Ordering number: EN 1440E

Monolithic Linear IC

SANYO No.1440E

LA4508

8.5W 2-CHANNEL AF POWER AMPLIFIER

Features

- Low idling current (20mA/2 channels)
- Output power 8.5W x 2 typ. (R_L = 3ohms)
- High ripple rejection (60dB at steady state)
- Small pop noise at the time of power supply ON
- Thermal protector
- Adoption of SEP14H ($\Theta_{j\text{-}c}$ = 3°C/W) facilitates thermal design.

Maximum Ratings/T_a = 25°C

				unit
Maximum supply voltage	V_{CC} max		24	V
Allowable power dissipation	P_d max	With infinite heat sink	15	W
Maximum output current	I_O peak	1 channel	2.5	A
Operating temperature	T_{opr}		−20 to +75	°C
Storage temperature	T_{stg}		−40 to +150	°C

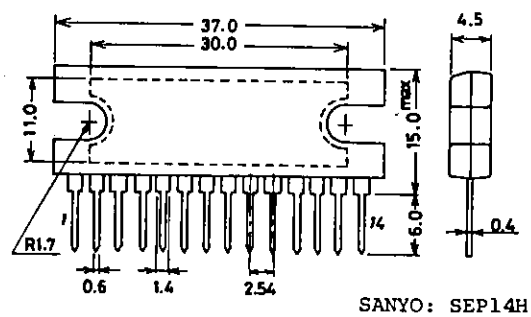
Operating Conditions/T_a = 25°C

				unit
Recommended supply voltage	V_{CC}		15	V
Operating voltage range	V_{CC}*	P_d max must not be exceeded.	9 to 23	V
Recommended load resistance	R_L	2 channels	3	Ω

Operating Characteristics/T_a = 25°C, V_{CC} = 15V, R_L = 3Ω (2 channels), f = 1kHz, R_g = 600Ω, See specified test circuit.

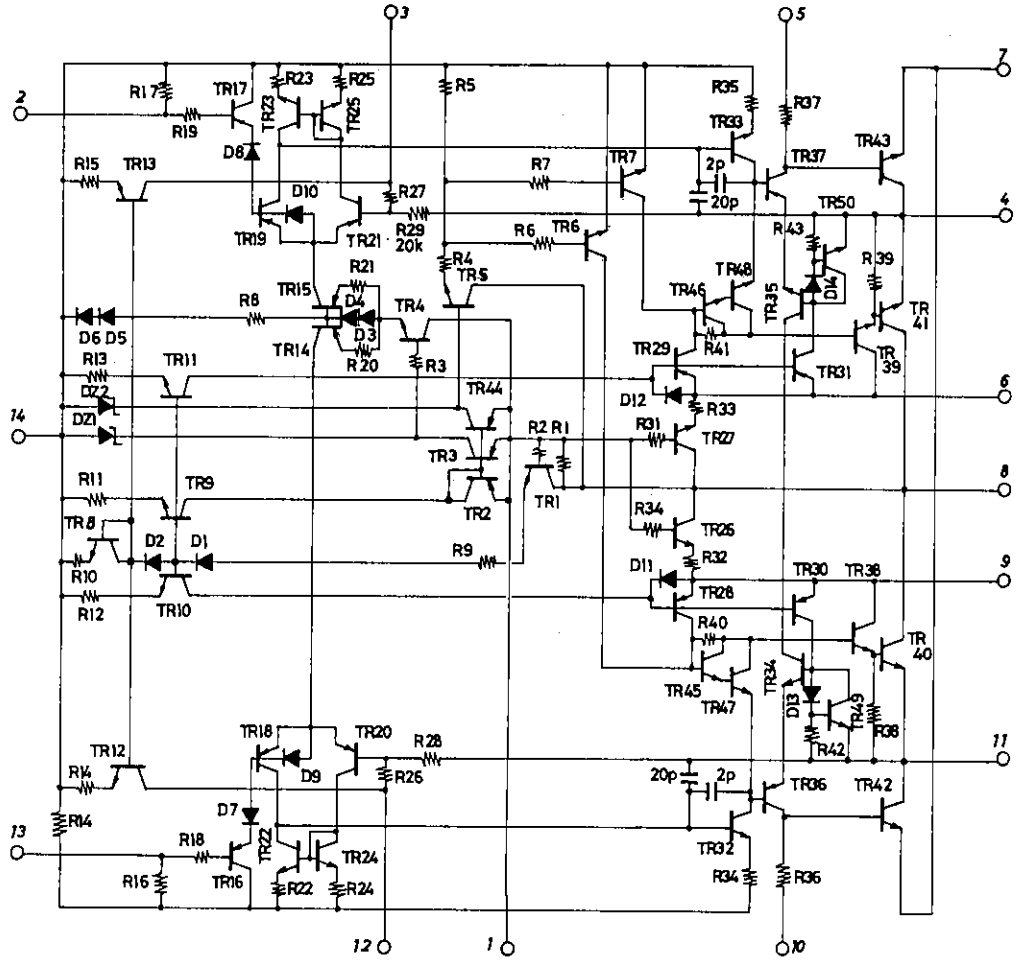
			min	typ	max	unit
Quiescent current	I_{CCO}	2 channels	10	20	30	mA
Voltage gain	VG		42	44	46	dB
Voltage gain difference	ΔVG	ch1, ch2			±1	dB
Output power	P_O	THD = 10%	7.5	8.5		W
Total harmonic distortion	THD	V_O = 2V		0.15	1.0	%
Input resistance	r_i			30k		Ω
Output noise voltage	V_{NO1}	R_g = 0, f = 20Hz to 20kHz, B.P.F		0.2	0.5	mV
	V_{NO2}	R_g = 10kΩ, f = 20Hz to 20kHz, B.P.F		0.3	1.0	mV
Ripple rejection	R_r		45	60		dB
Channel separation	ch sep		45	55		dB

Package Dimensions 3023A-S14HIC
(unit: mm)



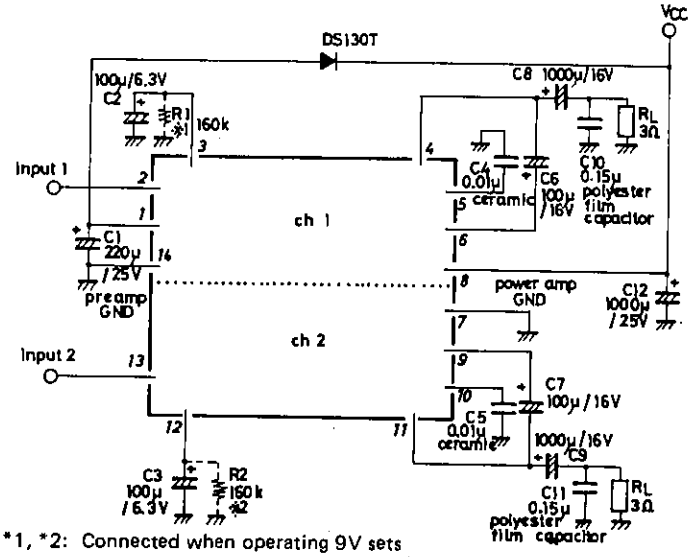
SANYO: SEP14H

Equivalent Circuit



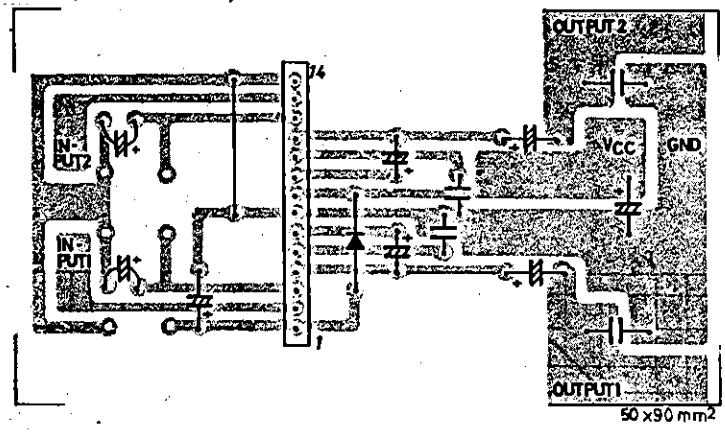
Unit (resistance: Ω, capacitance: F)

