LM108/208/308
LM108A/208A/308A

Operational Amplifiers

Description: The 108, 208, 308, 108A, 208A and 308A monolithic operational amplifiers are functionally, electrically and pin-for-pin equivalents to the National LM108, LM208, LM308, LM108A, LM208A and LM308A. They are available in the hermetic TO-99 metal can, dual-in-line, and flat packages.

Distinctive Characteristics: 100% reliability assurance testing including high-temperature bake, temperature cycling, centrifuge and fine leak hermeticity testing in compliance with MIL STD 883.

Electrically tested and optically inspected dice for the assemblers of hybrid products.

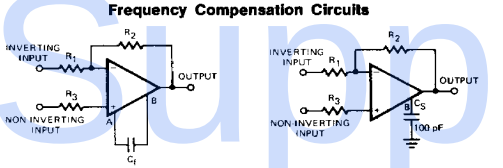
5

FUNCTIONAL DESCRIPTION

These differential input, precision amplifiers provide low input current and offset voltage competitive with FET and chopper stabilized amplifiers. They feature low power consumption over a supply voltage range of ±2V to ±20V. The amplifiers may be frequency compensated with a single external capacitor and are pin-for-pin interchangeable with the 101A/201A/301A. The 108A, 208A, and 308A are high performance selections from the 108/208/308 amplifier family.

FUNCTIONAL DIAGRAM

Frequency Compensation Circuits



$$C_f \geq C_o\left(\frac{1}{1+\frac{R_2}{R_1}}\right)$$

C_o = 30 pF

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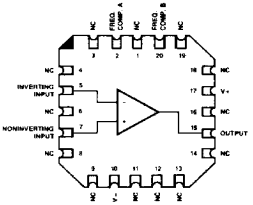
ORDERING INFORMATION*

Part Number	Package Type	Temperature Range	Order Number
LM308	Hermetic DIP	0 to +70°C	LM308D
	TO-99	0 to +70°C	LM308H
	Molded DIP	0 to +70°C	LM308N
	Dice	0 to +70°C	LD308
	Leadless	0 to +70°C	LM308L
LM308A	Hermetic DIP	0 to +70°C	LM308AD
	TO-99	0 to +70°C	LM308AH
	Molded DIP	0 to +70°C	LM308AN
	Dice	0 to +70°C	LD308A
	Leadless	0 to +70°C	LM308AL
LM208	Hermetic DIP	−25 to +85°C	LM208D
	TO-99	−25 to +85°C	LM208H
	Leadless	−25 to +85°C	LM208L
LM208A	Hermetic DIP	−25 to +85°C	LM208AD
	TO-99	−25 to +85°C	LM208AH
	Leadless	−25 to +85°C	LM208AL
LM108	Hermetic DIP	−55 to +125°C	LM108D
	TO-99	−55 to +125°C	LM108H
	Dice	−55 to +125°C	LD108
	Leadless	−55 to +125°C	LM108L
LM108A	Hermetic DIP	−55 to +125°C	LM108AD
	TO-99	−55 to +125°C	LM108AH
	Dice	−55 to +125°C	LD108A
	Leadless	−55 to +125°C	LM108AL

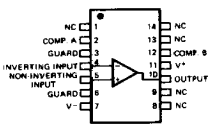
*Also available with burn-in processing. To order add suffix B to part number.

CONNECTION DIAGRAMS – Top Views

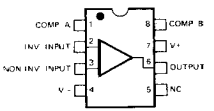
Leadless Chip-Pak
L-20-1



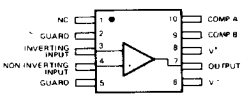
Molded Dual In-Line
P-14-1



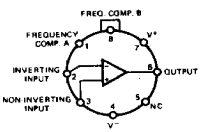
Hermetic Dual In-Line
D-18-1



Flat Package
F-10-1



Metal Can
H-8-1



Notes: 1. On Metal Can, pin 4 is connected to case.
2. On DIP pin 7 is connected to bottom of package.
3. On Flat Package, pin 6 is connected to bottom of package.

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MAXIMUM RATINGS

Supply Voltage	
LM108, 208, 108A, 208A,	±20 V
LM308, 308A	±18 V
Internal Power Dissipation (Note 1)	500 mW
Differential Input Current (Note 2)	±10 mA
Input Voltage (Note 3)	±15 V
Output Short-Circuit Duration	Indefinite
Operating Temperature Range	
LM108, 108A	−55°C to +125°C
LM208, 208A	−25°C to +85°C
LM308, 308A	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 60 sec.)	300°C

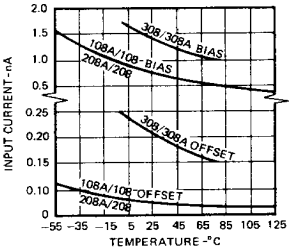
ELECTRICAL CHARACTERISTICS T_A = 25°C unless otherwise specified (see Note 4)

