T-79-09

IR91308 Programmable Power Operational Amplifier

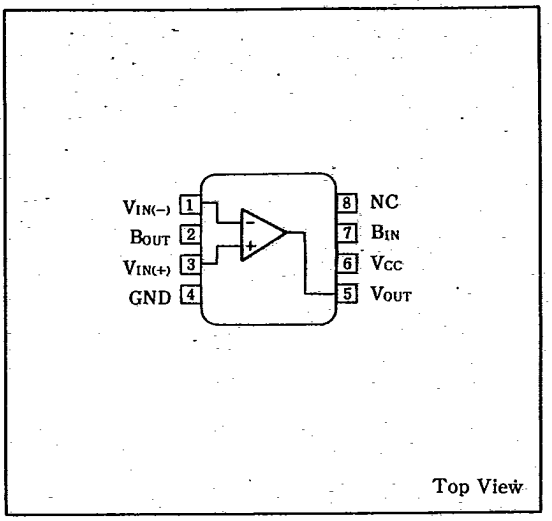
Description

The IR91308 is an internally compensated medium power operational amplifier, which has the added advantage of having an input stage programmed with an external resistor. Applications include high input impedance audio amplifier, DC to DC converters and motor speed controls.

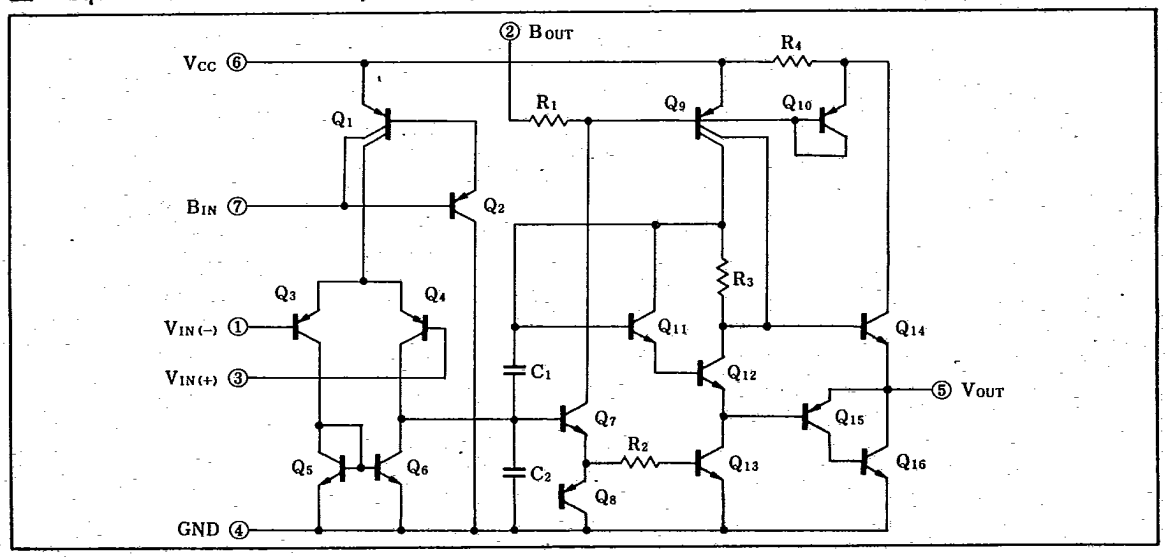
Features

1. High voltage gain 106dB(TYP.)
2. Short-circuit protected output
3. Offset voltage null capability
4. No frequency compensation required
5. 8-pin dual-in-line package

Pin Connections



Equivalent Circuit



■ Absolute Maximum Ratings

(Ta=25℃)

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	V_{CC}		3~15 or ±1.5~±7.5	V
Differential input voltage	V_{ID}		±15	V
In-phase input voltage	V_{ICM}		−0.3~±15	V
Input current	I_{IN}		20	mA
Power dissipation	P_D	Ta≦25℃	730	mW
P_D derating ratio	ΔP_D/℃	Ta>25℃	5.8	mW/℃
Operating temperature	T_{opr}		0~+70	℃
Storage temperature	T_{stg}		−65~+150	℃

