Ordering number: EN 2087C

Monolithic Linear IC

SANYO No.2087C

# LA4557

## 2-Channel AF Power Amp 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. minimum)
- Good ripple rejection (55dB)
- Soft tone at the output saturation mode
- Good channel separation
- Easy thermal design
- Small pop noise at the time of power supply ON/OFF
- On-chip muting

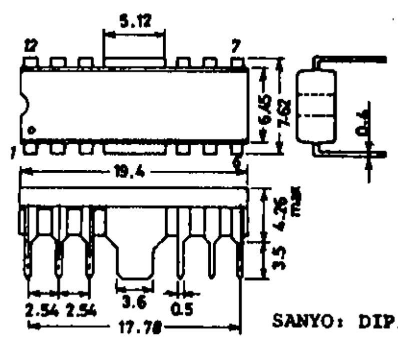
**Maximum Ratings** at Ta=25°C

| | | | | unit |
|---|---|---|---|---|
| Maximum Supply Voltage | $V_{CC}max$ | Quiescent | 15 | V |
| | | Operating | 12 | V |
| Allowable Power Dissipation | Pdmax | With recommended PCB | 4 | W |
| Operating Temperature | Topr | | -20 to +75 | °C |
| Storage Temperature | Tstg | | -55 to +150 | °C |

**Operating Conditions** at Ta=25°C

| | | | | unit |
|---|---|---|---|---|
| Recommended Supply Voltage | $V_{CC}$ | | 7.5 to 9.0 | V |
| Load Resistance | $R_L$ | Stereo | 3 to 8 | ohm |
| | | BTL | 8 | ohm |
| Operating Voltage Range | $V_{CC}op$ | | 4.5 to 12 | V |

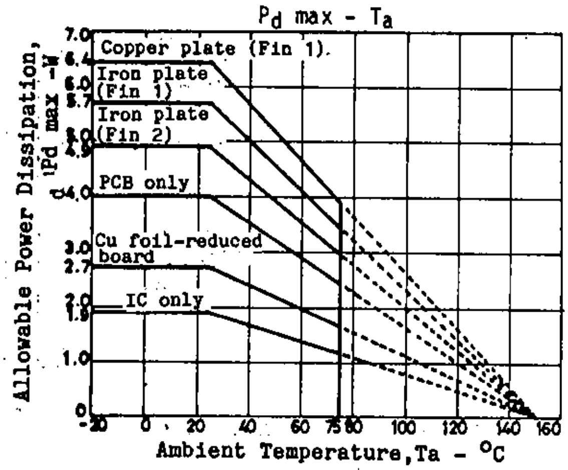
**Package Dimensions** 3022A-D12FIC
(unit: mm)

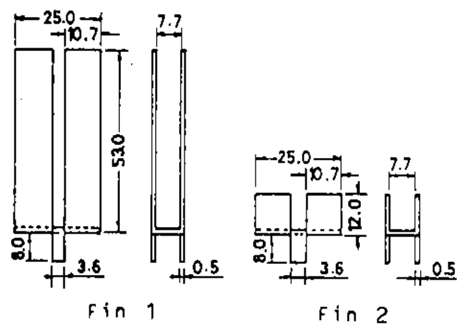



SANYO: DIP12F

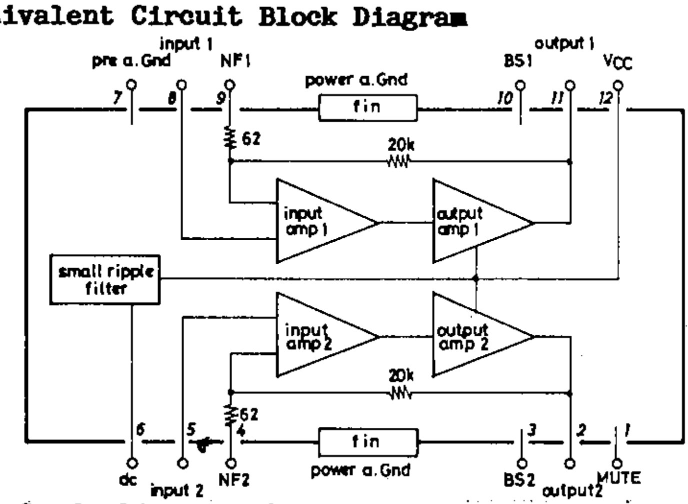
**Operating Characteristics** at $Ta=25^{o}C$, $V_{CC}=9V$, $f=1kHz$, $Rg=600ohms$, $R_L=4ohms$, $VG=50dB$, See specified Test Circuit.

