LA4440

6W 2-Channel, Bridge 19W typ Power Amplifier

General Description

The LA4440 is a monolithic integrated class AB car radio amplifier. Built-in 2 channels (dual) enabling use in stereo and bridge amplifier applications.

Dual : 6W×2 (typ.), Bridge : 19W (typ.).

The LA4440 is available in HSIP14 package.

HSIP14

Features

- Minimum number of external parts required
- Good ripple rejection : 46dB (typ.)
- Good channel separation
- Small residual noise (Rg=0).
- Small pop noise at the time of power supply ON/OFF and good starting balance
- Low distortion over a wide range from low frequencies to high frequencies
- Easy to design radiator fin
- Built-in audio muting function
- Built-in protectors
  a. Thermal protector
  b. Overvoltage, surge voltage protector
  c. Pin-to-pin short protector

Package Information

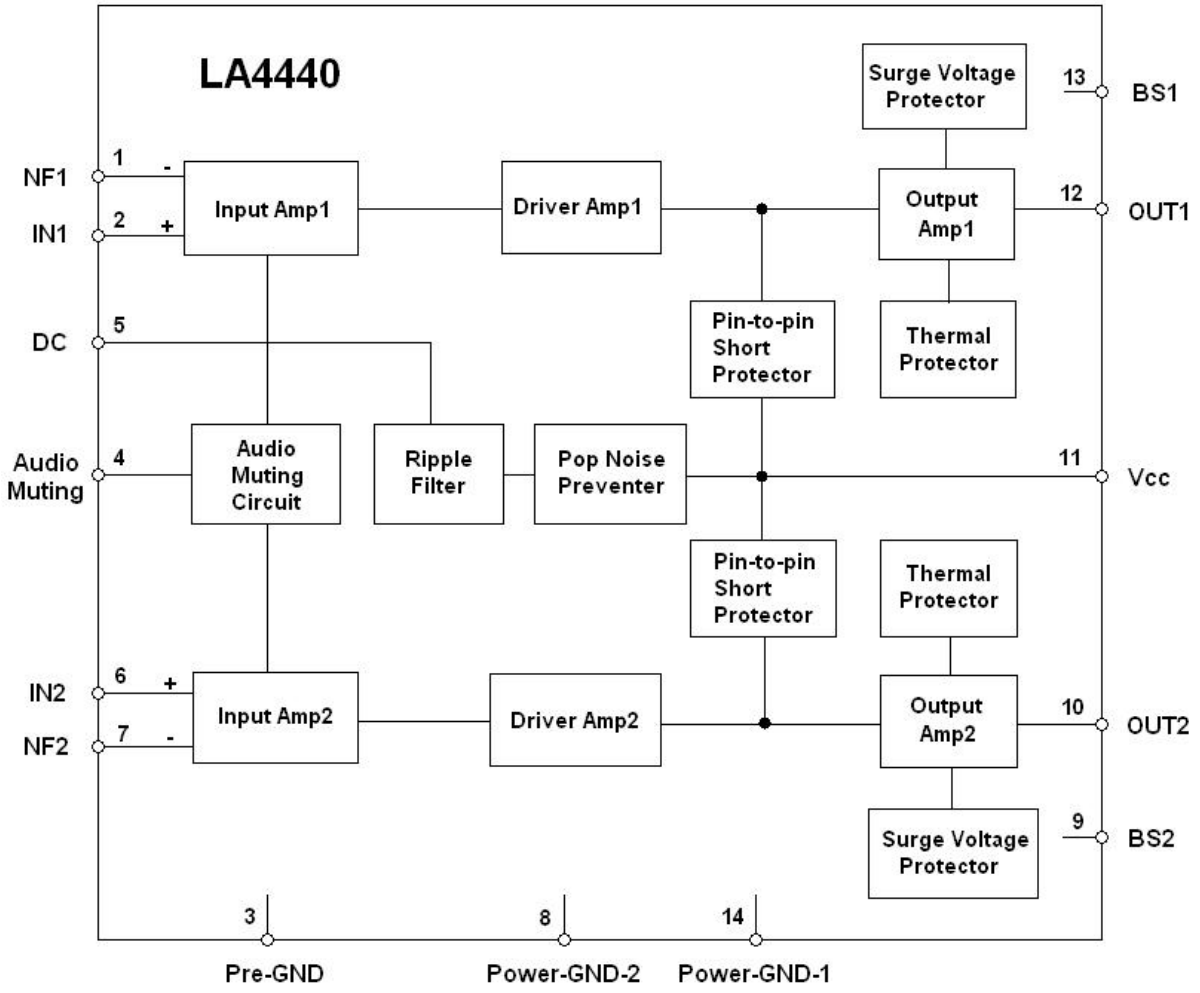
Part NO.	Order NO	Package Description	Package Marking	Package Option
LA4440	LA4440	HSIP14	LA4440 SXXXX	10or15/Tube

CHMC:Trademark LA4440:Part NO. SXXXX:Lot NO.

