



MOTOROLA

Precision Operational Amplifier

The LM308A operational amplifier provides high input impedance, low input offset and temperature drift, and low noise. These characteristics are made possible by use of a special Super Beta processing technology. This amplifier is particularly useful for applications where high accuracy and low drift performance are essential. In addition high speed performance may be improved by employing feedforward compensation techniques to maximize slew rate without compromising other performance criteria.

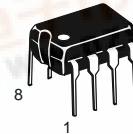
The LM308A offers extremely low input offset voltage and drift specifications allowing usage in even the most critical applications without external offset nulling.

- Operation from a Wide Range of Power Supply Voltages
- Low Input Bias and Offset Currents
- Low Input Offset Voltage and Guaranteed Offset Voltage Drift Performance
- High Input Impedance

LM308A

SUPER GAIN OPERATIONAL AMPLIFIER

SEMICONDUCTOR TECHNICAL DATA



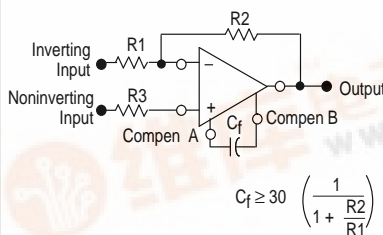
N SUFFIX
PLASTIC PACKAGE
CASE 626



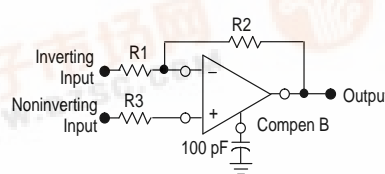
D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)

Frequency Compensation

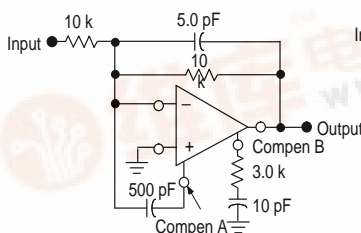
Standard Compensation



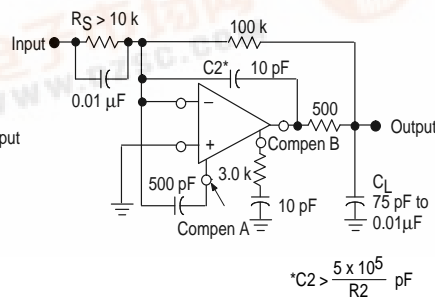
Modified Compensation



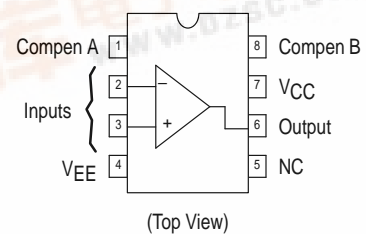
Standard Feedforward Compensation



Feedforward Compensations for Decoupling Load Capacitance



PIN CONNECTIONS



ORDERING INFORMATION

| Device | Operating Temperature Range | Package |
|--------------------|--|---------------------|
| LM308AN LM308AD | $T_A = 0^\circ \text{ to } +70^\circ \text{C}$ | Plastic DIP SO-8 |

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MAXIMUM RATINGS (T_A = +25°C, unless otherwise noted.)

| Rating | Symbol | Value | Unit |
|--|-----------------------------------|-------------|------|
| Power Supply Voltage | V _{CC} , V _{EE} | ±18 | Vdc |
| Input Voltage (See Note 1) | V _I | ±15 | V |
| Input Differential Current (See Note 2) | I _{ID} | ±10 | mA |
| Output Short Circuit Duration | t _{SC} | Indefinite | |
| Operating Ambient Temperature Range | T _A | 0 to +70 | °C |
| Storage Temperature Range | T _{stg} | –65 to +150 | °C |
| Junction Temperature | T _J | +150 | °C |

- NOTES:** 1. For supply voltages less than ±15 V, the maximum input voltage is equal to the supply voltage.
 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 1.0 V is applied between the inputs, unless some limiting resistance is used.

