



# MC33272A MC33274A

## Single Supply, High Slew Rate Low Input Offset Voltage, Bipolar Operational Amplifiers

The MC33272/74 series of monolithic operational amplifiers are quality fabricated with innovative Bipolar design concepts. This dual and quad operational amplifier series incorporates Bipolar inputs along with a patented Zip-R-Trim element for input offset voltage reduction. The MC33272/74 series of operational amplifiers exhibits low input offset voltage and high gain bandwidth product. Dual-doublet frequency compensation is used to increase the slew rate while maintaining low input noise characteristics. Its all NPN output stage exhibits no deadband crossover distortion, large output voltage swing, and an excellent phase and gain margin. It also provides a low open loop high frequency output impedance with symmetrical source and sink AC frequency performance.

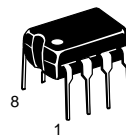
The MC33272/74 series is specified over  $-40^{\circ}$  to  $+85^{\circ}\text{C}$  and are available in plastic DIP and SOIC surface mount packages.

- Input Offset Voltage Trimmed to  $100\ \mu\text{V}$  (Typ)
- Low Input Bias Current:  $300\ \text{nA}$
- Low Input Offset Current:  $3.0\ \text{nA}$
- High Input Resistance:  $16\ \text{M}\Omega$
- Low Noise:  $18\ \text{nV}/\sqrt{\text{Hz}}$  @  $1.0\ \text{kHz}$
- High Gain Bandwidth Product:  $24\ \text{MHz}$  @  $100\ \text{kHz}$
- High Slew Rate:  $10\ \text{V}/\mu\text{s}$
- Power Bandwidth:  $160\ \text{kHz}$
- Excellent Frequency Stability
- Unity Gain Stable: w/Capacitance Loads to  $500\ \text{pF}$
- Large Output Voltage Swing:  $+14.1\ \text{V}/-14.6\ \text{V}$
- Low Total Harmonic Distortion:  $0.003\%$
- Power Supply Drain Current:  $2.15\ \text{mA}$  per Amplifier
- Single or Split Supply Operation:  $+3.0\ \text{V}$  to  $+36\ \text{V}$  or  $\pm 1.5\ \text{V}$  to  $\pm 18\ \text{V}$
- ESD Diodes Provide Added Protection to the Inputs

### ORDERING INFORMATION

| Op Amp Function | Device    | Operating Temperature Range                  | Package     |
|-----------------|-----------|--|-------------|
| Dual            | MC33272AD | $T_A = -40^{\circ}$ to $+85^{\circ}\text{C}$ | SO-8        |
|                 | MC33272AP |  | Plastic DIP |
| Quad            | MC33274AD |  | SO-14       |
|                 | MC33274AP |  | Plastic DIP |

### HIGH PERFORMANCE OPERATIONAL AMPLIFIERS SEMICONDUCTOR TECHNICAL DATA

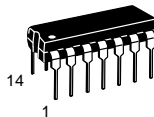
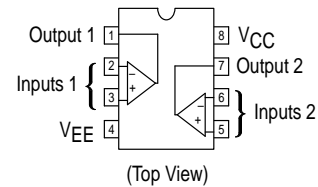