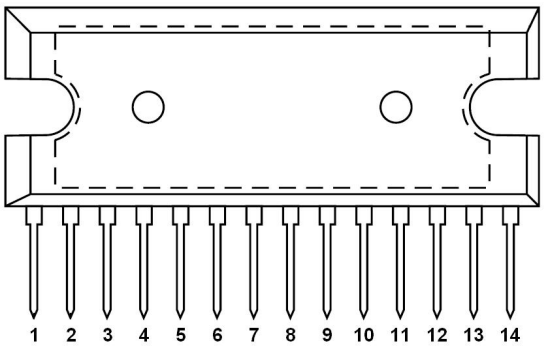
Applications

- Car Radio Amplifier

Functional Block Diagram



Pin Configuration



LA4440(HSIP14)

Pin Description

Pin Number	Pin Name	Function Description
1	NF1	Channel 1 Feedback
2	IN1	Channel 1 Input
3	Pre GND	Pre-amp Ground
4	Audio Muting	AC Audio Muting
5	DC	Ripple Filter
6	IN2	Channel 2 Input
7	NF2	Channel 2 Feedback
8	Power GND (Ch2)	Channel 2 Power GND
9	BS2	Channel 2 Bootstrap
10	OUT2	Channel 2 Output
11	Vcc	Supply Voltage
12	OUT1	Channel 1 Output
13	BS1	Channel 1 Bootstrap
14	Power GND (Ch1)	Channel 1 Power GND

Absolute Maximum Ratings

Parameter Name	Symbol	Conditions	Value	Unit
Maximum Supply Voltage	Vcc-max1	Quiescent(t=30s)	25	V
	Vcc-max2	Operating	18	V
Surge Supply Voltage	Vcc-surge	T≤0.2s	50	V
Allowable Power Dissipation	Pd-max	Tc=75℃ (Ta Characteristic)	15	W
Operating Temperature	T_{OPR}		-20 to +75	℃
Storage Temperature Range	T_{STG}		-40 to +150	℃
Thermal Resistance(JC)	θ_{JC}	Junction-to-case	3	℃/W

Recommended Operating Conditions

Parameter Name	Symbol	Conditions	Value	Unit
Supply Voltage	Vcc		13.2	V
Load Resistance	R_L	Stereo	2 to 8	Ω
		Bridge	4 to 8	Ω

Electrical Characteristics

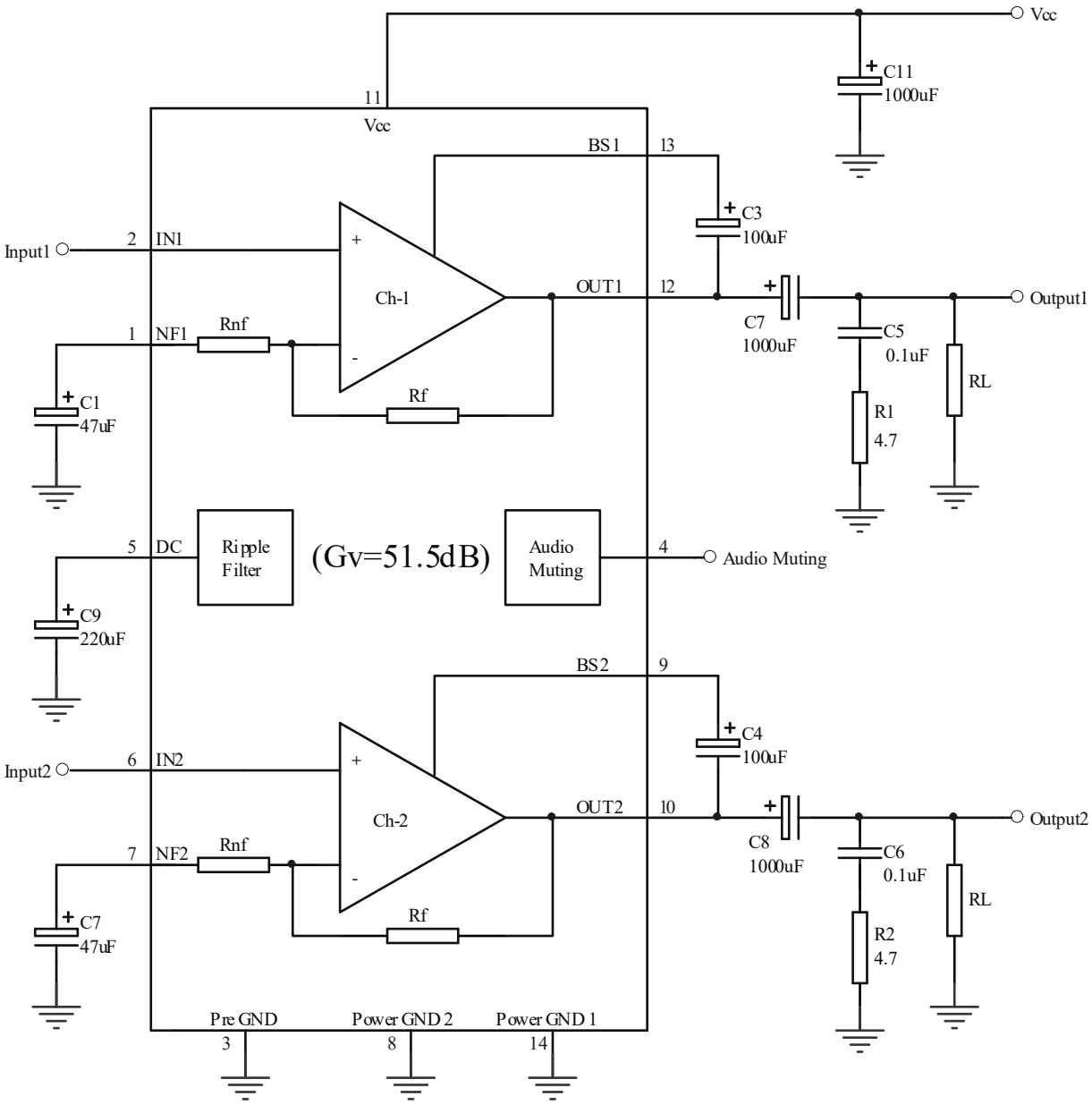
All measurements at T_J = 25°C unless otherwise noted.