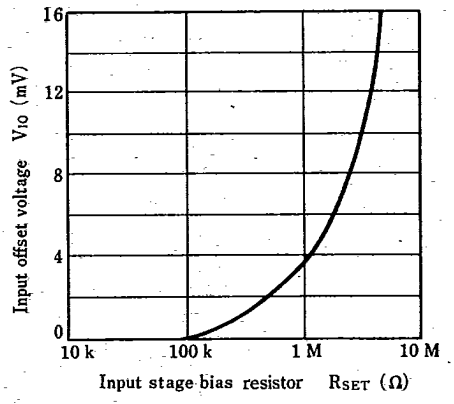
■ Electrical Characteristics

(V_{CC}=12V, R_{SET}=680kΩ, Ta=25℃)

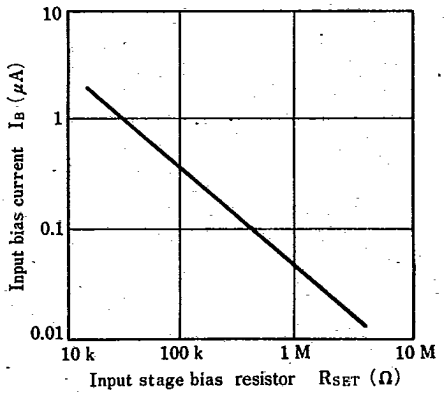
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Input offset voltage	V_{IO}			±3	±7	mV
Input offset current	I_{IO}			±30	±70	nA
Input bias current	I_B			100	400	nA
Voltage gain	A_V	V_{CC}=±6V, R_L=50Ω, f=100Hz	70	80		dB
In-phase input voltage	V_{ICM}	V_{CC}≦15V	1		V_{CC}−1.5	V
Supply current	I_{CC}	R_L=∞		3	6	mA
Output voltage swing	V_{OH}	R_L=50Ω, V_{CC}=±6V	4.5	5		V
		R_L=8Ω, V_{CC}=±6V	1.2			
	V_{OL}	R_L=50Ω, V_{CC}=±6V		−5	−4.5	V
		R_L=8Ω, V_{CC}=±6V			−2	

■ Electrical Characteristic Curves (Unless otherwise specified, Ta=25℃)

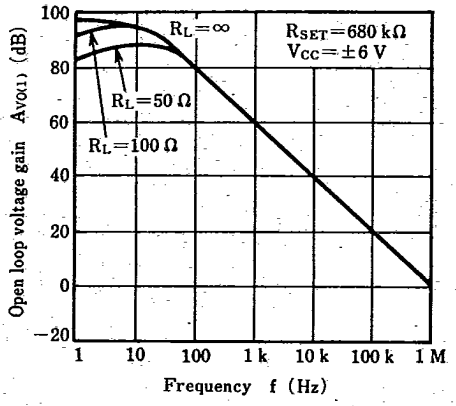
Input offset voltage—Input stage bias resistor Characteristics



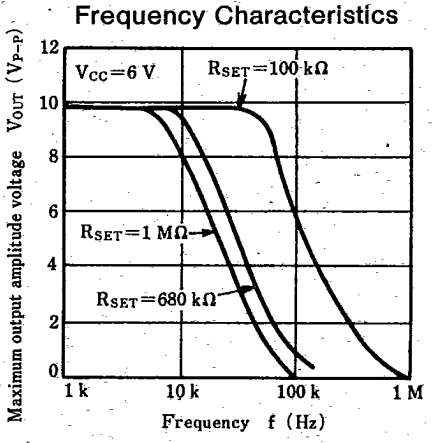
Input bias current—Input stage bias resistor Characteristics



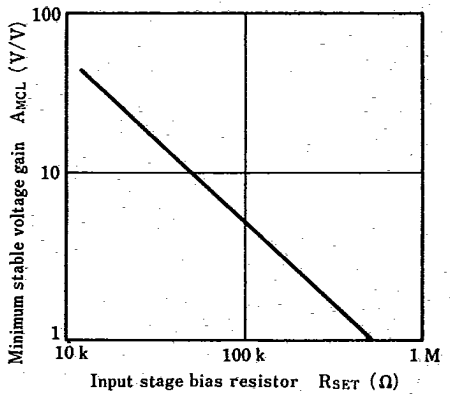
Open loop voltage gain—Frequency Characteristics