Parameters	Test Conditions	LM308			LM308A			LM108 LM208			LM108A LM208A			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage			2.0	7.5		0.3	0.5		0.7	2.0		0.3	0.5	mV
Input Offset Current			0.2	1.0		0.2	1.0		0.05	0.2		0.05	0.2	nA
Input Bias Current			1.5	7		1.5	7		0.8	2.0		0.8	2.0	nA
Input Resistance		10	40		10	40		30	70		30	70		MΩ
Supply Current	V_S = ±20V								0.3	0.6		0.3	0.6	mA
	V_S = ±15V		0.3	0.8		0.3	0.8							
Large Signal Voltage Gain	V_S = ±15V, V_{OUT} = ±10V, $R_L \geq 10k\Omega$	25	300		80	300		50	300		80	300		V/mV
The Following Specifications Apply over the Operating Temperature Ranges														
Input Offset Voltage				10			0.73			3.0			1.0	mV
Input Offset Current				1.5			1.5			0.4			0.4	nA
Average Temperature Coefficient of Input Offset Voltage			6.0	3.0		1.0	5.0		3.0	15		1.0	5.0	μV/°C
Average Temperature Coefficient of Input Offset Current			2	10		2.0	10		0.5	2.5		0.5	2.5	pA/°C
Input Bias Current				10			10			3.0			3.0	nA
Large Signal Voltage Gain	V_S = ±15V, V_{OUT} = ±10V, $R_L \geq 10k\Omega$	15			60			25			40			V/mV
Input Voltage Range	V_S = ±15V	±13.5			±13.5			±13.5			±13.5			V
Common Mode Rejection Ratio		80	100		96	110		85	100		96	110		dB
Supply Voltage Rejection Ratio		80	96		96	110		80	96		96	110		dB
Output Voltage Swing	V_S = ±15V, R_L = 10kΩ	±13	±14		±13	±14		±13	±14		±13	±14		V
Supply Current	V_S = ±20V, T = T_A Max								0.15	0.4		0.15	0.4	mA
	V_S = ±15V, T = T_A Max		0.6	1.0		0.6	0.8							

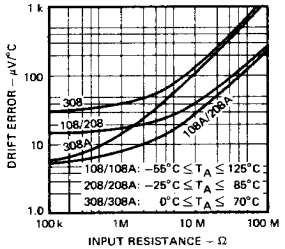
Notes:
1. Derate Metal Can package at 6.8mW/°C for operation at ambient temperatures above 75°C and the Dual In-Line package at 9mW/°C for operation at ambient temperatures above 95°C.
2. The inputs are shunted with back-to-back diodes for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs unless some limiting resistance is used.
3. For supply voltages less than ±15V, the maximum input voltage is equal to the supply voltage.
4. Unless otherwise specified, these specifications apply for supply voltages from ±5 to ±20V for the 108, 208, 108A and 208A and from ±5 to ±15V for the 308 and 308A.