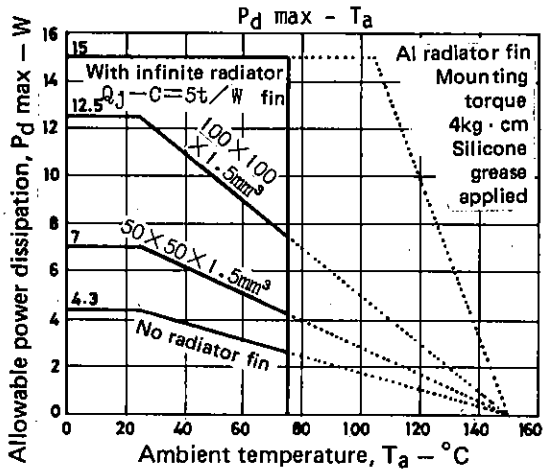
■ **Sample Application Circuit**

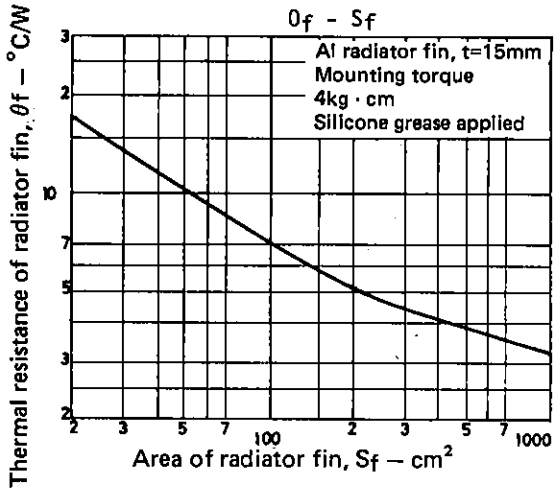


*1, *2: Connected when operating 9V sets

Sample Printed Circuit Pattern (Cu-foiled area)







Description of external parts

C_1: Decoupling capacitor
Used for the ripple filter. Since the rejection effect is saturated at a certain capacity, it is meaningless to increase the capacity more than needed. This capacitor, being also used for the time constant of the pop noise preventer, affects the starting time. Too small a capacity makes the pop noise level higher. (Recommended value: 100μF to 330μF)

C_2 (C_3): Feedback capacitor
Since the low cutoff frequency depends on this feedback capacitor, the required bandwidth must be considered before determining the value of this feedback capacitor. This feedback capacitor also affects the starting time.

C_4 (C_5): Switching distortion suppressing capacitor
Used to suppress switching distortion which often appears at high frequencies in overinput mode. The recommended value is 0.01μF (ceramic capacitor).

C_6 (C_7): Bootstrap capacitor
The output at low frequencies depends on this capacitor. If the capacity is decreased, the output at low frequencies goes lower. 47μF min. is required. (This, however, does not apply if load R_L is light.)

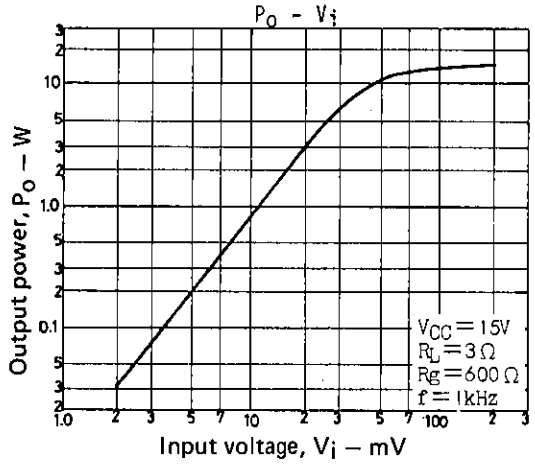
C_8 (C_9): Output capacitor
The low cutoff frequency depends on this output capacitor. (Refer to the characteristic graph.)

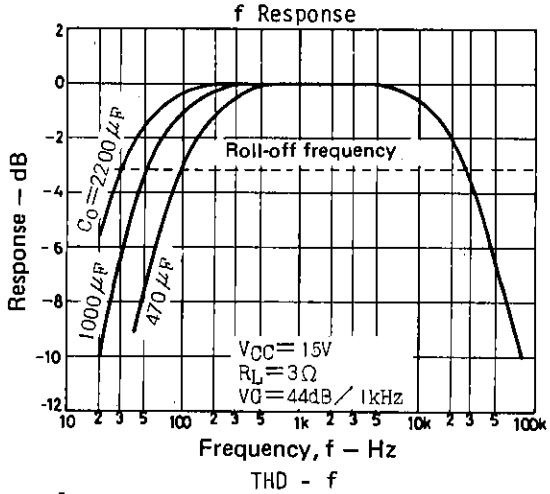
C_{10} (C_{11}): Oscillation blocking capacitor
Polyester film capacitor, being excellent in temperature characteristic, frequency characteristic, is used. The use of an aluminum electrolytic capacitor or ceramic capacitor may cause oscillation to occur at low temperatures.

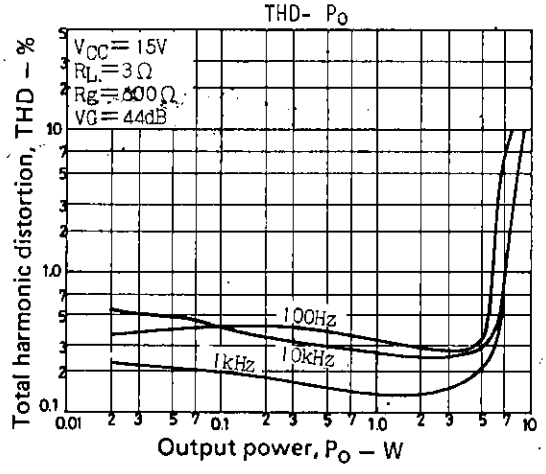
C_{12}: Power source capacitor
This power source capacitor must accomodate loads (motor, etc.) in the power line or ripple in the transformer output. The recommended value is 1000μF to 2200μF.

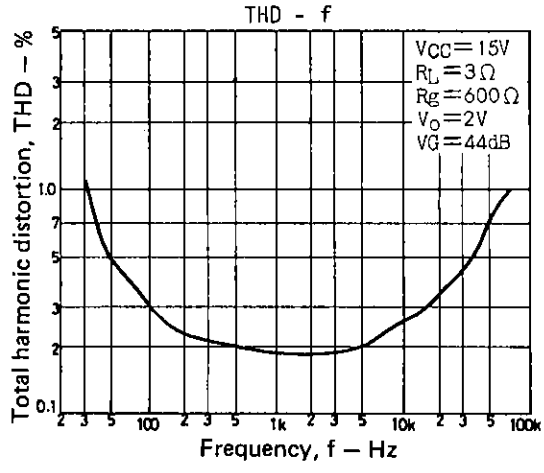
R_1 (R_2): Normally, this resistor is not required.
If the IC is used at V_{CC} = 9V or thereabouts, clip balance may be disturbed. This resistor can be used to correct such disturbance.

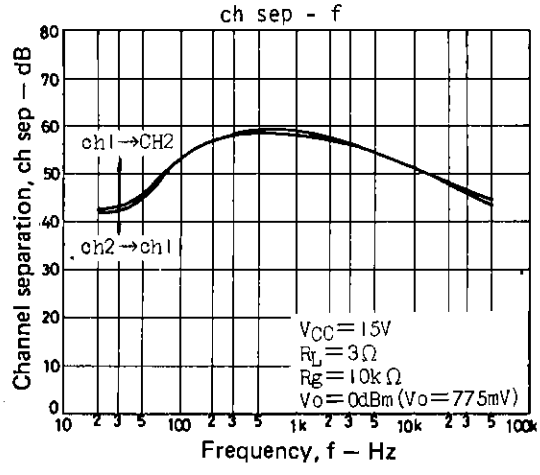
D_1: When a motor is started, or in similar modes, the supply voltage drops abruptly, causing the filter transistor to be saturated. This diode is a bypass diode and can be used to prevent such saturation from occurring. Whether or not to use this diode depends on the set to be made.