ELECTRICAL CHARACTERISTICS (Unless otherwise noted these specifications apply for supply voltages of +5.0 V ≤ V_{CC} ≤ +15 V and –5.0 V ≥ V_{EE} ≥ –15 V, T_A = +25°C.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|-----------------------------------|-----|------|------|------|
| Input Offset Voltage | V _{IO} | – | 0.3 | 0.5 | mV |
| Input Offset Current | I _{IO} | – | 0.2 | 1.0 | nA |
| Input Bias Current | I _{IB} | – | 1.5 | 7.0 | nA |
| Input Resistance | r _i | 10 | 40 | – | MΩ |
| Power Supply Currents (V _{CC} = +15 V, V _{EE} = –15 V) | I _{CC} , I _{EE} | – | ±0.3 | ±0.8 | mA |
| Large Signal Voltage Gain (V _{CC} = +15 V, V _{EE} = –15 V, V _O = ±10 V, R _L ≥ 10 kΩ) | A _{VOL} | 80 | 300 | – | V/mV |

The following specifications apply over the operating temperature range.

| | | | | | |
|---|----------------------|-----|-----|------|-------|
| Input Offset Voltage | V _{IO} | – | – | 0.73 | mV |
| Input Offset Current | I _{IO} | – | – | 1.5 | nA |
| Average Temperature Coefficient of Input Offset Voltage T _A (min) ≤ T _A ≤ T _A (max) | ΔV _{IO} /ΔT | – | 1.0 | 5.0 | μV/°C |
| Average Temperature Coefficient of Input Offset Current | ΔI _{IO} /ΔT | – | 2.0 | 10 | pA/°C |
| Input Bias Current | I _{IB} | – | – | 10 | nA |
| Large Signal Voltage Gain (V _{CC} = +15 V, V _{EE} = –15 V, V _O = ±10 V, R _L ≥ 10 kΩ) | A _{VOL} | 60 | – | – | V/mV |
| Input Voltage Range (V _{CC} = +15 V, V _{EE} = –15 V) | V _{ICR} | ±14 | – | – | V |
| Common Mode Rejection (R _S ≤ 50 kΩ) | CMR | 96 | 110 | – | dB |
| Supply Voltage Rejection (R _S ≤ 50 kΩ) | PSR | 96 | 110 | – | dB |
| Output Voltage Range (V _{CC} = +15 V, V _{EE} = –15 V, R _L = 10 kΩ) | V _{OR} | ±13 | ±14 | – | V |

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Figure 1. Input Bias and Input Offset Currents

