Ordering number:ENN556F

Monolithic Linear IC

LA4422

5.8W typ AF Power Amplifier for Car Stereos, Car Radios

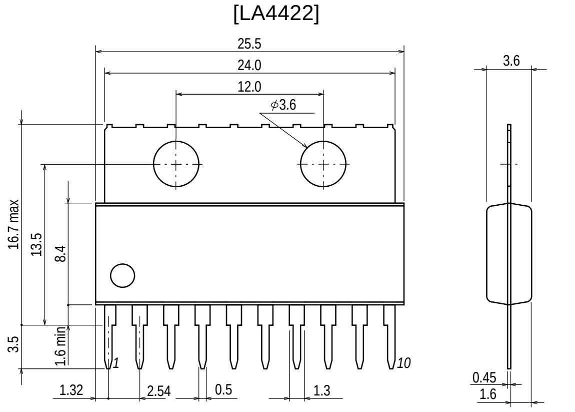
Features

- High gain (53dB typ.) and high output (5.8W typ).
- Soft clip.
- Small number of external parts (4 pcs).
- Bridge construction usable (P_O=18W/R_L=4Ω).
- Built-in thermal shutdown circuit against load short, overload.
- Built-in circuit to prevent pop noise at the time of power supply ON.
- SIP package (single ended pins) facilitating easy mounting.

Package Dimensions

unit:mm

3018A-SIP10FD



SANYO : SIP10FD

Specifications

Absolute Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		18	V
Maximum output current	I_O	Pin 1 flow-in, pin 8 flow-out, Pin 10 flow-out *	4.5	A
Surge supply voltage	Vsurge	t≤0.2s	40	V
Allowable power dissipation	Pd max		7	W
Operating temperature	Topr		–20 to +75	˚C
Storage temperature	Tstg		–40 to +150	˚C

* : 100×100×1.5mm³ Al heat sink used.

Operating Conditions at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		13.2	V
Recommended load resistance	R_L		4	Ω

Operating Characteristics at Ta = 25˚C, V_{CC}=13.2V, R_L=4Ω, f=1kHz, 100×100×1.5mm³ Al heat sink.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent current	I_{CCO}			35	80	mA
Voltage gain	VG	Closed loop	51	53	55	dB
		Open loop based on specified circuit		70		dB
Output power	P_O1	THD=10%, R_L=4Ω	5.0	5.8		W
	P_O2	THD=10%, R_L=2Ω		9.0		W

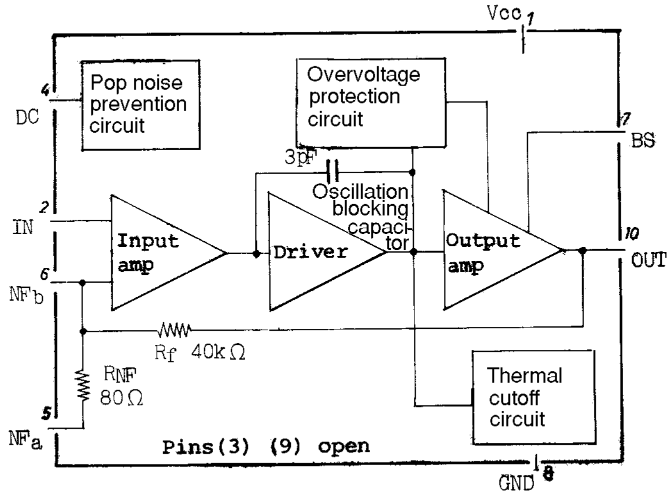
Continued on next page

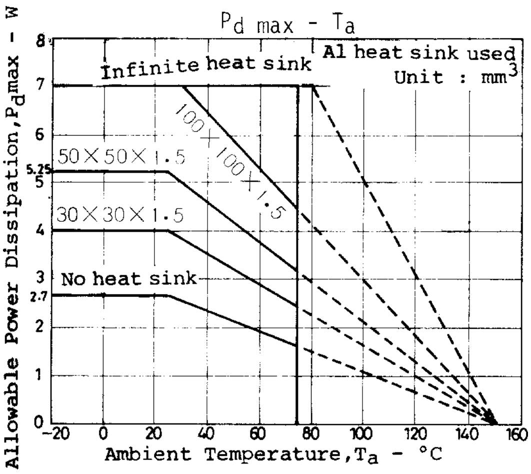
SANYO Electric Co.,Ltd. Semiconductor Company
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

Continued from preceding page.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Total harmonic distortion	THD	P_O=1W		0.7	2.0	%
Input resistance	ri			30		kΩ
Output noise voltage	V_{NO}	Rg=10kΩ, no filter		1.2	2.5	mV

Equivalent Circuit Block Diagram





Proper Cares in Using IC

1. Maximum ratings
   Extreme caution should be excrcised when using the IC in the vicinity of the maximum ratings as a slight factor may cause the maximum ratings to be exceeded, thereby leading to a breakdown accident.
2. Pin-to-pin short
   If the power supply is truned ON with pin-to-pin short, a breakdown or de-gradation may occur. When installing the IC on the board, be sure to check that pin-to-pin area is not shorted with solder, etc. and turn ON the power supply.
3. Printed Circuit Board
   When designing the printed circuit board, make the power supply and ground lines thicker and shorter so that no feedback loop of input/output is formed. When using under the condition where the signal source impedance (Rg) is large, a stable operation against distortion is obtained by separating the input /output ground line at the root of GND pin [pin (8)]. The heat sink fin must be reliably connected to the external line of the same potential as pin (8) (GND).

Functions of External Parts

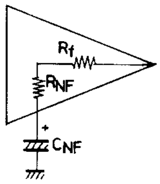
The recommended number of external parts of the LA4422 is 4 pcs. as follows.

- · Feedback capacitor from pin (5) C_{NF}.
- · Pin (7) to (10) bootstrap capacitor C_{BS}.
- · Output capacitor from pin (10) C_{OUT}.
- · High frequency parasitic oscillation compensating capacitor C_X.

The fixed values of these parts are C_{NF}=100µF, C_{BS}=100µF, C_{OUT}=1000µF, C_X=0.15µF. We now consider what will occur when these values are changed.

