

AN7190NK

Dual 20W BTL Output Power IC for Car Audio

■ Overview

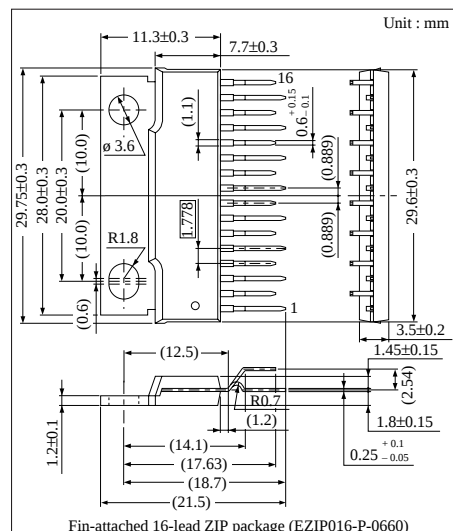
The AN7190NK is an audio power IC developed for sound output of car audio (20W × 2ch.).

It incorporates various protective circuits which protect the IC from the GND open earth breakdown, supply surge breakdown and other breakdowns, and can contribute to highly reliable design of a set. The above protection functions are most major topics for power ICs.

It incorporates the complete muting circuit without shock noise and can facilitate the design for preventing shock noise under the set transient condition together with stand-by function.

■ Features

- BTL 20W × 2ch. (4Ω), $G_V=40\text{dB}$
- Various protective circuits built-in
(Protection from atmospheric and ground faults, V_{CC} open atmospheric and ground faults, GND open ground fault, over-voltage and supply surge, and ASO and temperature protection etc.)
Supply surge breakdown withstand voltage : 100V
GND open breakdown withstand voltage : 16V
- Stand-by function (No shock noise at STB – ON/OFF) built-in
- Muting function built-in
No shock noise at MUTE– ON/OFF
Abnormal sound due to wave form variation prevented by attenuator method
Attack time, recovery time 50ms or less
- Fewer external components required
NF (Negative Feedback) and BS (Boot-strap) electrolytic capacitors not required
Muting function not required
Supply choke coil not required
- With beep sound input pin
- 2Ω load guaranteed

