LM108/LM208/LM308 Operational Amplifiers

Check for Samples: LM108-N, LM208-N, LM308-N

FEATURES

- **Maximum input bias current of 3.0 nA over temperature**
- **Offset current less than 400 pA over temperature**
- **Supply current of only 300 μA, even in saturation**
- **Specified drift characteristics**

DESCRIPTION

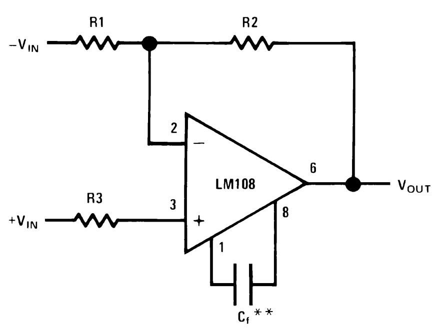
The LM108 series are precision operational amplifiers having specifications a factor of ten better than FET amplifiers over a −55°C to +125°C temperature range.

The devices operate with supply voltages from ±2V to ±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.

The low current error of the LM108 series makes possible many designs that are not practical with conventional amplifiers. In fact, it operates from 10 MΩ source resistances, introducing less error than devices like the 709 with 10 kΩ sources. Integrators with drifts less than 500 μV/sec and analog time delays in excess of one hour can be made using capacitors no larger than 1 μF.

The LM108 is guaranteed from −55°C to +125°C, the LM208 from −25°C to +85°C, and the LM308 from 0°C to +70°C.

COMPENSATION CIRCUITS

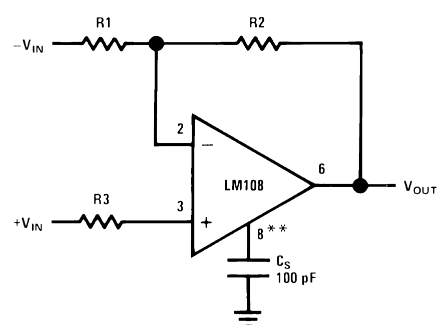


$C_f \geq \frac{R1\ C_O}{R1 + R2}$

C_O = 30 pF

**Bandwidth and slew rate are proportional to $1/C_f$

Figure 1. Standard Compensation Circuit



(1) Improves rejection of power supply noise by a factor of ten.

**Bandwidth and slew rate are proportional to $1/C_S$

Figure 2. Alternate Frequency Compensation

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

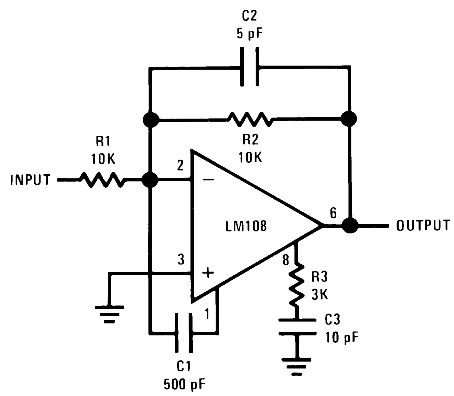


Figure 3. Feedforward Compensation

ABSOLUTE MAXIMUM RATINGS (1) (2)

	LM108/LM208	LM308
Supply Voltage	±20V	±18V
Power Dissipation (3)	500 mW	500 mW
Differential Input Current (4)	±10 mA	±10 mA
Input Voltage (5)	±15V	±15V
Output Short-Circuit Duration	Continuous	Continuous
Operating Temperature Range (LM108)	−55°C to +125°C	0°C to +70°C
(LM208)	−25°C to + 85°C	
Storage Temperature Range	−65°C to +150°C	−65°C to +150°C
Lead Temperature (Soldering, 10 sec)		
DIP	260°C	260°C
H Package Lead Temp, (Soldering 10 seconds)	300°C	300°C
Soldering Information, Dual-In-Line Package, Soldering (10 seconds)	260°C	
Small Outline Package		
Vapor Phase (60 seconds)	215°C	
Infrared (15 seconds)	220°C	
ESD Tolerance (6)	2000V	
See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for other methods of soldering surface mount devices.		

