Ordering number:ENN1164C

Monolithic Linear IC

LA4500

5.3W 2-Channel AF Power Amplifier

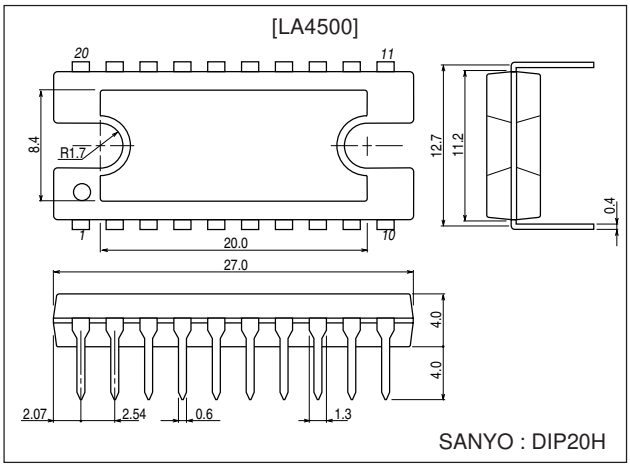
Features

- Low idling current (20mA/2 channels) enabling prolonged battery life.
- Less dependence of idling current on V_{CC}.
- High power (5.3W typ. ×2).
- High ripple rejection (60dB at steady state).
  Since filters are arranged in 3 stages (including 1 stage inside the IC) to attain satisfactory ripple rejection at transient state, ripple occuring at the time of motor start can be prevented from mixing in.
- Low pop noise at the time of power supply ON/OFF and good starting balance between both channels (0.6s.) due to built-in pop noise limiter.
- Pins provided for compensating high frequency responce.
- Low residual noise (0.4mV).
- Wide supply voltage range (6 to 24V) fascilitating design of transformer power supply.
- Built-in thermal shutdown circuit,
- Designed so that inverse insertion or short between adjacent pins causes no destruction.
- Channel-to channel mirror image pin assignment and provision of Pre GND, Power GND pins enabling stable operation and fascilitating artwork of printed circuit board.
- Minimum number of external parts required (9pcs. min., 12pcs. typ.).
- Audio muting capability (for automatic music selection, electronic tuner).

Package Dimensions

unit:mm

3037A-DIP20H



Specifications

Absolute Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		24	V
Maximum output current	I_O peak	1 channel	2.5	A
Allowable power dissipation	Pd max	With infinite heat sink	15	W
Operating temperature	Topr		–20 to +75	˚C
Storage temperature	Tstg		–40 to +150	˚C

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

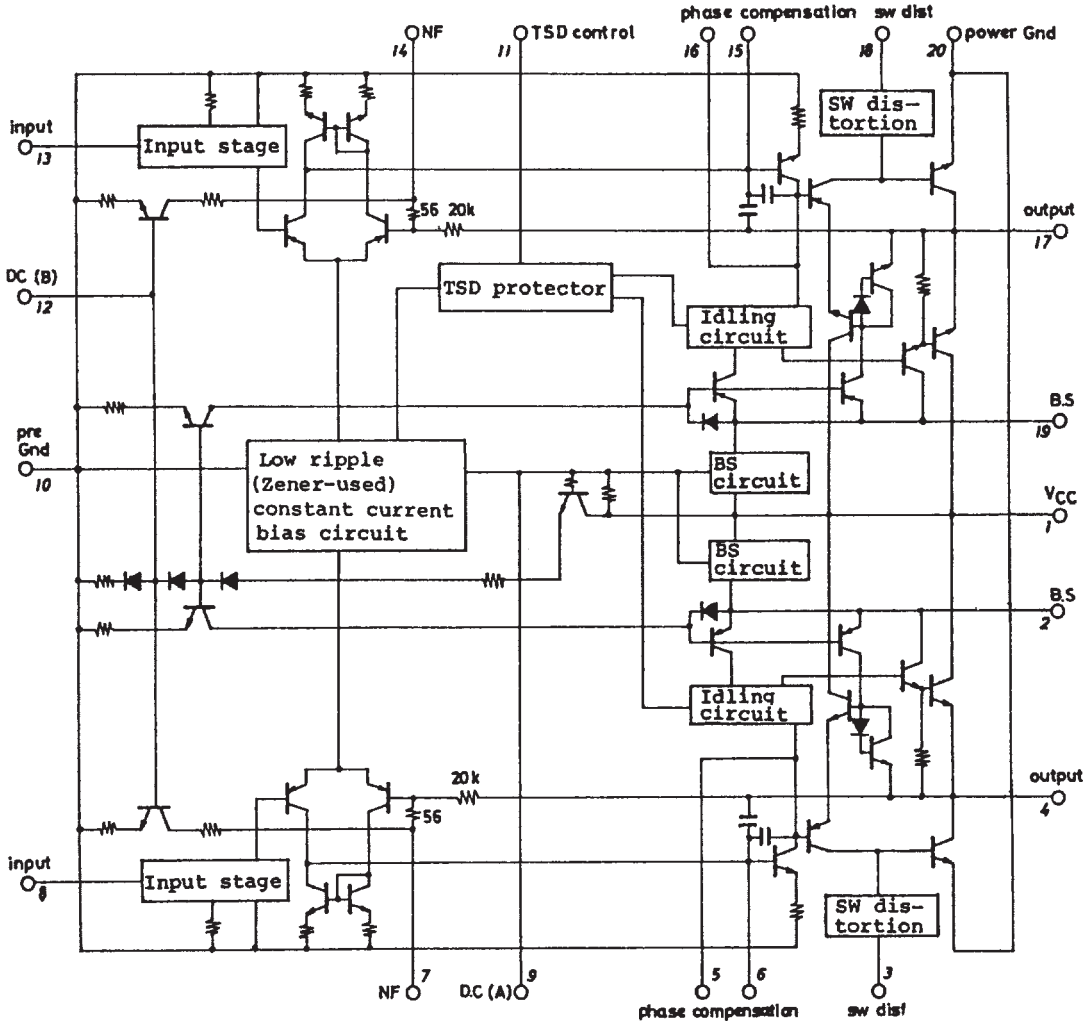
Recommended Operating Conditions at Ta = 25°C

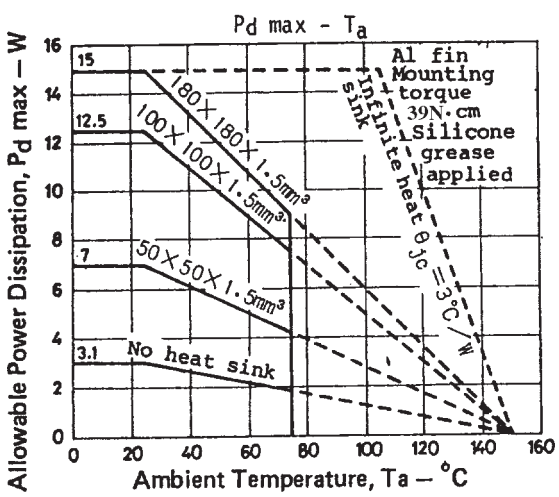
Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		12	V
Load resistance	R_L	Stereo	3	Ω

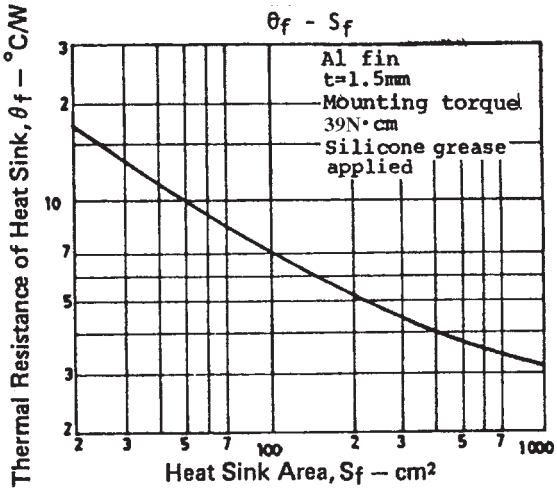
Operating Characteristics at Ta = 25°C, V_{CC}=12V, R_L=3Ω (stereo), f=1kHz, Rg=600Ω, See specified test circuit.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent current	I_{CCO}	Stereo	10	20	30	mA
Voltage gain	VG		48	50	52	dB
Voltage gain difference	ΔVG	Channel 1, 2			±1	dB
Output power	P_O	THD=10%	4.5	5.3		W
Total harmonic distortion	THD	V_O=2V		0.3	1.5	%
Input resistance	r_i			30		kΩ
Output noise voltage	$V_{NO}1$	Rg=0, f=20Hz to 20kHz, Band-pass filter		0.4	1.0	mV
	$V_{NO}2$	Rg=10kΩ, f=20Hz to 20kHz, Band-pass filter		0.6	2.0	mV
Ripple rejection	R_r	Rg=0, f_R=100Hz, V_R=0dBm	50	60		dB
Channel separation	ch sep	Rg=10kΩ, Vo=0dBm	45	55		dB