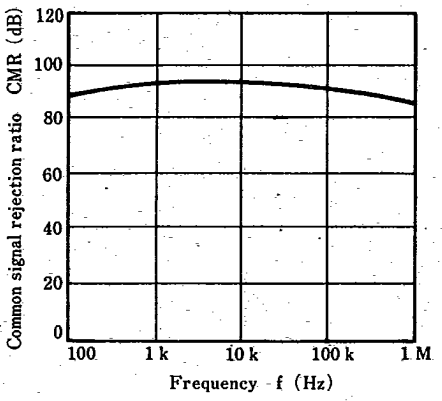
Maximum output amplitude voltage—Frequency Characteristics



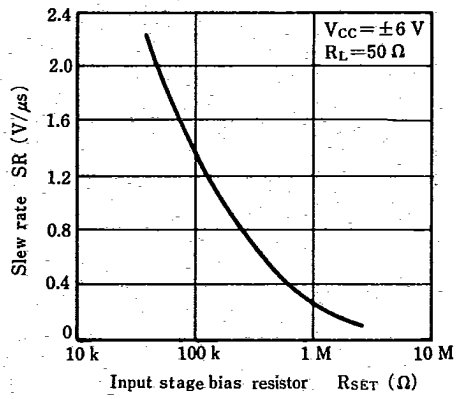
Minimum stable voltage gain—Input stage bias resistor Characteristics



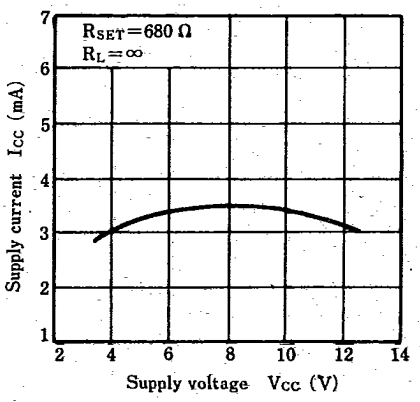
Common signal rejection ratio—Frequency Characteristics



Slew rate—Input stage bias resistor Characteristics



Supply current—Supply voltage Characteristics



■ Precautions

The IR91308 is an operational amplifier capable of generating source current and sync current of over 150 mA but with no built-in current limitter or thermal shutdown mechanism. This prompts an adequate caution to be exercised to operate within the rated allowable loss for the package. The allowable loss is 730 mA where the ambient temperature is 25℃ and the package soldered on a printed circuit board. If the ambient temperature is higher than 25℃, the allowable loss can be determined by the following equation.

$$P_D = \frac{T_j - Ta}{\theta_{ja}}$$

where P_D = allowable loss, T_j is the maximum junction temperature, Ta the ambient temperature and θ_{ja} the thermal resistance of the printed circuit board of the package. Take for example the allowable loss at the ambient temperature of 70℃, which is given as follows.

$$\frac{150℃ - 70℃}{170℃/W} \fallingdotseq 460mW$$

The IR91308 using mixed NPN/PNP in the output stage requires 10Ω resistor and 0.047μF capacitor to be placed in series between the amplifier's output (terminal 5) and the negative power supply (terminal 4). This resistor or capacitor does not eliminate the oscillation component from the output but effectively stabilizes the circuit. If the input is below the in-phase input voltage range, it may cause a phase inversion which will become particularly conspicuous on the non-inverted input (terminal 3). Also either of the inputs going 0.3V lower than the substrate (terminal 4) will turn ON the parasitic NPN transistor which is formed of emitter of epitaxial, base of substrate and collector of different epitaxial. And it cannot be defined how the circuit will operate under this condition. The input voltage lower than the substrate may destroy the amplifier if the input current exceeds 20mA.

By selecting the value for the bias resistor R_{SET} in the first stage it can be made to act as an amplifier as will suit the specific purpose of application. For example if low input bias current and low input offset current is desired, increase R_{SET}. It is also possible to reduce the input offset voltage by selecting an appropriate R_{SET} value.

As power supply voltage fluctuation elimination ratio is a function of voltage variation, to obtain an improved PSRR, bypass terminal 7 to terminal 6. In an application in which PSRR is held of importance, a bypass capacitor is required.

When the electronic shutdown function is to be brought out, connect the output bias terminal (terminal 2) and the lower voltage terminal of R_{SET} and connect a saturated NPN transistor (or a substitute electronic switch) between the output bias terminal and the negative power supply (GND in the case of a single power supply). When this transistor turns OFF, all the currents in the operational amplifier turns OFF making the voltage on all the input and output terminals indeterminable.

