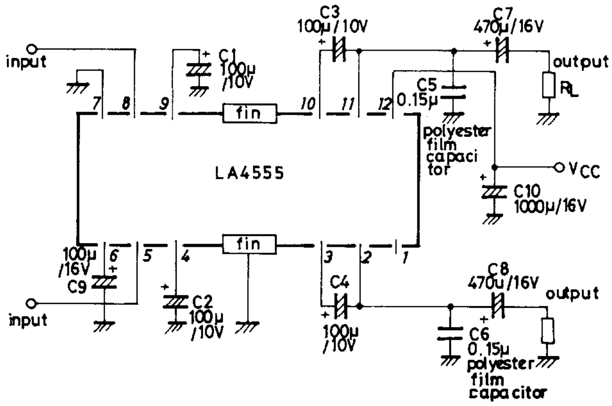




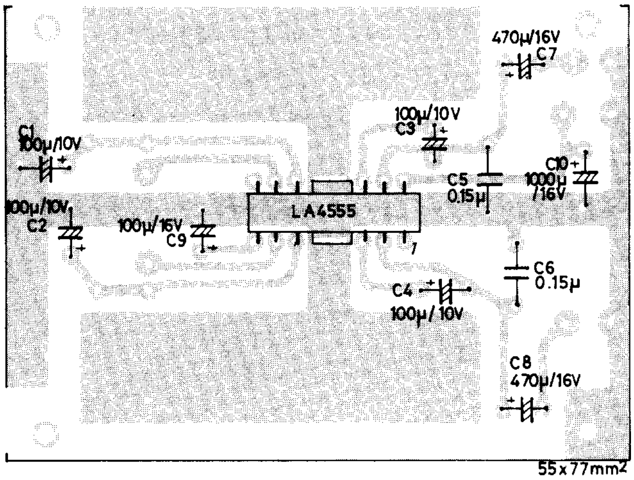
Equivalent Circuit Block Diagram



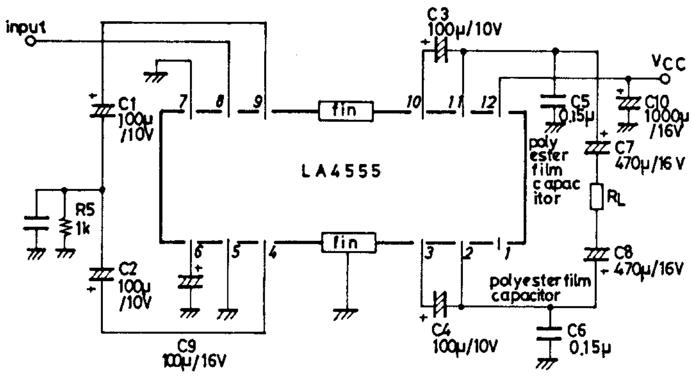
Sample Application Circuit : Stereo Use



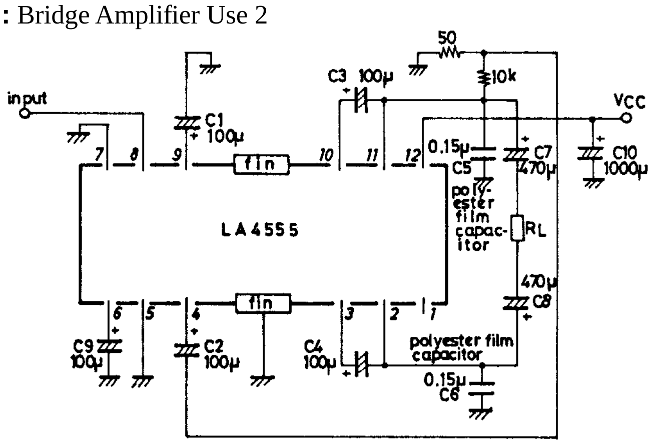
Sample Printed Circuit Pattern (Cu-foiled side)



Sample Application Circuit : Bridge Amplifier Use 1



Sample Application Circuit : Bridge Amplifier Use 2



Description of External Parts

C1 (C2) : Feedback capacitor. The low cutoff frequency is determined by the following formula.

$$fL=\frac{1}{2\pi C1Rf}$$

fL : Low cutoff frequency
Rf : Feedback resistance

Since this capacitor as well as decoupling capacitor affects the starting time, the capacitor value must be fixed with the necessary low frequency band fully considered.

C3 (C4) : Bootstrap capacitor. The output at low frequencies depends on this capacitor. Decreasing the capacitor value lowers the output at low frequencies. A capacitor value of 47μF or more is required.

C5 (C6) : Oscillation blocking capacitor. Use a polyester film capacitor that is good in high frequency response and temperature characteristic. The use of an electrolytic capacitor, ceramic capacitor may cause oscillation to occur at low temperatures.

Continued on next page.

Continued from preceding page.

C7 (C8) : Output capacitor. The low cutoff frequency is determined by the following formula.

$$fL=\frac{1}{2\pi C7RL}$$

fL : Low cutoff frequency
RL : Load resistance

To make the low frequency response in the bridge amplifier mode identical with that in the stereo mode, the capacitor value must be doubled.

C9 : Decoupling capacitor. Used for the ripple filter. Since the rejection effect is saturated at a certain capacitor value, it is meaningless to increase the capacitor value more than needed. This capacitor, being also used for the time constant of the muting circuit, affects the starting time.