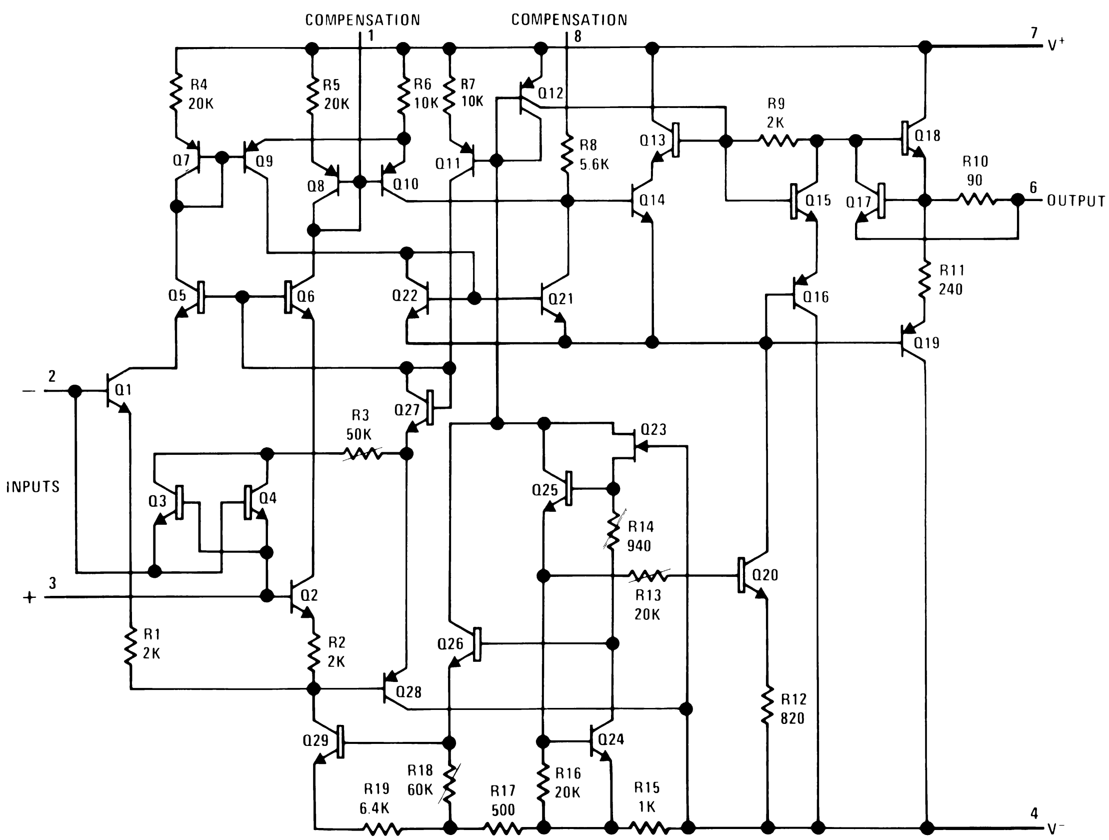
(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but **do not** guarantee specific performance limits.
(2) Refer to RETS108X for LM108 military specifications and RETs 108AX for LM108A military specifications.
(3) The maximum junction temperature of the LM108 is 150°C, for the LM208, 100°C and for the LM308, 85°C. For operating at elevated temperatures, devices in the H08 package must be derated based on a thermal resistance of 160°C/W, junction to ambient, or 20°C/W, junction to case. The thermal resistance of the dual-in-line package is 100°C/W, junction to ambient.
(4) 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.
(5) For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.
(6) Human body model, 1.5 kΩ in series with 100 pF.

ELECTRICAL CHARACTERISTICS [(1)]