| | | | min | typ | max | unit |
|---|---|---|---|---|---|---|
| Quiescent Current | Icco | Rg=0 | | 20 | 40 | mA |
| Voltage Gain | VG | $V_{IN}$=-50dBm | 48 | 50 | 52 | dB |
| Voltage Gain Difference | ΔVG | $V_{IN}$=-50dBm | | | ±1 | dB |
| Output Power | Po | THD=10%, stereo | 1.7 | 2.4 | | W |
| | | THD=10%, BTL($R_L$=8ohms) | | 4.5 | | W |
| Total Harmonic Distortion | THD | Po=250mW | | 0.3 | 1.0 | % |
| Input Resistance | ri | | 21 | 30 | | kohm |
| Output Noise Voltage | $V_{NO}$ | Rg=0, stereo | | 0.5 | 1.0 | mV |
| | | Rg=10kohms, stereo | | 0.8 | 2.0 | mV |
| Ripple Rejection | Rr | Rg=0, $f_R$=100Hz, $V_{CCR}$=0dBm | 45 | 55 | | dB |
| Crosstalk | CT | Rg=10kohms, Vo=0dBm | 45 | 55 | | dB |
| Muting Attenuation | $A_{TT}$ | Vo=0dBm, pin1=9V | 70 | | | dB |



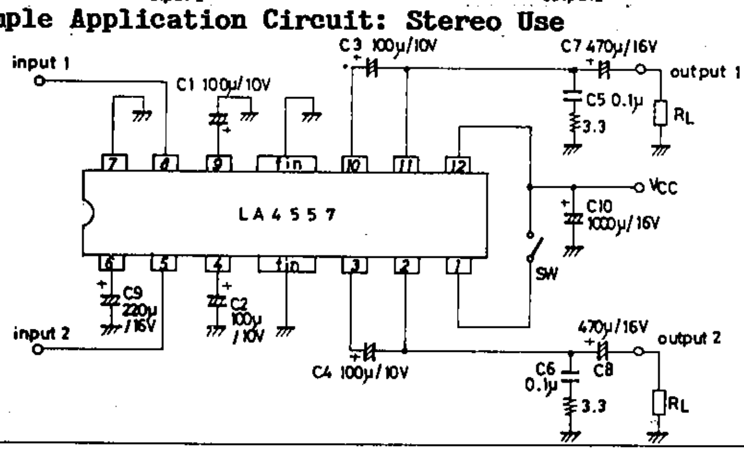




**Equivalent Circuit Block Diagram**

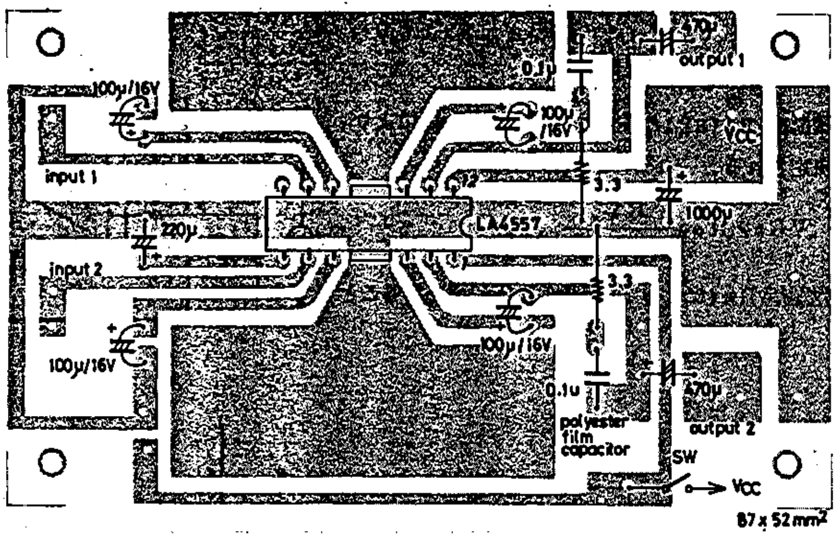



Unit (resistance: Ω, capacitance: F)