C10 : Power source capacitor.

Application Circuits

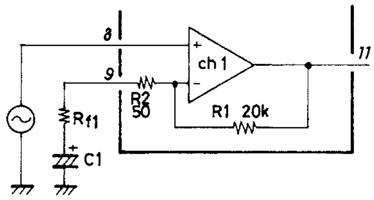
Voltage gain adjust

· Stereo mode

The voltage gain is determined by on-chip resistor R1 (R2) and external feedback resistor Rf as follows :

$$VG=20\log\frac{R1}{Rf1+R2}\ [dB]$$

Any voltage gain can be obtained by external resistor Rf.



· Bridge amplifier 1 mode

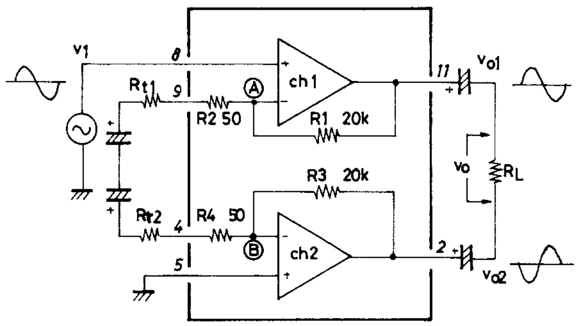
Since point Ⓐ is at the same potential as Vi and point Ⓑ is a virtual GND point,

$$Vo1\approx\frac{R1}{R2+R4+Rf1+Rf2}\ Vi$$

$$Vo2\approx\frac{-R3}{R2+R4+Rf1+Rf2}\ Vi$$

$$Vo=Vo1-Vo2=\frac{R1+R3}{R2+R4+Rf1+Rf2}\ Vi$$

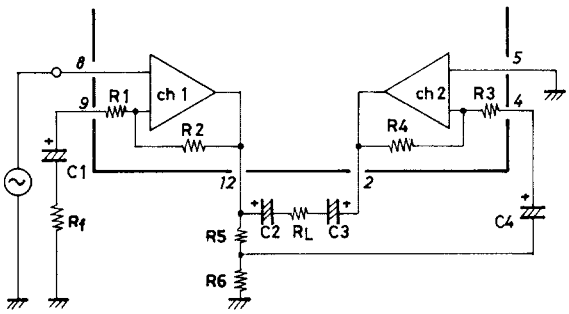
$$VG=20\log\frac{Vo}{Vi}=20\log\frac{R1+R3}{R2+R4+Rf1+Rf2}\ [dB]$$



Assuming R2=R4=50Ω, R1=R3=20kΩ and Rf1=Rf2, the voltage gain is obtained by :

$$VG=20\log\frac{R1}{Rf1+R2}\ [dB]$$

· Bridge amplifier 2 mode



The CH1 is a noninverting amplifer and the CH2 is an inverting amplifier. The total voltage gain, being apparently higher than that of the CH1 by 6dB, is approximately calculated by the following formula.

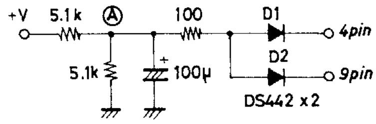
VG=20log R2/R1+6 (dB)

To reduce the voltage gain, Rf is connected and the following formula is used.

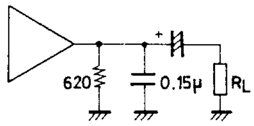
VG=20log R2/Rf+R1+6 (dB)

Proper Cares in Using LA4555-Applied Set

1. If the transformer regulation is not as specified, the supply voltage drops momentarily when the motor is an AC-powered set is turned ON. In this case, hum noise may be generated. So, be careful of the transformer regulation.
2. DC muting
   To apply DC muting by controlling the NF pin, it is recommended to use the circuit configuration shown right. The potential at point Ⓐ is set to 3.5 to 4V.



3. Pop noise
   If pop noise generated at the time of power ON/OFF disturbs you, connect a resistor of approximately 620Ω across the middle point and GND.



4. Slider contact noise of variable resistor
   Since the input circuit uses PNP transistors, no input coupling capacitor is required. However, if slider contact noise of the variable resistor presents any problem, connect a capacitor in series with input.

Thermal Design

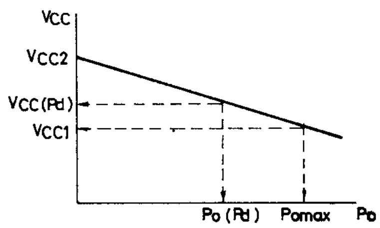
Since the DIP-12F package is such that the Cu-foiled area of the printed circuit board is used to dissipate heat, make the Cu-foiled area in the vicinity of the heat sink of the IC as large as possible when designing the printed circuit board. The use of the Cu-foiled area indicated by shading in the above-mentioned sample printed circuit pattern makes it possible to dissipate more heat. Power dissipation Pd is increased depending on the supply voltage and load. So, it is recommended to use the printed circuit board together with the heat sink. The following is a formula to be used to calculate Pd (for stereo use). For AC power supply, however, it is recommended to actually measure Pd on the transformer of each set. For bridge amplifier use, Pd is calculated at 1/2 of the load.