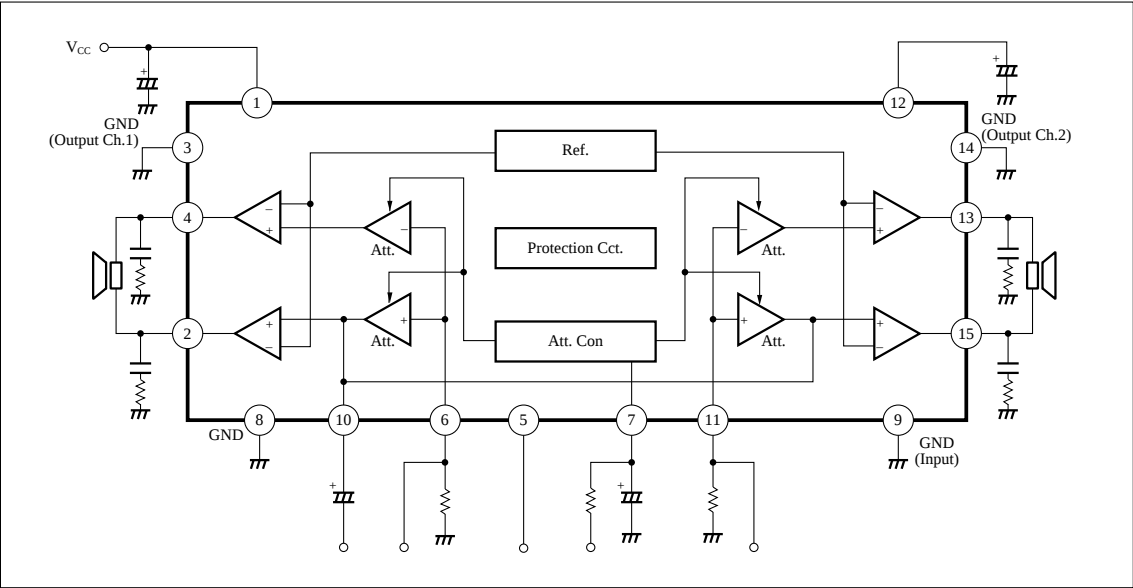


■ Pin Name

Pin No.	Pin Name	Pin No.	Pin Name
1	V_{CC}	9	GND (Input)
2	Ch.1 Output (+)	10	Beep Sound Input
3	GND (Output Ch.1)	11	Ch.2 Input
4	Ch.1 Output (–)	12	Ripple Filter
5	Stand-by	13	Ch.2 Output (–)
6	Ch.1 Input	14	GND (Output Ch.2)
7	Muting	15	Ch.2 Output (+)
8	GND (Board)	16	NC

Note) Do not apply voltage or current to NC pin from outside.

■ Block Diagram



■ Absolute Maximum Ratings (Ta= 25°C)

Parameter	Symbol	Rating	Unit
Supply Voltage ^{Note 1)}	V _{CC}	24	V
Supply Current	I _{CC}	6.0	A
Power Dissipation ^{Note 2)}	P _D	32.5	W
Peak Supply Voltage ^{Note 3)}	V _{surge}	80	V
Operating Ambient Temperature	T _{opr}	− 30 ~ + 85	°C
Storage Temperature	T _{stg}	− 55 ~ + 150	°C

Note 1) At no signals

Note 2) Ta = 85°C

Note 3) t = 0.2s

■ Recommended Operating Range (Ta = 25°C)

Parameter	Symbol	Range
Operating Supply Voltage Range	V _{CC}	8.0V ~ 18.0V

■ Precautions on use

1. Always attach an outside heat sink to use the AN7190NK. In addition, the outside heat sink must be fastened onto a chassis for use.
2. Connect the radiation fin to the GND potential.
3. Prevent atmospheric and ground faults, and load short-circuit.
4. The temperature protective circuit gets actuated when Tj= approx. 150°C, but it is automatically reset when the chip temperature drops below the above set level.
5. The overvoltage protective circuit starts the protective operation at V_{CC} = approx. 20V.
6. Take into consideration the heat radiation design particularly when V_{CC} is set high or when the load is 2Ω.
7. When the beep sound function is not used, open the beep sound input pin (Pin10) or connect it to Pin9 with 0.01μF around.

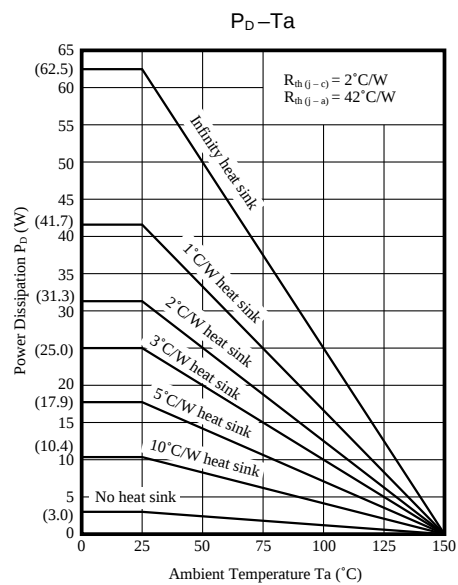
■ Electrical Characteristics (Ta = 25°C±2°C)