Parameter	Condition	LM108/LM208			LM308			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	T_A = 25°C		0.7	2.0		2.0	7.5	mV
Input Offset Current	T_A = 25°C		0.05	0.2		0.2	1	nA
Input Bias Current	T_A = 25°C		0.8	2.0		1.5	7	nA
Input Resistance	T_A = 25°C	30	70		10	40		MΩ
Supply Current	T_A = 25°C		0.3	0.6		0.3	0.8	mA
Large Signal Voltage	T_A = 25°C, V_S = ±15V	50	300		25	300		V/mV
Gain	V_{OUT} = ±10V, R_L ≥ 10 kΩ							
Input Offset Voltage				3.0			10	mV
Average Temperature								
Coefficient of Input			3.0	15		6.0	30	μV/°C
Offset Voltage								
Input Offset Current				0.4			1.5	nA
Average Temperature								
Coefficient of Input			0.5	2.5		2.0	10	pA/°C
Offset Current								
Input Bias Current				3.0			10	nA
Supply Current	T_A = +125°C		0.15	0.4				mA
Large Signal Voltage	V_S = ±15V, V_{OUT} = ±10V	25			15			V/mV
Gain	R_L ≥ 10 kΩ							
Output Voltage Swing	V_S = ±15V, R_L = 10 kΩ	±13	±14		±13	±14		V
Input Voltage Range	V_S = ±15V	±13.5			±14			V
Common Mode		85	100		80	100		dB
Rejection Ratio								
Supply Voltage		80	96		80	96		dB
Rejection Ratio								

(1) These specifications apply for ±5V ≤ V_S ≤ ±20V and −55°C ≤ T_A ≤ +125°C, unless otherwise specified. With the LM208, however, all temperature specifications are limited to −25°C ≤ T_A ≤ 85°C, and for the LM308 they are limited to 0°C ≤ T_A ≤ 70°C.

SCHEMATIC DIAGRAM



TYPICAL PERFORMANCE CHARACTERISTICS – LM108/LM208

Input Currents

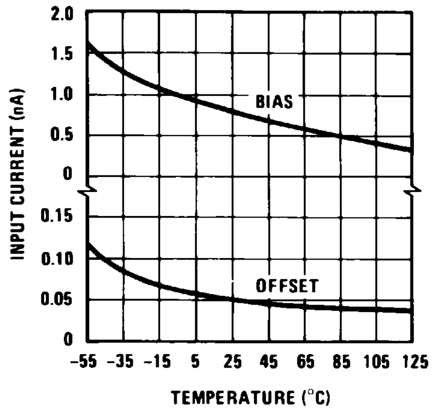


Figure 4.

Offset Error

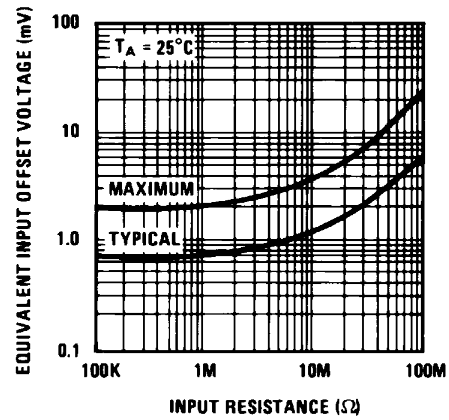


Figure 5.

Drift Error

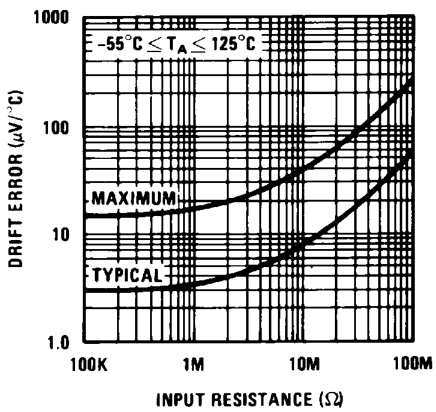


Figure 6.

Input Noise Voltage

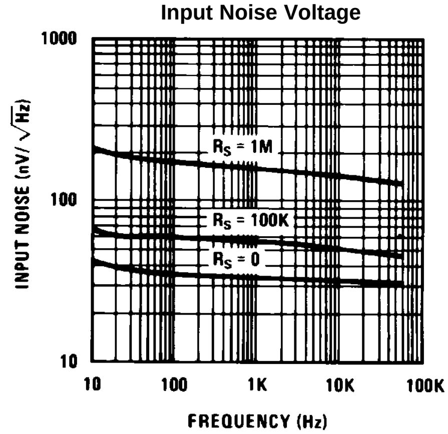


Figure 7.