(1) DC power supply

$$\text{Pd max} = \frac{V_{CC}^2}{\pi^2 R_L} + \text{Icco} \cdot V_{CC} \quad \text{(For stereo use) ..... (1)}$$

(2) AC power supply

V_{CC2} : Supply voltage at quiescent mode
V_{CC} (Pd) : Supply voltage at Pd max
$V_{CC}1$: Supply voltage at maximum output
r : Voltage regulation $\frac{V_{CC2} - V_{CC1}}{V_{CC1}}$
Icco : Quiescent current



$$\text{Pd max} = \frac{V_{CC}(\text{Pd})^2}{\pi^2 R_L} + \text{Icco} \cdot V_{CC}\ (\text{Pd}) \quad \text{(For stereo use) .... (2)}$$

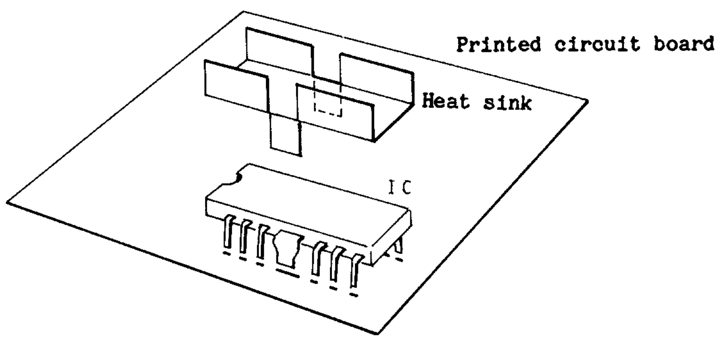
where

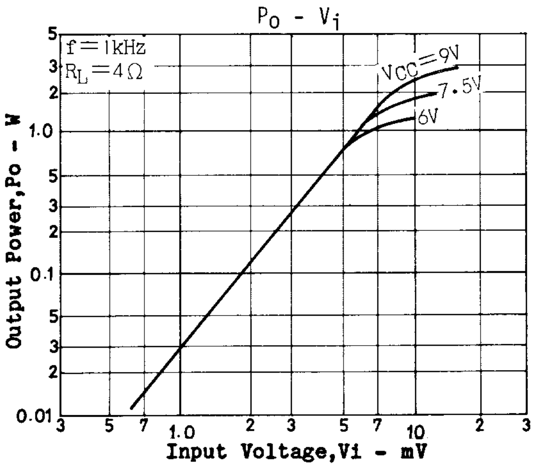
$$V_{CC}\ (\text{Pd}) = \frac{(1+r)\ V_{CC1}}{1 + \frac{r \cdot V_{CC1}}{\sqrt{2} \cdot \pi \cdot R_L} \times \sqrt{\frac{R_L}{\text{Po max}}}}$$

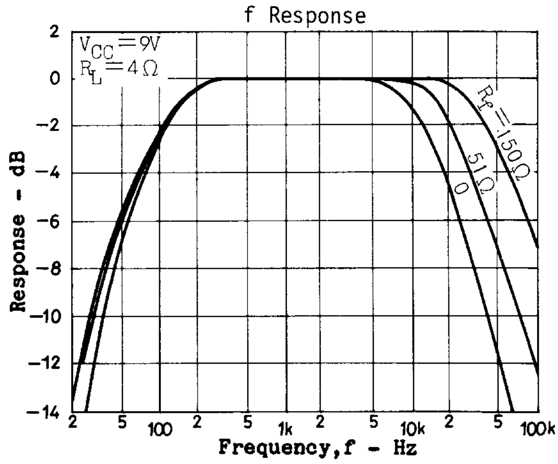
Example of Heat Sink Mounting Method

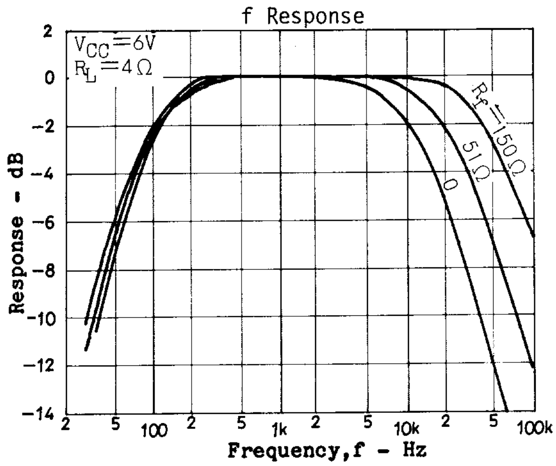
The heat sink must be of such a shape as to be able to dissipate heat from the IC plastic area and fin area and is soldered to the printed circuit board as shown below. For the size of the heat sink, refer to the Pd – Ta characteristic. The material of the heat sink is recommended to be copper or iron which is solderable. It is recommended to apply silicone grease to the IC plastic area to reduce thermal resistance between the heat sink and the IC plastic area.