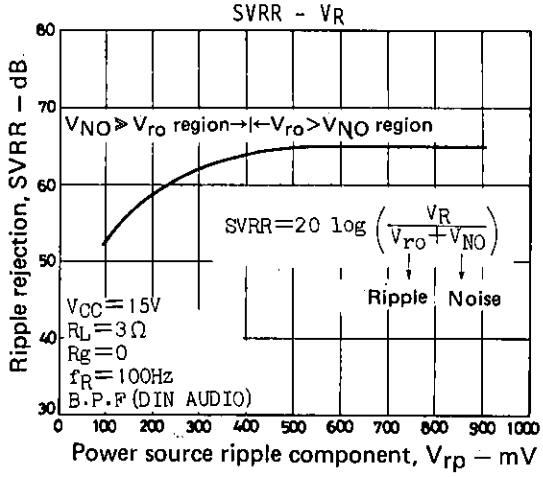




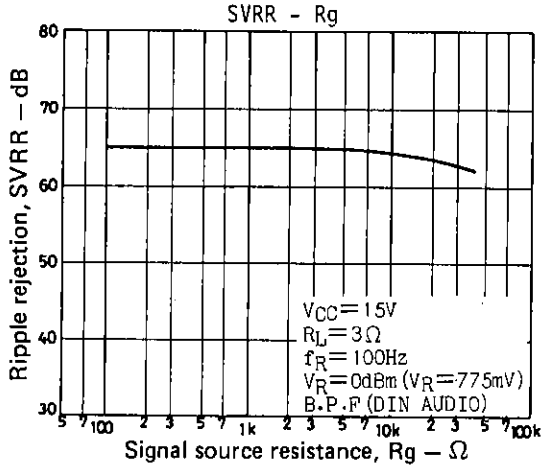




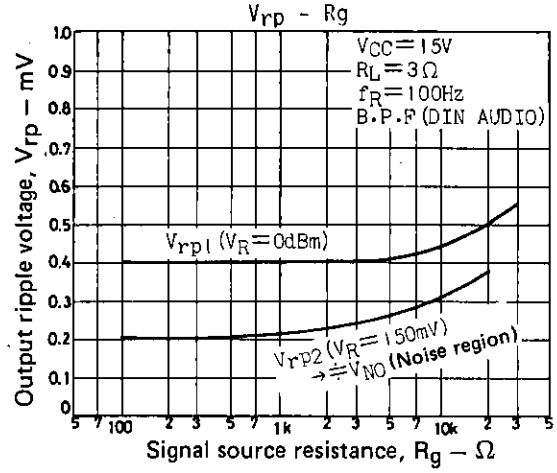




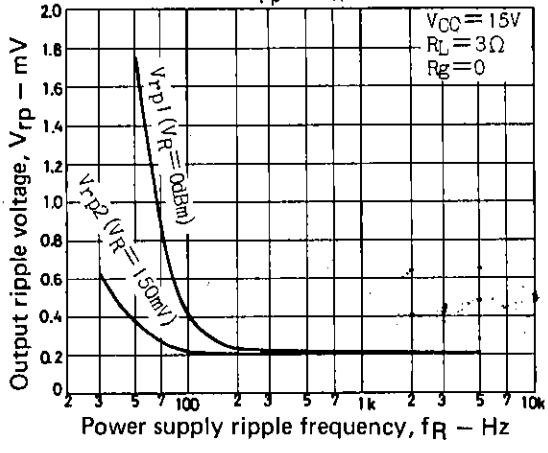
SVRR - Rg



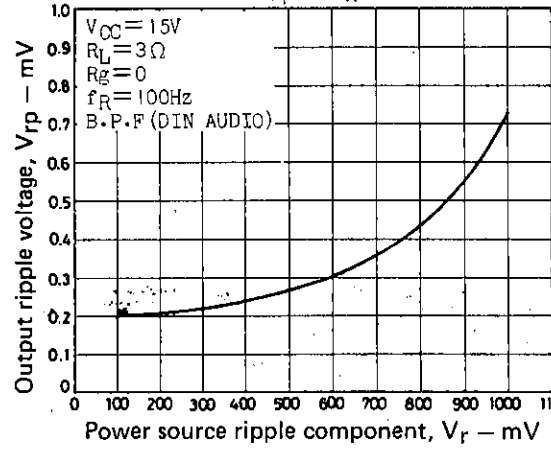
Vrp - Rg



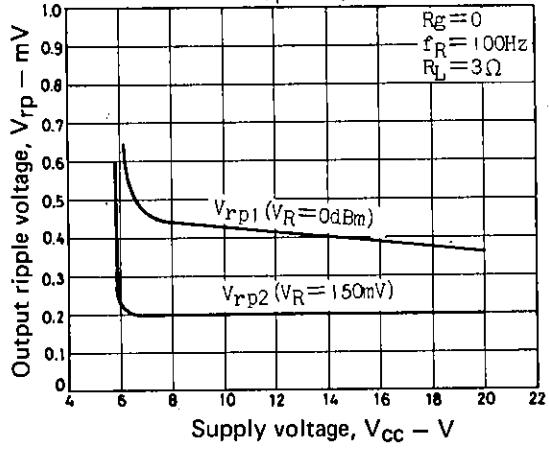
Vrp - fR



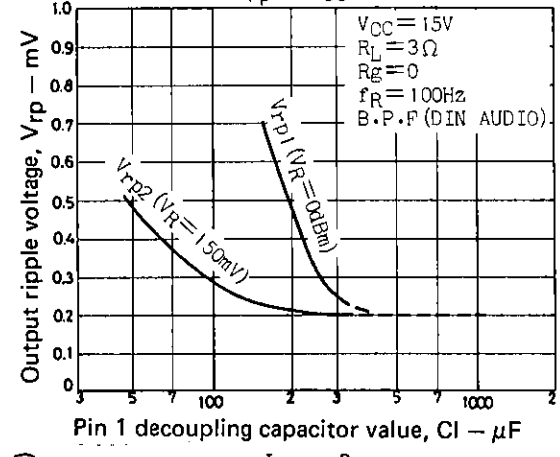
Vrp - VR



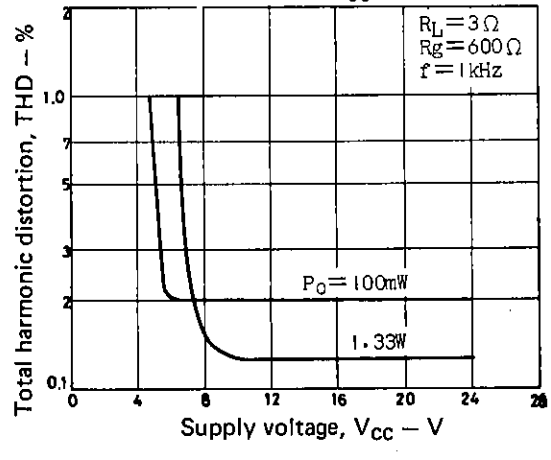
Vrp - VCC



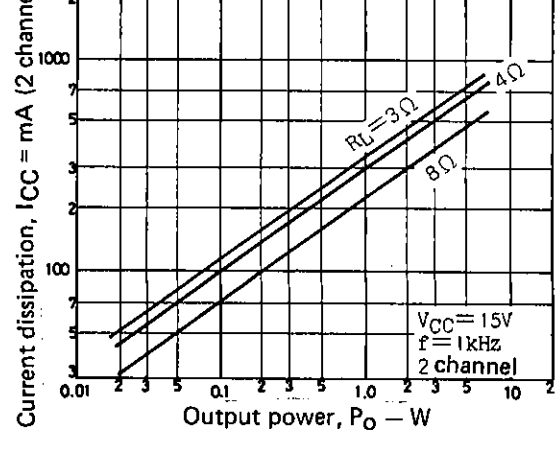
Vrp - Cdc

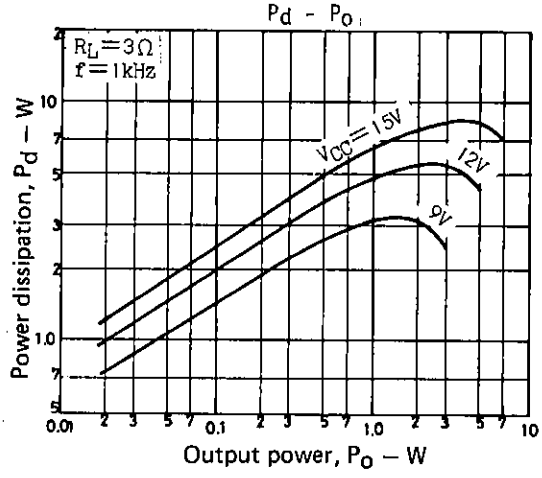


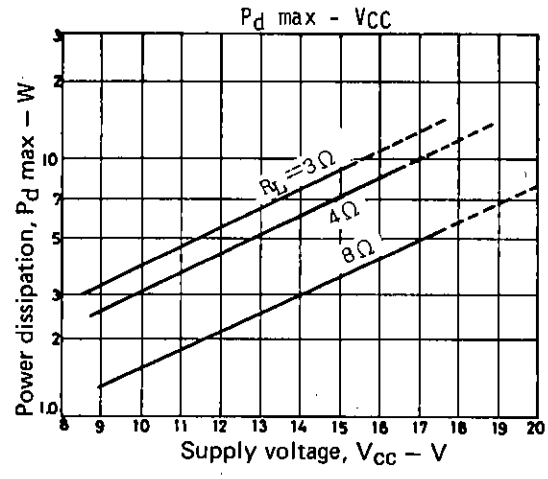
THD - VCC

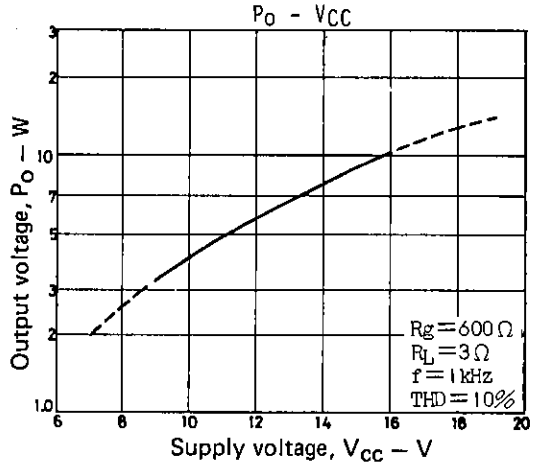


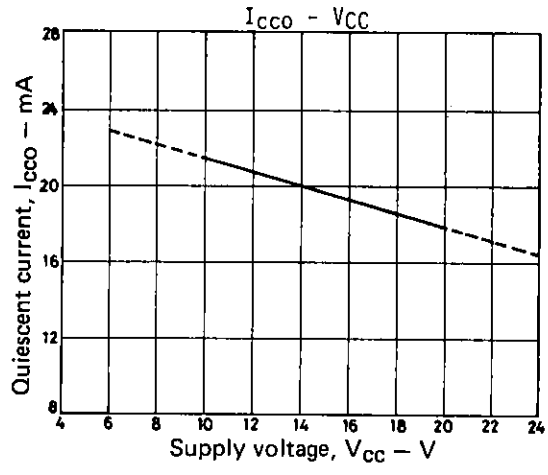
ICC - PO











Proper cares in using IC

1. If the IC is used in the vicinity of the maximum rating, even a slight variation in conditions may cause the maximum rating 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 rating is not exceeded.
2. Pin-to-pin short, inverted insertion
   If supply voltage is applied when the space between pins is shorted, breakdown or deterioration may occur. When mounting the IC on the board or applying supply voltage, make sure that the space between pins is not shorted with solder, etc. If the IC is inserted inversely, it may be broken down momentarily because of pin 7: Power Gnd, pin 8: V_{CC}.
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. Change in closed-loop gain
   By connecting R_{NF} in series with pins 3, 12 (NF pin), the gain can be reduced, but the following must be noted.
   a. If R_{NF} is connected, the ripple bypass effect brought about by the NF capacitor is lessened, leading to insufficient ripple rejection.
   b. Do not operate at 40dB or less so that stable oscillation is maintained.
5. When the IC is used in radios or radio-cassette tape recorders, keep a good distance between IC and bar antenna. A capacitor of 0.022μF or more (polyester film capacitor) connected between pins 9 and 7 and between pins 6 and 7 acts effectively against radiation to the SW band.
6. Printed circuit board
   When making the board, refer to the sample printed circuit pattern. No feedback loop must be formed between input and output and make the line thick and short so that no common resistor exists between pre-GND and power-GND.

