



# Operational Amplifiers

## LM108A/LM208A/LM308A operational amplifiers general description

The LM108A, LM208A and LM308A are precision operational amplifiers having specifications about a factor of ten better than FET amplifiers over their operating temperature range. In addition to low input currents, these devices have extremely low offset voltage, making it possible to eliminate offset adjustments, in most cases, and obtain performance approaching chopper stabilized amplifiers.

The devices operate with supply voltages from  $\pm 2V$  to  $\pm 20V$  and have sufficient supply rejection to use unregulated supplies. Although the circuit is interchangeable with and uses the same compensation as the LM101A, an alternate compensation scheme can be used to make it particularly insensitive to power supply noise and to make supply bypass capacitors unnecessary. Outstanding characteristics include:

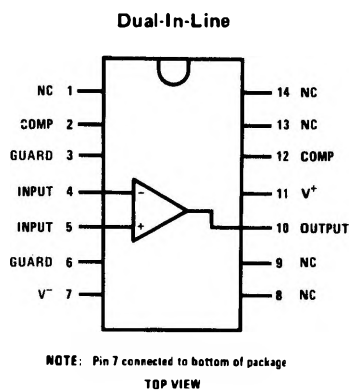
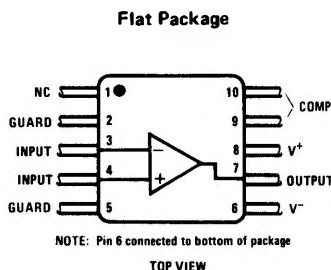
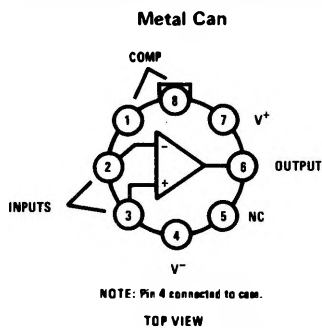
- Offset voltage guaranteed less than 0.5 mV
- Maximum input bias current of 3.0 nA over temperature

- Offset current less than 400 pA over temperature
- Supply current of only 300  $\mu A$ , even in saturation
- Guaranteed 5  $\mu V/^{\circ}C$  drift.

The low current error of the LM108A series makes possible many designs that are not practical with conventional amplifiers. In fact, it operates from 10 M $\Omega$  source resistances, introducing less error than devices like the 709 with 10 k $\Omega$  sources. Integrators with drifts less than 500  $\mu V/sec$  and analog time delays in excess of one hour can be made using capacitors no larger than 1  $\mu F$ .

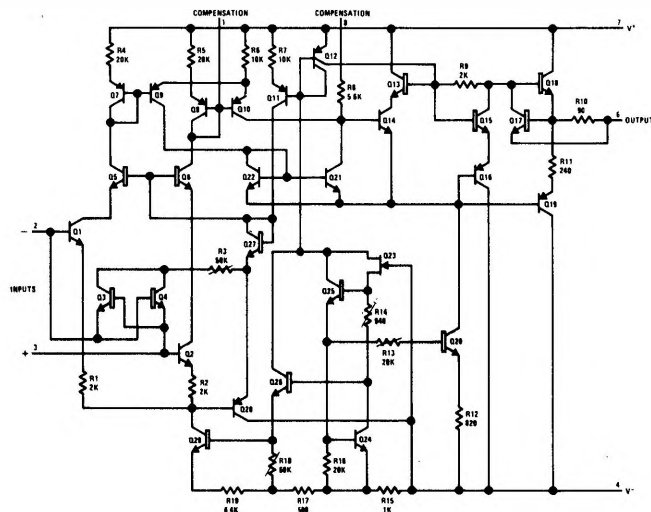
The LM208A is identical to the LM108A, except that the LM208A has its performance guaranteed over a  $-25^{\circ}C$  to  $85^{\circ}C$  temperature range, instead of  $-55^{\circ}C$  to  $125^{\circ}C$ . The LM308A has slightly-relaxed specifications and has its performance guaranteed over a  $0^{\circ}C$  to  $70^{\circ}C$  temperature range.

## connection diagrams \*

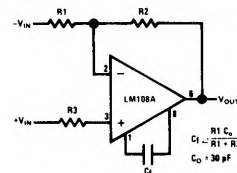


\*Pin connections shown on schematic diagram are for TO-5 package.