If the transistor (or the electronic switch) turns ON, the output restores to the normal level in 5μs. In order to turn this IC OFF without fail, it is required that the leakage of the control device be limited to the level where the voltage on terminal 2 and terminal 7 is higher than $V_{CC}-0.4V$.

■ Application Circuit Example

(1) Line driver

The line driver shown in Fig. 1 receives a high impedance out of equilibrium and converts it into an output in equilibrium suitable for driving a low impedance line. This is particularly effective when electromagnetically indicated hum or noise is the problem. If the output phases of two ICs (IIR91308) are opposite to each other, a load connected to the output will have the inphase interferences cancel themselves out. This circuit has $20V_{P-P}$ driving capability with a 50 load under the frequency of 10kHz and $13V_{P-P}$ driving capability at the frequency of 20kHz beyond which frequency it can drive as far as to the

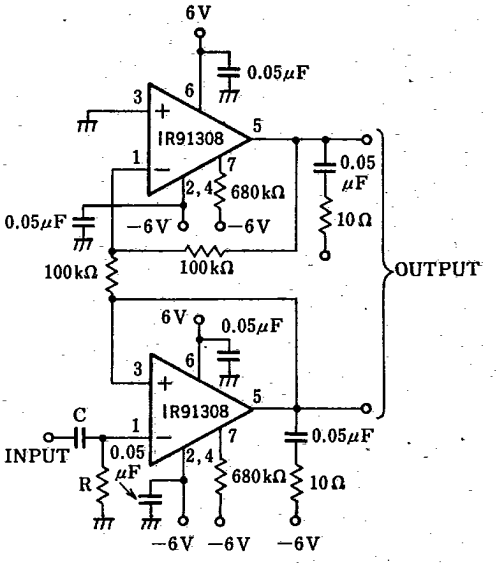


Fig. 1 Line-driver

slew rate limit. The voltage gain of this circuit is 2 with the low-frequency roll-off to be determined by the following equation.

$$f_L = \frac{1}{2\pi RC}$$

If the load is connected direct between the outputs of the two IR91308, the line driver will be able to act as an amplifier capable of supplying 500mA output to a 16Ω load.

(2) Piezo-electric alarm

The piezo-electric alarm shown in Fig. 2 uses a 3-terminal piezo semiconductor to organize an 80dB-SPL alarm. The alarm is controlled by means of electric shutdown of the IR91308.

(3) Siren

Fig. 3 shows a dual state (ON-OFF) type siren and Fig. 4 shows a siren that sounds 2 different alternating sounds constantly.