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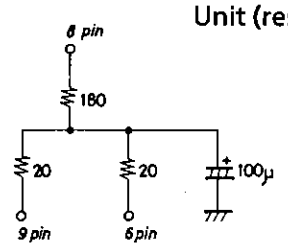
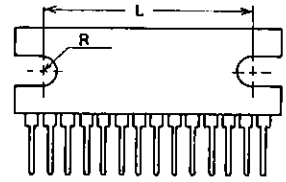
7. Some plug jacks to be used for connecting to the external speaker are such that both poles are short-circuited once when connecting. In this case, the load is short-circuited, which may break down the IC.
8. Improvement in reduced voltage characteristic (Reference example).
   By connecting parts as shown below, distortion-free operation can be performed at a supply voltage down to V_{CC} = 4.5V or thereabouts. The capacitor of 100μF is connected to suppress pop noise.

Unit (resistance: Ω, capacitance: F)



Proper cares in mounting radiator fin

1. The mounting torque is in the range of 4 to 6kg.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 truss machine screw or binder machine screw defined by JIS. Washers must be also 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.

Ordering number: EN 1161D

Monolithic Linear IC

SANYO No. 1161D

LA4510

240mW AF Power Amplifier

Applications

- Especially suited for use in 3V micro cassette recorder, mini cassette recorder, headphone stereo applications.

Features

- Operating supply voltage range : 2 to 5V
- Low current dissipation (7mA typ/V_{CC}=3V)
- Output power : 240mW typ at V_{CC}=3V, R_L=4ohms, THD=10%
  40mW typ at V_{CC}=3V, R_L=32ohms, THD=10%
- Built-in muting circuit to be operated at the time of power switch ON capable of varying starting time and making pop noise low.
- Soft clipping

Maximum Ratings at T_a=25°C

			unit
Maximum Supply Voltage	V_{CC}max	6.0	V
Maximum Output Current	$I_O$peak	570	mA
Allowable Power Dissipation	$P_d$max	700	mW
Operating Temperature	**Topr**	-10 to +60	°C
Storage Temperature	Tstg	-55 to +150	°C

Operating Conditions at Ta=25°C

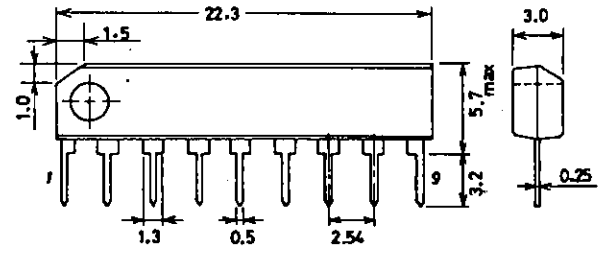
Recommended Supply Voltage	V_{CC}	3.0	4.5	V
Load Resistance	R_L	4 to 32	8 to 32	ohm

Electrical Characteristics at T_a=25°C, V_{CC}=3.0V, R_L=4ohms, f=1kHz, See Sample Application circuit 1.