Parameter	Symbol	Condition	min.	typ.	max.	Unit
Quiescent Current	I _{CQ}	V _{IN} = 0mV, R _L = 4Ω	—	120	250	mA
Stand-by Current	I _{STB}	V _{IN} = 0mV, R _L = 4Ω	—	1	10	μA
Output Noise Voltage ^{Note 1)}	V _{NO}	R _g = 4.7kΩ, R _L = 4Ω	—	0.22	0.5	mVrms
Voltage Gain 1	G _{V1}	V _{IN} = 20mV, R _L = 4Ω	38	40	42	dB
Total Harmonics Distortion 1	THD1	V _{IN} = 20mV, R _L = 4Ω	—	0.07	0.4	%
Max. Output Power 1	P _{O1}	THD = 10%, R _L = 4Ω	16	18	—	W
Ripple Rejection ^{Note 1)}	RR	R _L = 4Ω, R _g = 4.7kΩ, V _r = 1Vrms, fr = 1kHz	60	72	—	dB
Channel Balance	CB	V _{IN} = 20mV, R _L = 4Ω	—	0	1	dB
Crosstalk ^{Note 1)}	CT	V _{IN} = 20mV, R _L = 4Ω, R _g = 4.7kΩ	55	65	—	dB
Output Offset Voltage	V _{off}	R _g = 4.7kΩ, R _L = 4Ω	−300	0	300	mV
Muting Effect ^{Note 1)}	MT	V _O = 1W, R _L = 4Ω	70	82	—	dB
Input Impedance	Z _i	V _{IN} = ±0.3V _{DC}	22	27	32	kΩ
Voltage Gain 2	G _{V2}	V _{IN} = 20mV, R _L = 2Ω	38	40	42	dB
Total Harmonics Distortion 2	THD2	V _{IN} = 20mV, R _L = 2Ω	—	0.1	0.5	%
Max. Output Power 2	P _{O2}	THD = 10%, R _L = 2Ω	16	24	—	W

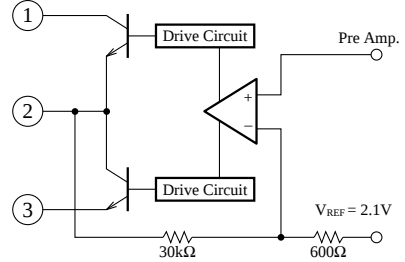
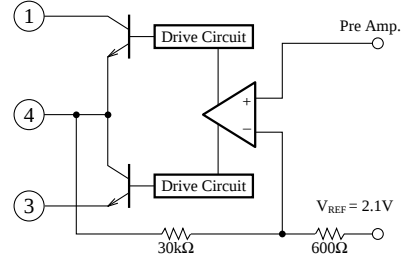
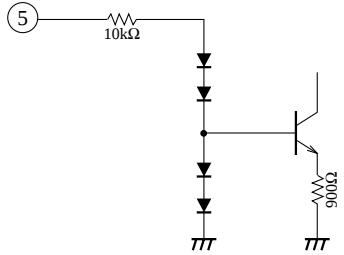
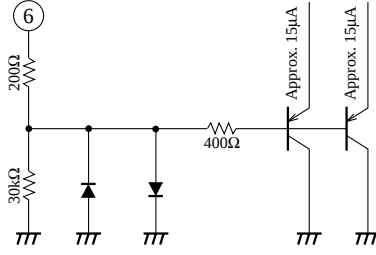
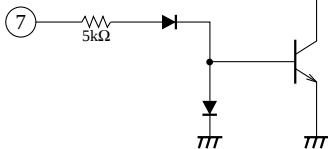
Note) Unless otherwise specified, the above values are given when V_{CC} = 13.2V, f_{req.} = 1kHz

Note 1) Measured through 15Hz to 30kHz (12dB/OCT) filter

■ Characteristic Curve



■ Pin Description

Pin No.	Pin Name	DC Voltage	Pin Description	Equivalent Circuit
1	Supply Voltage Pin	13.2V	Supply connecting pin	_____
2	Ch.1 Output Pin (+)	6.6V	Ch.1 positive-phase output pin	
3	GND (Output)	0V	Ground pin for Ch.1 output	_____
4	Ch.1 Output Pin (-)	6.6V	Ch.1 reverse-phase output pin	
5	Stand-by Control Pin	—	Stand-by changeover pin : Threshold voltage approx. 2.1V	
6	Ch.1 Input Pin	0 ~10mV	Ch.1 input signal applied pin : Input impedance 30kΩ	
7	Mute Control Pin	—	Mute changeover pin : Threshold voltage approx. 2.0V	
8	GND (Board)	0V	Connected with board only	_____
9	GND (Input)	0V	Ground pin for input	_____

■ Pin Description (Cont.)