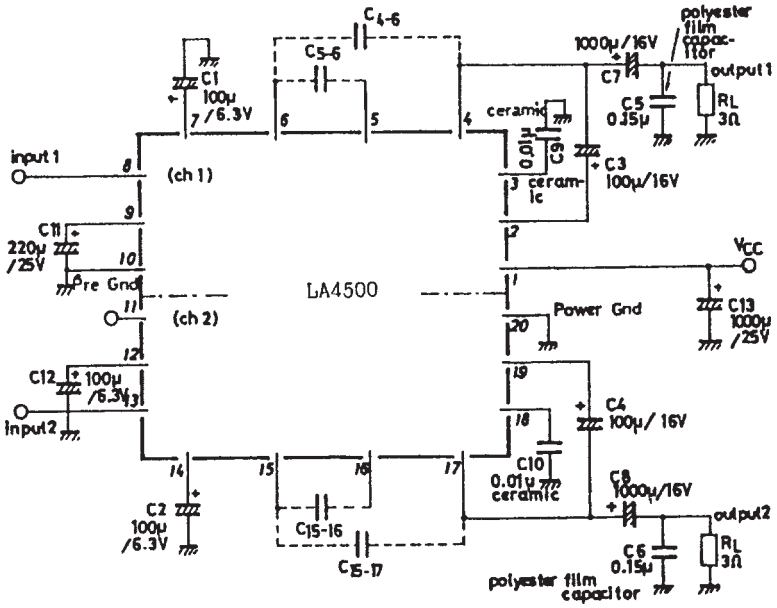
Equivalent Circuit Block Diagram

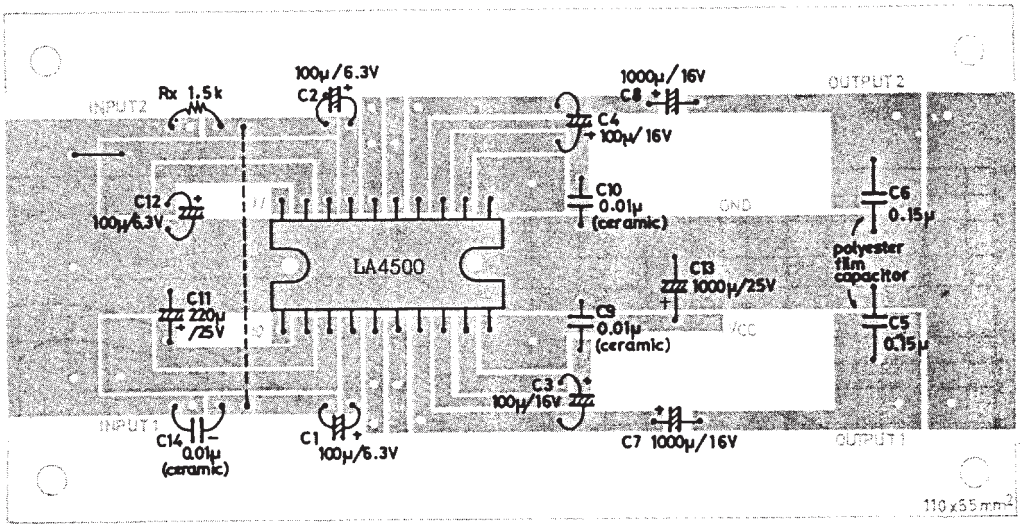






Sample Application Circuit 1





Description of External Parts

C1 (C1) Feedback capacitors
Related to low roll-off frequency f_L for –3dB (100µF, f_L=60Hz).
A capacitance value of 47µF to 100µF is recommended. Increasing the capacitance value makes the starting time (t_s) later. Decreasing the capacitance value makes the starting time (t_s) earlier.

C3 (C4) Bootstrap capacitors
Decreasing the capacitance value lowers output at low frequencies. A capacitance value of 47µF to 100µF is recommended.

C5 (C6) Oscillation blocking capacitors
Polyester film capacitor, being excellent in temperature characteristic, frequency characteristics, is recommended.

C7 (C8) Output capacitors
Related to low roll-off frequency and output at low frequencies. BTL applications normally require output capacitors.

C9 (C10) Switching distortion compensating capacitors
Compensates switching distortion which occurs at a high frequency of 10kHz. Ceramic capacitor of 0.01µF is recommended. If no problem arises in terms of radio-casette recorder design or tone, it is unnecessary to use these capacitors.

C11 Filter capacitor (A)
Ripple filter circuit provided in power supply line. A capacitance value of 220µF is recommended. Ripple rejection SVRR starts to be saturated at 47µF. The starting time and pop noise generated at the time of power supply ON must be considered when fixing the capacitance value. A capacitance value of 100µF to 220µF is usable.

C12 Filter capacitor (B)
Ripple filter circuit provided in bias circuit. A capacitance value of 100µF is recommended. 3V suffices the breakdown voltage of this capacitor. This capacitor is for ripple rejection at transient state and rejects noise “buzz” generated when the above-mentioned filter circuit provided in power supply line is saturated due to large ripple and supply voltage drop induced at the time of start of the motor connected to power supply line. If the motor is satisfactory in performance and the power supply regulation including ripple is 500mVrms or less, it is unnecessary to use this capacitor. If noise “buzz” is not offensive to the ear, it is unnecessary to use this capacitor. In this case, other basic performances are not affected adversely.

Feaures of IC Contents and Functions of Other Pins

(a) Since the input circuit uses PNP transistors and the bias voltage is set nearly equal to 0, no input coupling capacitor is required, thereby enabling direct coupling. However, if slider contact noise of the variable resistor presents any problem, connect a capacitor in series with input.

(b) Various ideas embodied in the idling circuit enable reduced I_{CCO} and prolonged battery life. Since the non-operating level of the idling circuit is made equal to that of the amplifier, crossover distortion does not worsen at the time of reduced voltage.

(c) The open loop voltage gain is lowered and the negative feedback amount is made small to assure stable operation. Radiation to the radio-frequency stage is made less by soft clipping.

(d) Capacitors for oscillation compensation are contained as a means of reducing the number of external parts. 10pF×2 and 2pF×2 are used. Hig roll-off frequency f_H (–3dB point) depends on these capacitance values. (f_H=28kHz)

(e) A thermal shutdown (THD) circuit is contained to prevent the IC from being destroyed by abromal heat generation attributable to insufficient heat dissipation. Pin (11) is used as THD control pin. Biasing pin (11) externally makes the operating temperature lower ; and connecting a resister across pin (11) and (10) makes the operating temperature higher. If pin (11) is connected to GND, the thermal shutdown circuit stops operating.

(f) The pin assignment is carefully considered so that no destruction takes place even if power supply is applied at a state where adjacent pins are shorted by solder bridge, etc. Even 180°C-rotated insertion causes no destruction.

(g) Collector pins (5), (16) and base pins (6), (15) for predrive can be conveniently used in applications. For oscillation compensation occuring when operated at a lowered gain, connect a capacitor across the pins (4) and (6) and a capacitor across pins (15) and (16). For fH compensation occuring when operated at a lowered gain, connect a capacitor across pins (4) and (6) and a capacitor across pins (17) and (15). Further soft clippling and prevention of waveform distortion at high frequencies are attained by connecting a series circuit of diode (DS442) and resistor (10kΩ) across pin (6) and GND and the same across pin (15) and GND.

