LH2108/2208/2308
LH2108A/2208A/2308A

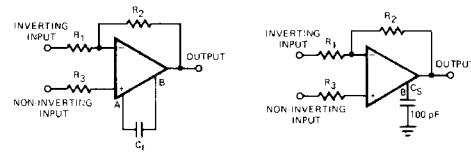
Dual Operational Amplifiers

Description: The 2108, 2208, 2308, 2108A, 2208A, and 2308A monolithic operational amplifiers are functionally, electrically and pin-for-pin equivalents to the National LH2108, LH2208, LH2308, LH2108A, LH2208A and LH2308A.

FUNCTIONAL DESCRIPTION

These dual 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. The 2108A, 2208A, and 2308A are high performance selections from the 2108/2208/2308 amplifier family.

FUNCTIONAL DIAGRAM
Frequency Compensation Circuits



$$C_1 \geq C_o\left(\frac{1}{1+\frac{R_2}{R_1}}\right)$$

C_o = 30 pF

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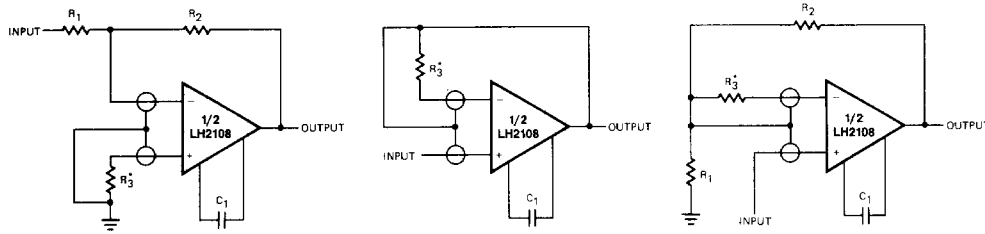
APPLICATIONS
Connection of Input Guards



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*Use to compensate for large source resistances.

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

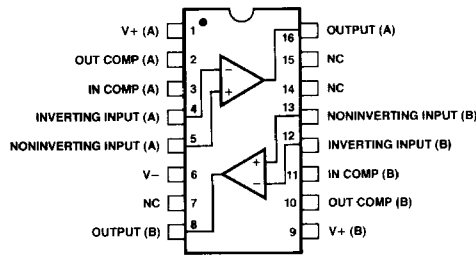
ORDERING INFORMATION

Part Number	Package Type	Temperature Range	Order Number
LH2308	Hermetic DIP	0 to +70°C	LH2308D
LH2208	Hermetic DIP	−25 to +85°C	LH2208D
LH2108	Hermetic DIP	−55 to +125°C	LH2108D
LH2308A	Hermetic DIP	0 to +70°C	LH2308AD
LH2208A	Hermetic DIP	−25 to +85°C	LH2208AD
LH2108A	Hermetic DIP	−55 to +125°C	LH2108AD

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

CONNECTION DIAGRAM — Top View

Hermetic
Dual In-Line
D-16-1



Note: Pin 1 is marked for orientation.

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MAXIMUM RATINGS

Supply Voltage	
LH2108, 2208, 2108A, 2208A	±20V
LH2308, 2308A	±18V
Internal Power Dissipation (Note 1)	500mW
Differential Input Current (Note 2)	±10mA
Input Voltage (Note 3)	±15V
Output Short-Circuit Duration	Indefinite
Operating Temperature Range	
LH2108, 2108A	−55 to +125°C
LH2208, 2208A	−25 to +85°C
LH2308, 2308A	0 to +70°C
Storage Temperature Range	−65 to +150°C
Lead Temperature (Soldering, 60 sec)	300°C

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

Parameters (See definitions)	Test Conditions	LH2308			LH2308A			LH2108 LH2208			LH2108A LH2208A			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	30		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 (each amplifier)	V_S = ±20V, $T_A = T_{HIGH}$								0.15	0.4		0.1.5	0.4	mA
	V_S = ±15V, $T_A = T_{HIGH}$		0.6	1.0		0.6	0.8							

Notes: 1. Derate the Dual In-Line package at 9mW/°C for operation at ambient temperature 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 2108, 2208, 2108A and 2208A and from ±5V to ±15V for the 2308 and 2308A.