Vcc=13.2V，R_L=4Ω，f=1kHz，Rg=600Ω，with 100×100×1.5mm^3 Al fin.

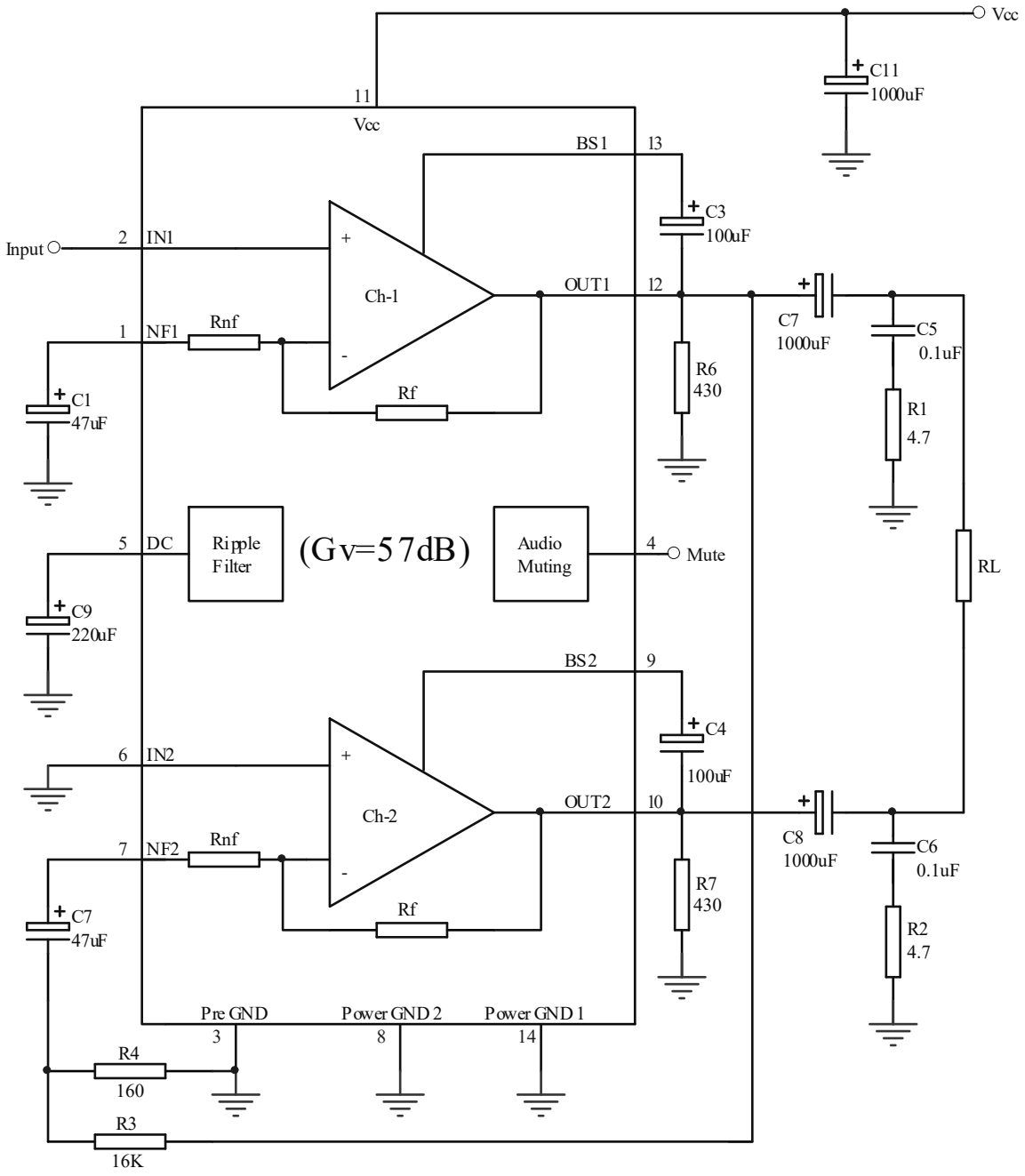
Parameter Name	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Quiescent Current	Icco			100	200	mA
Voltage Gain	Gv		49.5	51.5	53.5	dB
Output Power	Po	THD=10%, Stereo	5.0	6.0		W
		THD=10%, Bridge		19.0		W
Total Harmonic Distortion	THD	Po=1W		0.1	1.0	%
Input Resistance	Ri			30		kΩ
Output Noise Voltage	V_{NO}	Rg=0		0.6	1.0	mV
		Rg=10kΩ		1.0	2.0	mV
Ripple Rejection Ratio	Rr	V_R=200mV,f_R=100Hz,Rg=0		46		dB
Channel Separation	CS	V0=0dBm, Rg=10kΩ	45	55		dB
Muting Attenuation	ATT	V0=0dBm,V_M=9V		40		dB
Gain Difference Between Channels	ΔGv				2	dB