Power Supply Rejection

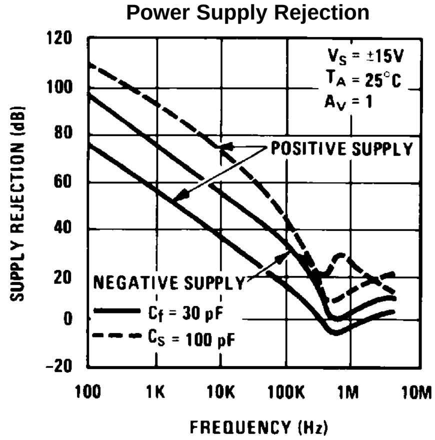


Figure 8.

Closed Loop
Output Impedance

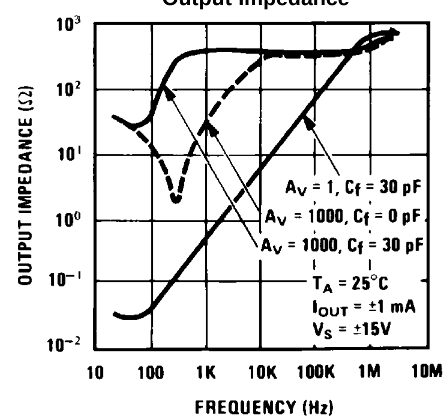


Figure 9.

TYPICAL PERFORMANCE CHARACTERISTICS – LM108/LM208 (continued)

Voltage Gain

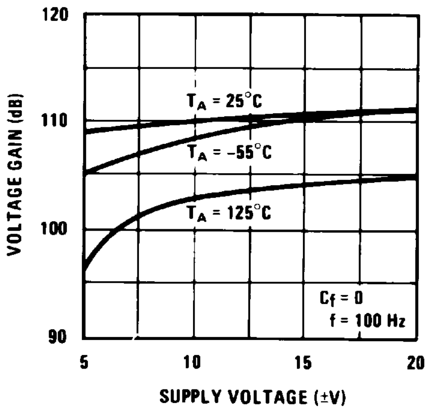


Figure 10.

Output Swing

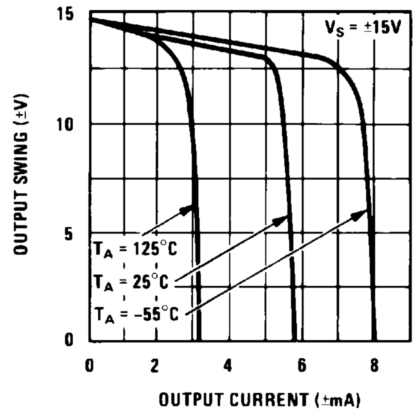


Figure 11.

Supply Current

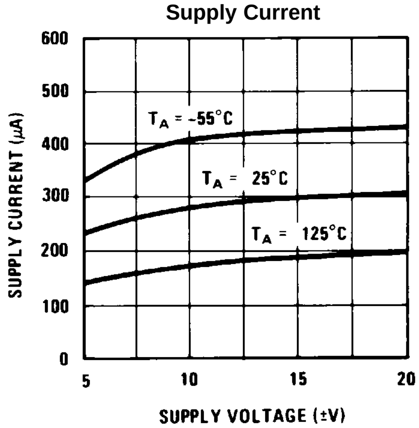


Figure 12.

Open Loop
Frequency Response

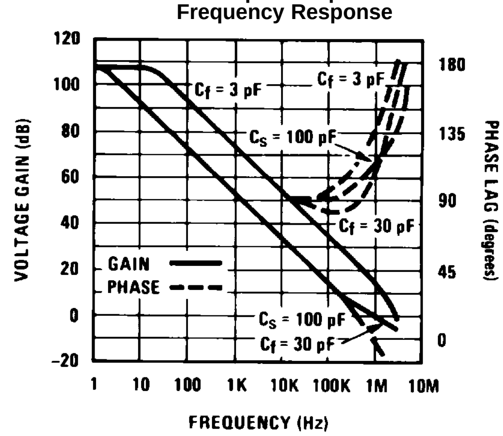


Figure 13.

Large Signal
Frequency Response

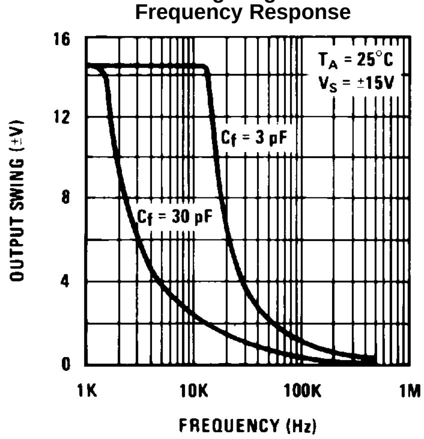


Figure 14.