Continued on next page.

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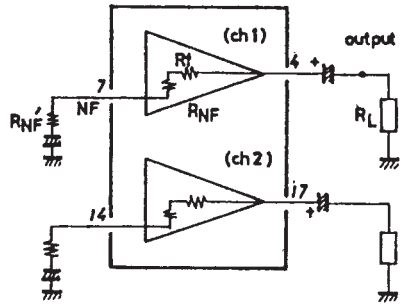
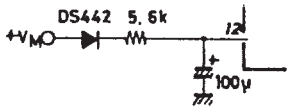
(h) Feedback resistance R_{NF} is contained and the voltage gain is fixed at 50dB so that the variations in the voltage gain can be minimized. The gain can be lowered by connecting R_{NF} externally.



(i) Biasing pin (12) as shown below causes DC audio muting to be applied, thereby cutting off the IC. This makes attack time, recovery time, pop noise, etc. saticefactory.
It is recommended that the following method be used to control the NF pin.



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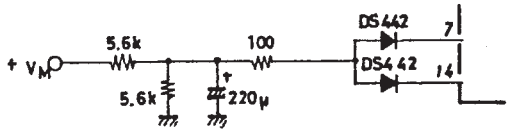
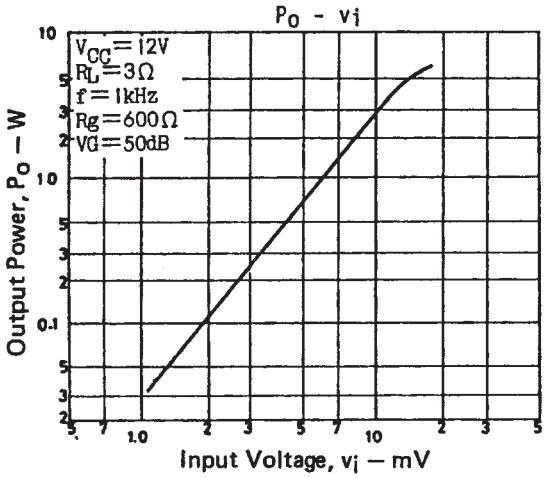
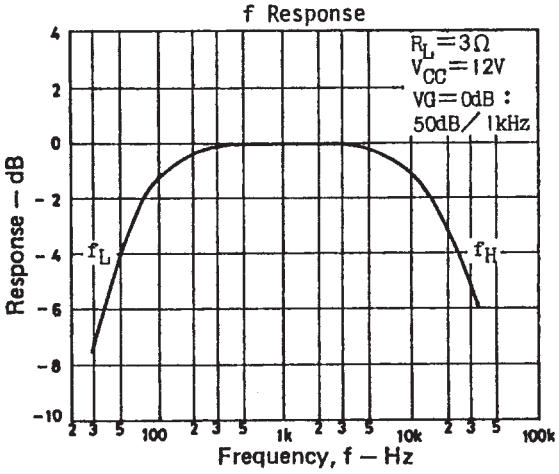
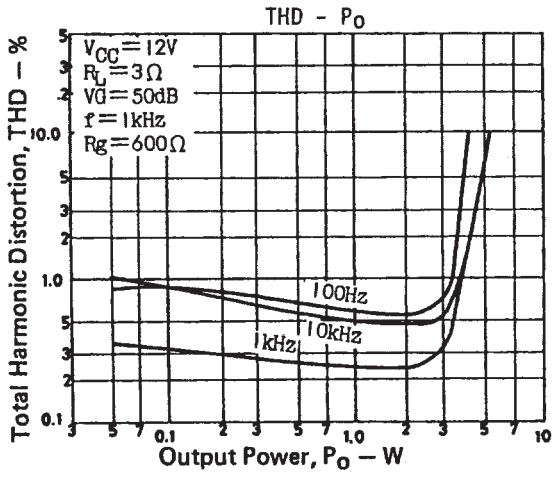
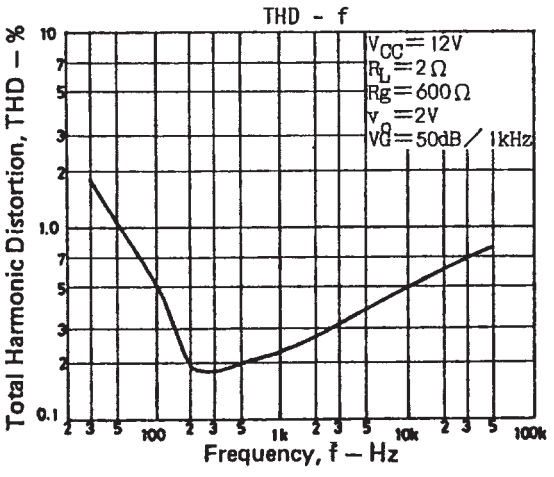