**Sample Application Circuit: Stereo Use**

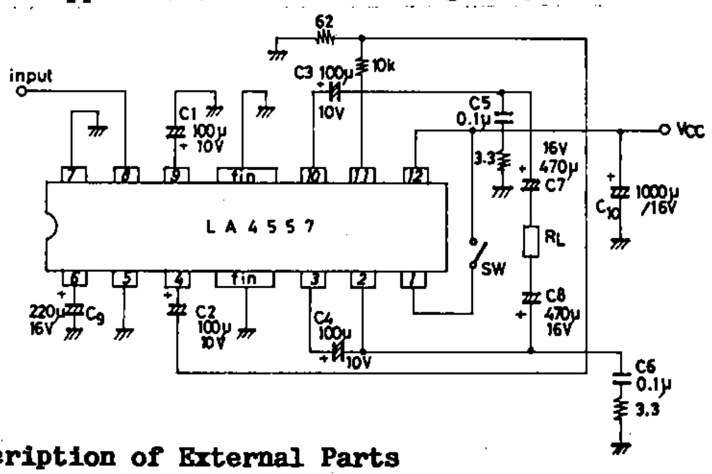


**Sample Printed Circuit Pattern** (Cu-foiled side)




**Sample Application Circuit:** Bridge Amp Use

Unit (resistance: Ω, capacitance: F)




**Description of External Parts**

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

$$f_L = \frac{1}{2\pi C1 R_f}$$

$f_L$: Low cutoff frequency
$R_f$: Feedback resistor

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 47uF or more is required.

C5(C6): Oscillation blocking capacitor. Use a polyester film capacior 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.

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

$$f_L = \frac{1}{2\pi C7 R_L}$$

$f_L$: Low cutoff frequency
$R_L$: 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 values 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**

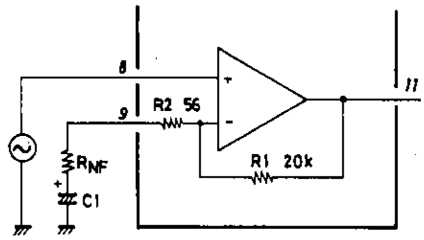
Voltage gain adjust

. Stereo mode

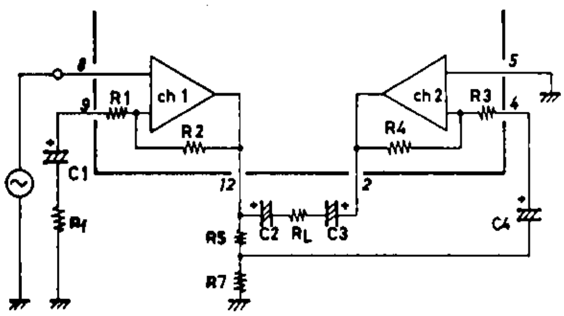
The voltage gain is determined by on-chip resistor R1(R2) and external feedback resistor $R_{Nf}$ as follows:

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

Any voltage gain can be obtained by external resistor $R_{Nf}$.




. Bridge amplifier mode




Unit (resistance: Ω)

The CH1 is a noninverting amplifier 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.

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

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

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

Proper cares in using LA4557-applied set

1. 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.
2. Pop noise
   If pop noise generated at the time of power ON/OFF disturbs you, connect a resistor of 500ohms to 1kohm acrross the middle point and GND.

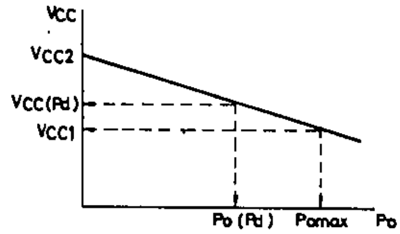
Thermal design

Since the DIP12F 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. 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 tramsformer of each set. For bridge amplifier use, Pd is calculated at 1/2 of the load.