Application Circuit

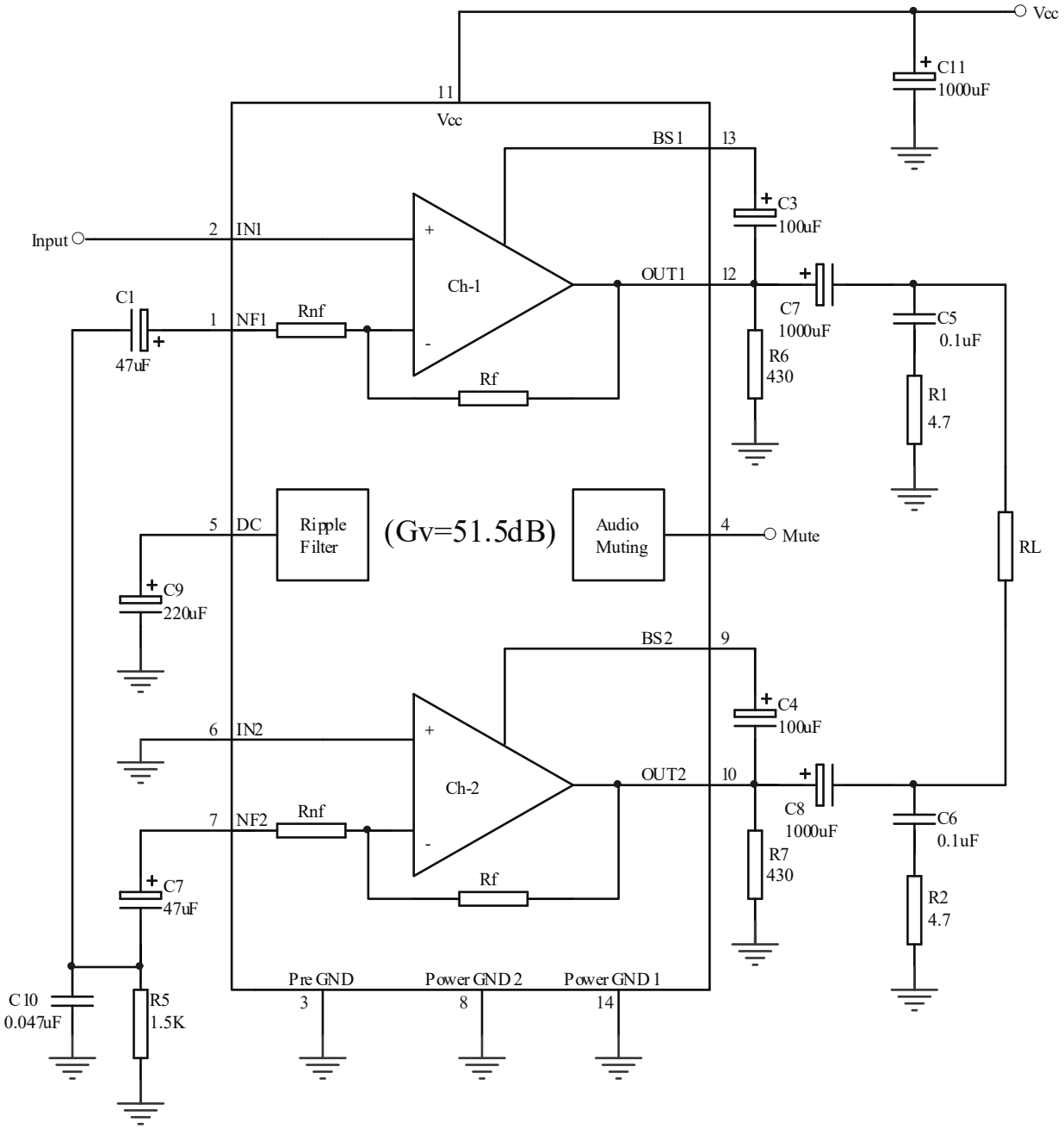
Stereo Amplifier



Bridge Amplifier 1



Bridge Amplifier 2



Application Information

Description of External Parts

C1 (C2) · Feedback capacitor : The low cutoff frequency depends on this capacitor.
If the capacitance value is increased, the starting time is delayed.

C3 (C4) · Bootstrap capacitor : If the capacitance value is decreased, the output at low frequencies goes lower.

C5 (C6) · Oscillation preventing capacitor : Polyester film capacitor, being good in temperature characteristic, frequency characteristic, is used.
The capacitance value can be reduced to 0.047μF depending on the stability of the board.

C7 (C8) · Output capacitor : The low cutoff frequency depends on this capacitor.
At the bridge amplifier mode, the output capacitor is generally connected.

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

R1 (R2) · Filter resistor for preventing oscillation.

R3 (R4) · Resistor for making input signal of inverting amplifier in Voltage Gain Adjust at Bridge Amplifier Mode (No. 1).

R5 ·Resistor for adjusting starting time in Voltage Gain Adjust at Bridge Amplifier Mode (No. 2)

C10 · Capacitor for preventing oscillation in Voltage Gain Adjust at Bridge Amplifier Mode (No. 2)