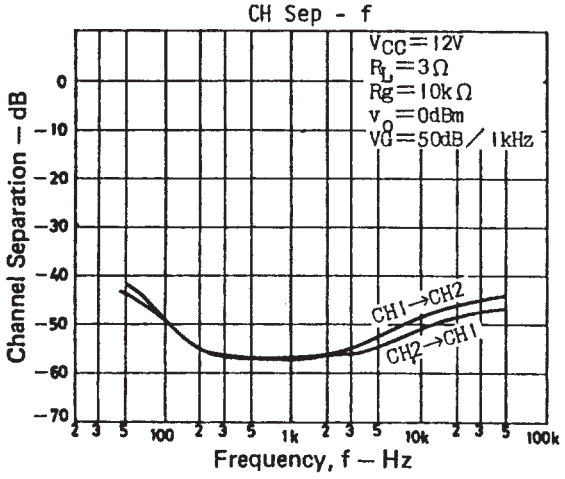




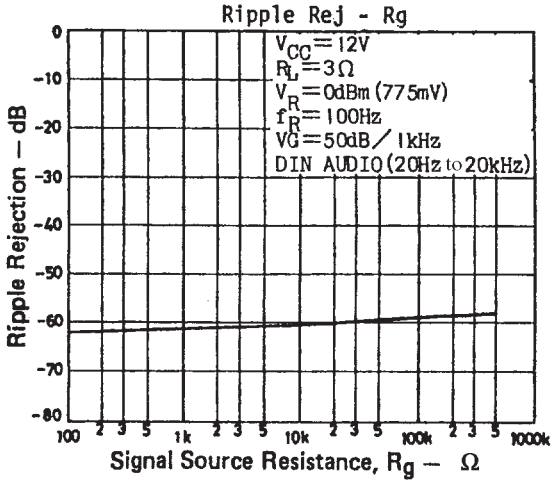




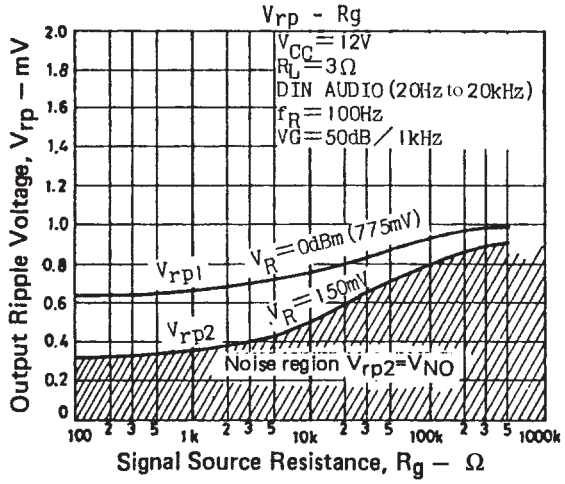
CH Sep - f



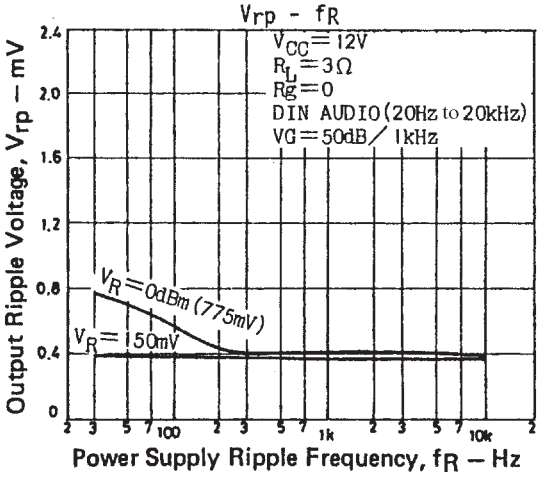
Ripple Rej - Rg



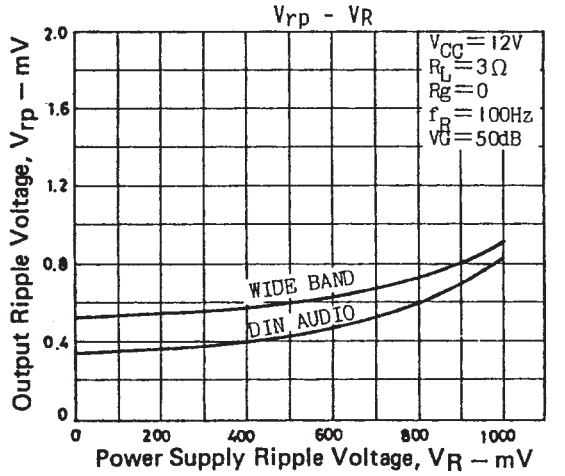
Vrp - Rg



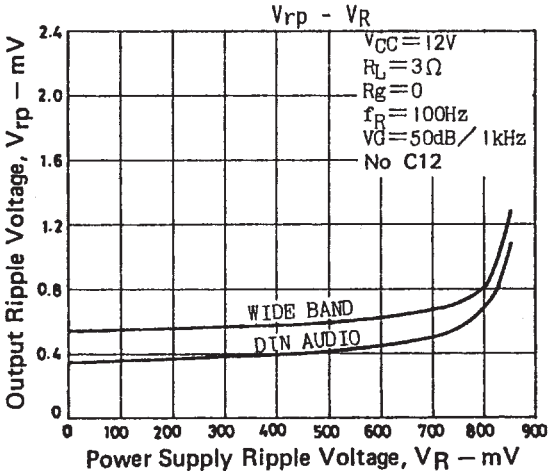
Vrp - fR



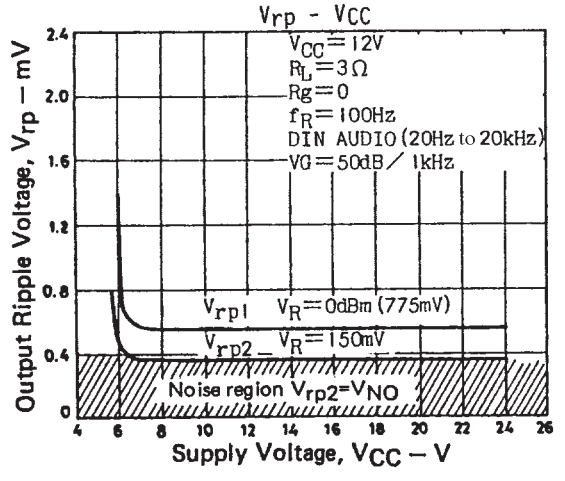
Vrp - VR



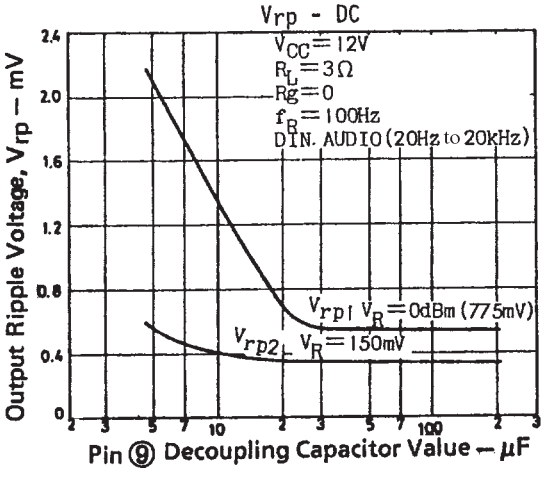
Vrp - VR

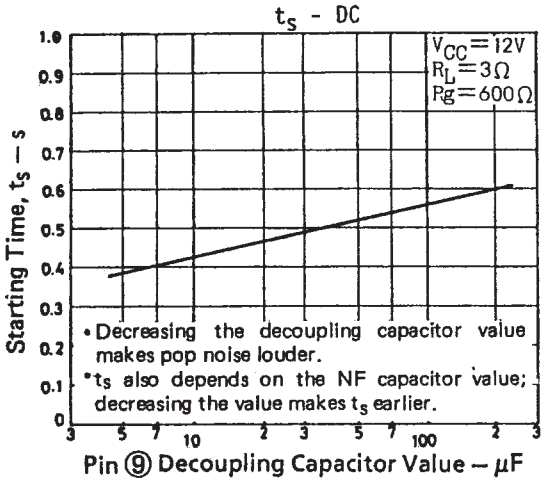


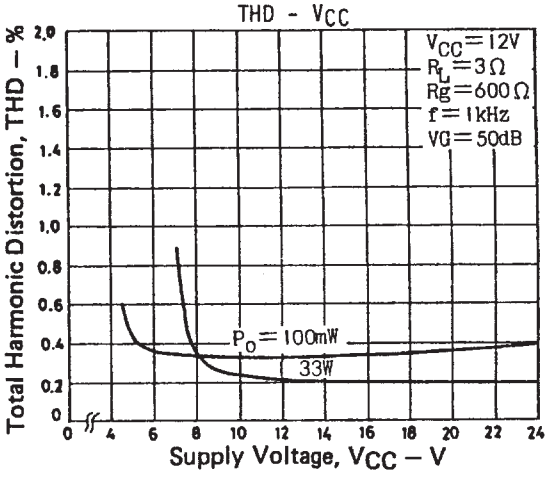
Vrp - VCC

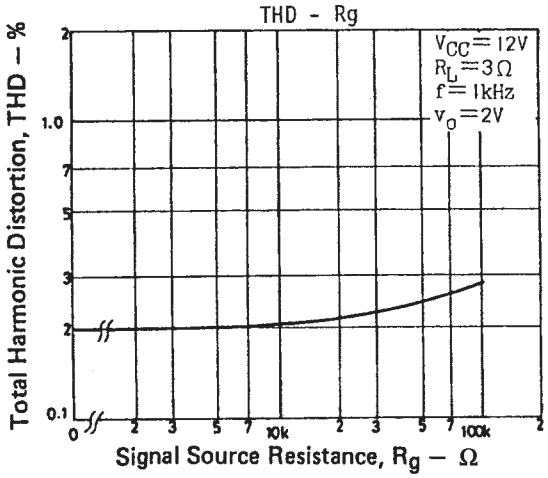


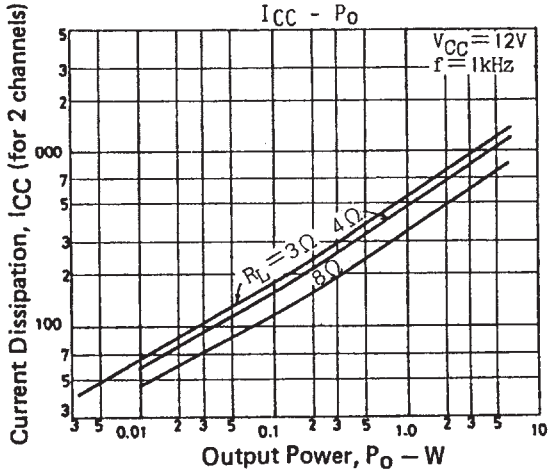
Vrp - DC

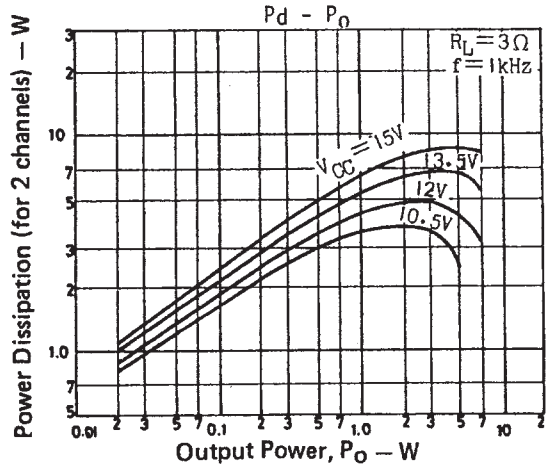


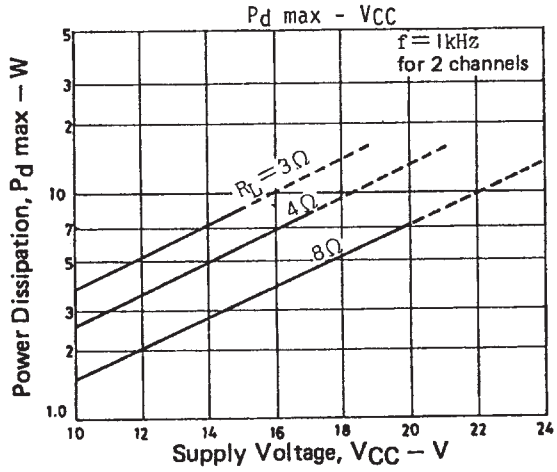

t_s - DC
V_{CC}=12V
R_L=3Ω
Rg=600Ω
Starting Time, t_s – s
• Decreasing the decoupling capacitor value makes pop noise louder.
*t_s also depends on the NF capacitor value; decreasing the value makes t_s earlier.
Pin ⑨ Decoupling Capacitor Value – μF