Voltage Follower
Pulse Response

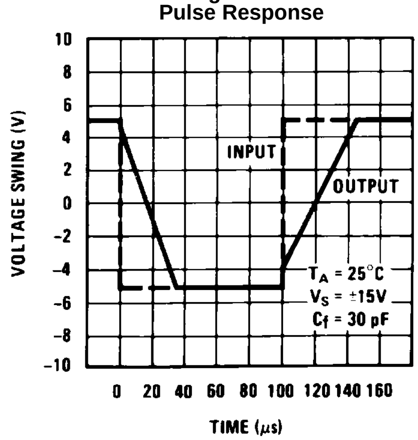


Figure 15.

TYPICAL PERFORMANCE CHARACTERISTICS – LM308

Input Currents

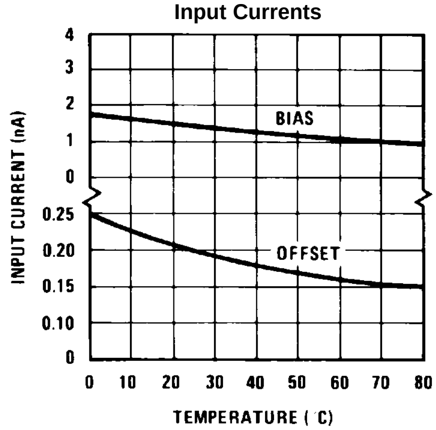


Figure 16.

Offset Error

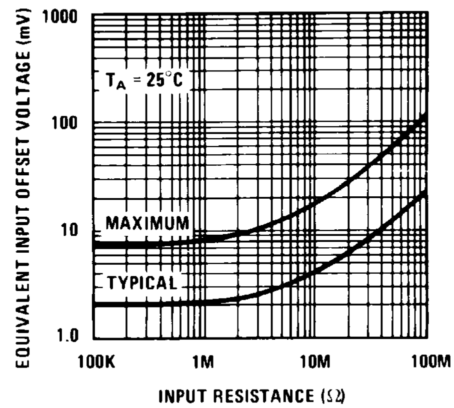


Figure 17.

Drift Error

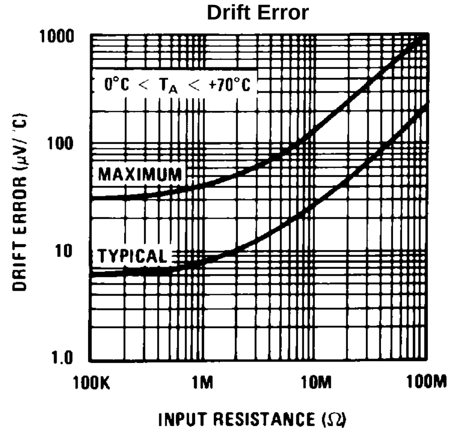


Figure 18.

Input Noise Voltage

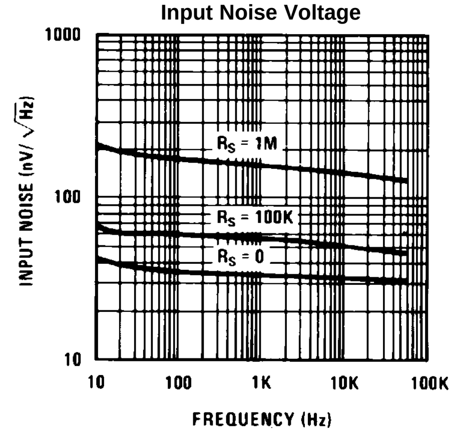


Figure 19.

Power Supply Rejection

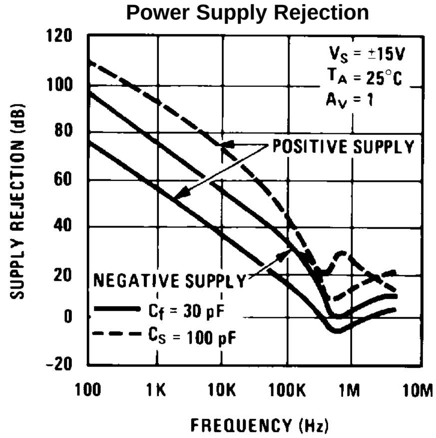


Figure 20.