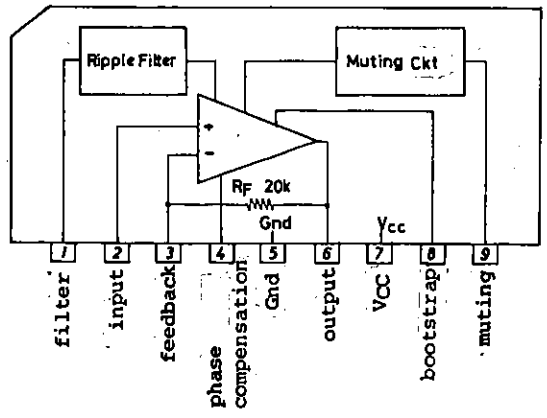
			min	typ	max	unit
Quiescent Current	I_{CCO}(1)	No signal		7	12	mA
	I_{CCO}(2)	No signal, V_{CC}=4.5V		8.5	15	mA
Voltage Gain	VG	R_1=100ohm	42	45	48	dB
Output Power	P_O	THD=10%	200	240		mW
Total Harmonic Distortion	THD	P_O=100mW		0.4	1.5	%
Output Noise Voltage	V_{NO}	Rg=1kohm, BW=20Hz to 20kHz		0.2	0.5	mV
Output Ripple Voltage	V_{rp}	Rg=0, f_R=100Hz, V_R=50mV		0.7		mV

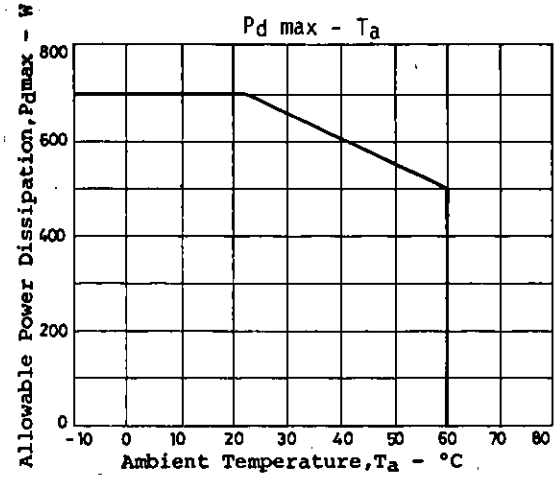
Package Dimensions 3017B

(unit : mm)

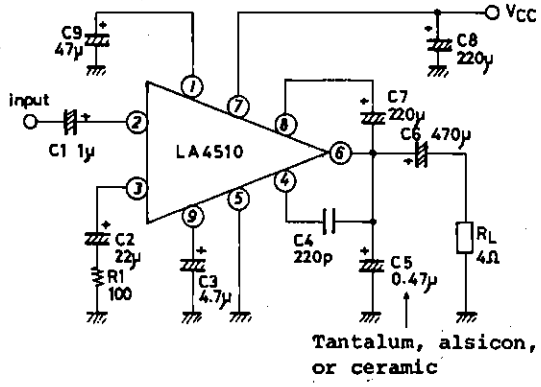


Equivalent Circuit Block Diagram

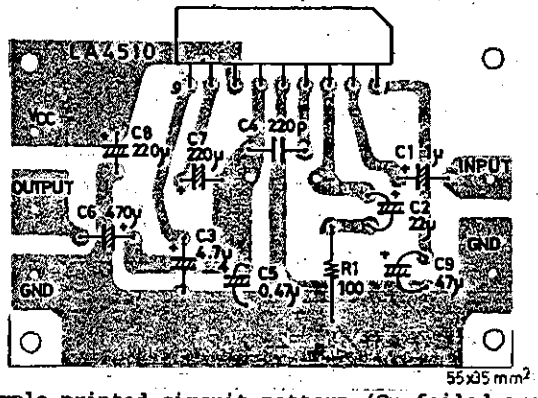




Sample Application Circuit 1 : Speaker load



Unit (resistance: Ω, capacitance: F)



Sample printed circuit pattern (Cu-foiled area)

1. Description of external parts

C1(1uF) . Input capacitor (Coupling capacitor for input signal)
Decreasing the capacitance value lowers the frequency response at low frequencies.

C2(22uF) . Feedback capacitor (Bypass of feedback signal)
Decreasing the capacitance value lowers the frequency response at low frequencies; increasing the capacitance value makes the starting time later.

C3(4.7uF) . Muting capacitor
Decreasing the capacitance value makes the starting time earlier; removing C3 causes pop noise. Increasing the capacitance value makes the starting time later.

C4(220pF) . Phase compensation capacitor (Phase compensation by local feedback)
Decreasing the capacitance value causes the frequency response to extend at high frequencies, and thereby oscillation is liable to occur. Increasing the capacitance value worsens distortion factor at high frequencies.

C5(0.47uF) . Oscillation blocking capacitor
Decreasing the capacitance value causes oscillation to liable to occur. Using an ordinary electrolytic capacitor may cause oscillation to occur at a low temperature. Use a tantalum or alsicon electrolytic capacitor that is good in temperature characteristic.

C6(470uF) . Output capacitor (Cutoff of DC to speaker)
Decreasing the capacitance value causes insufficient power at low frequencies.

C7(220uF) . Bootstrap capacitor (Feedback from output stage)
Decreasing the capacitance value causes insufficient power at low frequencies, especially when voltage is reduced.

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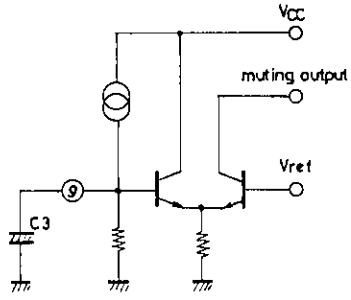
C8(220uF) . Power capacitor (Drop in power impedance)
Decreasing the capacitance value causes motor noise, etc. to be entered easily. Removing C8 may cause oscillation to occur.

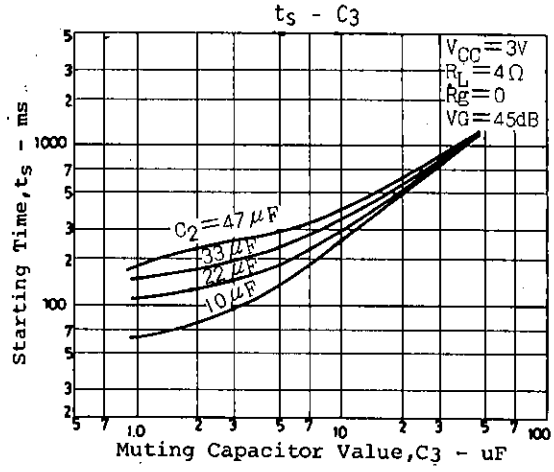
C9(47uF) . Capacitor for ripple filter (Filter for bias voltage)
Decreasing the capacitance value causes the circuit to be subjected to the influence of power supply, and thereby ripple is liable to occur.

r_i(100ohms) . Feedback resistor (Setting of voltage gain)
Decreasing the resistance value increases voltage gain, but worsens distortion factor, and thereby gain varies. Increasing the resistance value causes oscillation to liable to occur.

2. Setting of starting time

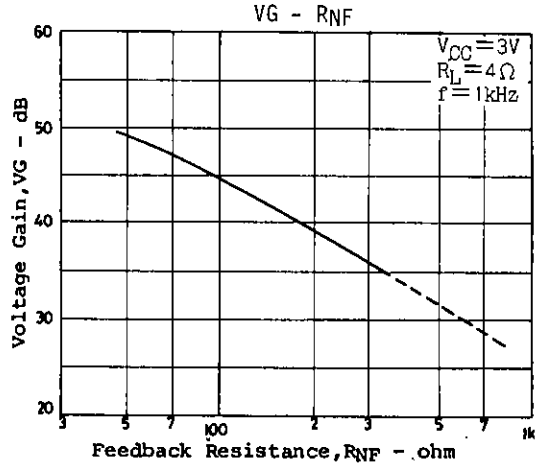
The LA4510 contains a muting circuit to be operated at the time of power switch ON/OFF. Thus, pop noise coming from power amplifier and preamplifier is rejected. The starting time depends on the capacitance value of feedback capacitor C2 as well as muting capacitor (C3).