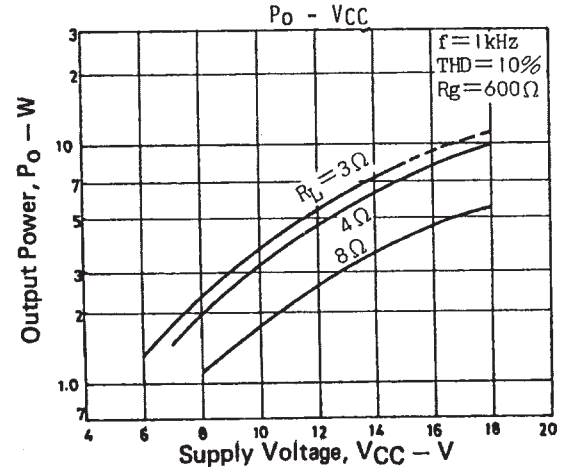

THD - V_{CC}
V_{CC}=12V
R_L=3Ω
Rg=600Ω
f=1kHz
VG=50dB
Total Harmonic Distortion, THD – %
P_O=100mW
3W
Supply Voltage, V_{CC} – V

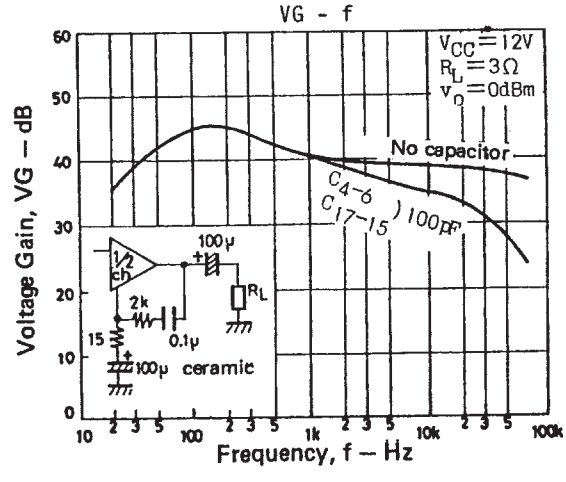

THD - Rg
V_{CC}=12V
R_L=3Ω
f=1kHz
v_o=2V
Total Harmonic Distortion, THD – %
Signal Source Resistance, R_g – Ω

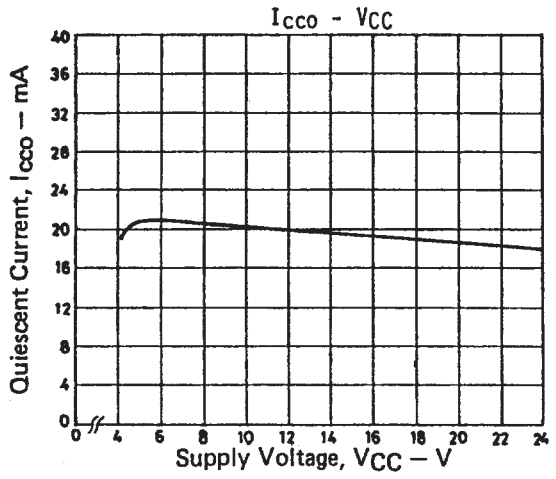

I_{CC} - P_O
V_{CC}=12V
f=1kHz
Current Dissipation, I_{CC} (for 2 channels)
R_L=3Ω
4Ω
8Ω
Output Power, P_O – W

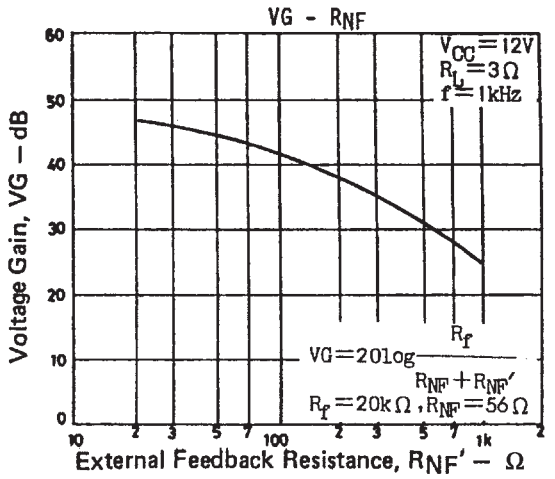

Pd - P_O
R_L=3Ω
f=1kHz
V_{CC}=15V
13.5V
12V
10.5V
Power Dissipation (for 2 channels) – W
Output Power, P_O – W

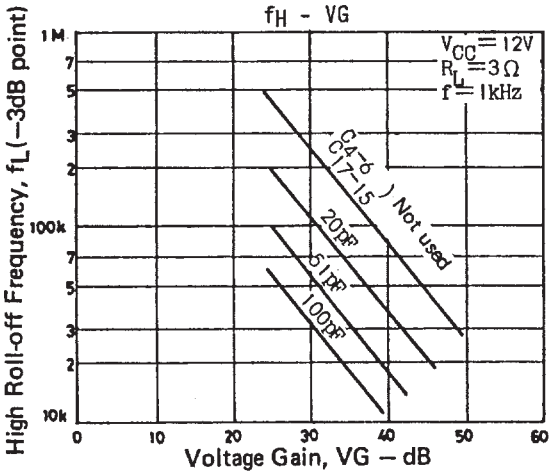

Pd max - V_{CC}
f=1kHz
for 2 channels
R_L=3Ω
4Ω
8Ω
Power Dissipation, Pd max – W
Supply Voltage, V_{CC} – V

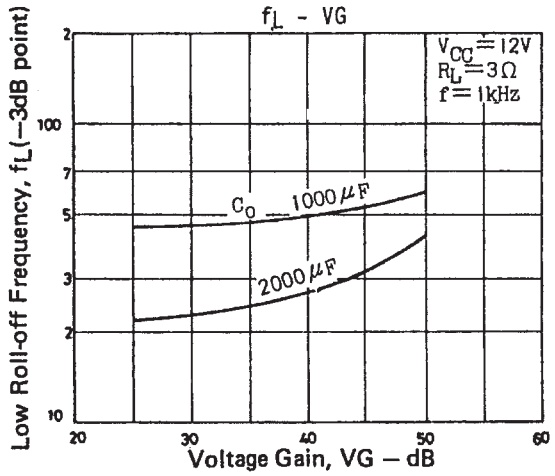

P_O - V_{CC}
f=1kHz
THD=10%
Rg=600Ω
R_L=3Ω
4Ω
8Ω
Output Power, P_O – W
Supply Voltage, V_{CC} – V