C11 · Power source capacitor.

R6 (R7) · Used at bridge amplifier mode in order to increase discharge speed and to secure transient stability.

Features of IC System and Functions of Remaining Pins

(a) Since the input circuit uses PNP transistors and the input potential is designed to be 0 bias, no input coupling capacitor is required and direct coupling is available. However, when slider contact noise caused by the variable resistor presents a problem, connect an capacitor in series with the input.

(b) The open-loop voltage gain is lowered and the negative feedback amount is reduced for stabilization. An increase in distortion resulted from the reduced negative feedback amount is avoided by use of the built-in unique distortion reduction circuit, and thus distortion is kept at 0.1% (typ.).

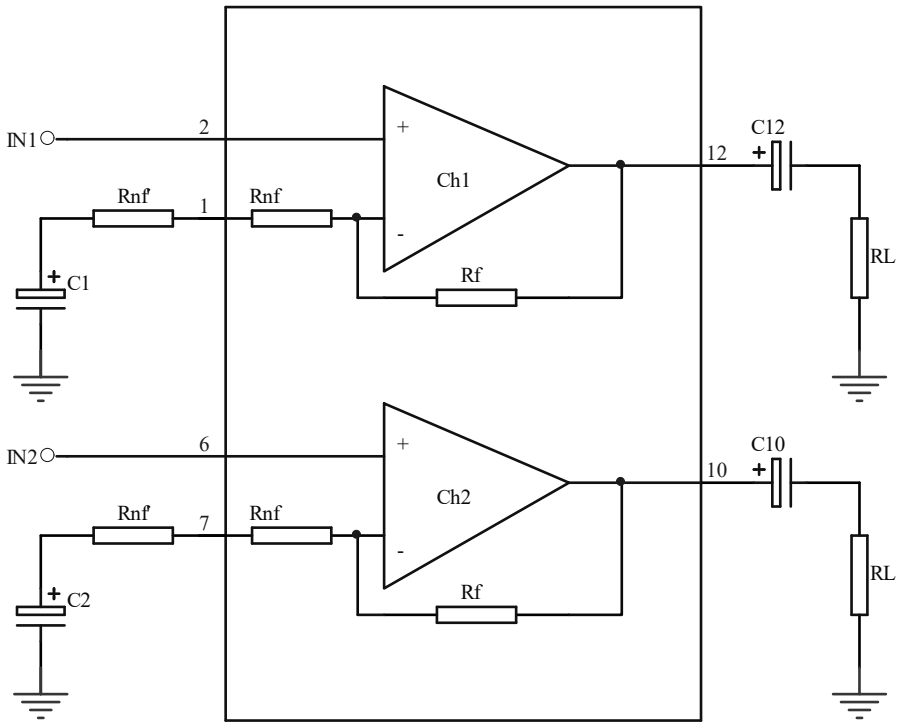
(c) A capacitor for oscillation compensation is contained as a means of reducing the number of external parts. The capacitance value is 35pF which determines high cutoff frequency f_H (–3dB point) of the amplifier ($f_H \approx 20$kHz).

(d) For preventing the IC from being damaged by a surge applied on the power line, an overvoltage protector is contained. Overvoltage setting is 25V. It is capable of withstanding up to 50V at giant pulse surge 200ms.