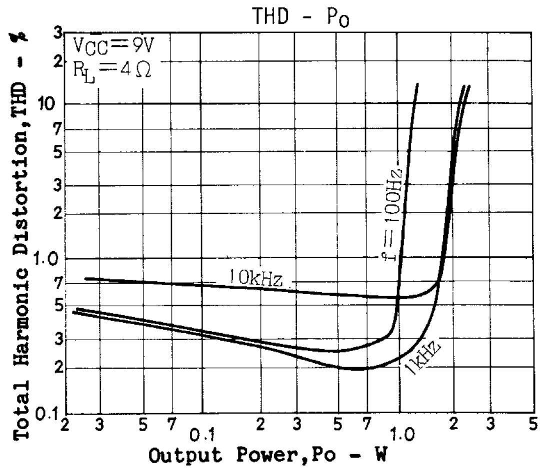
Example of Heat Sink Mounting

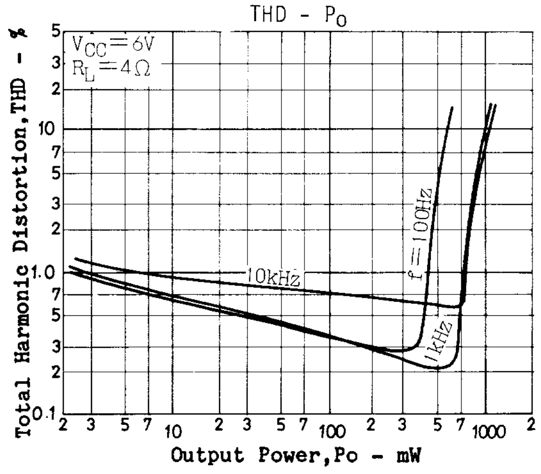


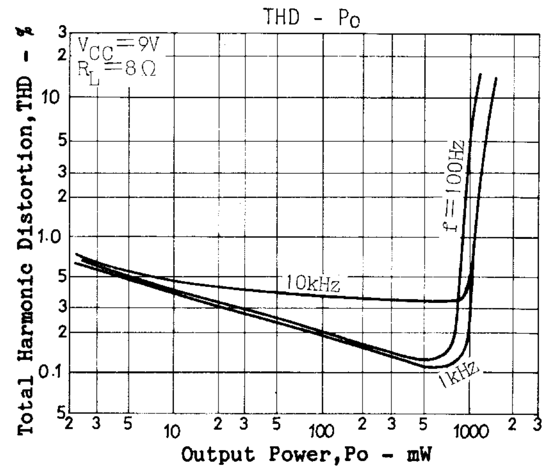

Po - Vi
f = 1kHz
RL = 4Ω
VCC = 9V
7.5V
6V
Output Power,Po - W
Input Voltage,Vi - mV

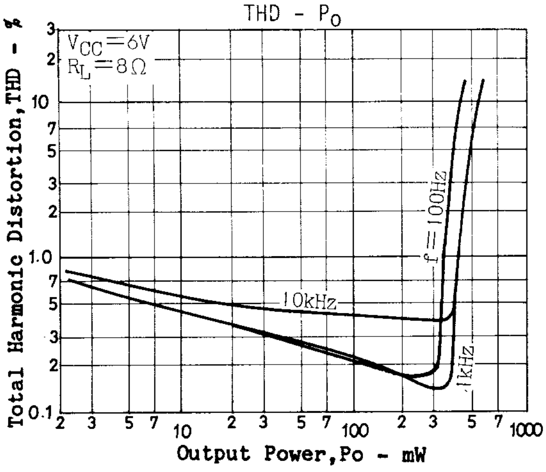

f Response
VCC = 9V
RL = 4Ω
Rf = 150Ω
51Ω
0
Response - dB
Frequency,f - Hz

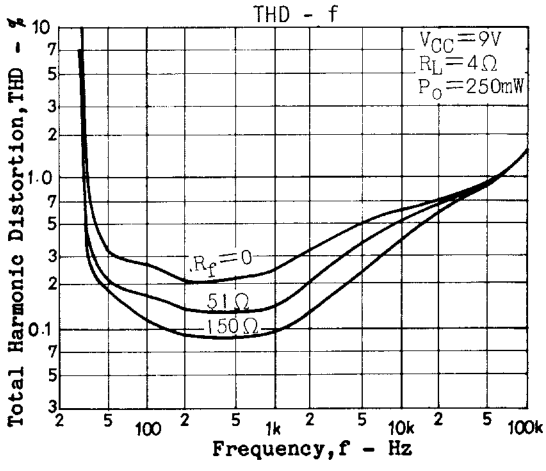

f Response
VCC = 6V
RL = 4Ω
Rf = 150Ω
51Ω
0
Response - dB
Frequency,f - Hz

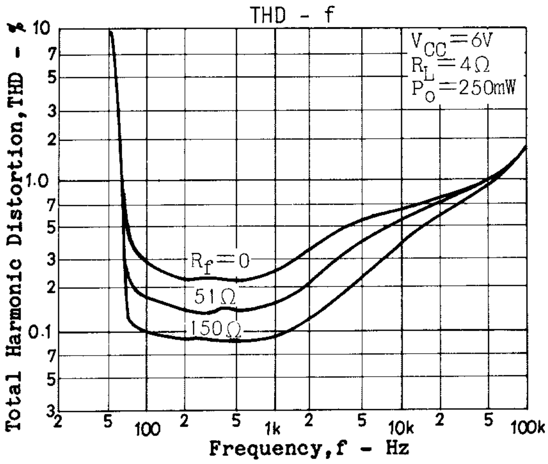

THD - Po
VCC = 9V
RL = 4Ω
10kHz
f = 100Hz
1kHz
Total Harmonic Distortion,THD - %
Output Power,Po - W