TYPICAL PERFORMANCE CURVES

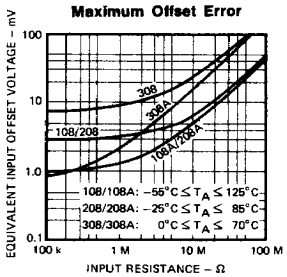
Input Currents



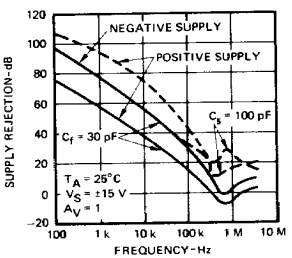
Maximum Drift Error



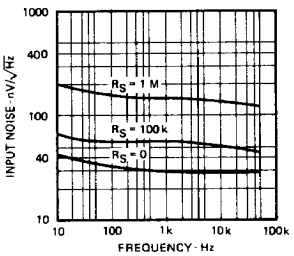
Maximum Offset Error



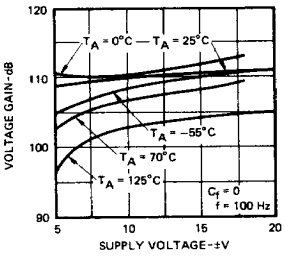
Power Supply Rejection



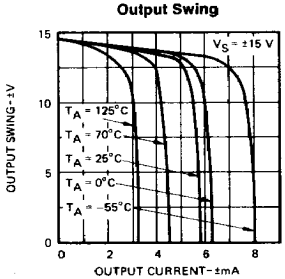
Input Noise Voltage



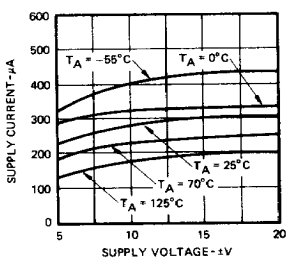
Voltage Gain



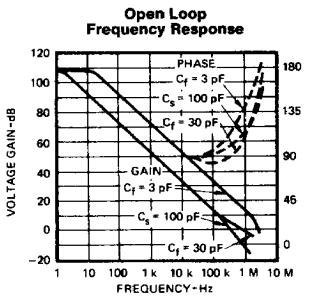
Output Swing



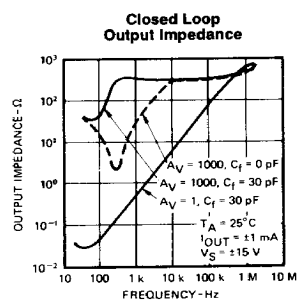
Supply Current



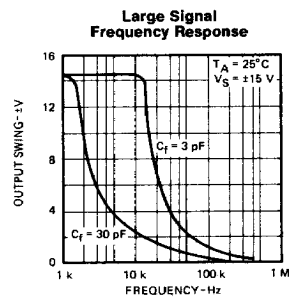
Open Loop Frequency Response



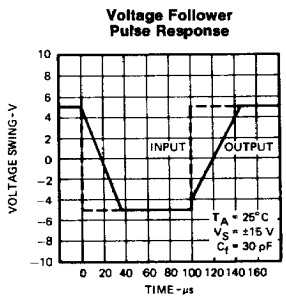
Closed Loop Output Impedance



Large Signal Frequency Response



Voltage Follower Pulse Response



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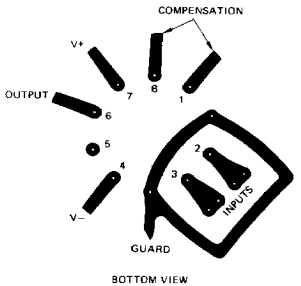
ADDITIONAL APPLICATION INFORMATION

GUARDING

Extra care must be taken in the assembly of printed circuit boards to take full advantage of the low input currents of the 108 amplifier. Boards must be thoroughly cleaned with TCE or alcohol and blown dry with compressed air. After cleaning, the boards should be coated with epoxy or silicone rubber to prevent contamination.

Even with properly cleaned and coated boards, leakage currents may cause trouble at 125°C, particularly since the input pins are adjacent to pins that are at supply potentials. This leakage can be significantly reduced by using guarding to lower the voltage difference between the inputs and adjacent metal runs. Input guarding of the 8-lead TO-99 package is accomplished by using a 10-lead pin circle, with the leads of the device formed so that the holes adjacent to the inputs are empty when it is inserted in the board. The guard, which is a conductive ring surrounding the inputs, is connected to a low-impedance point that is at approximately the same voltage as the inputs. Leakage currents from high-voltage pins are then absorbed by the guard.

The pin configuration of the dual-in-line package is designed to facilitate guarding, since the pins adjacent to the inputs are not used (this is different from the standard 741 and 101A pin configuration.)

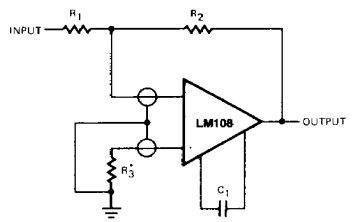


BOTTOM VIEW

Board layout for Input Guarding with TO-99 package.

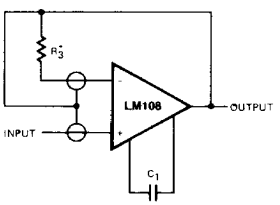
APPLICATIONS

Connection of Input Guards



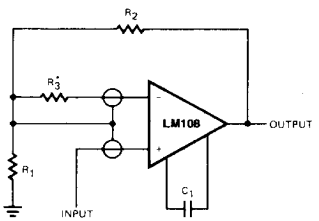
INVERTING AMPLIFIER

LIC-671



FOLLOWER

LIC-672



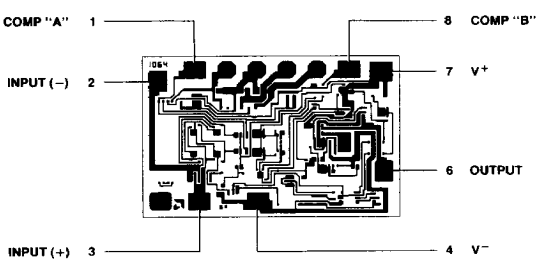
NON-INVERTING AMPLIFIER

LIC-673

*Use to compensate for large source resistances.

NOTE: $\frac{R_1 R_2}{R_1 + R_2}$ Must be LOW impedance

METALLIZATION AND PAD LAYOUT



DIE SIZE 0.046″ X 0.068″