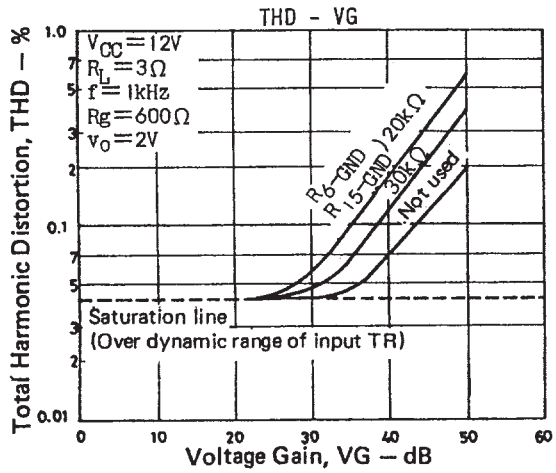

VG - f
V_{CC}=12V
R_L=3Ω
v_o=0dBm
No capacitor
C4-6
C17-15
100pF
100μ
1/2 ch
2k
R_L
15
0.1μ
100p ceramic
Voltage Gain, VG – dB
Frequency, f – Hz

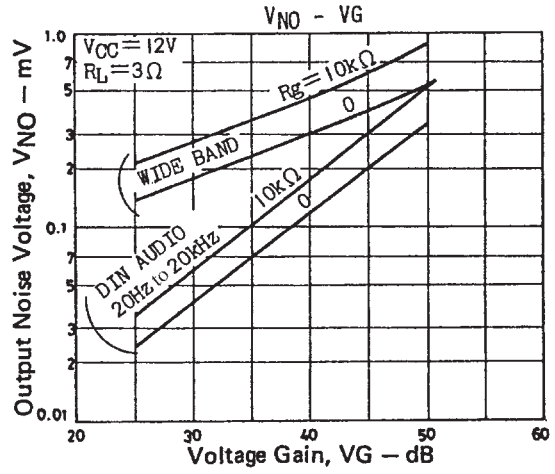

Icco - VCC
Quiescent Current, Icco – mA
Supply Voltage, VCC – V

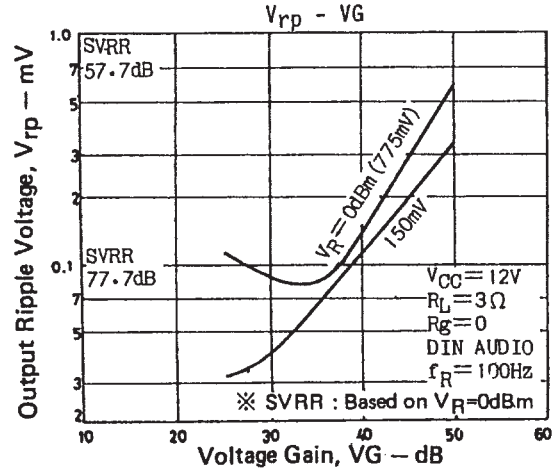

VG - RNF
VCC=12V
RL=3Ω
f=1kHz
Voltage Gain, VG – dB
External Feedback Resistance, RNF' – Ω
VG=20log Rf / (RNF+RNF')
Rf=20kΩ, RNF=56Ω

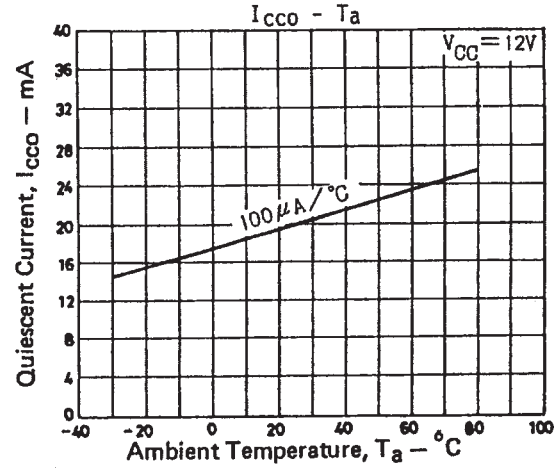

fH - VG
VCC=12V
RL=3Ω
f=1kHz
C4-6
C17-15
Not used
20pF
5.1pF
100pF
High Roll-off Frequency, fL(–3dB point)
Voltage Gain, VG – dB

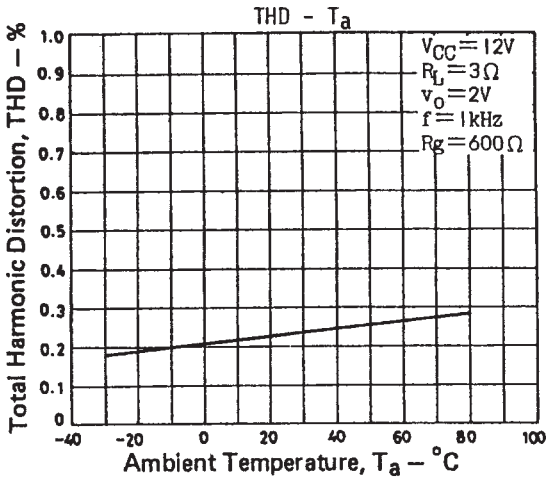

fL - VG
VCC=12V
RL=3Ω
f=1kHz
Co 1000μF
2000μF
Low Roll-off Frequency, fL(–3dB point)
Voltage Gain, VG – dB


THD - VG
VCC=12V
RL=3Ω
f=1kHz
Rg=600Ω
vo=2V
R6-GND
R15-GND
20kΩ
30kΩ
Not used
Saturation line
(Over dynamic range of input TR)
Total Harmonic Distortion, THD – %
Voltage Gain, VG – dB

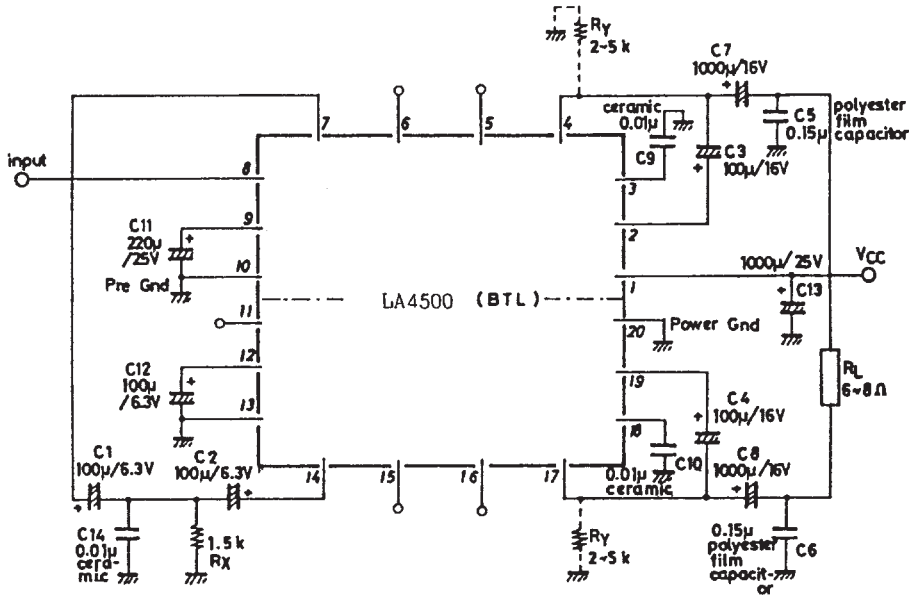

VNO - VG
VCC=12V
RL=3Ω
Rg=10kΩ
0
10kΩ
0
WIDE BAND
DIN AUDIO
20Hz to 20kHz
Output Noise Voltage, VNO – mV
Voltage Gain, VG – dB