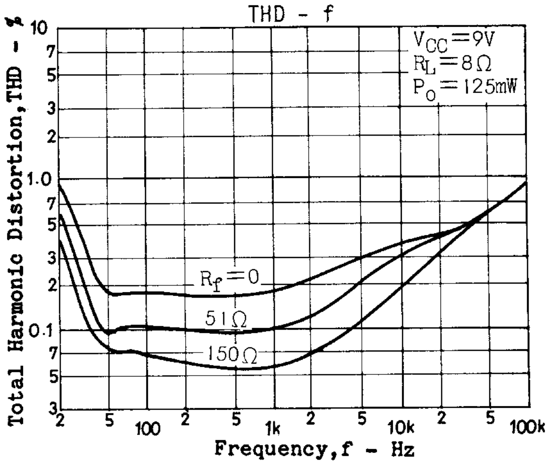

THD - Po
VCC = 6V
RL = 4Ω
10kHz
f = 100Hz
1kHz
Total Harmonic Distortion,THD - %
Output Power,Po - mW

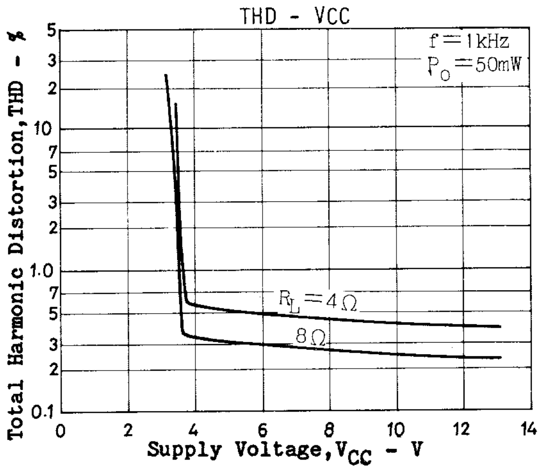

THD - Po
VCC = 9V
RL = 8Ω
10kHz
f = 100Hz
1kHz
Total Harmonic Distortion,THD - %
Output Power,Po - mW

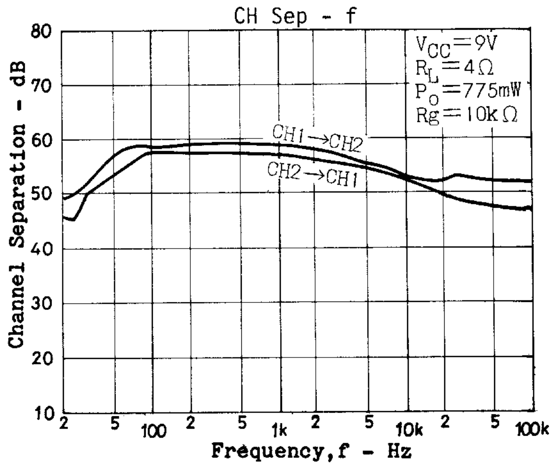

THD - Po
VCC = 6V
RL = 8Ω
10kHz
f = 100Hz
1kHz
Total Harmonic Distortion,THD - %
Output Power,Po - mW

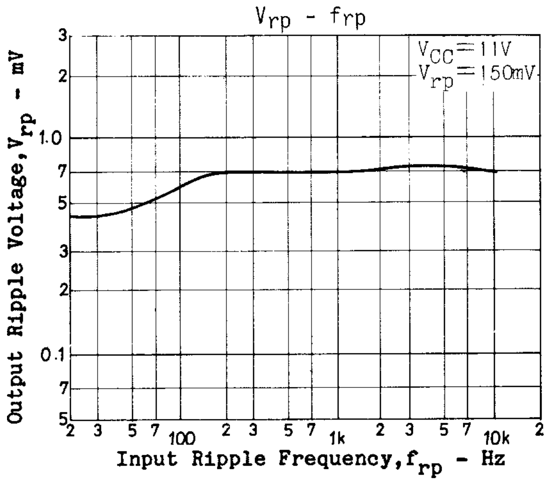

THD - f
VCC = 9V
RL = 4Ω
Po = 250mW
Rf = 0
51Ω
150Ω
Total Harmonic Distortion,THD - %
Frequency,f - Hz

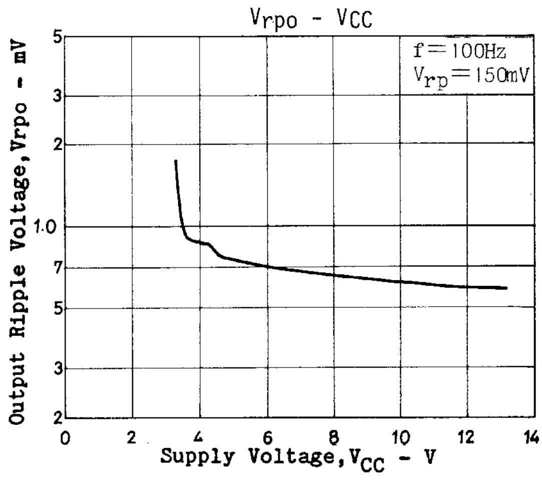

THD - f
VCC=6V
RL=4Ω
PO=250mW
Rf=0
51Ω
150Ω
Total Harmonic Distortion,THD - %
Frequency,f - Hz