Closed Loop Output Impedance

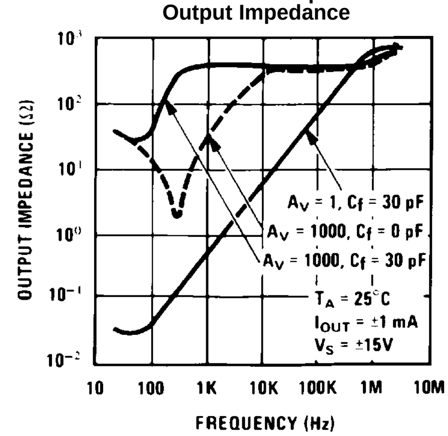


Figure 21.

TYPICAL PERFORMANCE CHARACTERISTICS – LM308 (continued)

Voltage Gain

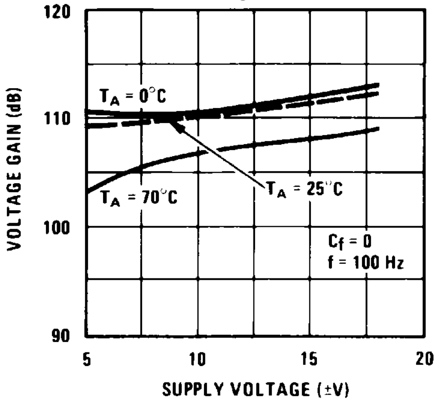


Figure 22.

Output Swing

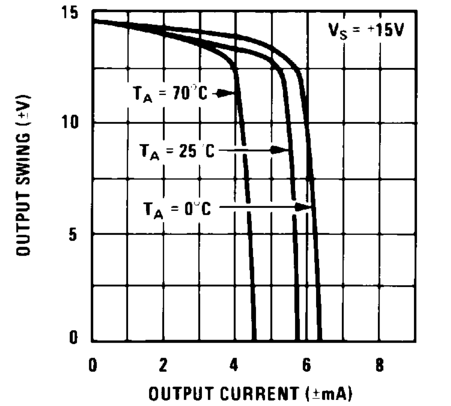


Figure 23.

Supply Current

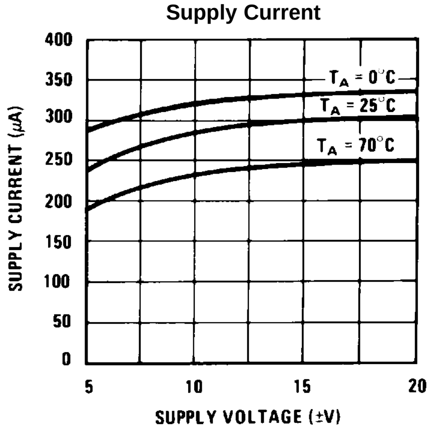


Figure 24.

Open Loop Frequency Response

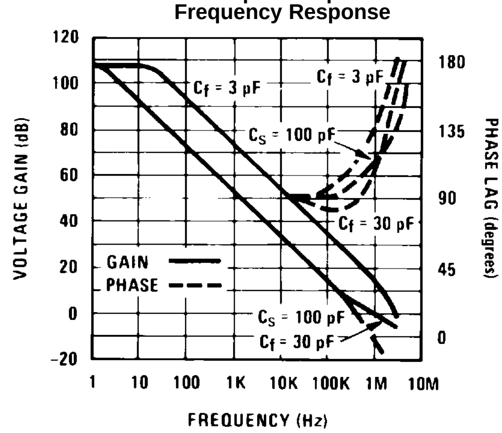


Figure 25.