Pin No.	Pin Name	DC Voltage	Pin Description	Equivalent Circuit
10	Beep sound input pin	2.1V	Beep sound signal input pin : Input impedance 25kΩ	
11	Ch.2 Input Pin	0 ~10mV	Ch.2 input signal applied pin : Input impedance 30kΩ	
12	Ripple Filter Pin	13.0V	Output current 3 to 10mA	
13	Ch.2 Output Pin (-)	6.6V	Ch.2 reverse-phase output pin	
14	GND (Output)	0V	Ground pin for Ch.2 output	
15	Ch.2 Output Pin (+)	6.6V	Ch.2 positive-phase output pin	
16	NC	—	Non-connection	

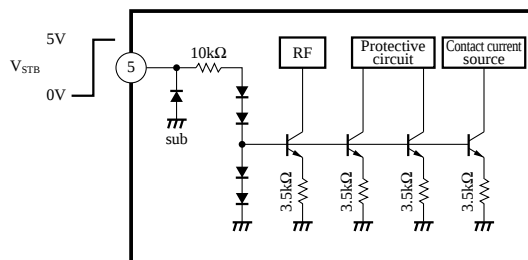
■ Operational Description

(1) Stand-by Function

- Power can be turned on or off by setting Pin5 (stand-by pin) high or low.
- The stand-by pin has threshold voltage of approx. 2.1V, however, it has temperature dependency of approx. $-8\text{mV}/^{\circ}\text{C}$. It is recommended that it should be used within the range shown in the above table.
- The following figure shows the internal circuit of stand-by pin. The current approximately expressed by the following equation is flown in the chip, with the stand-by pin set high.

$$I_{\text{STB}} = \frac{V_{\text{STB}} - 2.7\text{V}}{10\text{k}\Omega} \text{ (mA)}$$

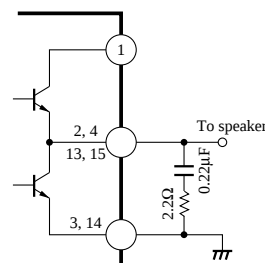
Pin Condition	Pin Voltage	Power
Open	0V	Stand-by mode
Low	0 ~ 1.0V	Stand-by mode
High	3V or more	Operation mode



- For the control voltage of stand-by pin, use the supply with no supply ripple element.

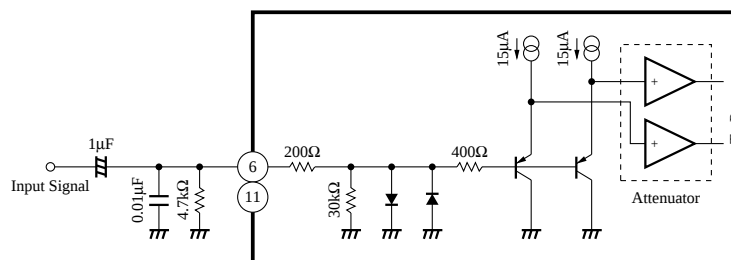
(2) Oscillation Countermeasures

- In order to increase the oscillation allowance, insert the serial connection of capacitor and resistor between each output pin and GND, as shown in the right figure.
- For a $0.22\mu\text{F}$ capacitor for oscillation prevention, use a polyester film capacitor with little fluctuation in temperature and frequency characteristics.



(3) Input Pin

- The reference voltage of input pin is 0V. When the input signal has a reference voltage other than 0V potential, connect a coupling capacitor (of several μF) for DC cut in series with the input pin. Check the low frequency characteristics to determine the capacitance value of capacitor.
- $10\text{k}\Omega$ or less of signal source impedance R_g can reduce the output end noise voltage.
- Change of signal source impedance R_g fluctuates the output offset voltage. Particular care must be taken, when the volume or similar devices are directly connected to the input pin to use the chip. In this case, it is recommended that a coupling capacitor should be used.
- When high frequency signal from tuners enters the input pin as noise, insert a capacitor of approx. $0.01\mu\text{F}$ between the input pin and input GND. When high frequency signals are inputted, malfunction of protective circuits may occur.