(a) Feedback capacitor C_{NF}

If C_{NF} is made smaller, the combined series impedance with R_{NF} at a low frequency is increased, the amplification degree A_{vf} is decreased, and the low cutoff frequency is made higher as seen from the following equation.



$$Avf= \frac{Rf}{(R_{NF}+ \frac{1}{j\omega C_{NF}})}$$

$$VG=20\log Avf\ (dB)$$

The ripple rejection is also lowered. It is possible, however, to make the starting time earlier at the time of the power supply switch ON. If C_{NF} is made larger, these are reversed.

(b) Bootstrap capacitor C_{BS}

The low cutoff frequency may be somewhat influenced, but the drive at a low frequency is more influenced. If C_{BS} is made smaller, power at a low frequency may be reduced. Therefore, C_{BS} should be more than 47µF.

(c) Output capacitor C_{OUT}

The low cutoff frequency may be somewhat influenced, but the most influence is that power is reduced as the impedance at a low frequency is increased. Therefore, C_{OUT} should be determined by the power band width. 470µF min. is required.

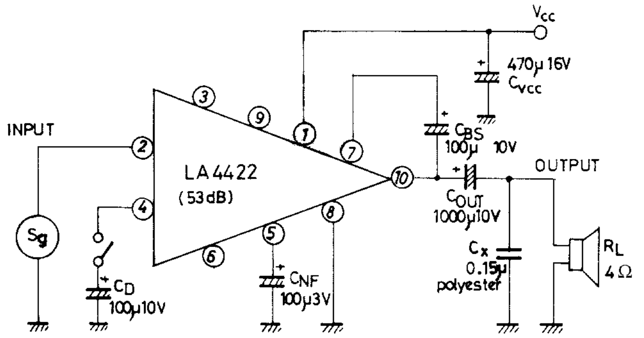
(d) High frequency parasitic oscillation compensating capacitor C_X.

C_X should be a polyester film capacitor of good frequency characteristic. If a ceramic capacitor is used, oscillation may occur.

Features of IC System and Functions of Remaining Pins

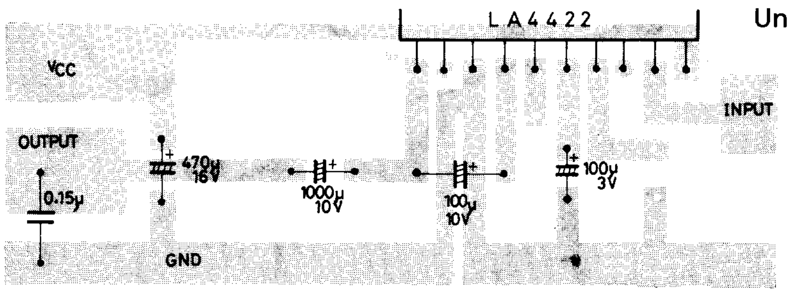
- · Since the input circuit uses pnp and the input potential is designed to be 0 bias, no input coupling capacitor is needed and the direct coupling is available.
- · The thermal shutdouwn protection circuit is built in to prevent breakdown or degradation attributable to generation of heat at the time of load short or overload.
- · The overvoltage protection circuit is built in to protect the IC from breaking down when a surge is applied to the power supply line.
- · The prevention circuit is provided to prevent pop noise which occures when the power supply is turned ON.
- · The voltage gain of open loop is lowered and the nagative feedback is made smaller to obtain a soft clip. Radiation to the high frequency circuit and stability are considered.
- · The feedback resistor R_f is set up at such a large value as 40kΩ and the cutoff frequency point f_L is considered so that the frequency characteristic is fully externded to a low frequency even if the capacity of capacitor C_{NF} is small.
- · The high frequency parasitic oscillation compensating capacitor is built in as a means to reduce the number of external parts. Therefore, the high cutoff frequency point f_H is fixed.
- · The feedback resistor R_{NF} is built in and the voltage gain is fixed to be 53dB in order to reduce the number of external parts and to minimize the variations of voltage gain.
  Pins (5) and (6) are provided to control the voltage gain externally. The voltage gain is lowered by inserting a resistor in series with pin (5). The voltage gain is increased by inserting a resistor between pin (5) and (6). If CR are connected to pin (6), the voltage gain is freely controlled through pin (6) alone.
- · Pin (4) is provided as a decoupling pin.
  Even if the power suppy is turned ON/OFF in succession, pop noise is minimized by connecting a capacitor to this pin, provided that a condition $C_D \geq C_{NF}$ is recommended. C_{NF} is related to the starting time. The ripple rejection is improved by connecting the decoupling capacitor C_D.

Sample Application Circuit 1. Power amplifier for 5.8W typ. car radio, car stereo



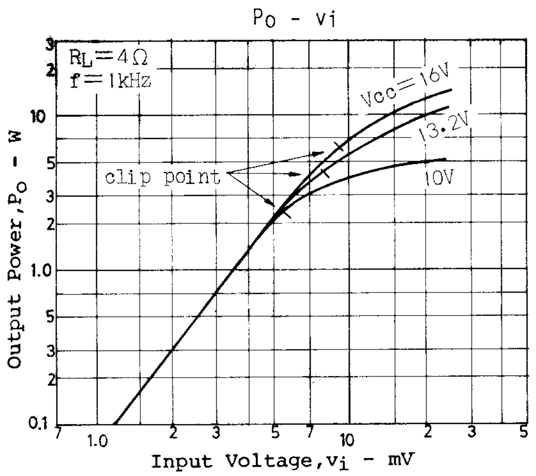
[Pin voltage]

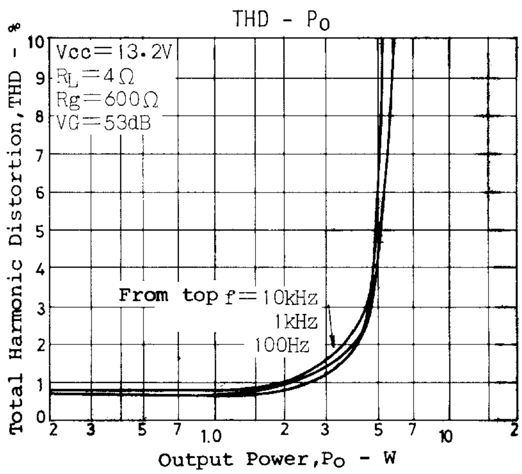
Pin	Voltage
①	13.2 V
②	10 mV
③	–
④	7.4 V
⑤	1.2 V
⑥	1.2 V
⑦	11.8 V
⑧	0 V
⑨	–
⑩	6.6 V