(1) DC power supply

$$P_{d\,max}=\frac{V_{CC}^2}{\pi^2 R_L}+I_{cco}\cdot V_{CC}\ \text{(for stereo use)}\cdots\cdots(1)$$

(2) AC power supply




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

Line regulation

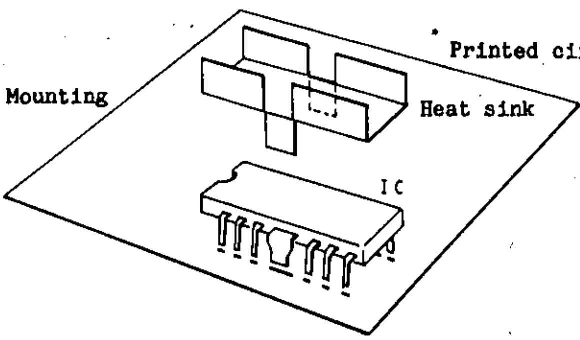
$$P_{d\,max}=\frac{V_{CC(Pd)}^2}{\pi^2 R_L}+I_{cco}\cdot V_{CC(Pd)}\ \text{(for stereo use)}\cdots\cdots(2)$$

where
$$V_{CC(Pd)}=\frac{(1+r)V_{CC1}}{1+\frac{r\cdot V_{CC1}}{\sqrt{2}\cdot\pi\cdot R_L}\times\sqrt{\frac{R_L}{P_{o\,max}}}}$$

**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



Printed circuit board

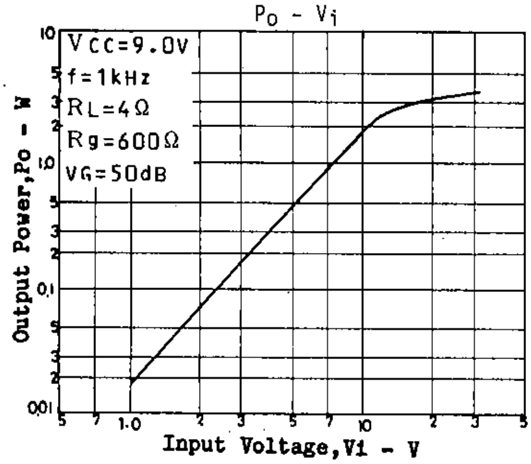
Heat sink

IC

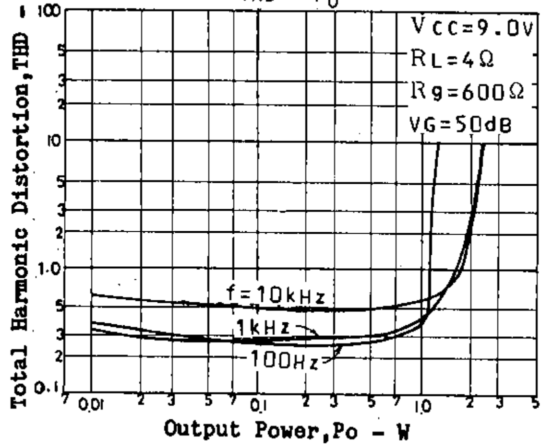
**Proper Cares in Using IC**

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 or 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.