(4) Ripple Filter

a) In order to suppress the fluctuation of supply voltage, connect a capacitor of approx. $33\mu\text{F}$ between RF pin (Pin12) and GND.

b) Relation between RR (Ripple Rejection Ratio) and a Capacitor

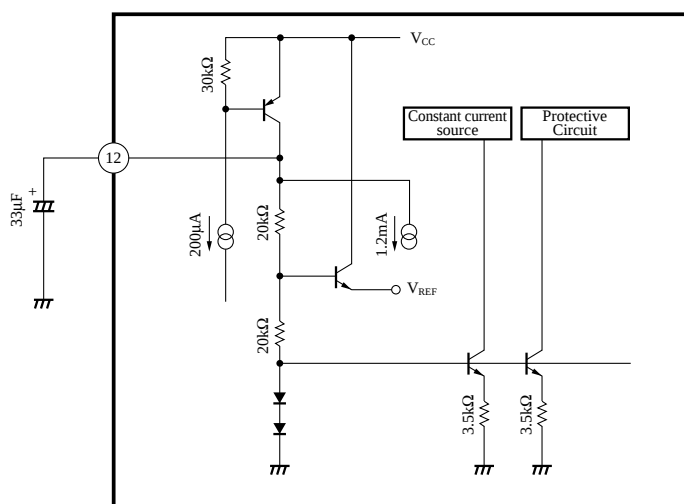
The larger capacitance that the capacitor of the ripple filter has, the better ripple rejection can be obtained.

c) Relation between Circuit Rise Time and a Capacitor

The larger capacitance that the capacitor of the ripple filter has, the longer time it takes from the power ON (STB – High) to the sound release.

d) DC voltage of output pin is located approximately the middle point of the voltage of ripple filter pin.

e) The internal circuit of ripple filter pin is shown in the following figure and the charging current is approx. 3 to 10mA.



f) After power OFF (STB – Low), it takes about 10 seconds or less for the total circuit current to become the stand-by current ($10\mu\text{A}$ or less). In order to reduce the check time at the set, insert the resistance of approx. $47\text{k}\Omega$ between the ripple filter pin and GND, this can reduce the above mentioned time to become the stand-by current.

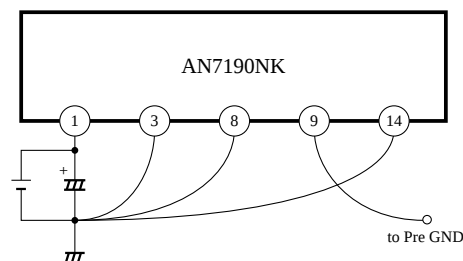
(5) GND Pin

a) Short each of the GND pins, Pin3, 8, 9 and 14 at the outside of the AN7190NK.

b) For each GND pin, the one-point earth with reference of GND connection of electrolytic capacitor between the supply pin and GND is most effective to reduce the distortion. Even in the worst case, ground Pin8 and 9 of input GND separately from all the other GND pins.

c) Each GND pin is not electrically shorted inside. Only Pin8 is connected with the board (sub).

d) Pin9 is input signal GND. Connect only Pin9 with Pre GND.



(6) Radiation Fin

- The radiation fin is not connected with GND pin by using Au wire. Only Pin8 is electrically connected through the board.
- Always attach an outside heat sink to the radiation fin. The radiation fin must be fastened onto a chassis for use. Otherwise, IC lead error may occur.
- Do not give the radiation fin any other potential than GND one. Otherwise, it may be broken.
- Connection of the radiation fin with GND can reduce the incoming noise hum. (It is not required to be connected with GND for use. For connection with GND, use power GND.)

(7) Shock Noise

a) STB ON/OFF

No shock noise is released. However, STB switch (switch for stand-by pin) may release slight shock noise. In this case, insert a capacitor of approx. 0.01 μ F between STB pin and GND.

b) MUTE ON/OFF

No shock noise is released. Refer to the section on the mute function.