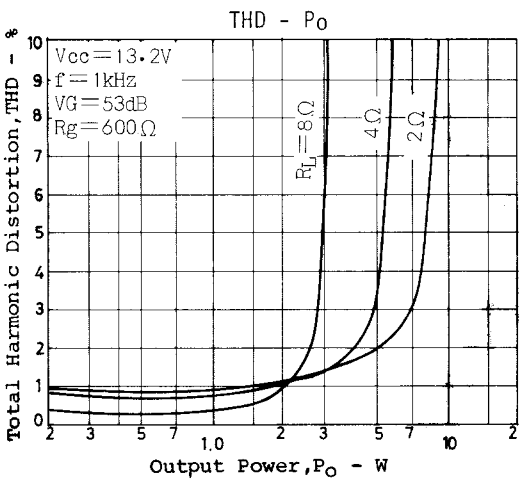


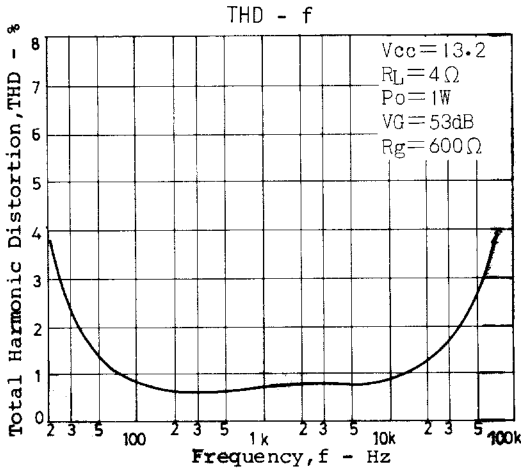
Unit (capacitance: F)

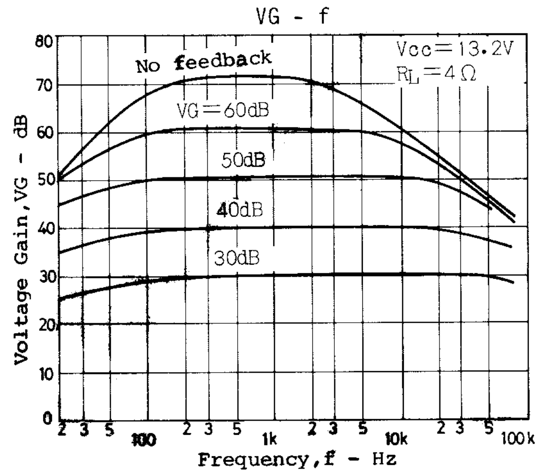
Printed Circuit Pattern (22 x 65mm², Cu-foiled side)