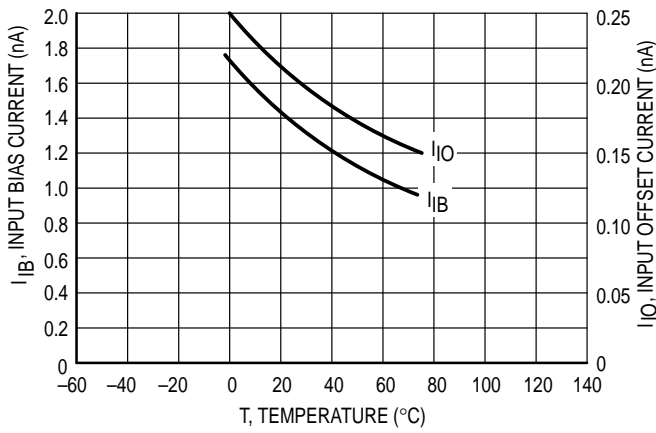


Figure 2. Maximum Equivalent Input Offset Voltage Error versus Input Resistance

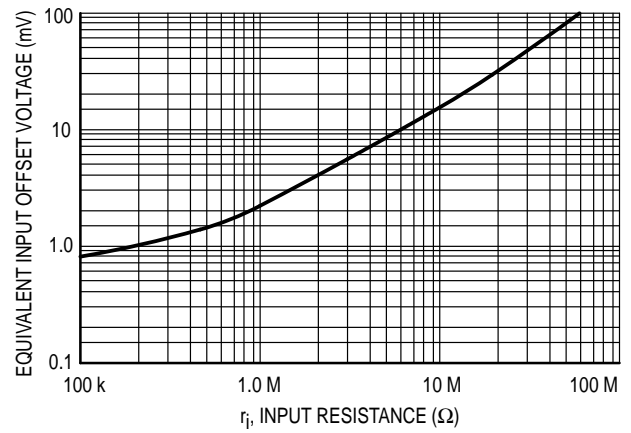


Figure 3. Voltage Gain versus Supply Voltages

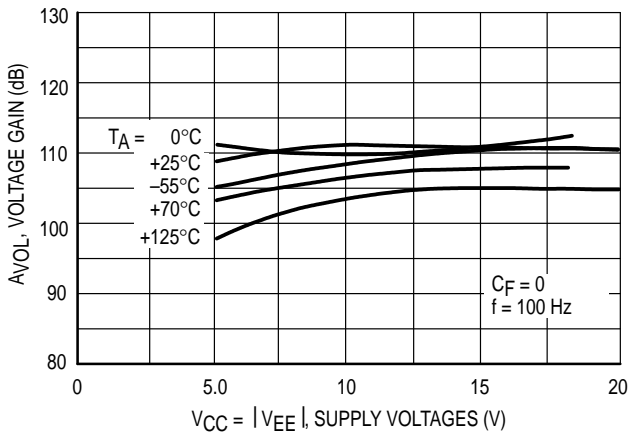


Figure 4. Power Supply Currents versus Power Supply Voltages

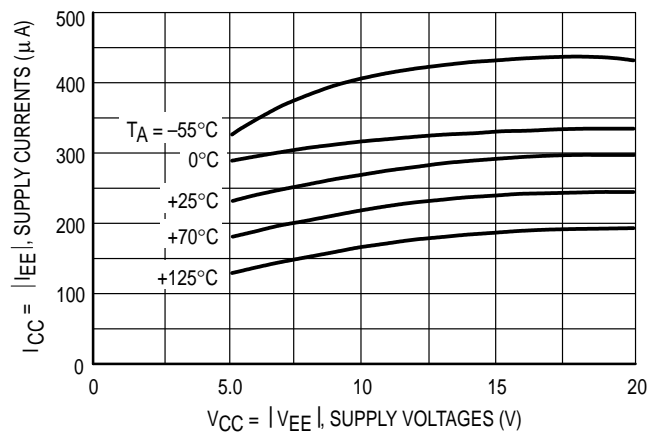


Figure 5. Open Loop Frequency Response

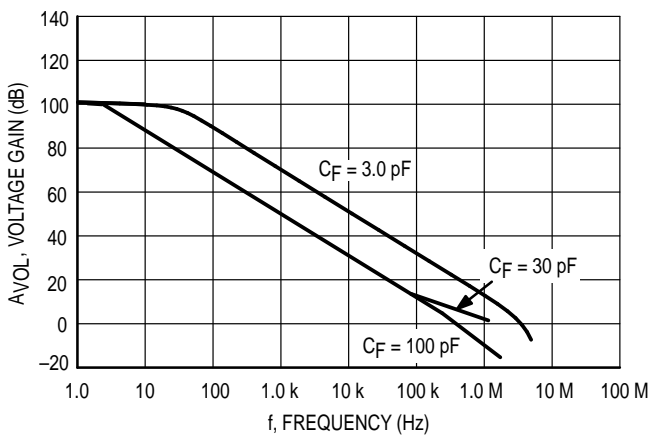
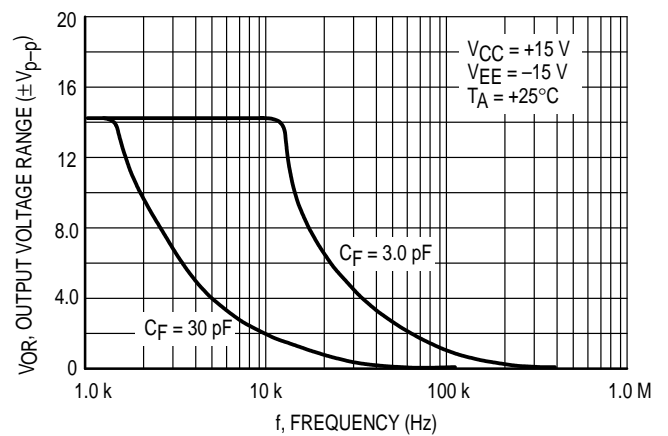


Figure 6. Large Signal Frequency Response



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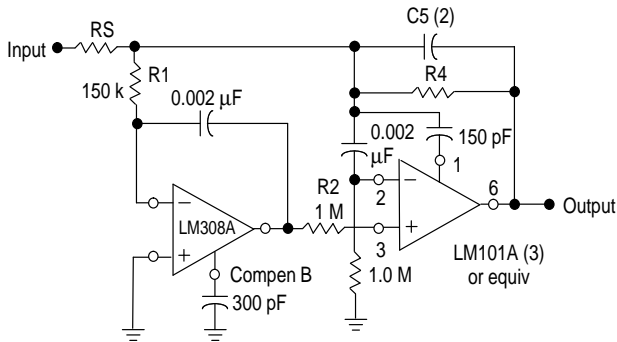
SUGGESTED DESIGN APPLICATIONS

INPUT GUARDING

Special care must be taken in the assembly of printed circuit boards to take full advantage of the low input currents of the LM308A amplifier. Boards must be thoroughly cleaned with 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.