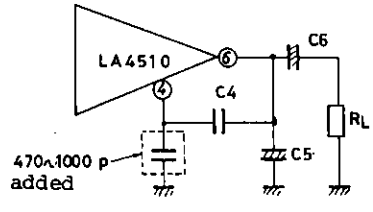
3. Voltage Gain

Voltage gain depends on the ratio of internal resistance value (20kohms) to external resistance value (R1). However, since setting of open loop voltage gain is a little on the low side (62dB) due to soft clipping, it is not recommendable to use the IC at a voltage gain greater than recommended. If the IC is used at a voltage gain less than recommended, take care not to cause oscillation to occur.



4. Action to prevent oscillation

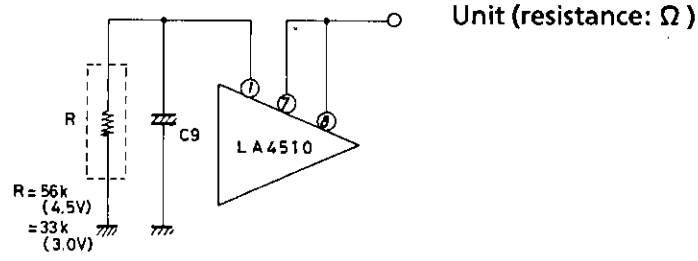
If oscillation occurs, check C5. The larger the capacitance value is or the smaller the value of tan δ is if the capacitance value is the same, C5 acts more effectively against oscillation. Using an electrolytic capacitor as C5 may cause oscillation to occur at a low temperature.



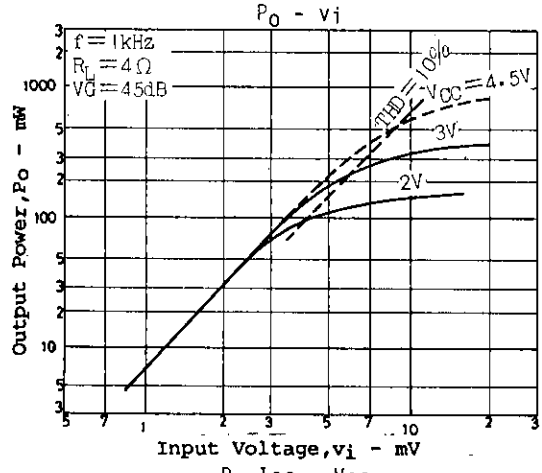
It is recommendable to use a tantalum or alsicon electrolytic capacitor that is good in temperature characteristic. For oscillation that occurs at a decreased voltage gain, increase the capacitance value of C4. If it is impossible for C4, C5 to act effectively against oscillation, add a ceramic capacitor of 470 to 1000pF across pin (4) and GND. In this case, distortion factor at high frequencies worsens to some extent.

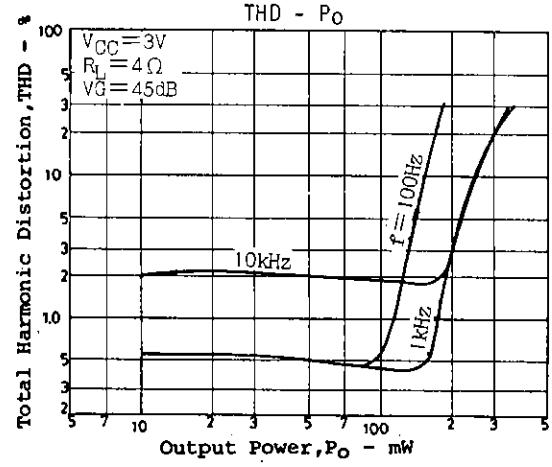
5. Removal of bootstrap capacitor

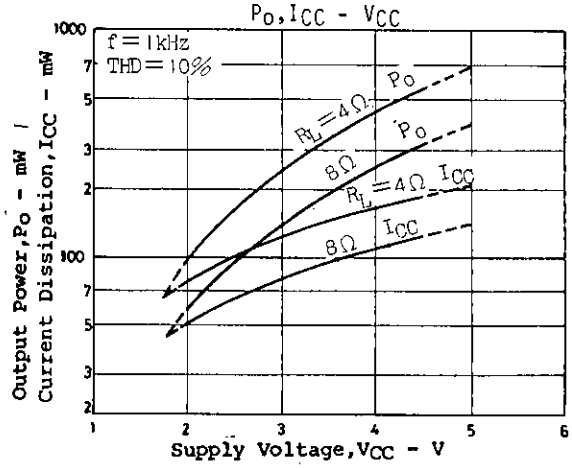
In applications where more power than required is available (approximately 60% of rating), it is possible to remove bootstrap capacitor C7 (pin (7)-to-pin (8) short). However, since this causes clipping unbalance to occur, this unbalance must be compensated by use of a resistor and a diode. A simple compensation method is shown below. This method makes it possible to attain clipping balance at a certain supply voltage only.