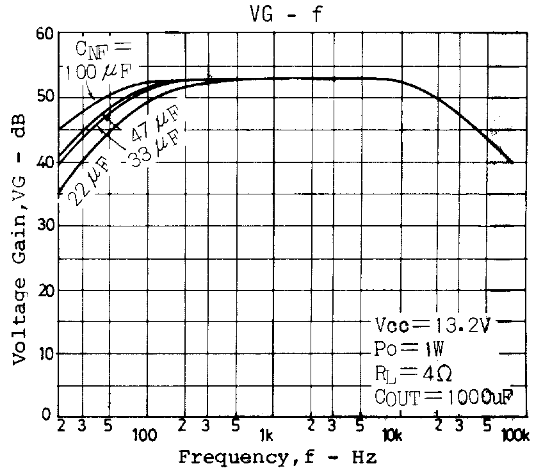


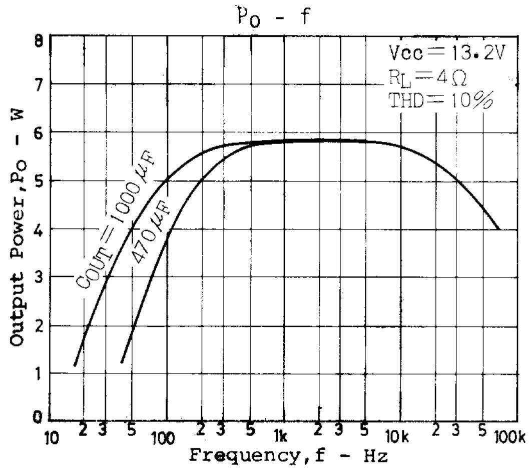


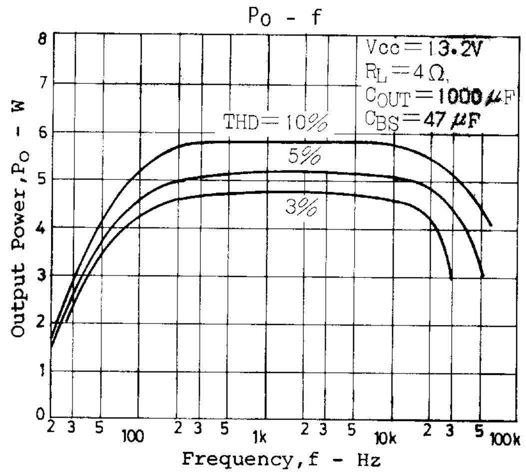


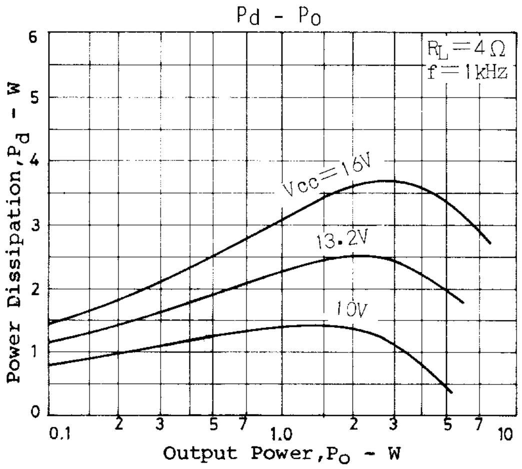


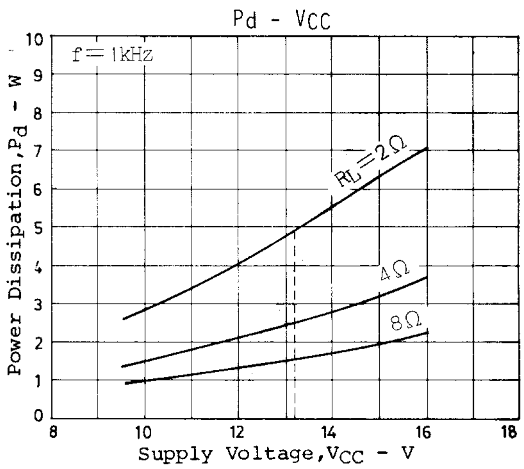

VG - f
No feedback
VG=60dB
50dB
40dB
30dB
Vcc=13.2V
RL=4Ω
Voltage Gain,VG - dB
Frequency,f - Hz

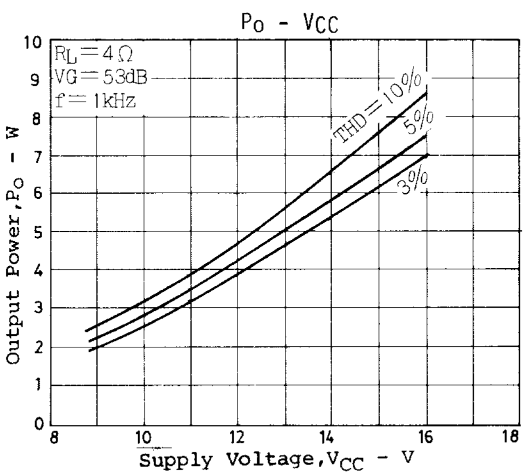

VG - f
CNF=
100μF
47μF
33μF
22μF
Vcc=13.2V
Po=1W
RL=4Ω
COUT=1000uF
Voltage Gain,VG - dB
Frequency,f - Hz

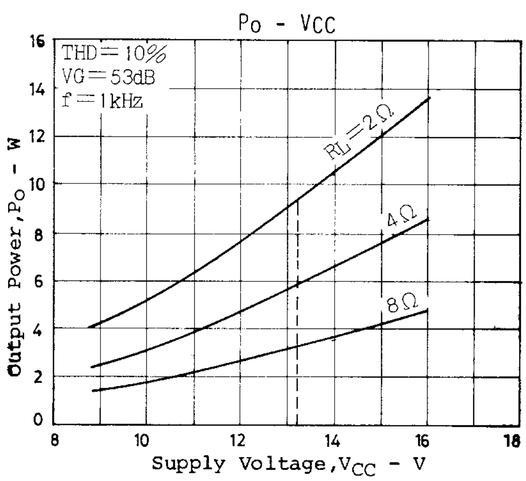

Po - f
Vcc=13.2V
RL=4Ω
THD=10%
COUT=1000μF
470μF
Output Power,Po - W
Frequency,f - Hz

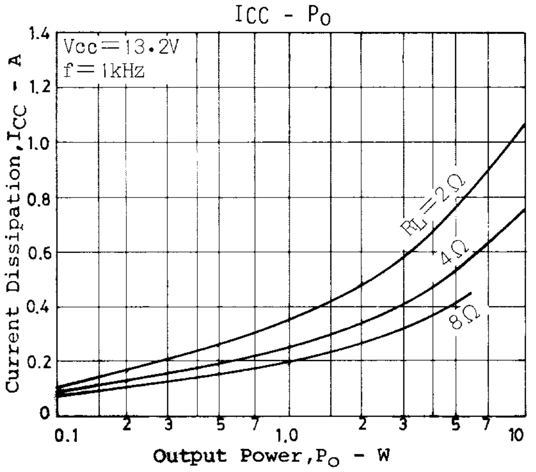

Po - f
Vcc=13.2V
RL=4Ω,
COUT=1000μF
CBS=47μF
THD=10%
5%
3%
Output Power,Po - W
Frequency,f - Hz

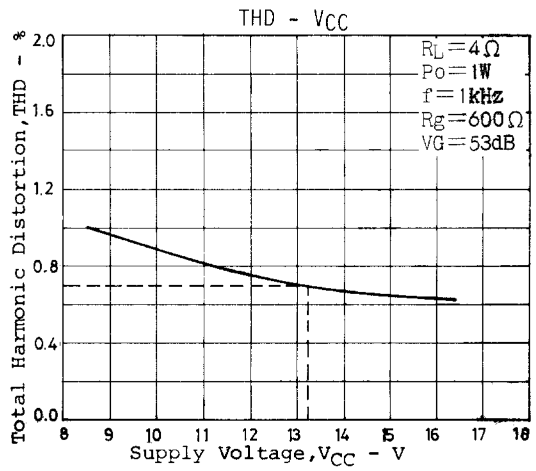

Pd - Po
RL=4Ω
f=1kHz
Vcc=16V
13.2V
10V
Power Dissipation,Pd - W
Output Power,Po - W