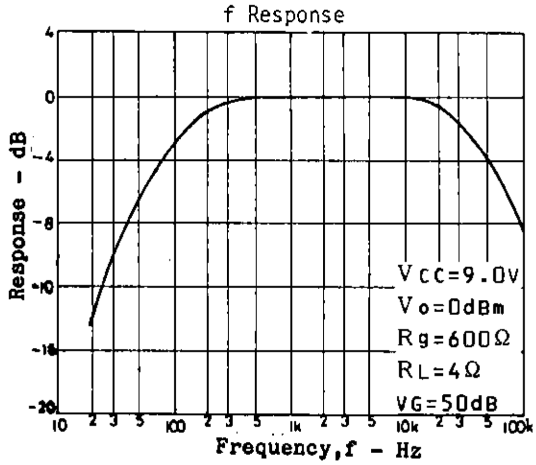
Po - Vi



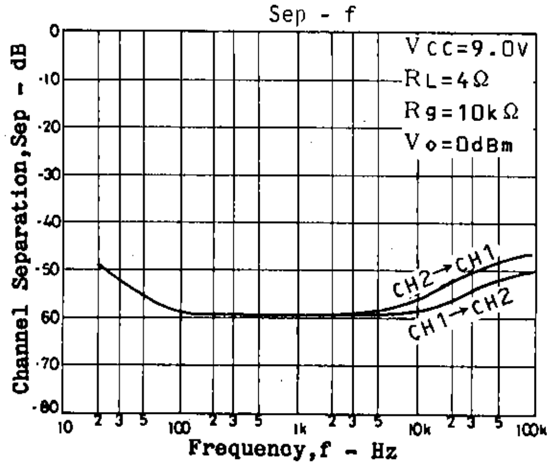

THD - Po



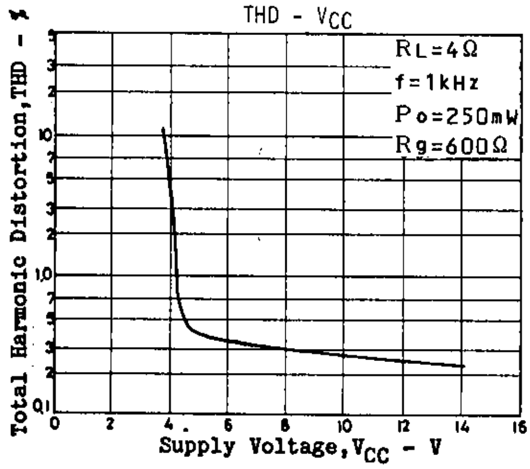

f Response



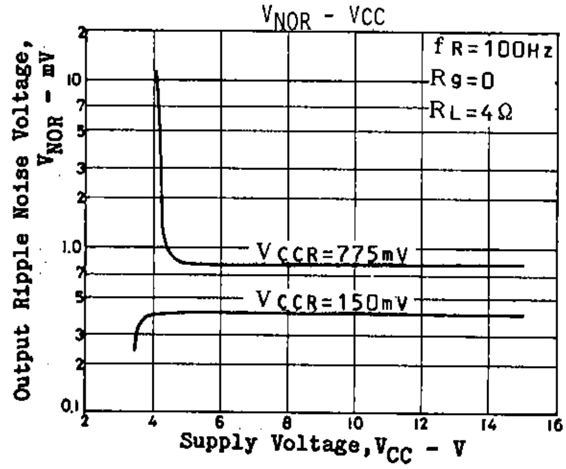

Sep - f



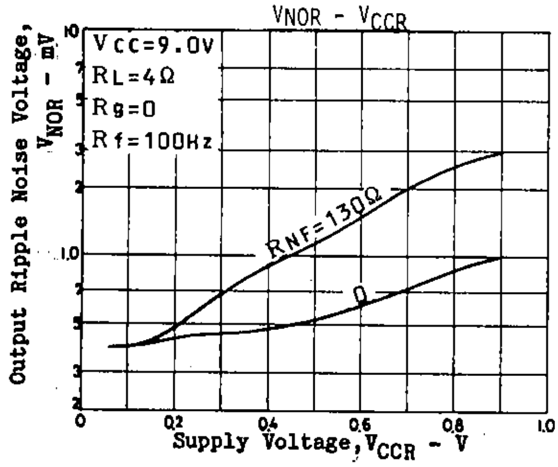

THD - VCC



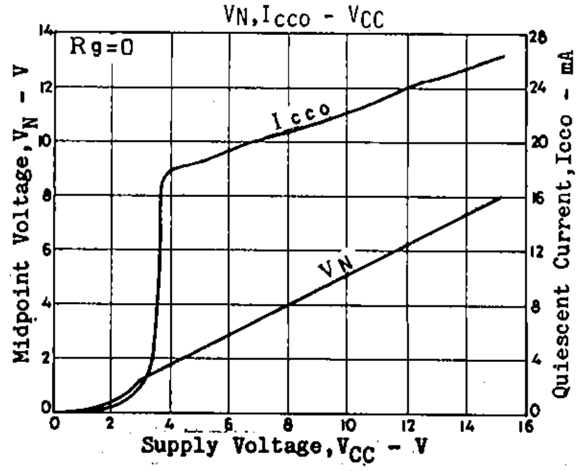

VNOR - VCC

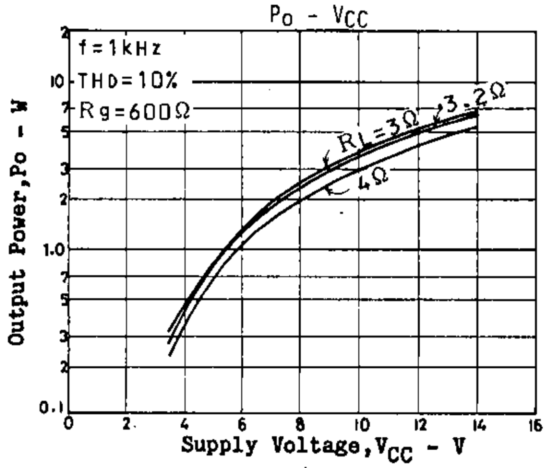


