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Monolithic Linear IC

LA4460N, 4461N

12W AF Power Amplifier for Car Radio, Car Stereo

Features

• High gain of 51dB typ. and high power output of 12W typ.

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- Possible to delete output and bootstrap capacitors, this encourages cost and space reductions due to external parts reduction.
- Reduced external components (8 pieces recommended, 6 pieces minimum).
- Almost no pop noises heard during power on or off operation.
- Soft tonal quality in saturated power output.
- Low distortion over low to high ranges of the audio frequencies.
- Low residual noises (Rg=0).
- Good operation conditions because of SIP (single ended pins) package having been employed for the LA4460N,
- All pin terminal layouts of the LA4461N are reversed for easy stereo PC board pattern arrengement.
- Two ground terminals for pre-amplifier and power amplifier are provided for easy PC board pattern arfangement and for stabilizing distortion chracteristics depending on signal source impedance.
- Voltage gain is fixed at 51dB, however, lowering the gain is possible by adding a resistor.
- IC is not damaged, if it is connected reversely.
- Audio muting functions (AC mute & DC mute) are equipped.
- Several protection circuits are installed, including : a. Thermal protection circuit.
 - b. Overvoltage & surge voltage protection circuit.
 - c. Load short-circuit current limiting protection circuit.
 - d. Output pins DC short-circuit protection circuit.
 - (grounding protection between OUT & GND, and speaker protection provided.)

Package Dimensions



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Specifications

Absolute Maximum Ratings at $Ta = 25^{\circ}C$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V _{CC} max1	Quiescent (30s)	25	V
	Parameter Symbol Conditions voltage V_{CC} max1 Quiescent (30s) V_{CC} max2 with signal instantaneous value duty≤5%, pulse width≤1ms flow-information only I_{10} peak Instantaneous value duty≤5%, pulse width≤1ms flow-information only instantaneous value duty≤5%, pulse width≤1ms age Vsurge t≤0.2s instantaneous value duty≤5%, pulse width≤1ms tissipation Pd max Tc=75°C, See Pd max – Ta graph. instantaneous value ature Topr instantaneous instantaneous	18	V	
Supply current	I ₁₀ peak	Instantaneous value duty≤5%, pulse width≤1ms flow-inc only	4.5	А
Output current	l ₇ , lg peak	Instantaneous value duty≤5%, pulse width≤1ms	4.5	A
Surge supply voltage	Vsurge	t≤0.2s	50	V
Allowable power dissipation	Pd max	Tc=75°C, See Pd max – Ta graph.	25	ŴW
Package thermal resistance	өј-с	/_ <i>\$</i> ?	3	°C/W
Operating temperature	Topr	// % <u>.</u>	-20 to +75	°C
Storage temperature	Tstg		-40.to #150	°C

Recommended Operating Conditions at $Ta = 25^{\circ}C$

Parameter	Symbol	Conditions Ratings	Unit
Recommended supply voltage	Vcc	13.2	V
Load resistance	RL	4 to 8	Ω

Operating Characteristics at Ta = 25°C, V_{CC} =13.2V, R_L =4 Ω , f=1kHz, Rg=600 Ω , with 100×100×1.5mm³

	Symbol			Ratings		
Parameter		Contaitions	min	typ	max	Unit
Quiescent current	Icco			65	120	mA
Voltage gain	VG	closed loop, at specified recommended circuit.	49	51	53	dB
Output power	PO	THD≓10%	10	12		W
Total harmonic distortion	THD	₽ _Q ≢1W		0.1	1.0	%
Input resistance	ri 🦾		21	30		kΩ
Output poiso voltago	V _{NO} 1	Rg=0, #20Hz to 20kHz, band-pass filter		0.4	1.0	mV
Output hoise voltage	V _{NO} 2	Rg≓10kΩ; I=20Hz to 20kHz, band-pass filter		0.6	2.0	mV
Output offset voltage	Voff	× *** //	-300		+300	mV
Muting attenuation (AC)	ATT A	Vo=0dBm V _M =9V		38		dB

Al heat sink, See specified Test Circuit

(Note) : For DC muting, ATT=∞











Functional Description on the External Parts

Recommended number of the external parts for the LA4460N/4461N is 8 as shown in the Sample Application Circuit 1. Namely they are :

Feedback capacitors 2 piece	$4.7\mu F/6.3V \times 2$
· Starting time adjustment resistor 1/pieae	ce $1.5k\Omega$
· Oscillation compensation capacitor /1 piece	e 0.01µF
· Oscillation compensation C R / 4 piece	es 0.033μ F×2, 4.7Ω ×2
a) Feedback capacitor CNF	-

This relates to a low range cutoff frequency fL, and fL lowers with increasing value of the 'CNF and increases with decreasing C_{NF} b) Oscillation compensation capacitor C_X

Signals are applied from the non-inverted NF terminal to the inverted NF terminal through the two CNF capacitors. It is recommended to connect the oscillation compensation capacitor $C_X=0.01\mu F$ between the floating junction of the capacitors (minus side of C_{NF}) and GND. As a rule a polyester film capacitor is recommended, but a ceramic type may be used if a PC board shows good circuit stability.

c) Starting time adjustment resistor R_X

The purpose of the R_X is to adjust the starting time ts, and a resistor of $1.5k\Omega$ is used. In this case, a rising DC locus as shown below will be obtained at the output terminals.