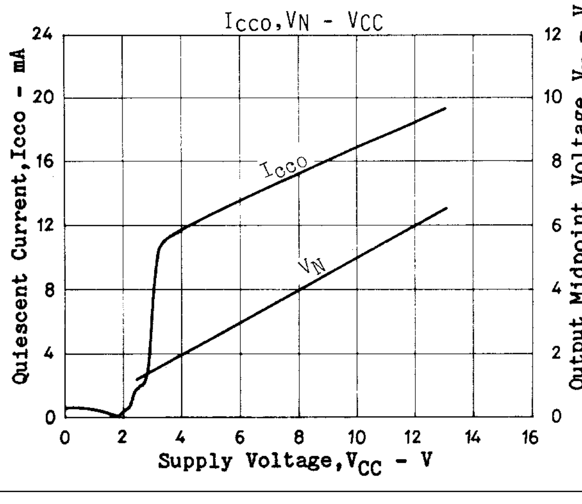

THD - f
VCC=9V
RL=8Ω
PO=125mW
Rf=0
51Ω
150Ω
Total Harmonic Distortion,THD - %
Frequency,f - Hz

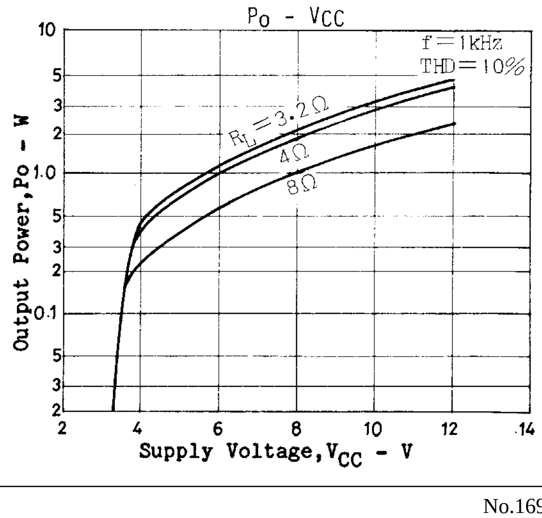

THD - VCC
f=1kHz
PO=50mW
RL=4Ω
8Ω
Total Harmonic Distortion,THD - %
Supply Voltage,VCC - V

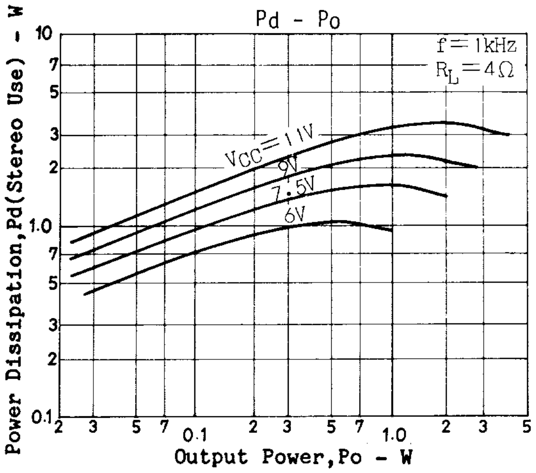

CH Sep - f
VCC=9V
RL=4Ω
PO=775mW
Rg=10kΩ
CH1→CH2
CH2→CH1
Channel Separation - dB
Frequency,f - Hz

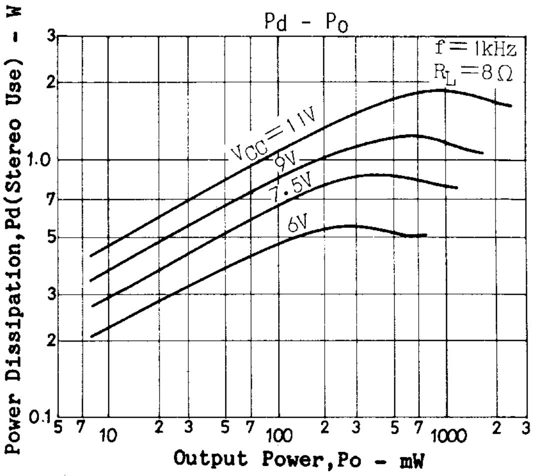

Vrp - frp
VCC=11V
Vrp=150mV
Output Ripple Voltage,Vrp - mV
Input Ripple Frequency,frp - Hz

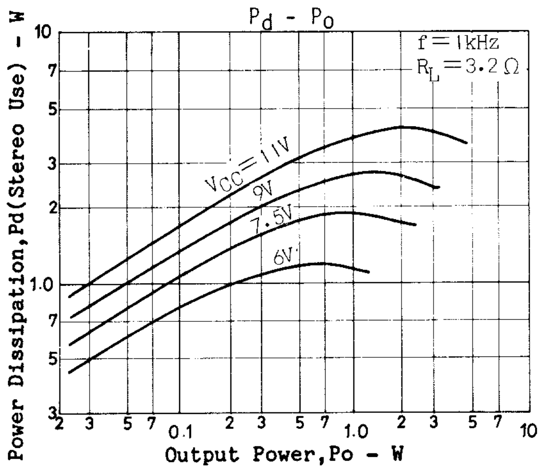

Vrpo - VCC
f=100Hz
Vrp=150mV
Output Ripple Voltage,Vrpo - mV
Supply Voltage,VCC - V