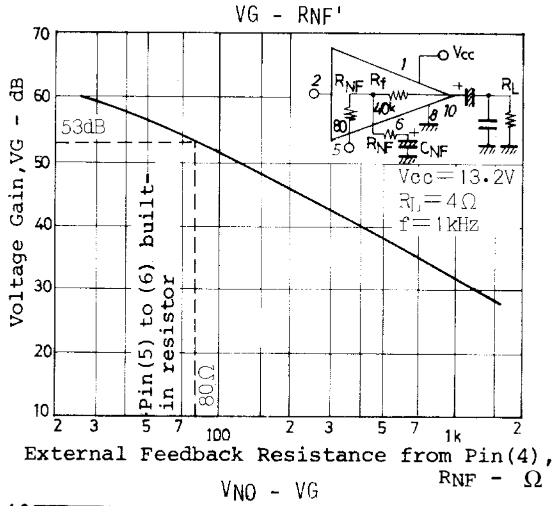

Pd - VCC
f=1kHz
RL=2Ω
4Ω
8Ω
Power Dissipation,Pd - W
Supply Voltage,VCC - V

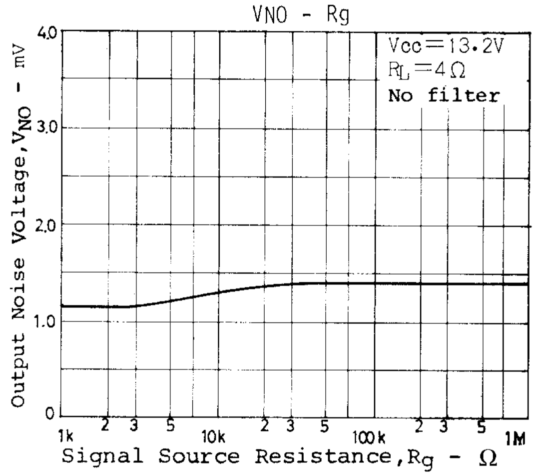

Po - VCC
RL=4Ω
VG=53dB
f=1kHz
THD=10%
5%
3%
Output Power,Po - W
Supply Voltage,VCC - V

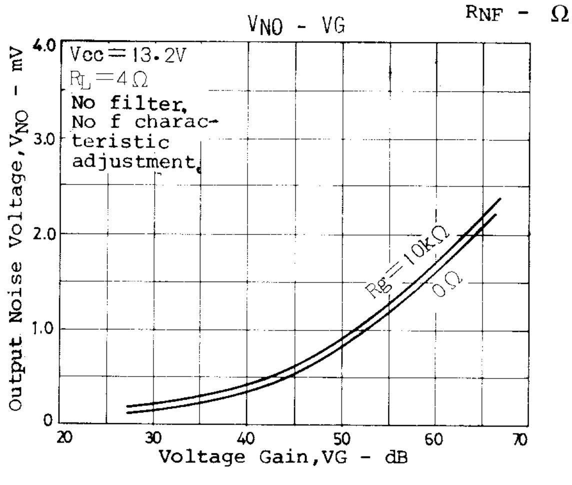

Po - VCC
THD=10%
VG=53dB
f=1kHz
RL=2Ω
4Ω
8Ω
Output Power,Po - W
Supply Voltage,VCC - V

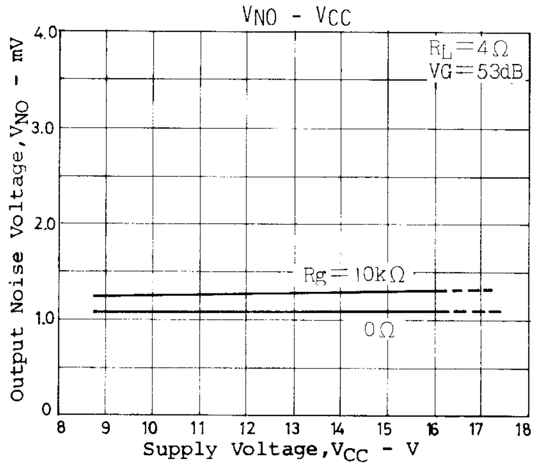

ICC - PO
Vcc=13.2V
f=1kHz
RL=2Ω
4Ω
8Ω
Current Dissipation,ICC - A
Output Power,PO - W

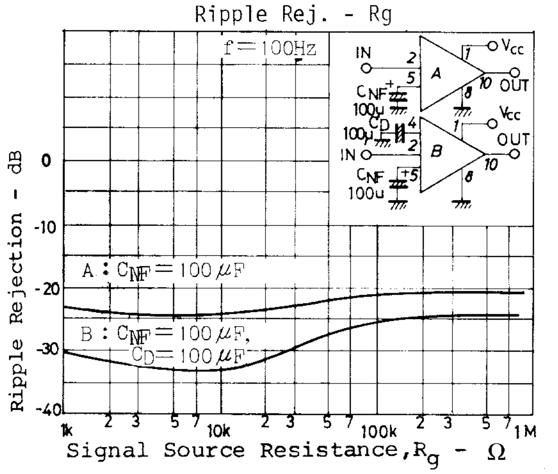

THD - VCC
RL=4Ω
Po=1W
f=1kHz
Rg=600Ω
VG=53dB
Total Harmonic Distortion,THD - %
Supply Voltage,VCC - V

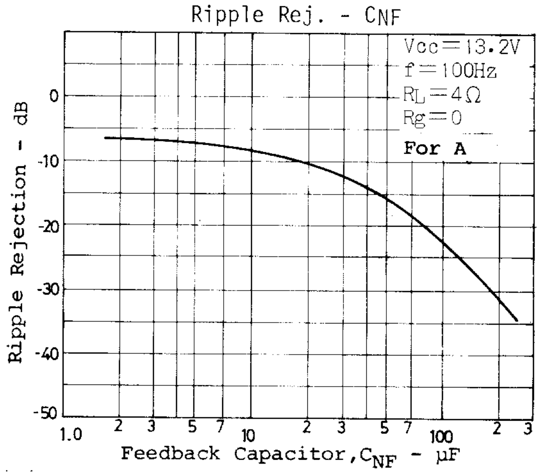

VG - RNF'
Vcc
RNF
Rf
40k
80
CNF
RL
Vcc=13.2V
RL=4Ω
f=1kHz
53dB
Pin(5) to (6) built-in resistor
80Ω
Voltage Gain,VG - dB
External Feedback Resistance from Pin(4), RNF - Ω

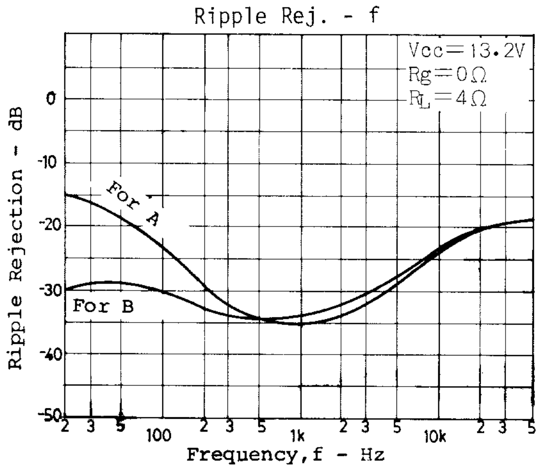

VNO - Rg
Vcc=13.2V
RL=4Ω
No filter
Output Noise Voltage,VNO - mV
Signal Source Resistance,Rg - Ω