**P SUFFIX**  
PLASTIC PACKAGE  
CASE 626

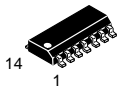


**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751  
(SO-8)

#### PIN CONNECTIONS

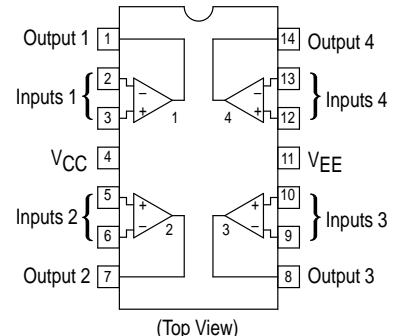


**P SUFFIX**  
PLASTIC PACKAGE  
CASE 646



**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751A  
(SO-14)

#### PIN CONNECTIONS



# MC33272A MC33274A

## MAXIMUM RATINGS

| Rating                                 | Symbol               | Value       | Unit |
|--|----------------------|-------------|------|
| Supply Voltage                         | $V_{CC}$ to $V_{EE}$ | +36         | V    |
| Input Differential Voltage Range       | $V_{IDR}$            | (Note 1)    | V    |
| Input Voltage Range                    | $V_{IR}$             | (Note 1)    | V    |
| Output Short Circuit Duration (Note 2) | $t_{SC}$             | Indefinite  | sec  |
| Maximum Junction Temperature           | $T_J$                | +150        | °C   |
| Storage Temperature                    | $T_{stg}$            | -60 to +150 | °C   |
| Maximum Power Dissipation              | $P_D$                | (Note 2)    | mW   |

**NOTES:** 1. Either or both input voltages should not exceed  $V_{CC}$  or  $V_{EE}$ .  
 2. Power dissipation must be considered to ensure maximum junction temperature ( $T_J$ ) is not exceeded (see Figure 2).