Large Signal Frequency Response

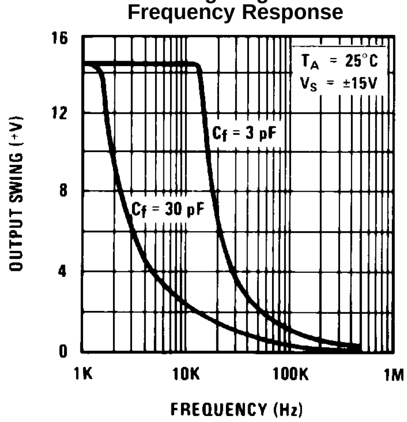


Figure 26.

Voltage Follower Pulse Response

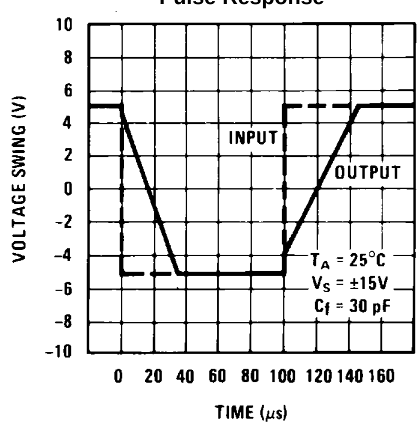


Figure 27.

TYPICAL PERFORMANCE CHARACTERISTICS – LM308 (continued)

Open Loop
Frequency Response

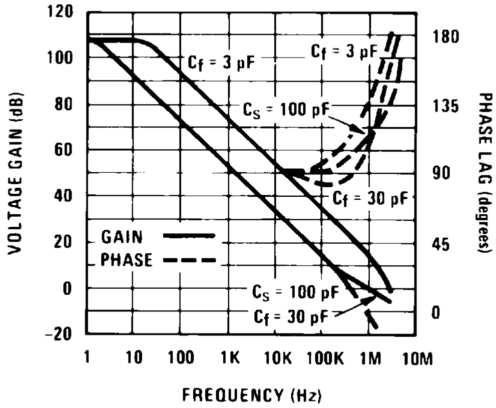


Figure 28.

Large Signal
Frequency Response

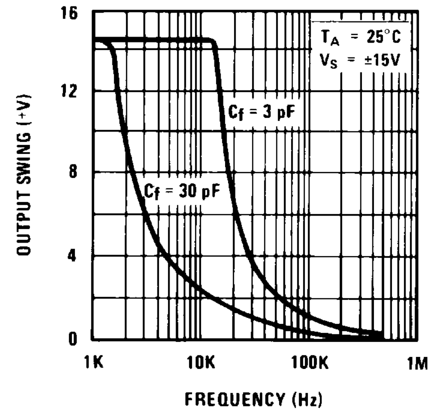


Figure 29.

Voltage Follower
Pulse Response

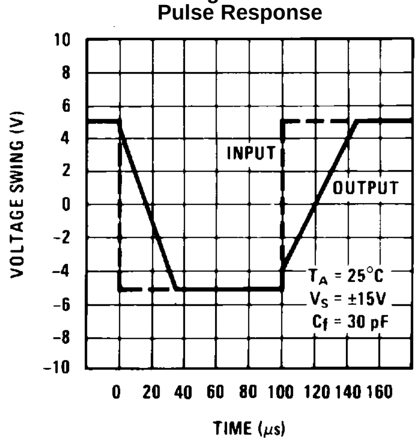
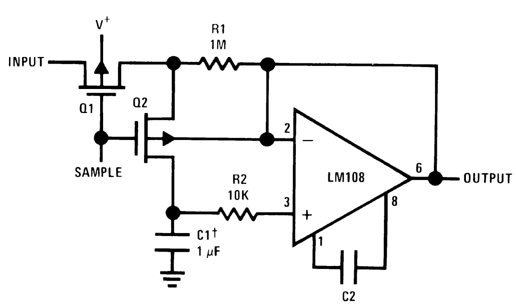


Figure 30.