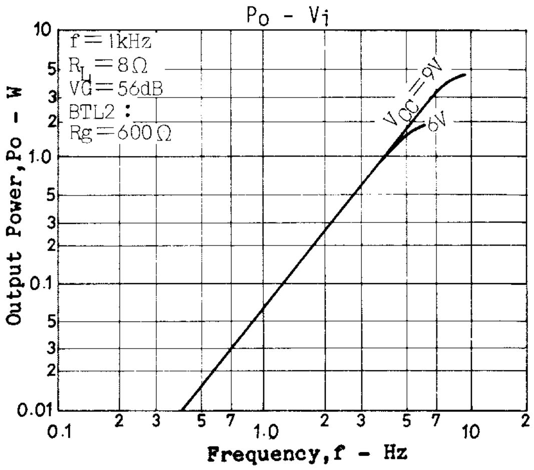

Icco,VN - VCC
Icco
VN
Quiescent Current,Icco - mA
Output Midpoint Voltage,VN - V
Supply Voltage,VCC - V

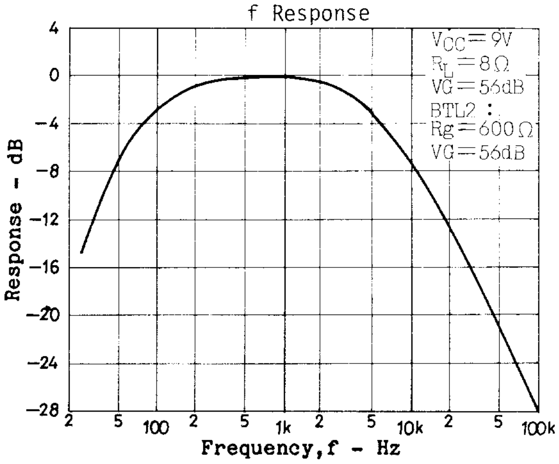

Po - VCC
f=1kHz
THD=10%
RL=3.2Ω
4Ω
8Ω
Output Power,Po - W
Supply Voltage,VCC - V

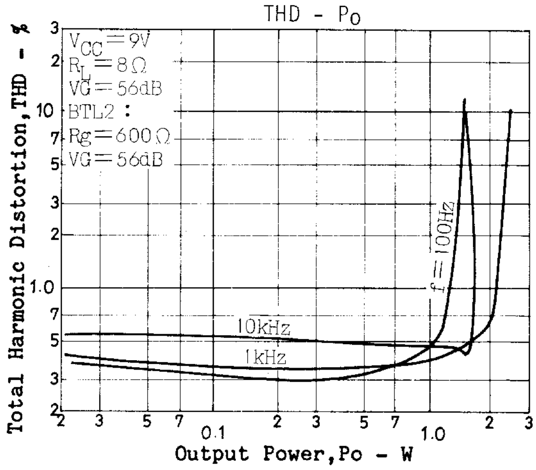

Pd - Po
f = 1kHz
RL = 4Ω
VCC = 11V
9V
7.5V
6V
Power Dissipation,Pd(Stereo Use) - W
Output Power,Po - W

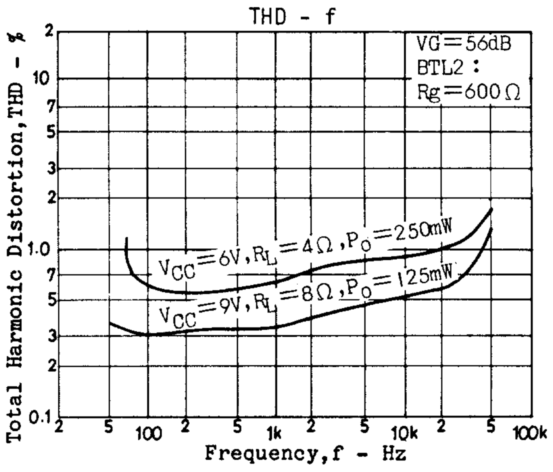

Pd - Po
f = 1kHz
RL = 8Ω
VCC = 11V
9V
7.5V
6V
Power Dissipation,Pd(Stereo Use) - W
Output Power,Po - mW

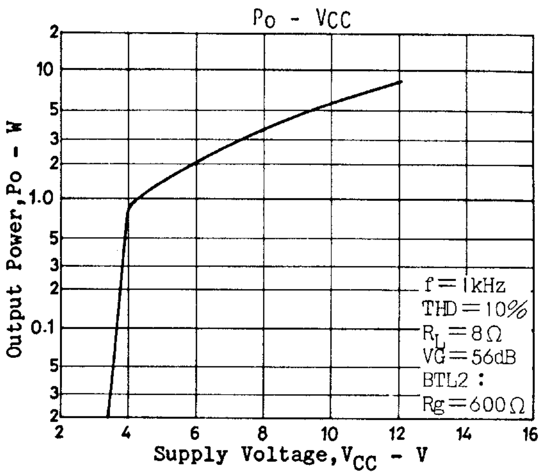

Pd - Po
f = 1kHz
RL = 3.2Ω
VCC = 11V
9V
7.5V
6V
Power Dissipation,Pd(Stereo Use) - W
Output Power,Po - W