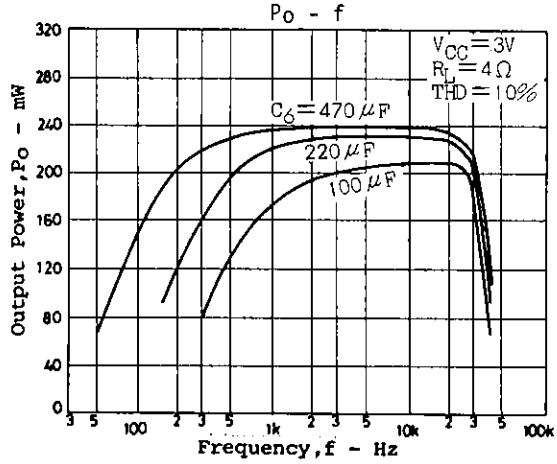


Unbalance compensation mothod

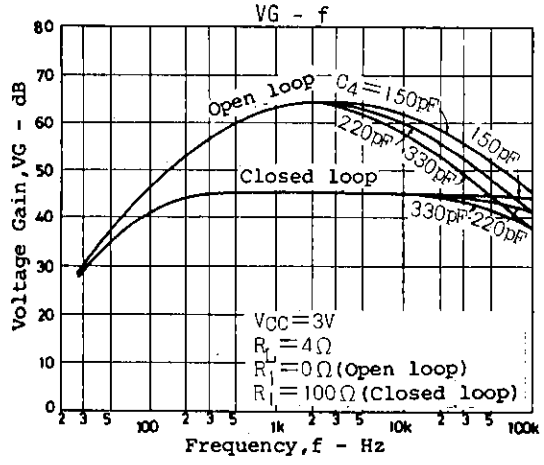




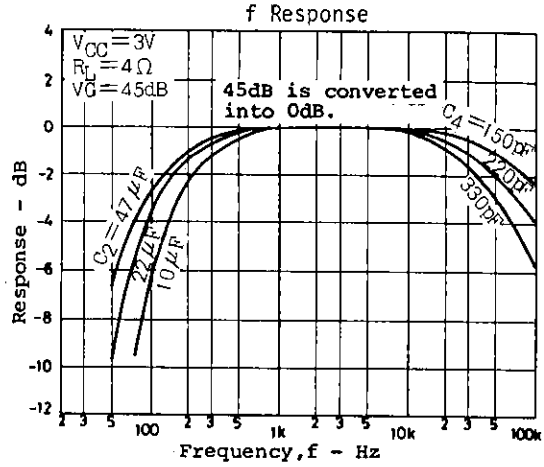




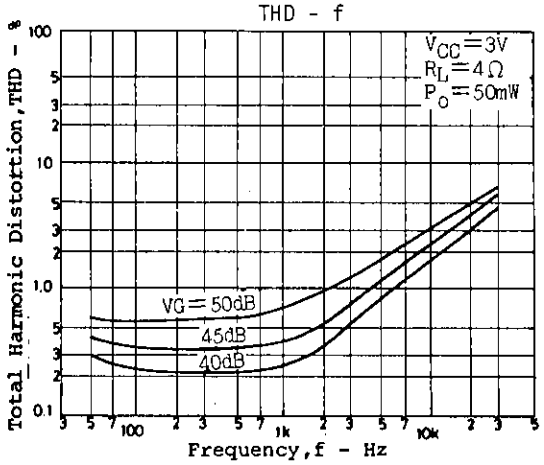
VG - f



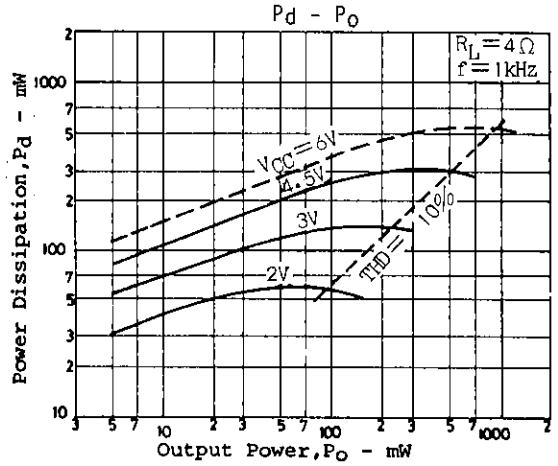
f Response



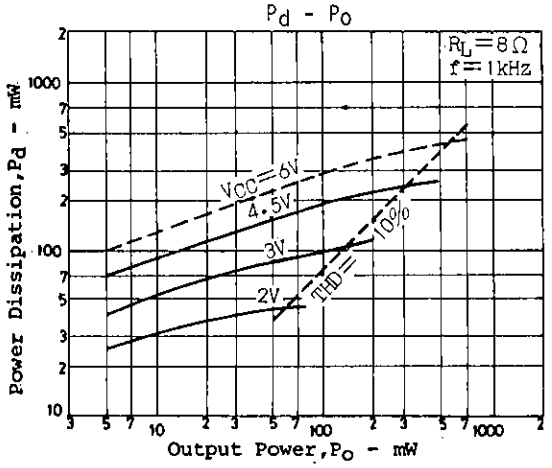
THD - f



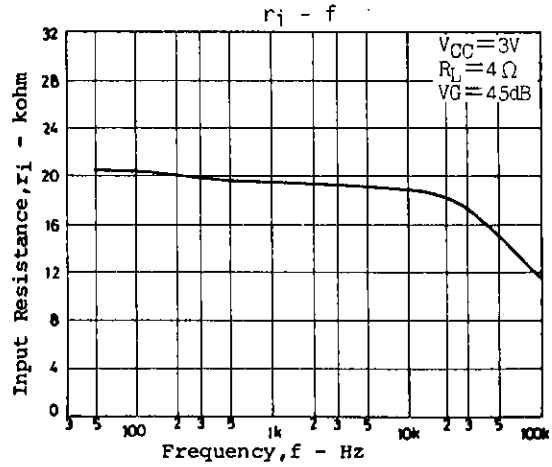
Pd - Po



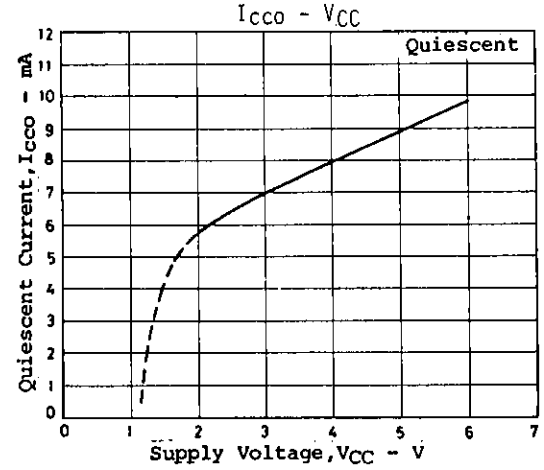
Pd - Po



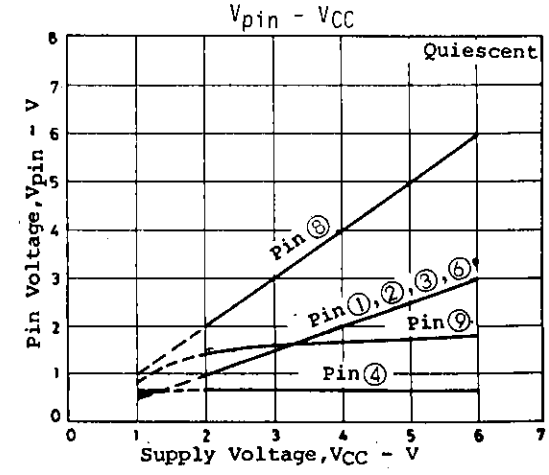
ri - f

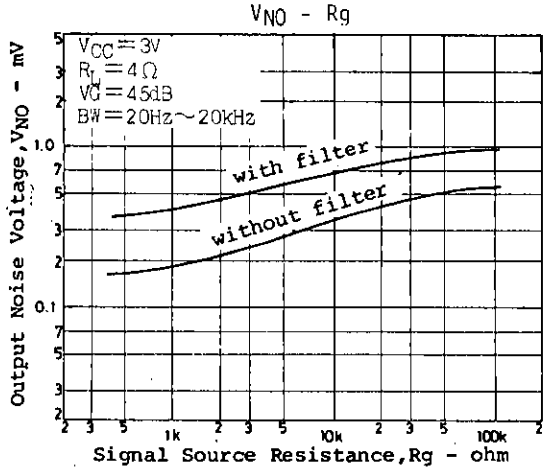


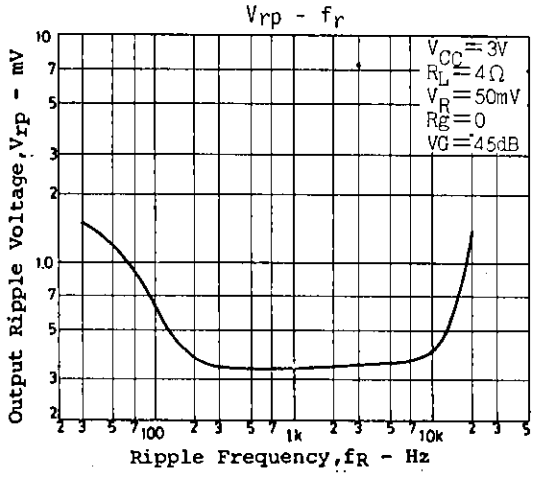
Icco - VCC

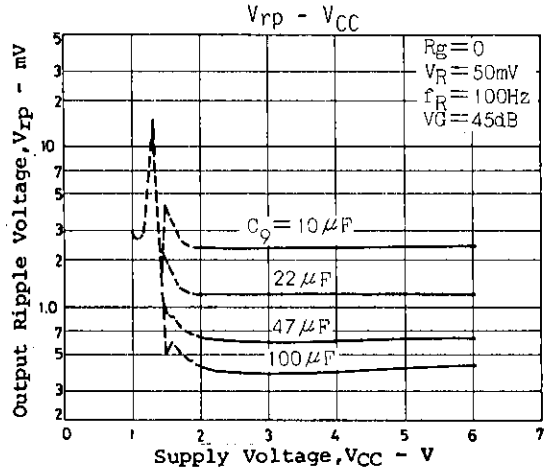


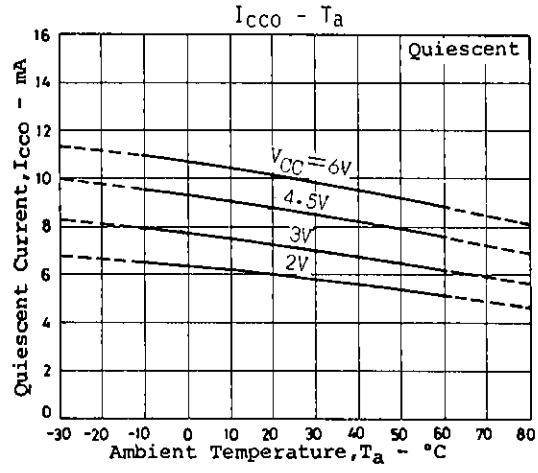
Vpin - VCC

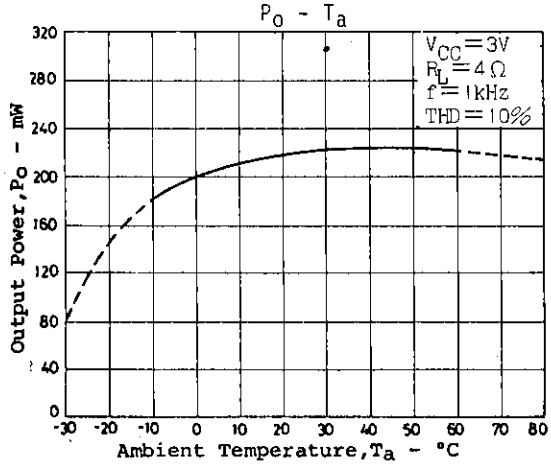


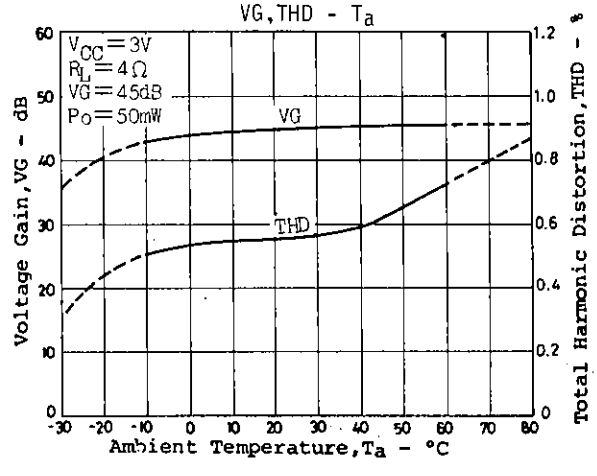




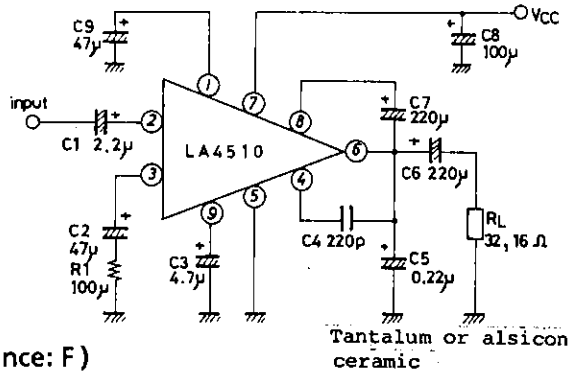




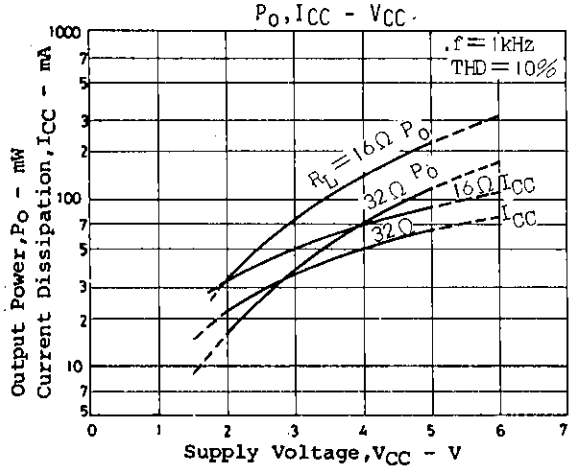


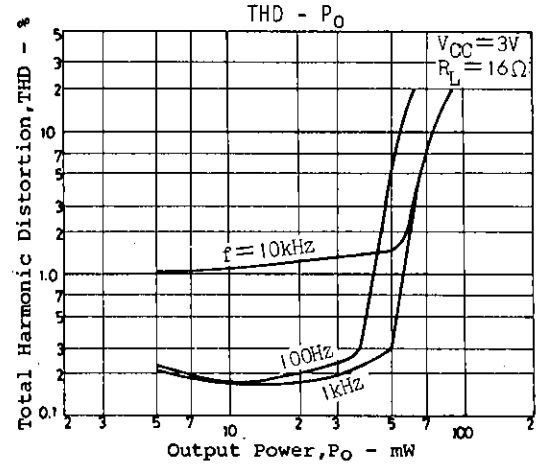


Sample Application Circuit 2 : Headphone load