Figure 7. Fast (1) Summing Amplifier with Low Input Current

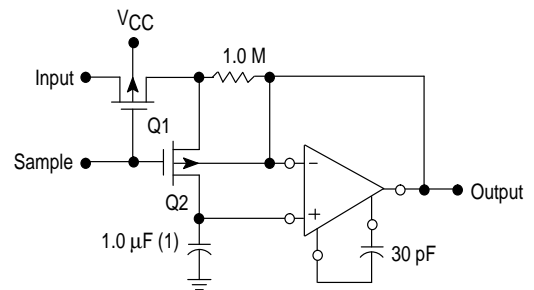


- (1) Power Bandwidth: 250 kHz
Small Signal Bandwidth:
3.5 MHz
Slew Rate: 10 V/μs

$$(2) C5 = \frac{6 \times 10^{-8}}{R1}$$

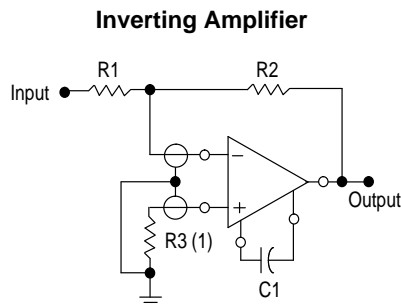
- (3) In addition to increasing speed, the LM101A raises high and low frequency gain, increases output drive capability and eliminates thermal feedback.

Figure 8. Sample and Hold

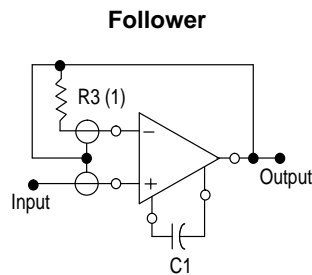


- (1) Teflon, Polyethylene or Polycarbonate Dielectric Capacitor

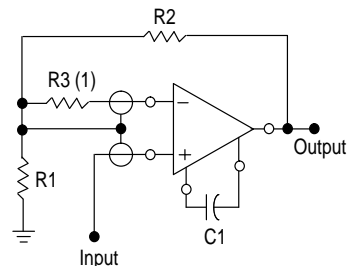
Figure 9. Connection of Input Guards



- (1) Used to compensate for large source resistances.



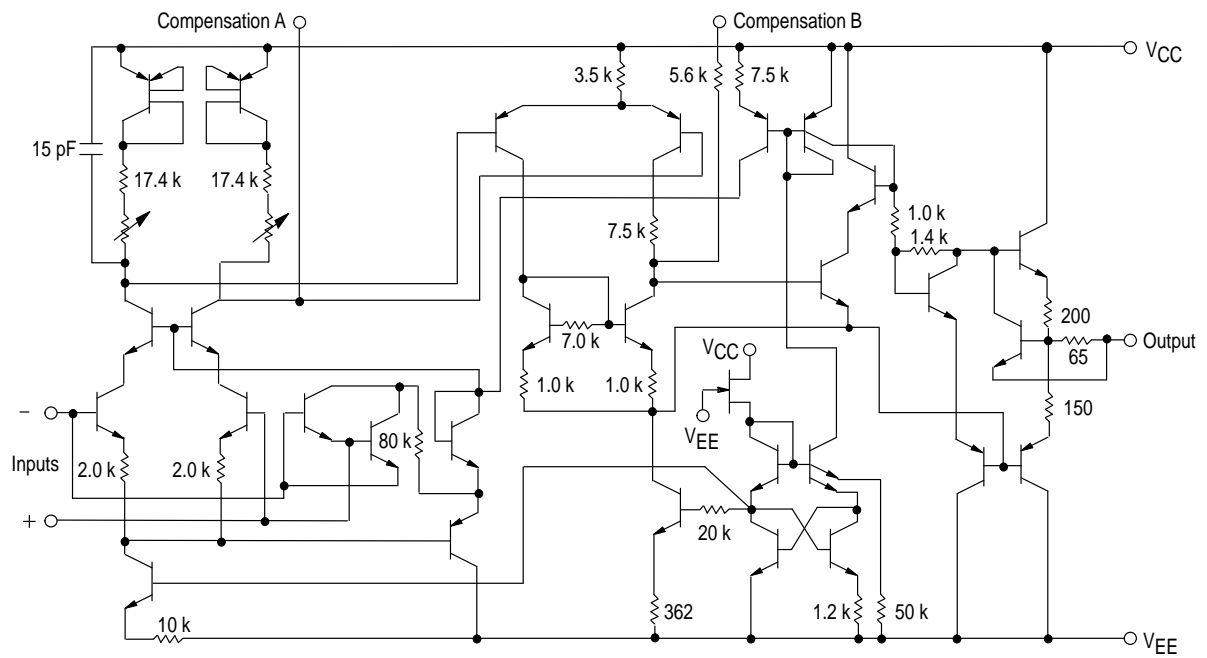
Noninverting Amplifier



Note: $\frac{R1 R2}{R1 + R2}$ must be an impedance.