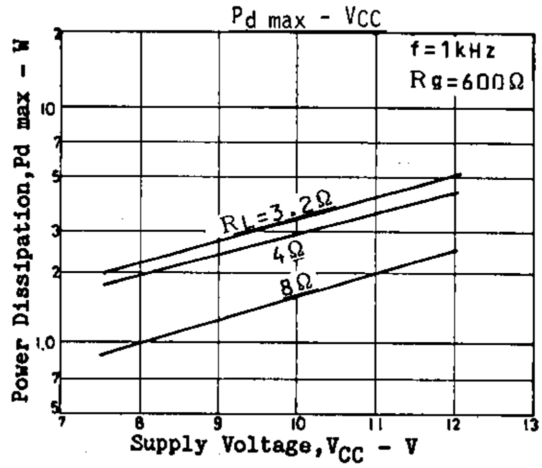

VNOR - VCCR

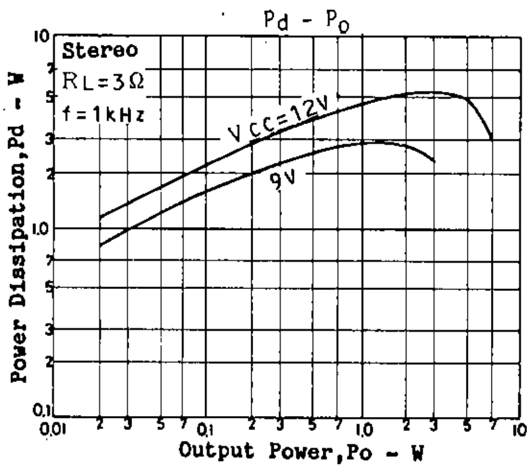


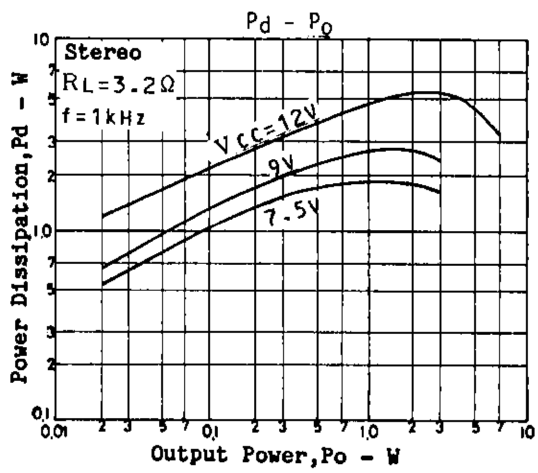

VN,Icco - VCC

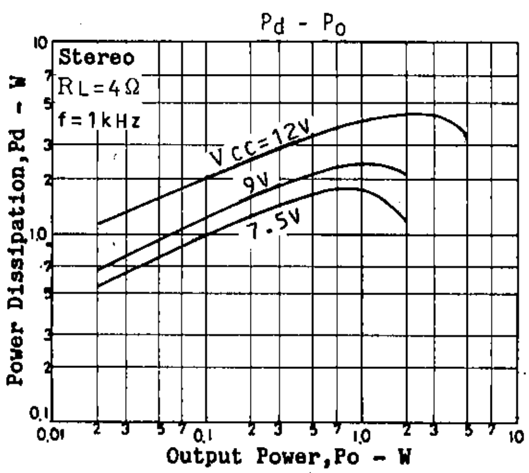


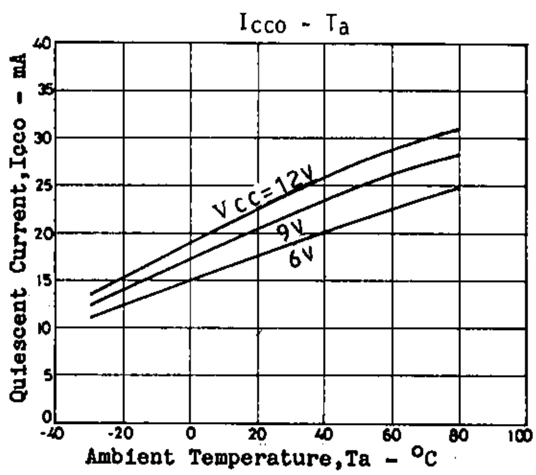

Po - VCC
f=1kHz
THD=10%
Rg=600Ω
RL=3Ω
3.2Ω
4Ω
Output Power,Po - W
Supply Voltage,VCC - V