(e) No damage occurs even when power is applied at a state where pins 10, 11, and 12 are short-circuited with solder bridge, etc.

(f) To minimize the variations in voltage gain, feedback resistor RNF is contained and voltage gain (51.5dB) is fixed.

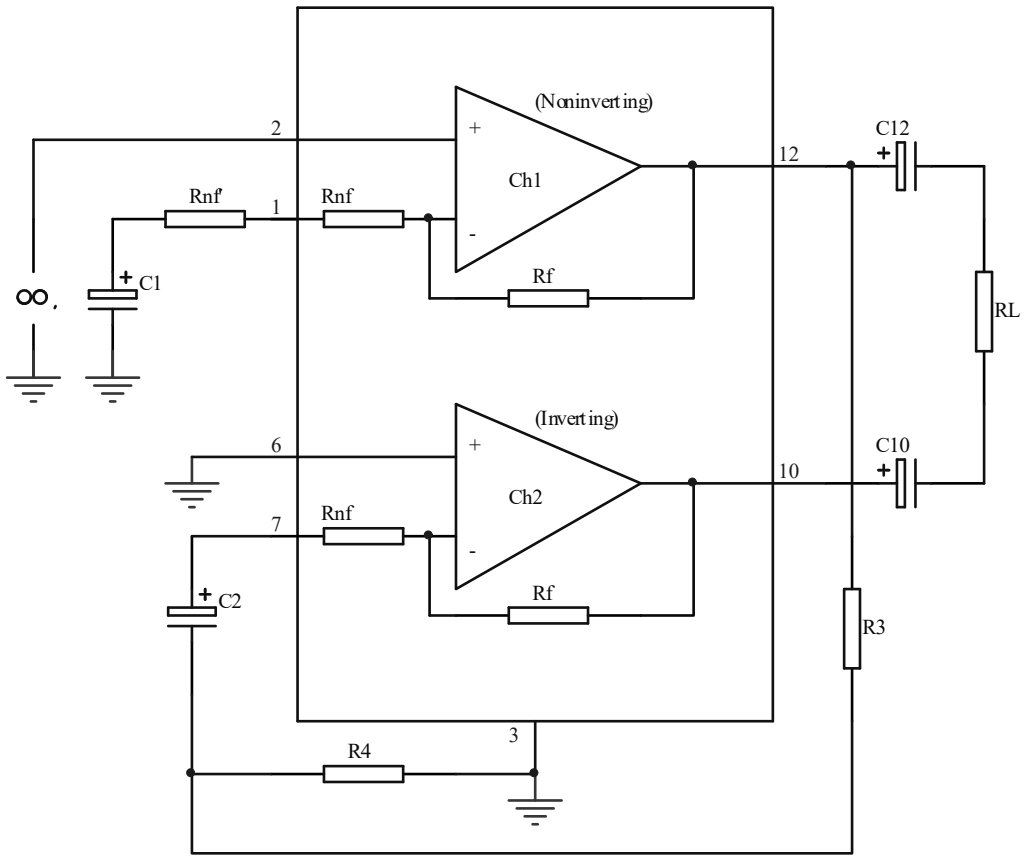
Voltage Gain Adjust at Stereo Mode



Rnf=50Ω(typ), Rf=20kΩ(typ), At Rnf'=0 (recommended Gv), $Gv = 20\log\frac{Rf}{Rnf}(dB)$.

In case of using Rnf', $Gv = 20\log\frac{Rf}{Rnf + Rnf'}(dB)$

Voltage Gain Adjust at Bridge Amplifier Mode (No. 1)



The bridge amplifier configuration is as shown No.1, in which ch1 and ch2 operate as non-inverting amplifier and inverting amplifier respectively.