(8) Mute Function

- Setting Pin7 (muting pin) to High or Low can turn MUTE function on or off.
- The following figure shows the muting circuit. The amp. gain including attenuator portion is given as follows :

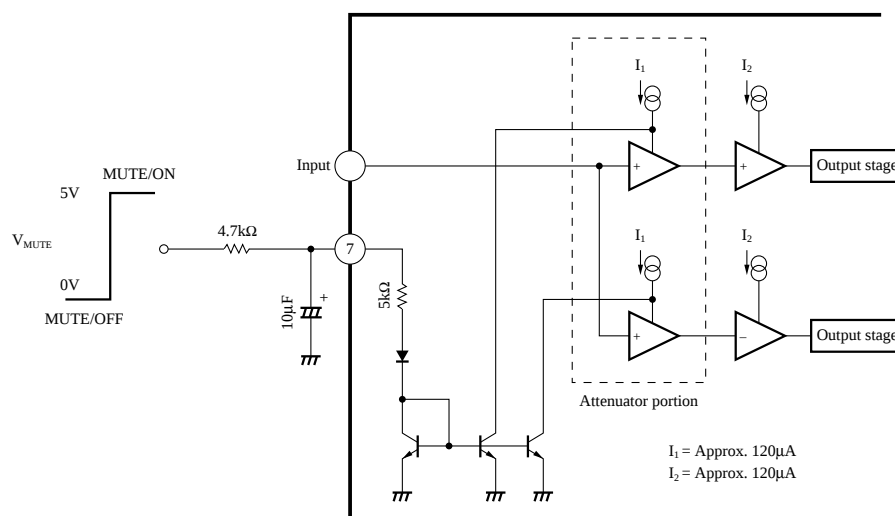
$$GV = \frac{I_1}{I_2} \times 100 \quad \leftarrow \text{Original gain}$$

By using the above equation, setting I_1 to 0mA can give the amp. gain 0 at muting.

- The threshold voltage of V_{MUTE} is as follows :

MUTE – OFF : Approx. 1V or less

MUTE – ON : Approx. 3V or more



- Attack time and recovery time can be changed by external CR of Pinu . For recommended circuits (4.7kΩ, 10μF), the above times are as follows :

Attack time : Approx. 30ms

Recovery time : Approx. 40ms

However, the control voltage of V_{MUTE} is assumed to be 5V. When it is not directly controlled by microcomputer (5V), for 13.2V separate supply, the CR value must be changed because the above times change.

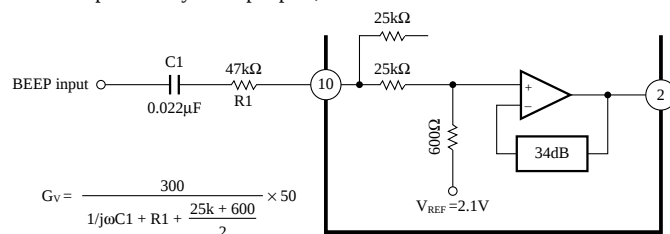
- When the attack time and recovery time are set 20ms or less, pay attention to the IC with larger output offset because it may release the shock noise.

(9) Voltage Gain

The voltage gain is 40dB fixed and can not be changed by adding an external resistance.