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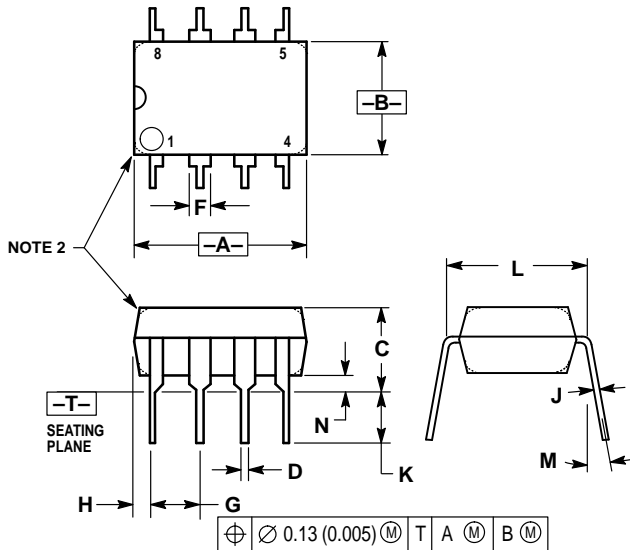
Representative Circuit Schematic



LM308A

OUTLINE DIMENSIONS

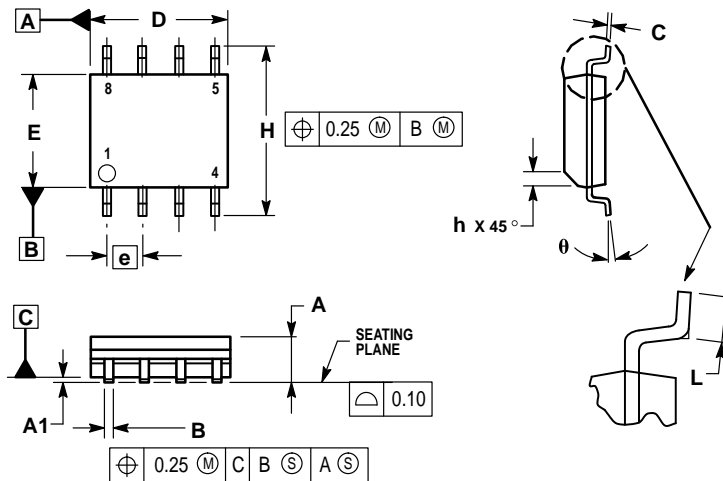
N SUFFIX PLASTIC PACKAGE CASE 626-05 ISSUE K



- NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
 2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
 3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 9.40 | 10.16 | 0.370 | 0.400 |
| B | 6.10 | 6.60 | 0.240 | 0.260 |
| C | 3.94 | 4.45 | 0.155 | 0.175 |
| D | 0.38 | 0.51 | 0.015 | 0.020 |
| E | 1.02 | 1.78 | 0.040 | 0.070 |
| F | 2.54 BSC | | 0.100 BSC | |
| G | 0.76 | 1.27 | 0.030 | 0.050 |
| H | 0.20 | 0.30 | 0.008 | 0.012 |
| I | 2.92 | 3.43 | 0.115 | 0.135 |
| J | 7.62 BSC | | 0.300 BSC | |
| K | — | 10° | — | 10° |
| L | 0.76 | 1.01 | 0.030 | 0.040 |


D SUFFIX PLASTIC PACKAGE CASE 751-05 (SO-8) ISSUE R



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 2. DIMENSIONS ARE IN MILLIMETERS.
 3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
 5. DIMENSION B DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | |
|-----|-------------|------|
| | MIN | MAX |
| A | 1.35 | 1.75 |
| A1 | 0.10 | 0.25 |
| B | 0.35 | 0.49 |
| C | 0.18 | 0.25 |
| D | 4.80 | 5.00 |
| E | 3.80 | 4.00 |
| e | 1.27 BSC | |
| H | 5.80 | 6.20 |
| h | 0.25 | 0.50 |
| L | 0.40 | 1.25 |
| θ | 0° | 7° |

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