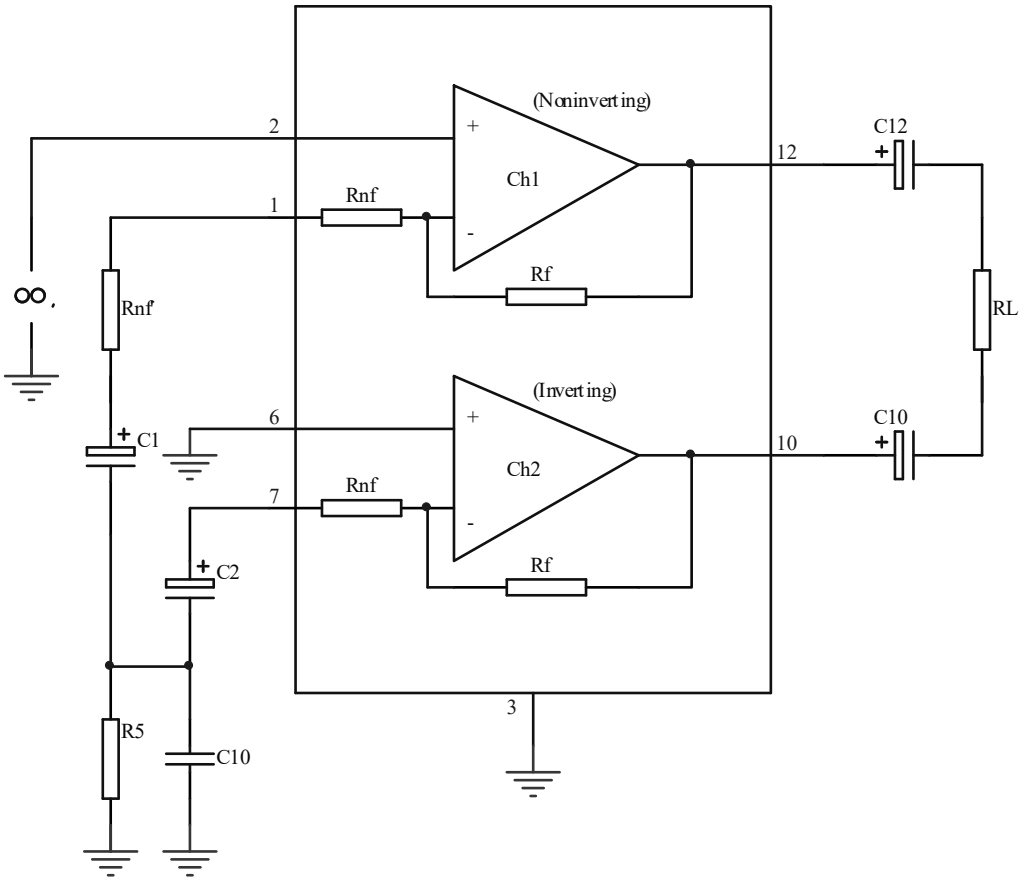
The output of the non-inverting amplifier divided by resistors R3, R4 is applied, as input, to the inverting amplifier. Since attenuation (R4/R3) of the non-inverting amplifier output and amplification factor (Rf/R4+Rnf) of the inverting amplifier are fixed to be the same, signals of the same level and 180° out of phase with each other can be obtained at output pins (12) and (10). The total voltage gain is apparently higher than that of the non-inverting amplifier by 6dB and is approximately calculated by the following formula.

$$Gv = 20\log\frac{Rf}{Rnf} + 6dB$$

In case of reducing the voltage gain, Rnf' is connected to the non-inverting amplifier side only and the following formula is used.

$$Gv = 20\log\frac{Rf}{Rnf + Rnf'} + 6dB$$

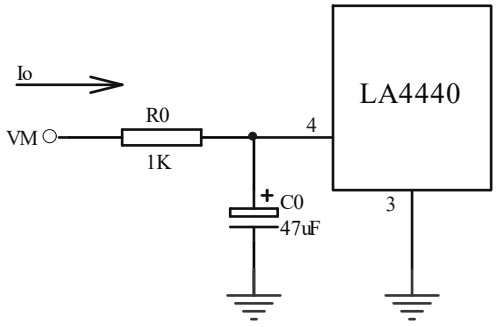
Voltage Gain Adjust at Bridge Amplifier Mode (No. 2)



$$Gv = 20\log\frac{Rf}{Rnf + \frac{Rnf'}{2}}(dB)$$, where (Rnf+Rnf')<<R5.

From this formula, it is seen that connecting Rnf' causes the voltage gain to be reduced at the modes of both stereo amplifier and bridge amplifier.

(g) In case of applying audio muting in each application circuit, the following circuit is used.

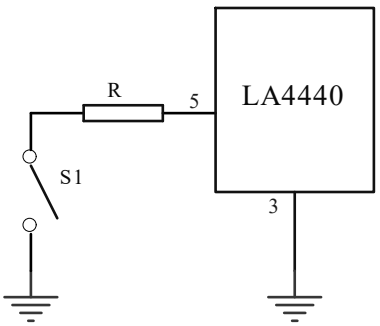


6V≤VM≤Vcc, Recommended VM=9V, ATT=40dB (Rg=600Ω).

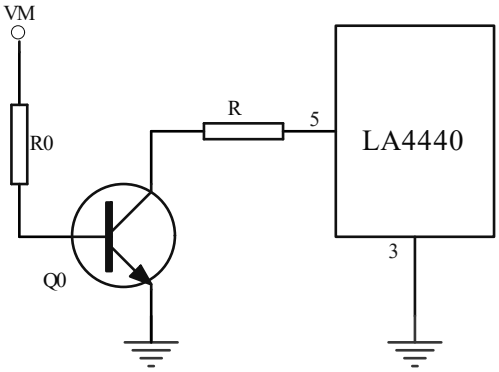
Flow-in current Io is calculated by the following formula.

$$Io = \frac{VM - Vbe}{Ro}$$

In case of increasing the muting attenuation, resistor 5.6kΩ is connected in series with the input, and then the attenuation is made to be 55dB. Be careful that connecting an input capacitor causes pop noise to be increased at the time of application of AC muting. Increased Ro, Co make it possible to reduce the noise. In case of com-completely cutting off power IC, pin (5) is grounded, and then DC control is available and the attenuation is made to be ∞.