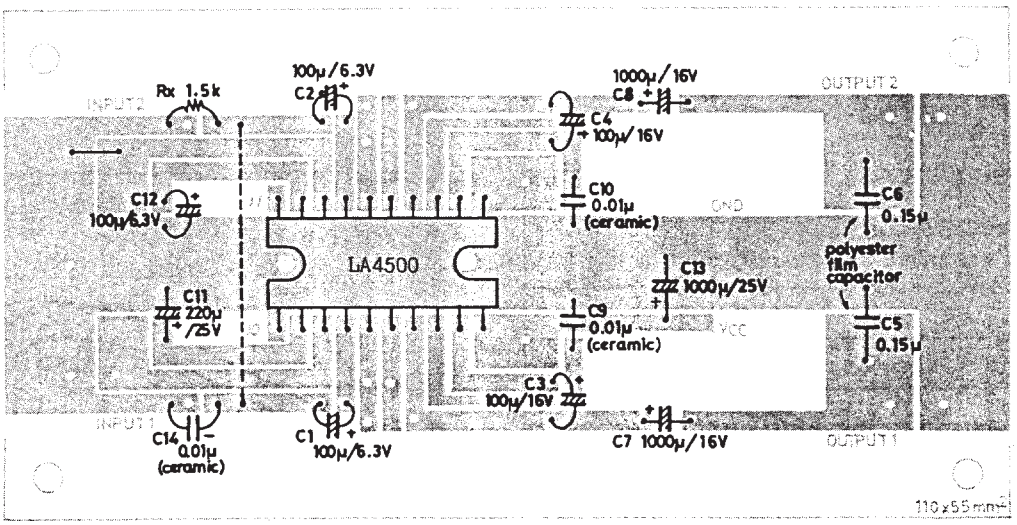

Vrp - VG
SVRR
57.7dB
SVRR
77.7dB
VR=0dBm (775mV)
150mV
VCC=12V
RL=3Ω
Rg=0
DIN AUDIO
fR=100Hz
※ SVRR : Based on VR=0dBm
Output Ripple Voltage, Vrp – mV
Voltage Gain, VG – dB

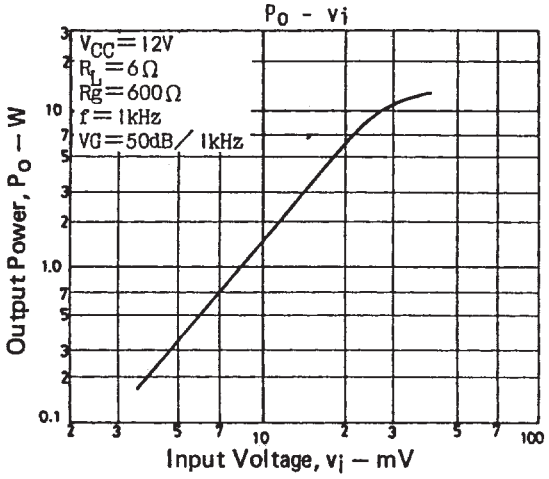

Icco - Ta
VCC=12V
100μA/°C
Quiescent Current, Icco – mA
Ambient Temperature, Ta – °C

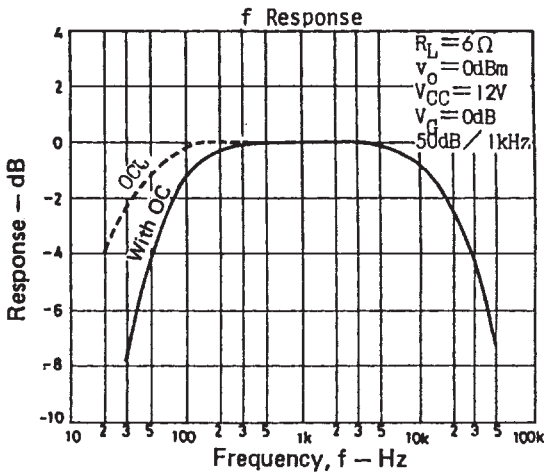


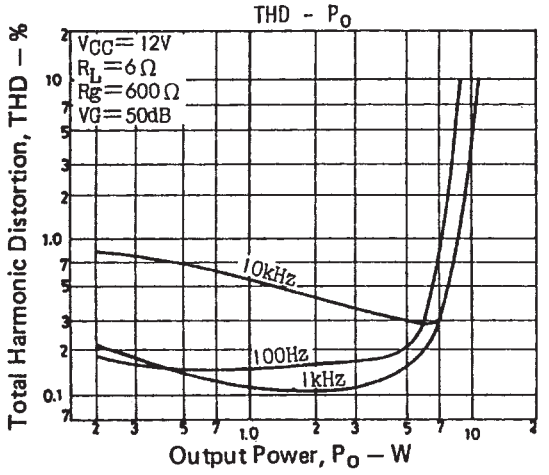
Sample Application Circuit 2

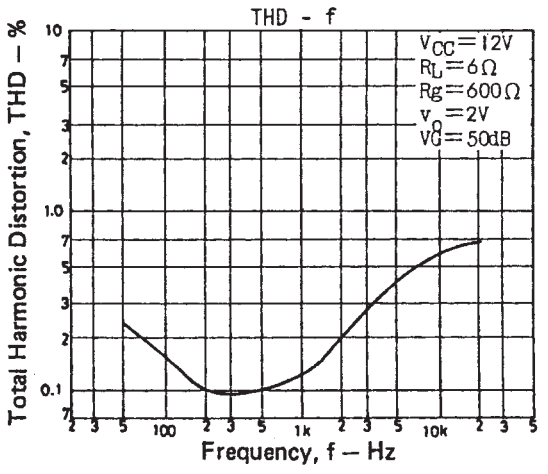


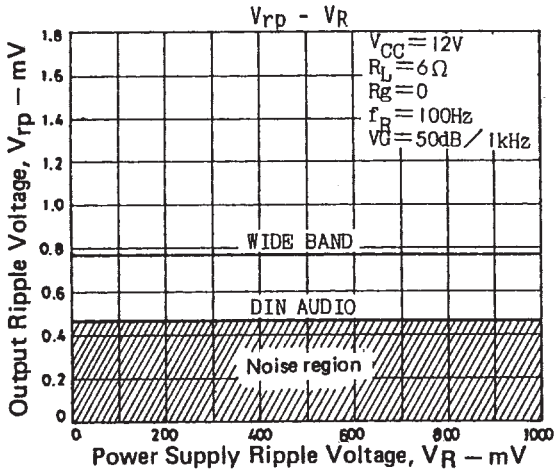


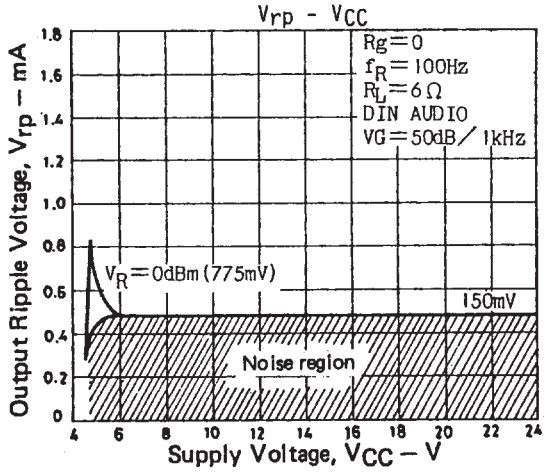

Po - vi
VCC=12V
RL=6Ω
Rg=600Ω
f=1kHz
VG=50dB/1kHz
Output Power, Po – W
Input Voltage, vi – mV

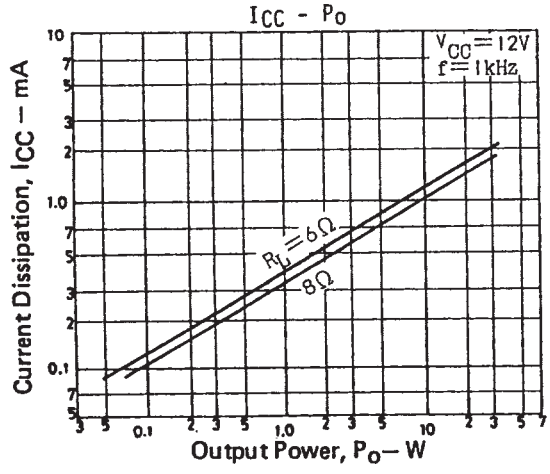

f Response
RL=6Ω
vo=0dBm
VCC=12V
VG=0dB
50dB/1kHz
With OC
Response – dB
Frequency, f – Hz