ADDITIONAL APPLICATION INFORMATION

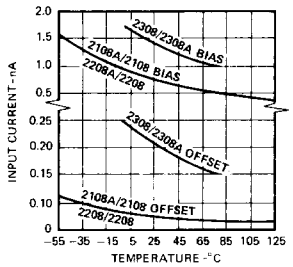
GUARDING

Extra care must be taken in the assembly of printed circuit boards to take full advantage of the low input currents of the 2108 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.

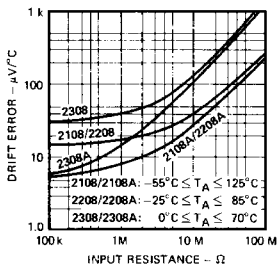
Even with properly cleaned and coated boards, leakage currents may cause trouble at 125°C, particularly since the input pins are adjacent to pins that are at supply potentials. This leakage can be significantly reduced by using guarding to lower the voltage difference between the inputs and adjacent metal runs. 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.

TYPICAL PERFORMANCE CURVES

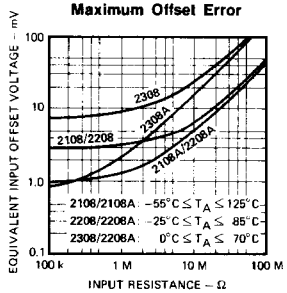
Input Currents



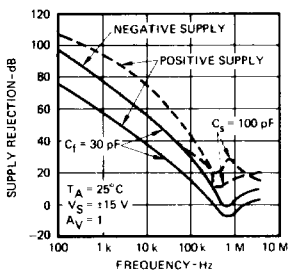
Maximum Drift Error



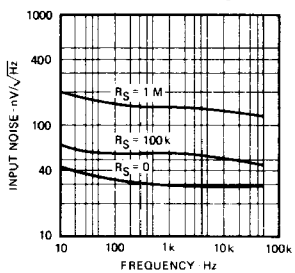
Maximum Offset Error



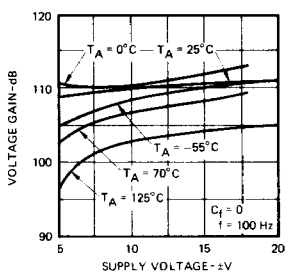
Power Supply Rejection



Input Noise Voltage



Voltage Gain



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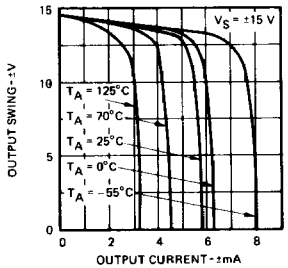
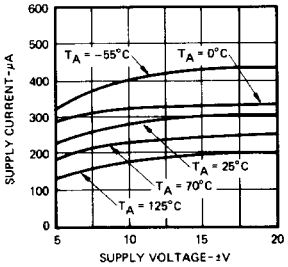
TYPICAL PERFORMANCE CURVES (Cont.)

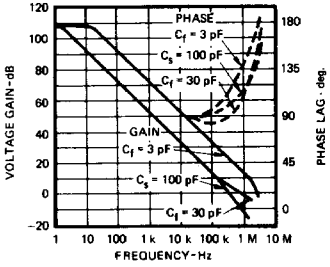
Output Swing



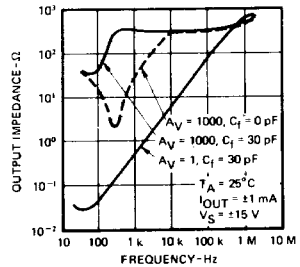
Supply Current Each Amplifier



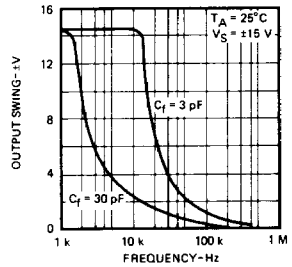
Open Loop Frequency Response



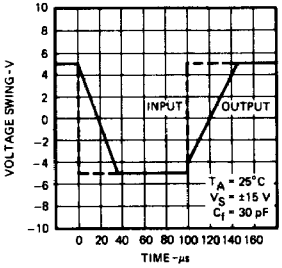
Closed Loop Output Impedance



Large Signal Frequency Response



Voltage Follower Pulse Response



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