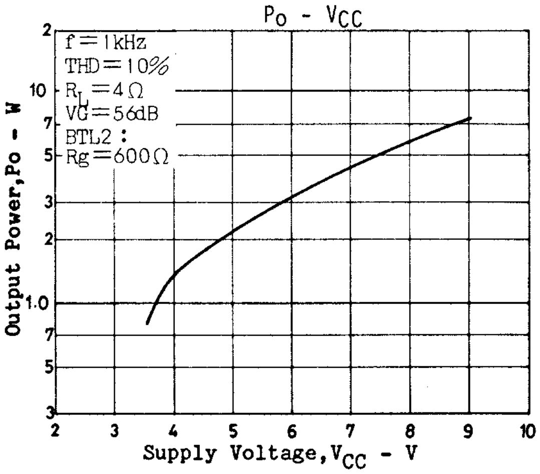

Po - Vi
f = 1kHz
RL = 8Ω
VG = 56dB
BTL2 :
Rg = 600Ω
VCC = 9V
6V
Output Power,Po - W
Frequency,f - Hz

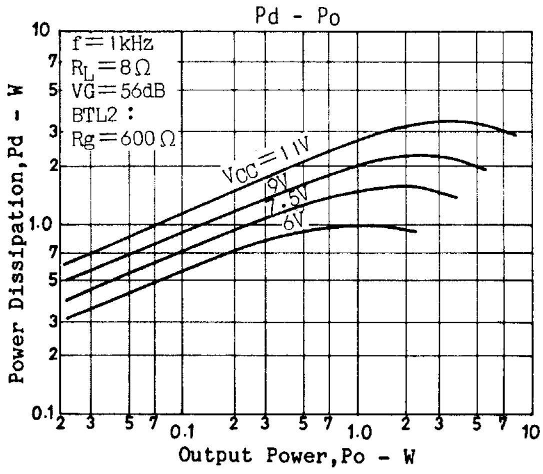

f Response
VCC = 9V
RL = 8Ω
VG = 56dB
BTL2 :
Rg = 600Ω
VG = 56dB
Response - dB
Frequency,f - Hz

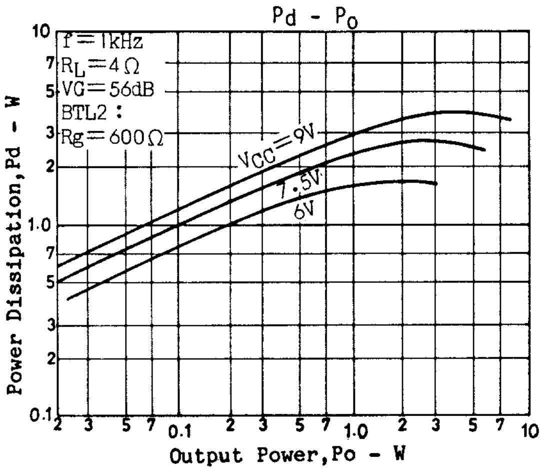

THD - Po
VCC = 9V
RL = 8Ω
VG = 56dB
BTL2 :
Rg = 600Ω
VG = 56dB
f = 100Hz
10kHz
1kHz
Total Harmonic Distortion,THD - %
Output Power,Po - W

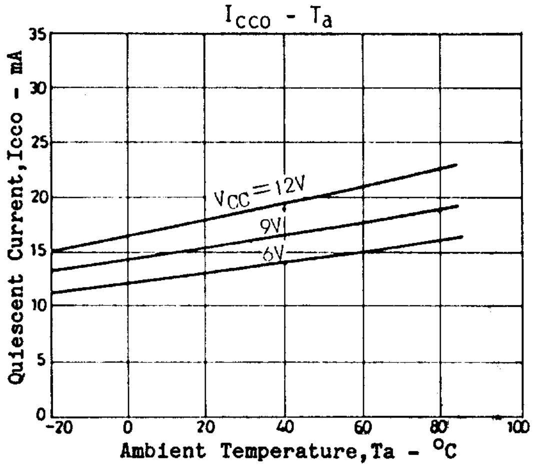

THD - f
VG = 56dB
BTL2 :
Rg = 600Ω
VCC = 6V, RL = 4Ω, Po = 250mW
VCC = 9V, RL = 8Ω, Po = 125mW
Total Harmonic Distortion,THD - %
Frequency,f - Hz


Po - VCC
f = 1kHz
THD = 10%
RL = 8Ω
VG = 56dB
BTL2 :
Rg = 600Ω
Output Power,Po - W
Supply Voltage,VCC - V









Proper Cares in Using IC

1. If the IC is used in the vicinity of the maximum ratings, even a slight variation in conditions may cause the maximum ratings to be exceeded, thereby leading to breakdown. Allow an ample margin of variation for supply voltage, etc. and use the IC in the range where the maximum ratings are not exceeded.
2. Pin-to-pin short : If power is applied when the space between pins is shorted, breakdown or deterioration may occur. When mounting the IC on the board and applying power, make sure that the space between pins is not shorted with solder, etc.
3. Load short : If the IC is used with the load shorted for a long time, breakdown or deterioration may occur. Be sure not to short the load.
4. When the IC is used in radios or radio cassette tape recorders, keep a good distance between IC and bar antenna.
5. When making the board, refer to the sample printed circuit pattern.
6. It should be noted that some plug jacks to be used for connecting to the external speaker are such that both poles are shorted once when connecting.