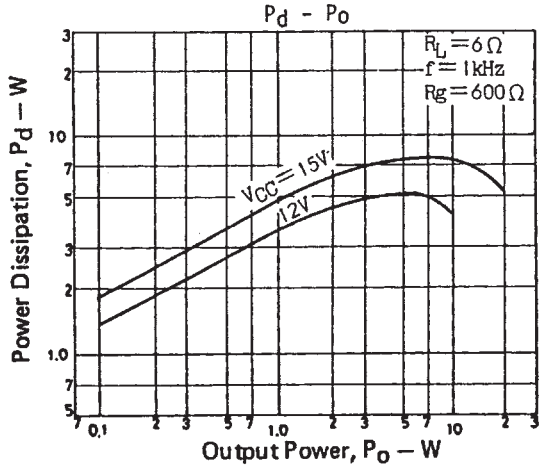

THD - Po
VCC=12V
RL=6Ω
Rg=600Ω
VG=50dB
10kHz
100Hz
1kHz
Total Harmonic Distortion, THD – %
Output Power, Po – W

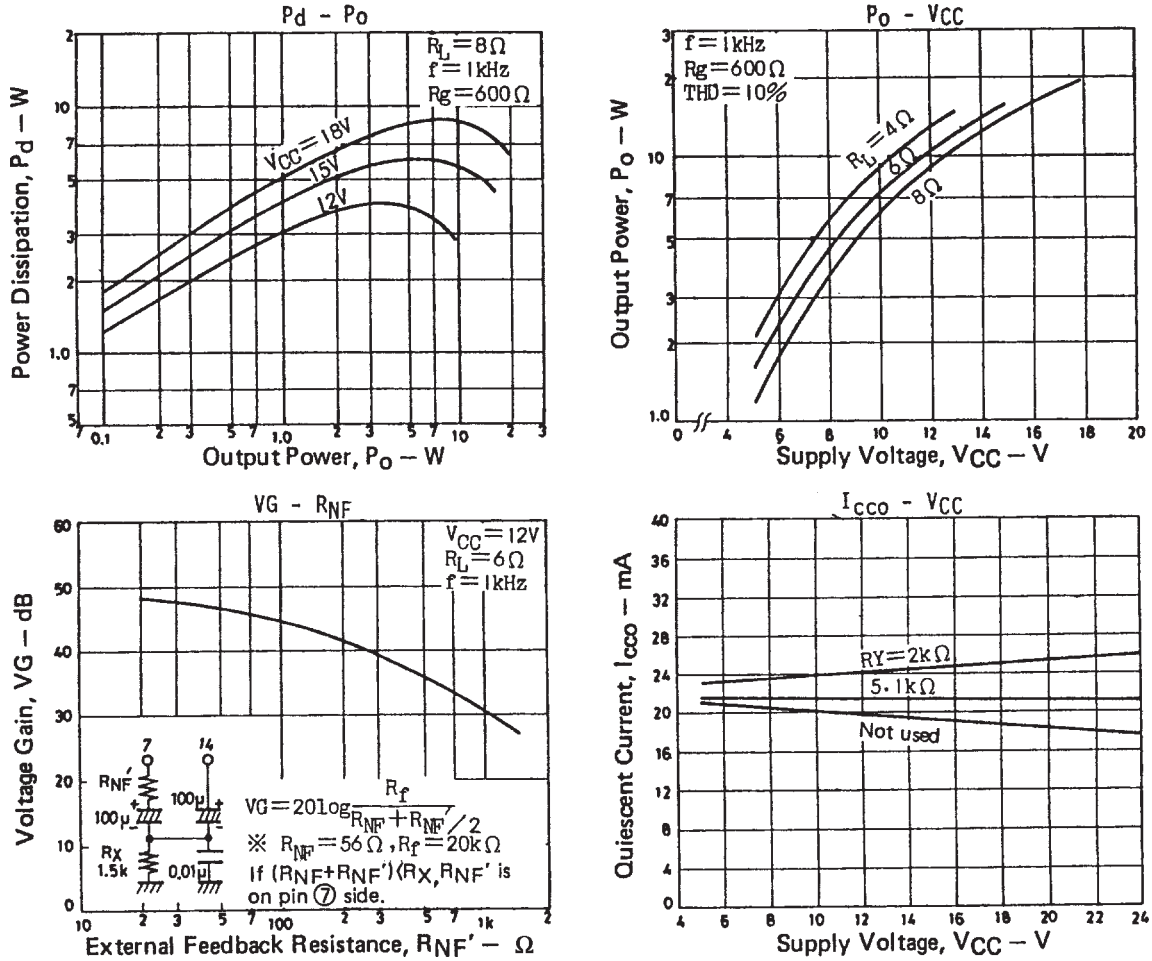

THD - f
VCC=12V
RL=6Ω
Rg=600Ω
vo=2V
VG=50dB
Total Harmonic Distortion, THD – %
Frequency, f – Hz


Vrp - VR
VCC=12V
RL=6Ω
Rg=0
fR=100Hz
VG=50dB/1kHz
WIDE BAND
DIN AUDIO
Noise region
Output Ripple Voltage, Vrp – mV
Power Supply Ripple Voltage, VR – mV


Vrp - VCC
Rg=0
fR=100Hz
RL=6Ω
DIN AUDIO
VG=50dB/1kHz
VR=0dBm(775mV)
150mV
Noise region
Output Ripple Voltage, Vrp – mA
Supply Voltage, VCC – V


ICC - Po
VCC=12V
f=1kHz
RL=6Ω
8Ω
Current Dissipation, ICC – mA
Output Power, Po – W


Pd - Po
RL=6Ω
f=1kHz
Rg=600Ω
VCC=15V
12V
Power Dissipation, Pd – W
Output Power, Po – W



Output power (reference value) corresponding to supply voltage and load resistance.

(THD=10%)

System	R_L	9V	12V	15V	18V
Stereo	8Ω	1.4W	2.5W	4.0W	5.6W
	6Ω	1.8W	3.2W	5.0W	7.4W
	4Ω	2.4W	4.5W	6.9W	9.8W
	3Ω	3.0W	5.3W	7.8W	–
	2Ω	3.5W	–	–	–
Bridge	8Ω	4.5W	8.5W	13W	18W
	6Ω	5.5W	9.5W	15W	–
	4Ω	7.0W	–	–	–

Proper Cares in Using IC

· Maximum ratings
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.

· Load short
If the IC is operated with the short loaded for a long time, breakdown or deterioration may take place. Be sure not to short the load.

· Printed circuit board
When drawing the printed circuit pattern, refer to the sample printed circuit pattern. Be careful not to form a feedback loop between input and output. Make the GND line thick and short so that no common resistance exists between Pre GND and Power GND.

· When using the IC in radios or radio-cassette tape recorders, allow a good distance between IC and ber antenna. An especially effective measure against radiation to the SW band is to additionally connect a capacitor of 0.033μF (polyester film capacitor) across pins (2) and (20) and across pins (19) and (20) respectively.

· Normally connect the heat sink of the package to GND.

Proper Cares in Mounging Radiator Fin

1. The mounting torque is in the range of 39 to 59N · cm.
2. The distance between screw holes of the radiator fin must coincide with the distance between screw holes of the IC. With case outline dimensions L and R referred to, the screws must be tightened with the distance between them as close to each other as possible.
3. The screw to be used must have a head equivalent to the one of truss machine screw or binder machine screw defined by JIS. Washers must also be used to protect the IC case.
4. No foreign matter such as cutting particles shall exist between heat sink and radiator fin. When applying grease on the junction surface, it must be applied uniformly on the whole surface.
5. IC lead pins are soldered to the printed circuit board after the radiator fin is mounted on the IC.