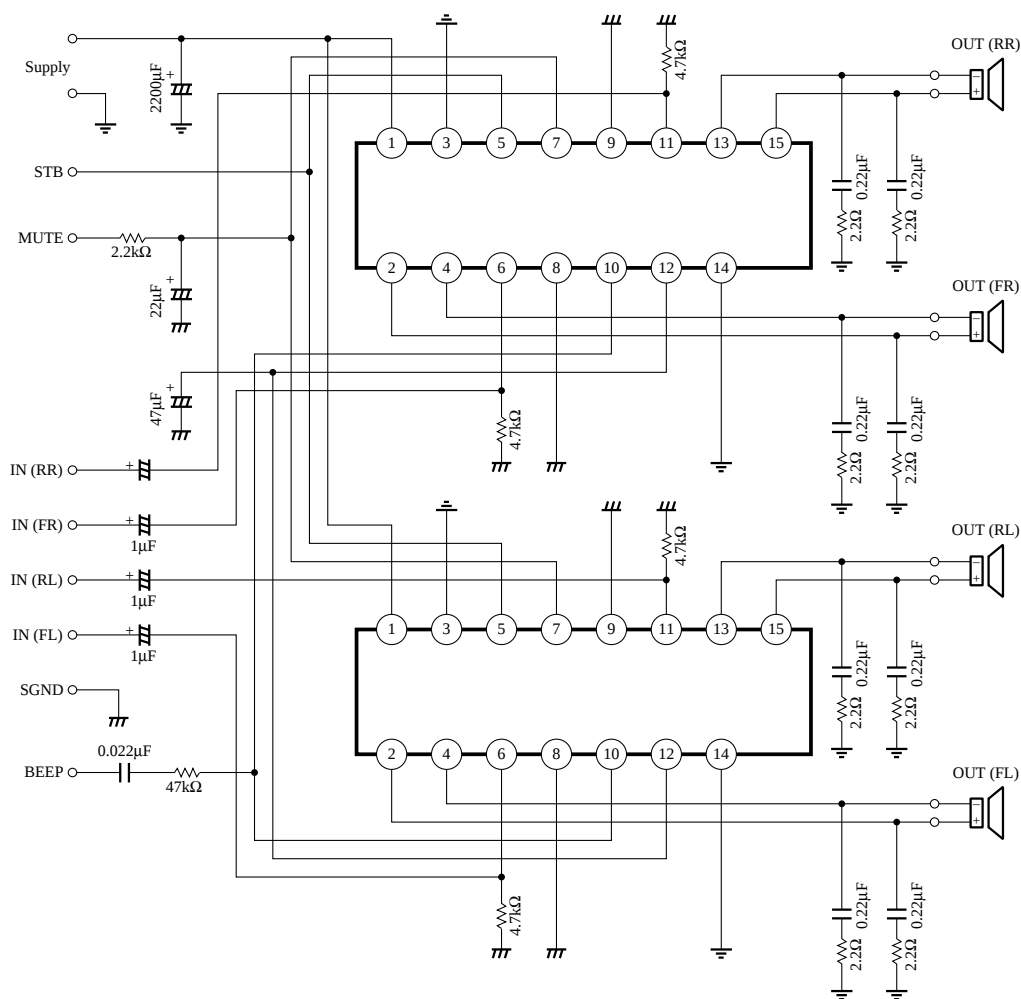
(10) Beep Sound Input Function

- The figure below shows the application circuit using the beep sound input. Connect beep signals from the microcomputer to Pin10 through Capacitor C1 for DC cut and Resister R1 for voltage gain adjustment.
- The voltage gain of beep sound pin is approx. 1.5dB. With settings as shown in the following figure, it is approx. -13dB (f=1kHz).
- Beep signals are outputted only to output pins, of Pins2 and 15.



(11) Two IC use

The following shows the application circuit diagram when two ICs are used :



- a) Supply pin Insert an electrolytic capacitor of approx. 2200 μ F into the supply pins, making short-circuit between them.
However, when sufficient characteristics such as ripple rejection can not be obtained, use an even larger capacitor or insert a 2200 μ F capacitor in each IC. The best sound quality can be provided by inserting a 2200 μ F capacitor near the pin of each IC.
- b) Stand-by pin (Pin5)
Connecting stand-by pins with each other does not result in the abnormal operation. Connect stand-by pins with each other for connection with the microcomputer.
At this time, the current flowing into the stand-by pin is twice the current described above in (1) Stand-by function.
- c) Muting pin (Pin7)
Short-circuit between muting pins does not result in the abnormal operation.
Two IC connection provides the muting time constant different from for one IC use. Setting their CR constants respectively to twice or 1/2 time provides the same time constant.
- d) BEEP sound input pin (Pin10)
Short-circuit between BEEP sound input pins does not result in the abnormal operation.
However, when there is temperature difference between ICs, output offset may fluctuate. In order to prevent the above fluctuation, connect the ICs with each other through a resistance (47k Ω).
- e) Ripple filter pin (Pin12)
Short-circuit between ripple filter pins does not result in the abnormal operation.
However, when the stand-by of each IC is individually controlled, the above short-circuit is not allowed. Connect a capacitor (33 μ F) to each IC.