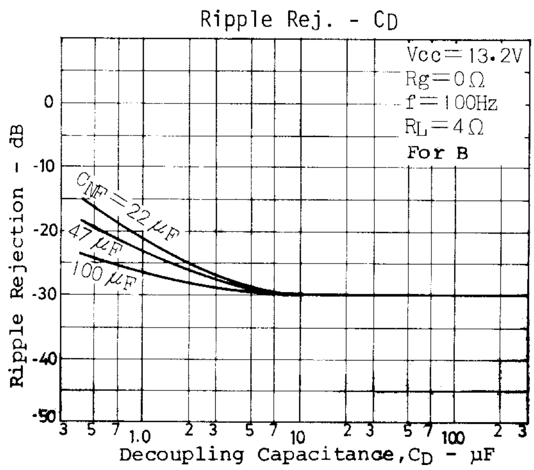

VNO - VG
Vcc=13.2V
RL=4Ω
No filter,
No f characteristic adjustment.
Rg=10kΩ
0Ω
Output Noise Voltage,VNO - mV
Voltage Gain,VG - dB

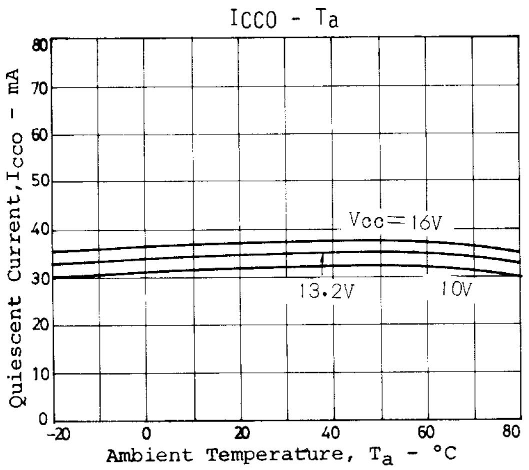

VNO - VCC
RL=4Ω
VG=53dB
Rg=10kΩ
0Ω
Output Noise Voltage,VNO - mV
Supply Voltage,VCC - V

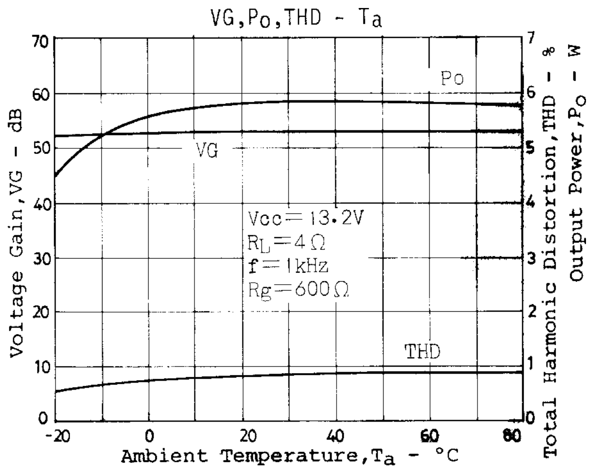

Ripple Rej. - Rg
f=100Hz
IN
CNF
100μ
CD
OUT
Vcc
A
B
A : CNF=100μF
B : CNF=100μF,
CD=100μF
Ripple Rejection - dB
Signal Source Resistance,Rg - Ω

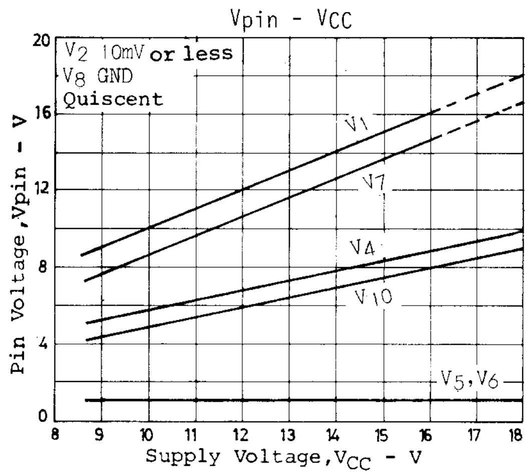

Ripple Rej. - CNF
Vcc=13.2V
f=100Hz
RL=4Ω
Rg=0
For A
Ripple Rejection - dB
Feedback Capacitor,CNF - μF