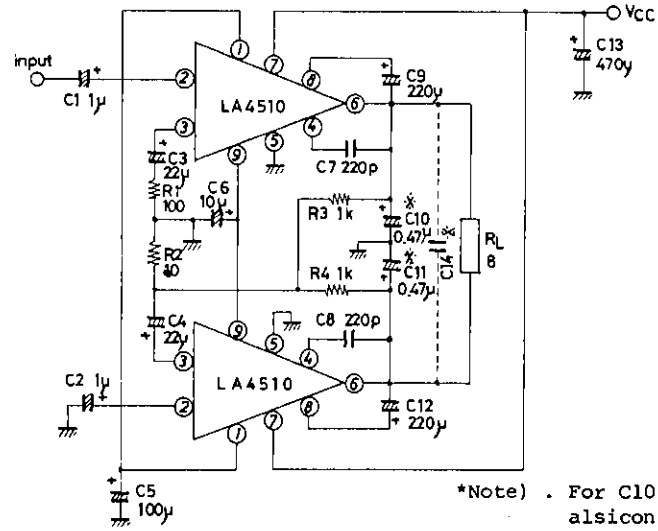


Unit (resistance: Ω, capacitance: F)



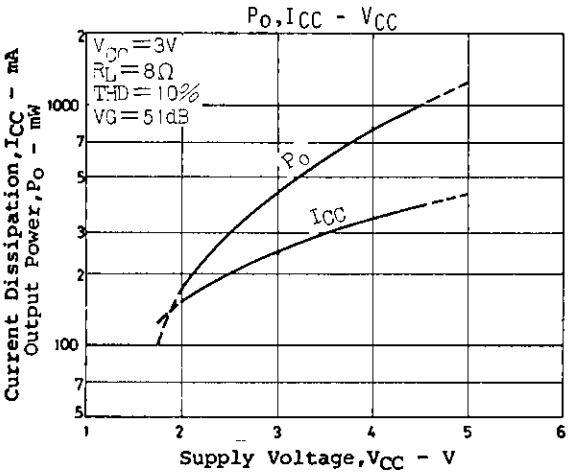


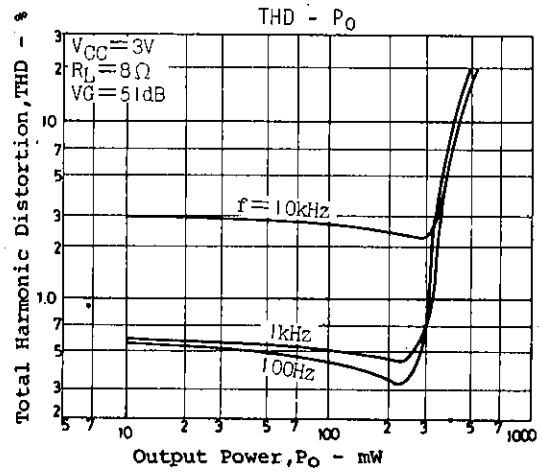
Sample Application Circuit 3 : Bridge



*Note) . For C10,C11, use tantalum or alsicon electrolytic capacitor.
. If oscillation occurs, add C14 (0.1 to 0.2u ceramic capacitor).

Unit (resistance: Ω, capacitance: F)





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.

. 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.

. Printed circuit pattern

When designing the printed circuit pattern, make the power supply, output, and ground lines thick and short and arrange the pattern and parts so that no feedback loop is formed between input and output. Place power capacitor C8, oscillation blocking capacitors C4, C5 as close to IC pins as possible to prevent oscillation from occurring. Refer to the sample printed circuit pattern.