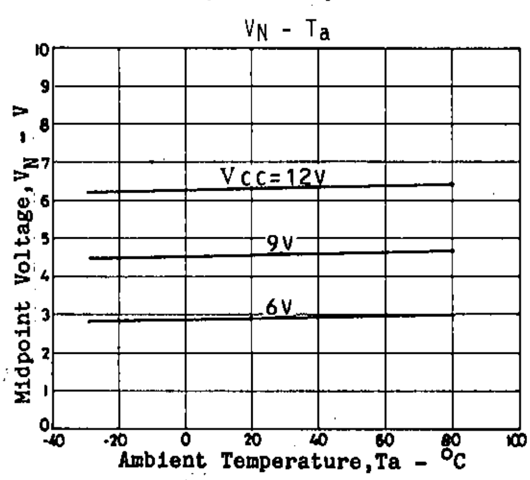

Pd max - VCC
f=1kHz
Rg=600Ω
RL=3.2Ω
4Ω
8Ω
Power Dissipation,Pd max - W
Supply Voltage,VCC - V

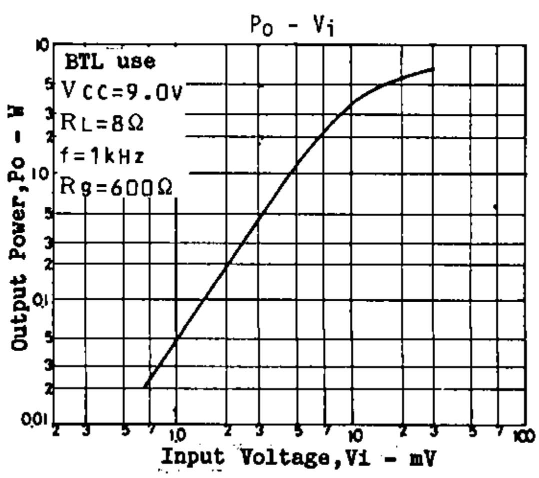

Pd - Po
Stereo
RL=3Ω
f=1kHz
VCC=12V
9V
Power Dissipation,Pd - W
Output Power,Po - W

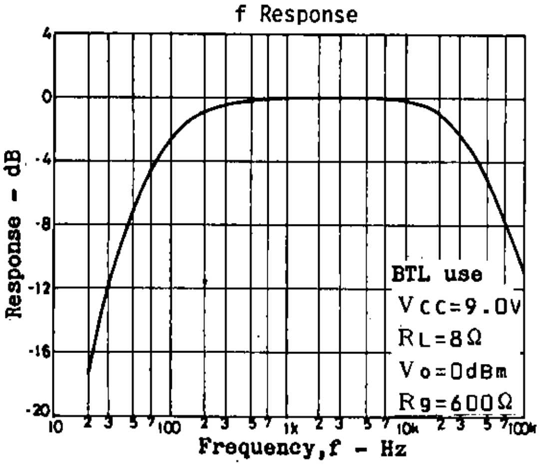

Pd - Po
Stereo
RL=3.2Ω
f=1kHz
VCC=12V
9V
7.5V
Power Dissipation,Pd - W
Output Power,Po - W

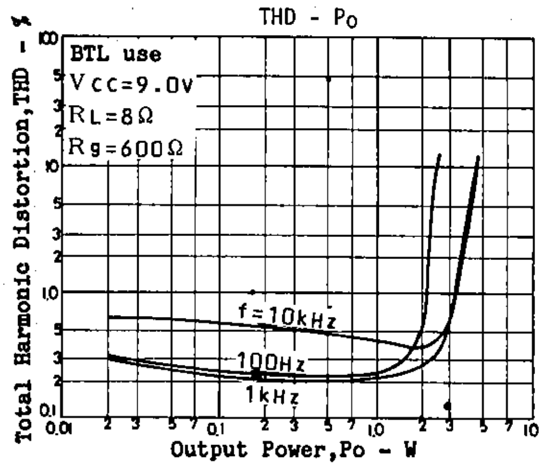

Pd - Po
Stereo
RL=4Ω
f=1kHz
VCC=12V
9V
7.5V
Power Dissipation,Pd - W
Output Power,Po - W