## DC ELECTRICAL CHARACTERISTICS ( $V_{CC} = +15$ V, $V_{EE} = -15$ V, $T_A = 25^\circ$ C, unless otherwise noted.)

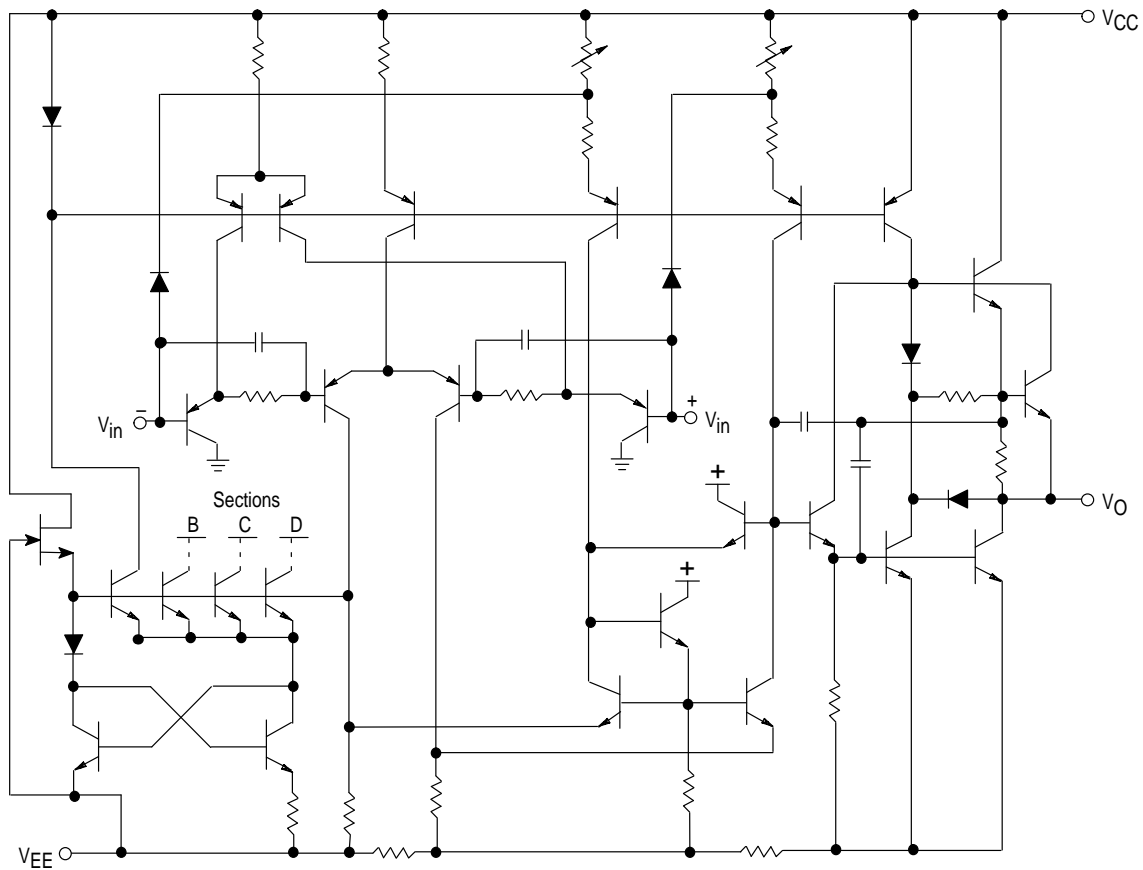
| Characteristics  | Figure                 | Symbol   | Min                                    | Typ  | Max  | Unit       |
|--|------------------------|--|--|--|--|------------|
| Input Offset Voltage ( $R_S = 10 \Omega$ , $V_{CM} = 0$ V, $V_O = 0$ V)<br>( $V_{CC} = +15$ V, $V_{EE} = -15$ V)<br>$T_A = +25^\circ$ C<br>$T_A = -40^\circ$ to $+85^\circ$ C<br>( $V_{CC} = 5.0$ V, $V_{EE} = 0$ )<br>$T_A = +25^\circ$ C | 3                      | $ V_{IO} $   | —                                      | 0.1  | 1.0  | mV         |
| Average Temperature Coefficient of Input Offset Voltage<br>$R_S = 10 \Omega$ , $V_{CM} = 0$ V, $V_O = 0$ V, $T_A = -40^\circ$ to $+85^\circ$ C   | 3                      | $\Delta V_{IO}/\Delta T$   | —                                      | 2.0  | —  | $\mu$ V/°C |
| Input Bias Current ( $V_{CM} = 0$ V, $V_O = 0$ V)<br>$T_A = +25^\circ$ C<br>$T_A = -40^\circ$ to $+85^\circ$ C   | 4, 5                   | $I_{IB}$   | —                                      | 300  | 650  | nA         |
| Input Offset Current ( $V_{CM} = 0$ V, $V_O = 0$ V)<br>$T_A = +25^\circ$ C<br>$T_A = -40^\circ$ to $+85^\circ$ C   |                        | $ I_{IO} $   | —                                      | 3.0  | 65   | nA         |
| Common Mode Input Voltage Range ( $\Delta V_{IO} = 5.0$ mV, $V_O = 0$ V)<br>$T_A = +25^\circ$ C  | 6                      | $V_{ICR}$  | $V_{EE}$ to $(V_{CC} - 1.8)$           |  |  | V          |
| Large Signal Voltage Gain ( $V_O = 0$ V to 10 V, $R_L = 2.0$ k $\Omega$ )<br>$T_A = +25^\circ$ C<br>$T_A = -40^\circ$ to $+85^\circ$ C   | 7                      | $A_{VOL}$  | 90<br>86                               | 100  | —  | dB         |
| Output Voltage Swing ( $V_{ID} = \pm 1.0$ V)<br>( $V_{CC} = +15$ V, $V_{EE} = -15$ V)<br>$R_L = 2.0$ k $\Omega$<br>$R_L = 10$ k $\Omega$<br>( $V_{CC} = 5.0$ V, $V_{EE} = 0$ V)<br>$R_L = 2.0$ k $\Omega$<br>$R_L = 2.0$ k $\Omega$        | 8, 9, 12<br><br>10, 11 | $V_{O+}$<br>$V_{O-}$<br>$V_{O+}$<br>$V_{O-}$<br><br>$V_{OL}$<br>$V_{OH}$ | 13.4<br>—<br>13.4<br>—<br><br>—<br>3.7 | 13.9<br>-13.9<br>14<br>-14.7<br><br>—<br>— | —<br>-13.5<br>—<br>-14.1<br><br>0.2<br>5.0 | V          |
| Common Mode Rejection ( $V_{in} = +13.2$ V to -15 V)   | 13                     | CMR  | 80                                     | 100  | —  | dB         |
| Power Supply Rejection<br>$V_{CC}/V_{EE} = +15$ V/-15 V, +5.0 V/-15 V, +15 V/-5.0 V  | 14, 15                 | PSR  | 80                                     | 105  | —  | dB         |
| Output Short Circuit Current ( $V_{ID} = 1.0$ V, Output to Ground)<br>Source<br>Sink   | 16                     | $I_{SC}$   | +25<br>-25                             | +37<br>-37                                 | —<br>—                                     | mA         |
| Power Supply Current Per Amplifier ( $V_O = 0$ V)<br>( $V_{CC} = +15$ V, $V_{EE} = -15$ V)<br>$T_A = +25^\circ$ C<br>$T_A = -40^\circ$ to $+85^\circ$ C<br>( $V_{CC} = 5.0$ V, $V_{EE} = 0$ V)<br>$T_A = +25^\circ$ C                      | 17                     | $I_{CC}$   | —<br>—<br>—                            | 2.15<br>—<br>—                             | 2.75<br>3.0<br>2.75                        | mA         |