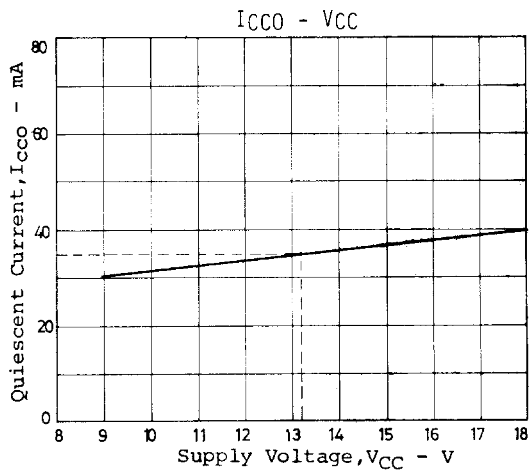




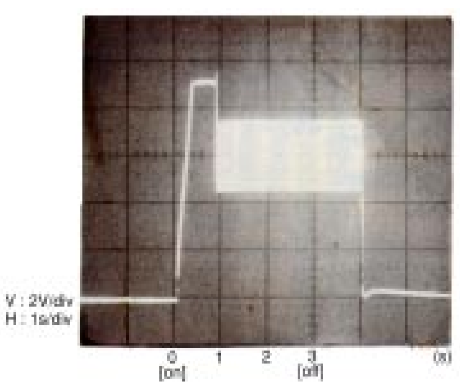




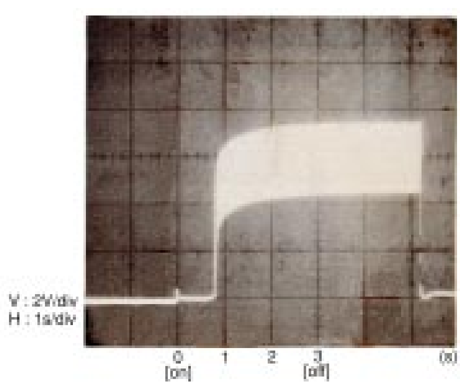




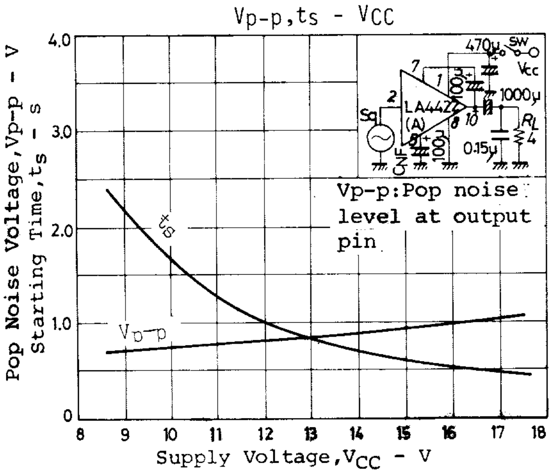
Output wave form (pop noise) influenced by C_D/V_{CC}=13.2V, R_L=4Ω, f=1kHz, V_O=1V

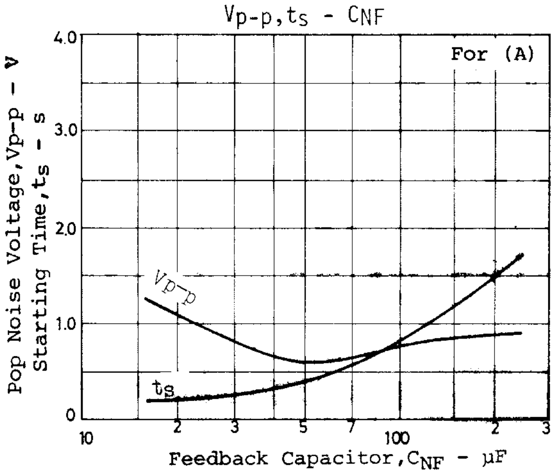


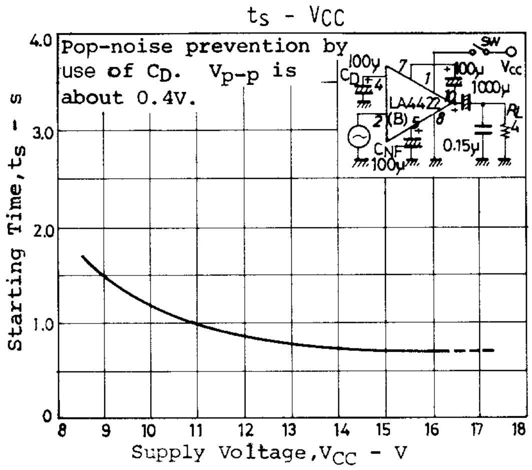
(1) C_{NF}==100μF, perfect discharge

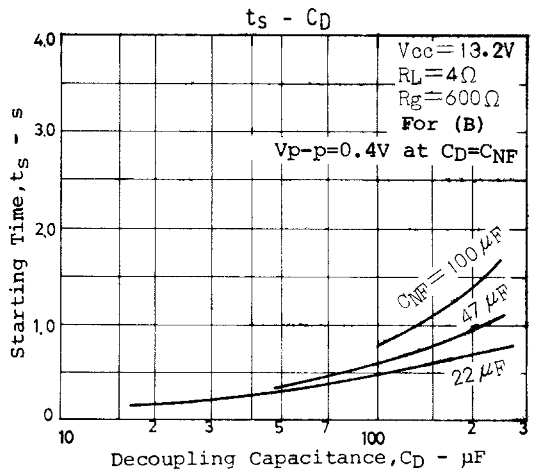


(2) C_{NF}=100μF, C_D=100μF

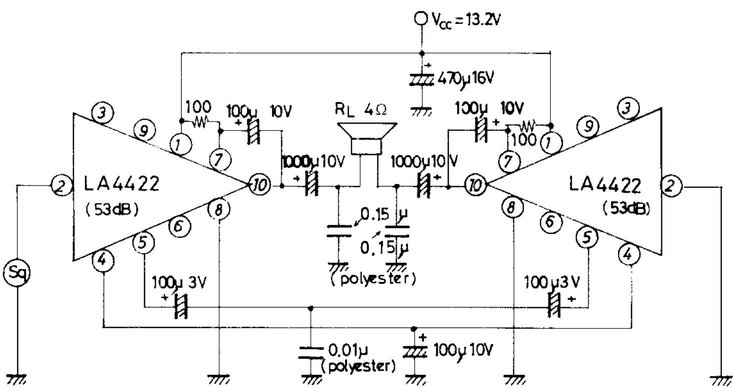








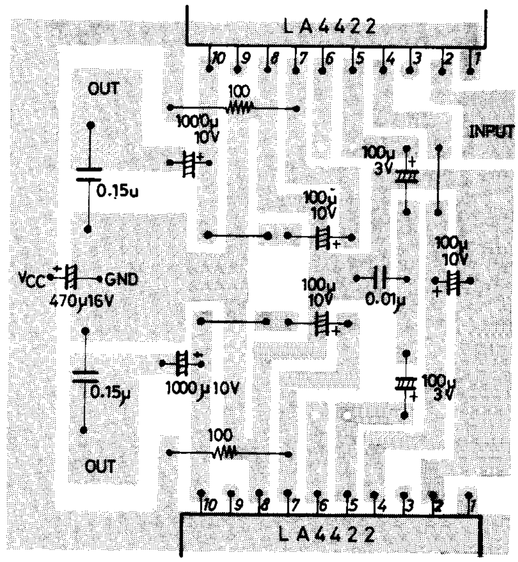
Sample Application Circuit 2. 18W typ. (V_{CC}=13.2V, R_L=4Ω) BTL amplifier