- Since a zero-bias design is introduced into the input circuit to keep the input potential at about zero by employing PNP in the input circuit an input coupling capacitor can be removed for direct connection. However, when noises caused by a DC current flowing to a volume control circuit or the input circuit causes problems, connect a capacitor in series with the input circuit.
- To prevent damage or deterioration of the IC due to the load short-circuited, a load short-circuit current limiting type protection circuit has been provided.
- However, when making the load short-circuit test, always mount the IC on the specified heat sink.
- A circuit which prevents pop noise caused by the power on-off operation is also provided, thereby reducing the offset voltage and protecting speaker systems against damage.

Continued from preceding page.

- Soft clipping characteristics are accomplished by lowering the open loop voltage gain and reducing the amount of feedback to reduce undesired radiation to radio frequency circuits and to increase the circuit stability. The distortion deterioration resulted from the decreased amount of feedback will be avoided by using a unique distortion reduction circuit, thus 0.1% typ. will be assured.
- · A capacitor for oscillation compensation is included inside the IC as a method of reducing external parts.
- The capacitance is 30pF and this determines the cutoff frequency f_H (-3dB point) of the high range ($f_{H\approx}$ 30kHz).
- \cdot To reduce variations of the voltage gain, a feedback resistor R_{NF} is also built-in, and the voltage gain is fixed to 51dB.



- However the voltage gain will be decreased by adding a resistor R_{NF} , where the R_{NF} ' is the resistor to be connected to the pin 4. (In the Sample Application Circuit 2, the gain adjustment will be made with the resistor connected to either pin 4 or 5.)
- Two ground pin terminals are provided, one for the preamplifier and the other for the power amplifier. Accordingly, stability of the IC is increased, especially, distortion deterioration phenomenon caused by increased signal source impedance Rg is improved and a flat response will be obtained.
- An overvoltage protector circuit is included to protect the IC from damage when a surge voltage is applied to the power line. The overvoltage is set at 25V, however, the cucuit can resist 50V for giant pulse surge of 200ms.
- For OCL connections, a DC short-circuit protection circuit is required. Therefore a grounding protection circuit which endures against the OUTPUT-GND short-circuit is provided. Since consideration is given to the offset caused by short-circuit or releasing the short-circuit both the speaker and the IC can be protected.
- · When adding an audio muting circuit in each application circuit, refer to the illustration below.



To increase muting attenuation, connect a resistor of $5.6k\Omega$ in series with the input circuit, then the attenuation will be increased to 55dB. It should be noted that adding an input capacitor will increase pop noise when the AC muting is operated. Pop noise can be reduced by increasing the value of R_1 and C_1 .



Common switch

Transistorized switch

Pin Voltage (unit : V)

LA4460N	1	2	3	4	5	6	7	8	9	10
LA4461N	10	9	8	7	6	5	4	3	2	1
Function	AC Audio Muting	INPUT	Pre GND	NON INV NF	INV OUT	DC Audio Muting	INV OUT	Power GND	NON INV OUT	Vcc
Quiescent pin voltage	0	0.06	0	2.8	2.8	5.6	6.6	0	6.6	13.2

Much data on general characteristics are given for the Sample Application 1, but these data can be also applied to the Sample Application 2 because of no characteristic changed. However, the data on "Pop noise at power turned on", "Starting time t_s" and "DC muting" are shown for only the Sample Application 1. For the same characteristics to be applied to the Sample Application 2, refer to 1-C on page 4.



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Sample Application Circuit 3 :



Coil used : Air core Inner diameter : 8ø Mumber of turns : 6 turns Wire size : UEW 1.5 Winding method : solenoid (0.3µH)

4<u>0</u>

Connect each coil, L1 and L2, in series with each output terminal, where $L_1=L_2$.

0.033µ

4.7

7/7



Cy is a semiconductor ceramic capacitor (B.C.) of 0.5µF.

Note on LA4460N/4461N Usage

· Maximum ratings

When the IC is used in the vicinity of the maximum ratings, a minor change in the conditions could result in exceeding the maximum ratings, and this may lead the IC to damege. Therefore sufficient precautions should be taken in this case.

 \cdot Short-circuiting among pin terminals

Damage or deterioration could result if the power is turned on with pins short-circuited. Therefore always make sure the pins are not bridged by solder, etc. when mounting the IC on the PC board and turn the power on.

Printed circuit board

In designing a printed circuit board, refer to the foil pattern example attached. Also make sure no feedback loop exists between the input and output circuits.

· Others

The IC is an OCL type power IC in which a bridge connection is made. Care should be given to the ground connections of the test equipment so that the ground of the test equipment (VTVM, distortion analyzer, oscilloscope, etc.) connected to the output terminals are not commonly connected to those of the test equipment connected to the input terminals.

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