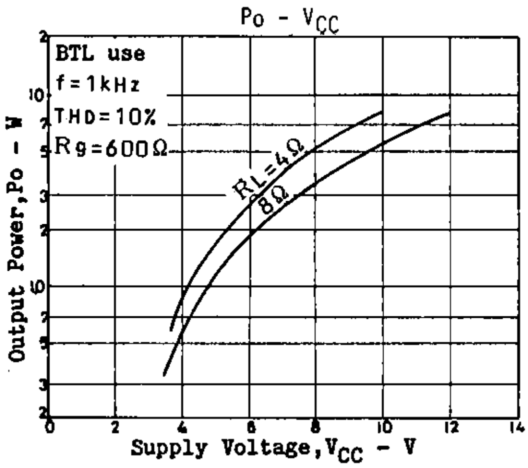

Icco - Ta
VCC=12V
9V
6V
Quiescent Current,Icco - mA
Ambient Temperature,Ta - °C

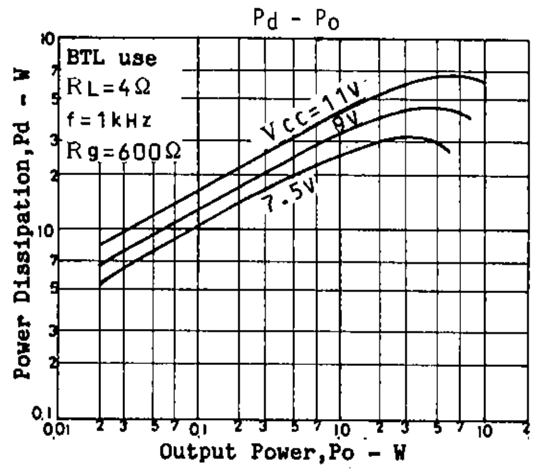

VN - Ta
VCC=12V
9V
6V
Midpoint Voltage,VN - V
Ambient Temperature,Ta - °C

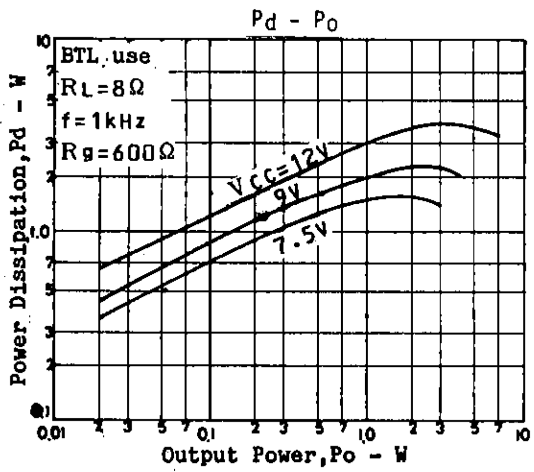

Po - Vi
BTL use
VCC=9.0V
RL=8Ω
f=1kHz
Rg=600Ω
Output Power,Po - W
Input Voltage,Vi - mV


f Response
BTL use
Vcc=9.0V
RL=8Ω
Vo=0dBm
Rg=600Ω
Response - dB
Frequency,f - Hz


THD - Po
BTL use
Vcc=9.0V
RL=8Ω
Rg=600Ω
f=10kHz
100Hz
1kHz
Total Harmonic Distortion,THD - %
Output Power,Po - W


Po - Vcc
BTL use
f=1kHz
THD=10%
Rg=600Ω
RL=4Ω
8Ω
Output Power,Po - W
Supply Voltage,Vcc - V


Pd - Po
BTL use
RL=4Ω
f=1kHz
Rg=600Ω
Vcc=11V
9V
7.5V
Power Dissipation,Pd - W
Output Power,Po - W


Pd - Po
BTL use
RL=8Ω
f=1kHz
Rg=600Ω
Vcc=12V
9V
7.5V
Power Dissipation,Pd - W
Output Power,Po - W