TYPICAL APPLICATIONS



†Teflon polyethylene or polycarbonate dielectric capacitor
Worst case drift less than 2.5 mV/sec

Figure 31. Sample and Hold

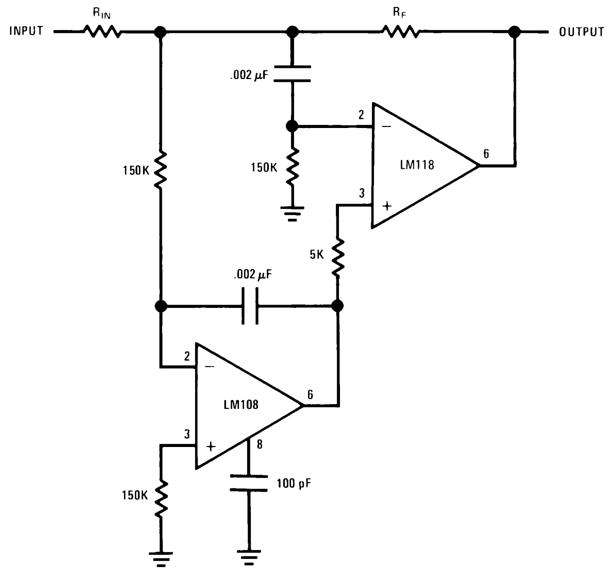
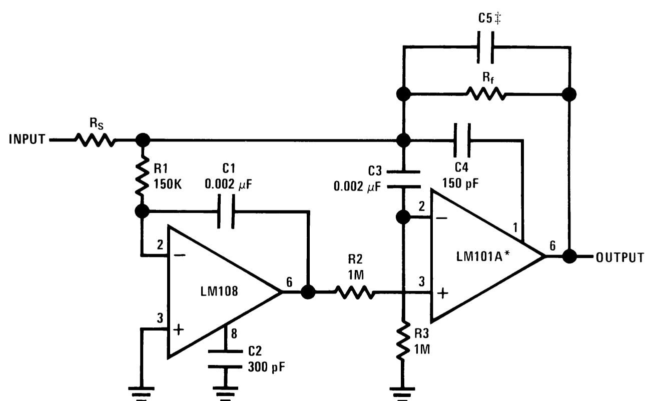


Figure 32. High Speed Amplifier with Low Drift and Low Input Current



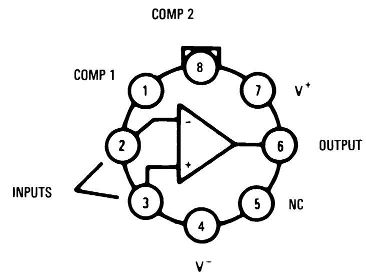
$$‡C5 = \frac{6 \times 10^{-8}}{R_f}$$

*In addition to increasing speed, the LM101A raises high and low frequency gain, increases output drive capability and eliminates thermal feedback.

1. Power Bandwidth: 250 KHz; Small Signal Bandwidth: 3.5 MHz; Slew Rate: 10V/µS

Figure 33. Fast Summing Amplifier(1)

CONNECTION DIAGRAMS



(1) Package is connected to Pin 4 (V⁻)

(2) Unused pin (no internal connection) to allow for input anti-leakage guard ring on printed circuit board layout.

Figure 34. Metal Can Package(1)(2)

Dual-In-Line Package

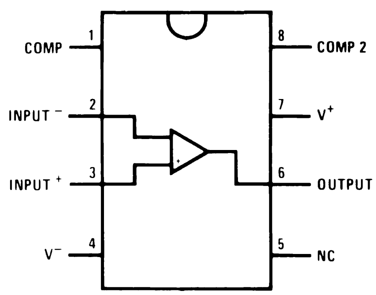


Figure 35. Top View (8-Pin)

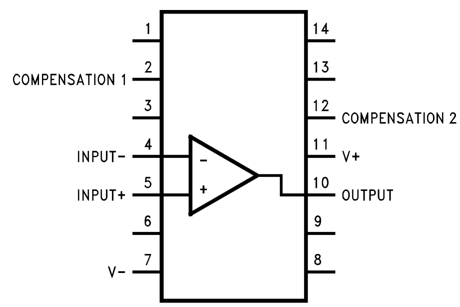


Figure 36. Top View (14-Pin)

†Also available per JM38510/10104

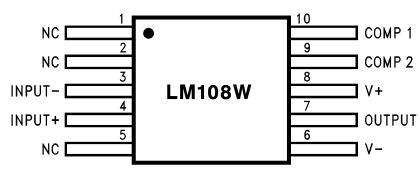


Figure 37. Top View (10-Pin)

REVISION HISTORY

Changes from Revision A (April 2013) to Revision B	Page
• Changed layout of National Data Sheet to TI format	11

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