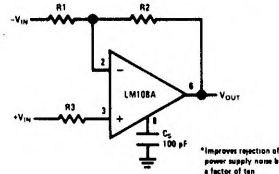
## schematic diagram and compensation circuits



### Standard Compensation Circuit



### Alternate\* Frequency Compensation



## LM108A/LM208A

### absolute maximum ratings

Supply Voltage	±20V
Power Dissipation (Note 1)	500 mW
Differential Input Current (Note 2)	±10 mA
Input Voltage (Note 3)	±15V
Output Short-Circuit Duration	Indefinite
Operating Temperature Range	LM108A -55°C to 125°C
LM208A	-25°C to 85°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

### electrical characteristics (Note 4)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$T_A = 25^\circ\text{C}$		0.3	0.5	mV
Input Offset Current	$T_A = 25^\circ\text{C}$		0.05	0.2	nA
Input Bias Current	$T_A = 25^\circ\text{C}$		0.8	2.0	nA
Input Resistance	$T_A = 25^\circ\text{C}$	30	70		MΩ
Supply Current	$T_A = 25^\circ\text{C}$		0.3	0.6	mA
Large Signal Voltage Gain	$T_A = 25^\circ\text{C}$ , $V_S = \pm 15\text{V}$ $V_{OUT} = \pm 10\text{V}$ , $R_L \geq 10\text{ k}\Omega$	80	300		V/mV
Input Offset Voltage				1.0	mV
Average Temperature Coefficient of Input Offset Voltage			1.0	5.0	$\mu\text{V}/^\circ\text{C}$
Input Offset Current				0.4	nA
Average Temperature Coefficient of Input Offset Current			0.5	2.5	$\text{pA}/^\circ\text{C}$
Input Bias Current				3.0	nA
Supply Current	$T_A = +125^\circ\text{C}$		0.15	0.4	mA
Large Signal Voltage Gain	$V_S = \pm 15\text{V}$ , $V_{OUT} = \pm 10\text{V}$ $R_L \geq 10\text{ k}\Omega$	40			V/mV
Output Voltage Swing	$V_S = \pm 15\text{V}$ , $R_L = 10\text{ k}\Omega$	±13	±14		V
Input Voltage Range	$V_S = \pm 15\text{V}$	±13.5			V
Common Mode Rejection Ratio		96	110		dB
Supply Voltage Rejection Ratio		96	110		dB

**Note 1:** The maximum junction temperature of the LM108A is 150°C, while that of the LM208A is 100°C. For operating at elevated temperatures, devices in the TQ-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. For the flat package, the derating is based on a thermal resistance of 185°C/W when mounted on a 1/16-inch-thick epoxy glass board with ten, 0.03-inch-wide, 2-ounce copper conductors. The thermal resistance of the dual-in-line package is 100°C/W, junction to ambient.

**Note 2:** The inputs are shunted with back-to-back diodes for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs unless some limiting resistance is used.

**Note 3:** For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

**Note 4:** These specifications apply for  $\pm 5\text{V} \leq V_S \leq \pm 20\text{V}$  and  $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ , unless otherwise specified. With the LM208A, however, all temperature specifications are limited to  $-25^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$ .

**LM308A****absolute maximum ratings**

Supply Voltage	±18V
Power Dissipation (Note 1)	500 mW
Differential Input Current (Note 2)	±10 mA
Input Voltage (Note 3)	±15V
Output Short-Circuit Duration	Indefinite
Operating Temperature Range	0°C to 70°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

**electrical characteristics** (Note 4)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$T_A = 25^\circ\text{C}$		0.3	0.5	mV
Input Offset Current	$T_A = 25^\circ\text{C}$		0.2	1	nA
Input Bias Current	$T_A = 25^\circ\text{C}$		1.5	7	nA
Input Resistance	$T_A = 25^\circ\text{C}$	10	40		MΩ
Supply Current	$T_A = 25^\circ\text{C}$ , $V_S = \pm 15\text{V}$		0.3	0.8	mA
Large Signal Voltage Gain	$T_A = 25^\circ\text{C}$ , $V_S = \pm 15\text{V}$ $V_{OUT} = \pm 10\text{V}$ , $R_L \geq 10\text{ k}\Omega$	80	300		V/mV
Input Offset Voltage				0.73	mV
Average Temperature Coefficient of Input Offset Voltage			1.0	5.0	$\mu\text{V}/^\circ\text{C}$
Input Offset Current				1.5	nA
Average Temperature Coefficient of Input Offset Current			2.0	10	$\text{pA}/^\circ\text{C}$
Input Bias Current				10	nA
Large Signal Voltage Gain	$V_S = \pm 15\text{V}$ , $V_{OUT} = \pm 10\text{V}$ $R_L \geq 10\text{ k}\Omega$	60			V/mV
Output Voltage Swing	$V_S = \pm 15\text{V}$ , $R_L = 10\text{ k}\Omega$	±13	±14		V
Input Voltage Range	$V_S = \pm 15\text{V}$	±14			V
Common Mode Rejection Ratio		96	110		dB
Supply Voltage Rejection Ratio		96	110		dB

**Note 1:** The maximum junction temperature of the LM308A is 85°C. For operating at elevated temperatures, devices in the TQ-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. For the flat package, the derating is based on a thermal resistance of 185°C/W when mounted on a 1/16-inch-thick epoxy glass board with ten, 0.03-inch-wide, 2-ounce copper conductors. The thermal resistance of the dual-in-line package is 100°C/W, junction to ambient.

**Note 2:** The inputs are shunted with back-to-back diodes for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs unless some limiting resistance is used.

**Note 3:** For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

**Note 4:** These specifications apply for  $\pm 5\text{V} \leq V_S \leq \pm 15\text{V}$  and  $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$ , unless otherwise specified.