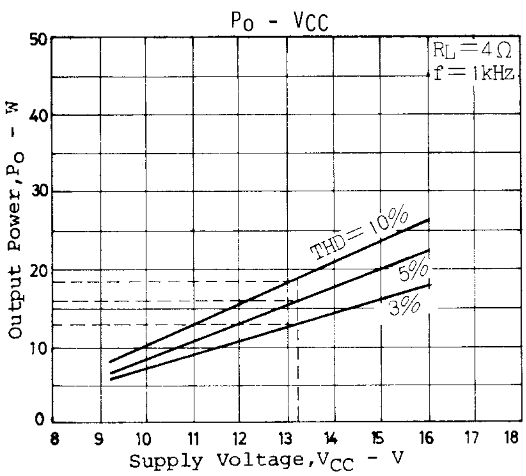
Unit (resistance: Ω, capacitance: F)

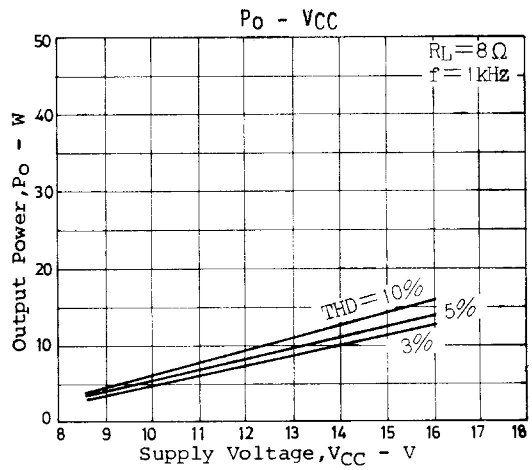
The heat sink design of this circuit is so important that it is requested that you should consult us beforehand.

Unit (resistance: Ω, capacitance: F)

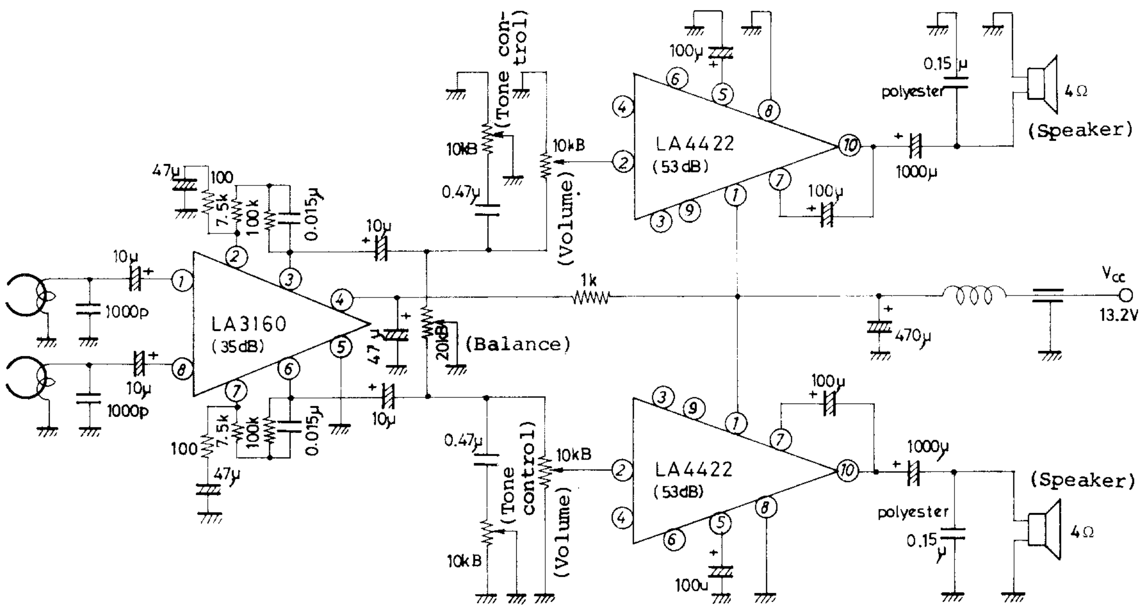


Sample Printed Circuit Pattern ($45 \times 43mm^3$, Cu-foiled side)





Sample Application Circuit 3. Pre-power amplifier for car stereo (4.75cm/s. cassette).



Unit (resistance: Ω, capacitance: F)

Proper Cares in Bridge Amplifier Application

For bridge amplifier design, take the following into consideration and consult our sales department.

· The LA4422 contains the thermal shutdown circuit which senses generation of abnormal heat attributable to load short, etc. and stops the internal circuit operation. Thus, breakdown attributable to generatin of abnormal heat is prevented.

· This function operates normally for single IC operation, but the following extraordinary phenomena appear for bridge operation.

a) Generation of heat of non-inverting, inverting amplifier ICs at the time of output non-clip depends on the radiation condition of each IC.

b) Generation of heat at the time of output clip is always larger for inverting amplifier IC, which cannot be compensated even if there is slight difference of radiation condition between two ICs. This is because the output of non-inverter amplifier IC is clipped and enters completely into the saturation region and Pd (power dissipation) is reduced, while the output clip of inverting amplifier IC is a mere amplification of output (clip waveform) of non-inverter amplifier and does not enter into the saturation region and Pd (power dissipation) is held somewhere at the max. level.

c) For this reason, the inverting amplifier IC always generates more heat at the time of output clip. If the radiation condition is not designed correctly, the thermal shutdouwn circuit of inverting amplifier starts operating earlier.

d) For single IC operation, as above-mentioned, when the thermal shutdown circuit operates, not only the output signal but also Pd (power dissipation) is reduced so as to minimize generation of heat.
For bridge operation also, if the thermal shutdown circuit of non-inverting amplifier IC operates earlier than the inverting amplifier IC, generation of heat is minimized similarly to the single IC operation. This is because reduction of output of input side amplifier (inverting IC) causes reduction of the total output. (It is almost impossible to realize this state with the normal radiation design.) To the contrary, if the thermal shutdown circuit of inverting amplifier IC operates earlier, the output of this inverting amplifier IC is reduced, but Pd (power dissipation) is not reduced due to the drive from the output pin because of bridge connection and operation outside the ASO (area of safety operation) may occur.

e) Therefore, if the thermal shutdown circuit operates (inverting side) at the time of bridge operation, the above phenomena occur, and if the applied voltage is high, breakdown of the IC beyond the ASO (area of safety operation) may result.

f) As seen from the above, it is one of the most important factors in the bridge operation circuit design that the radiation design should be made to prevent the thermal circuit from operating.

This catalog provides information as of February, 2000. Specifications and information herein are subject to change without notice.