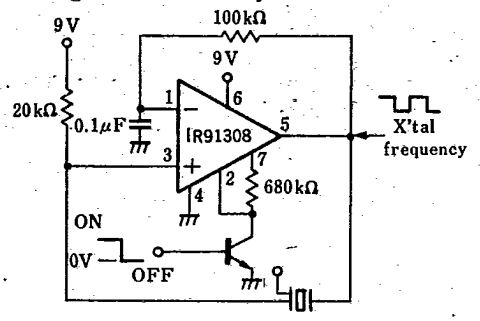


Fig. 2 Piezo electric alarm

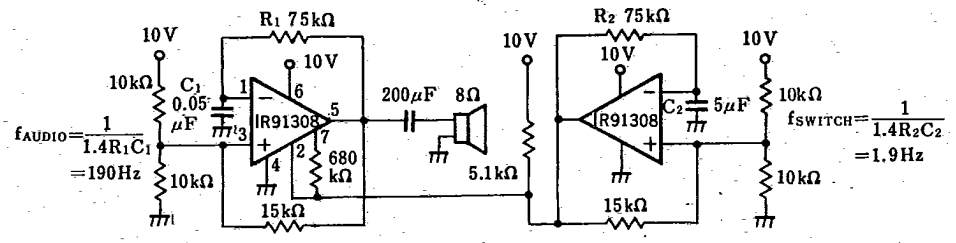


Fig. 3 Siren

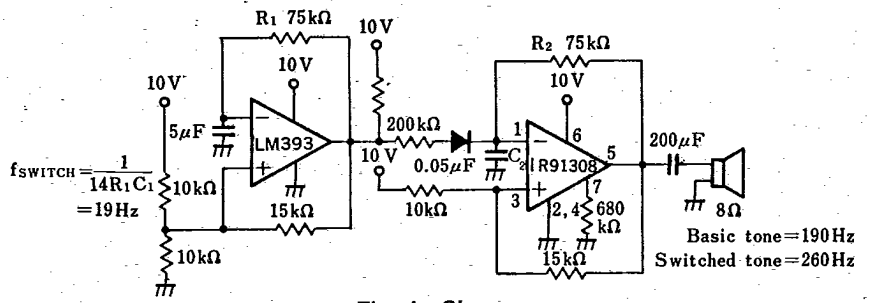


Fig. 4 Siren

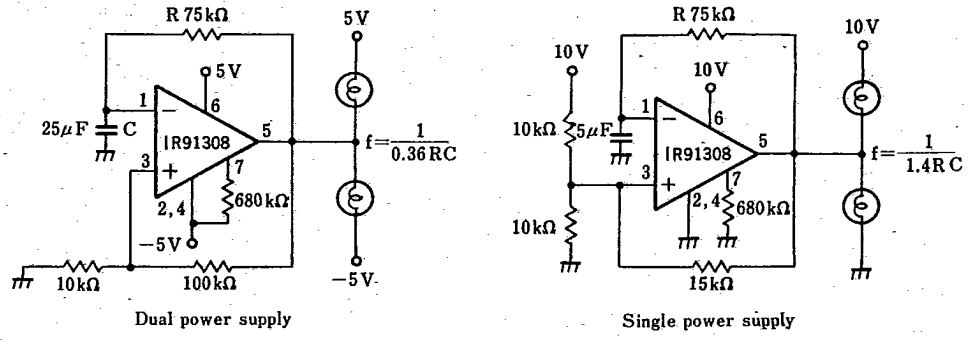


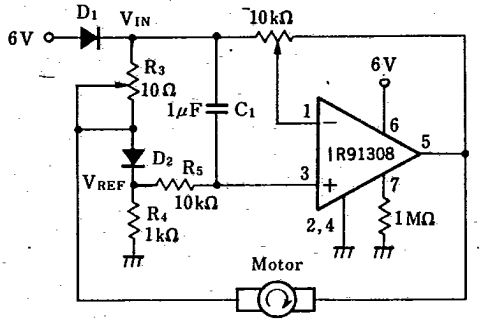
Fig. 5 Lampflasher relay driver

(4) Lamp flasher relay driver

The IR91308 finds its easy application in a low frequency alarming device. The circuits shown in Fig. 5 cause 2 incandescent lamps to glow alternatively.

(5) Motor speed control

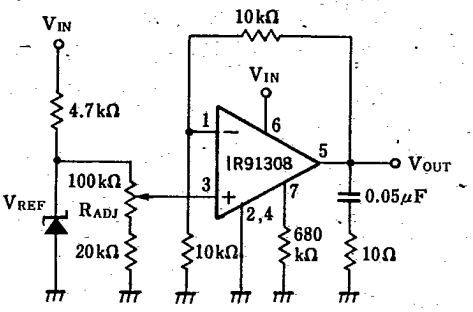
The IR91308 can be used to control the speed of a small motor with its starting current less than 0.5mA. The circuit in Fig. 6 will go into operation if a multiple of the reference voltage is applied to the motor. To control the voltage applied to the motor according to the motor load, the reference voltage will alter itself by means of quasifeedback.



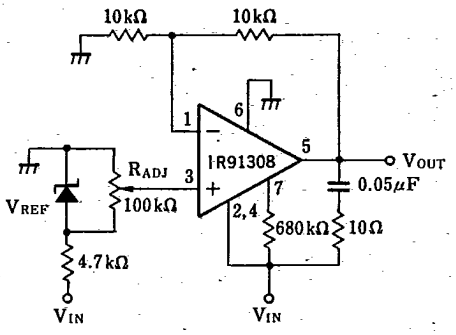
$$V_{MOTOR}=\frac{(V_{BE2}+I_3R_3)R_2}{R_1}+V_{BE}$$

Fig. 6 Motor speed control

(6) voltage regulator



$2V \leqq V_{OUT} \leqq (V_{IN}-2V)$



$-(V_{IN}-2V) \leqq V_{OUT} \leqq -1.5V$