General-purpose switch



Transistor switch

Stereo : 20Ω≤R≤100Ω

Bridge No.1: 20Ω≤R≤100Ω

Bridge No.2: 0Ω≤R≤50Ω

Pin Voltage (unit : V)

Pin No.	1	2	3	4	5	6	7
Function pin	CH1 NF	CH1 IN	Pre GND	AC Audio Muting	DC	CH2 IN	CH2 NF
Pin Voltage at quiescent mode	1.4	0.03	0	0	13.0	0.03	1.4

Pin No.	8	9	10	11	12	13	14
Function pin	CH2 Power GND	CH2 BS	CH2 OUT	Vcc	CH1 OUT	CH1 BS	CH1 Power GND
Pin Voltage at quiescent mode	0	11.9	6.8	13.2	6.8	11.9	0

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.

· Printed circuit board

When making the board, refer to the sample printed circuit pattern and be careful that no feedback loop is formed between input and output.

· Oscillation preventing capacitor

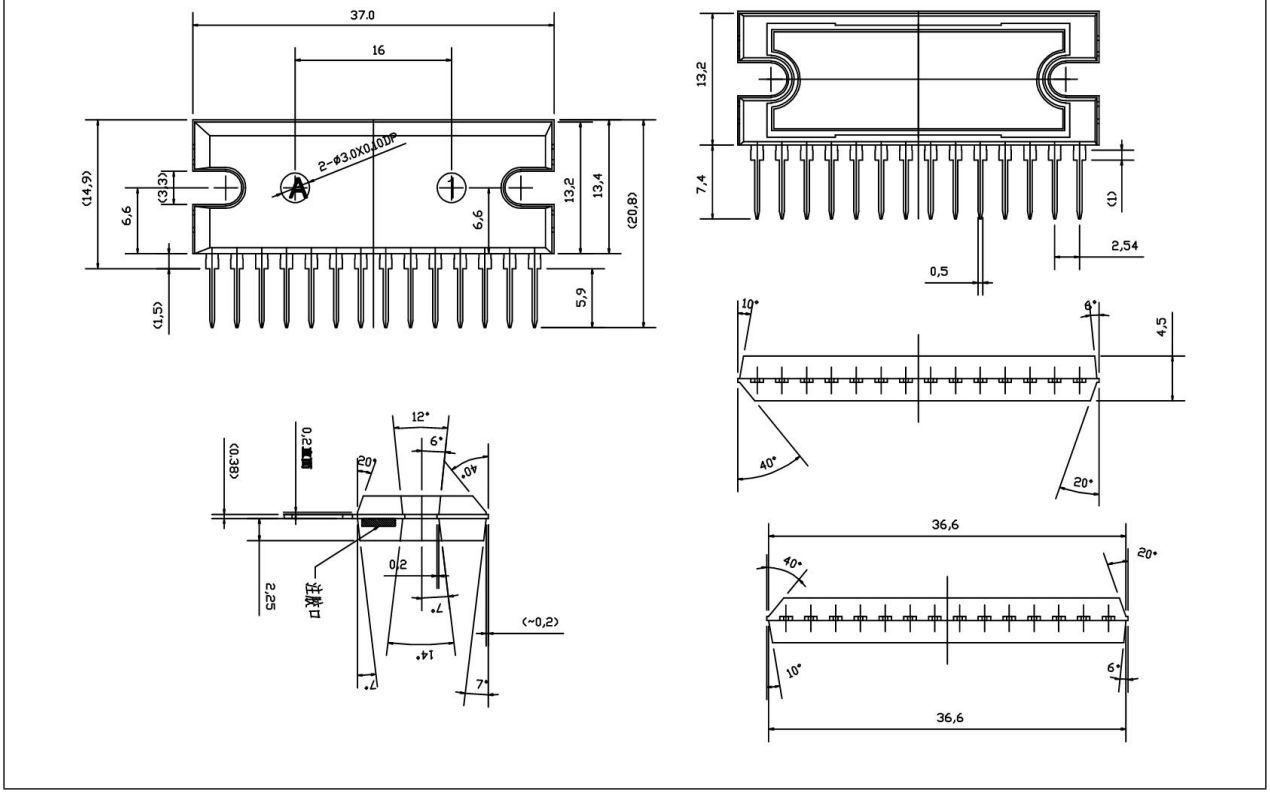
Normally, a polyester film capacitor is used for 0.1μF + 4.7Ω. The capacitance value can be reduced to 0.047μF depending on the stability of the board.

· Others

Connect the radiator fin of the package to GND.

Outline Dimensions

HSIP14 Unit: mm



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