# MC33272A MC33274A

**AC ELECTRICAL CHARACTERISTICS** ( $V_{CC} = +15\text{ V}$ ,  $V_{EE} = -15\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

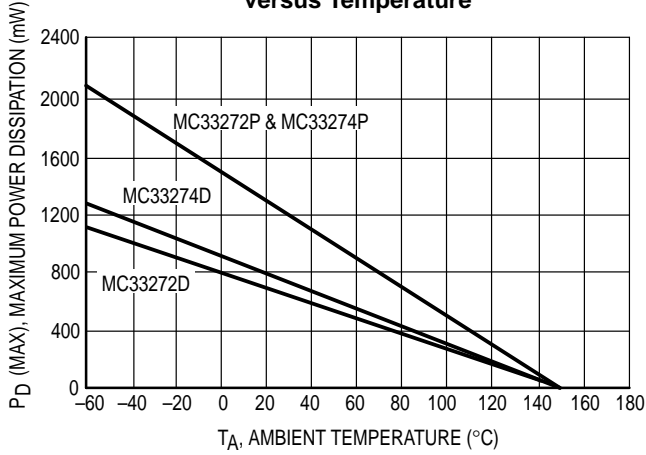
| Characteristics   | Figure     | Symbol   | Min | Typ   | Max | Unit                         |
|---|------------|----------|-----|-------|-----|------------------------------|
| Slew Rate<br>( $V_{in} = -10\text{ V}$ to $+10\text{ V}$ , $R_L = 2.0\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , $A_V = +1.0$ )                  | 18, 33     | SR       | 8.0 | 10    | —   | V/ $\mu\text{s}$             |
| Gain Bandwidth Product ( $f = 100\text{ kHz}$ )   | 19         | GBW      | 17  | 24    | —   | MHz                          |
| AC Voltage Gain ( $R_L = 2.0\text{ k}\Omega$ , $V_O = 0\text{ V}$ , $f = 20\text{ kHz}$ )   | 20, 21, 22 | $A_{VO}$ | —   | 65    | —   | dB                           |
| Unity Gain Frequency (Open Loop)  |            | $f_U$    | —   | 5.5   | —   | MHz                          |
| Gain Margin ( $R_L = 2.0\text{ k}\Omega$ , $C_L = 0\text{ pF}$ )  | 23, 24, 26 | $A_m$    | —   | 12    | —   | dB                           |
| Phase Margin ( $R_L = 2.0\text{ k}\Omega$ , $C_L = 0\text{ pF}$ )   | 23, 25, 26 | $\phi_m$ | —   | 55    | —   | Degrees                      |
| Channel Separation ( $f = 20\text{ Hz}$ to $20\text{ kHz}$ )  | 27         | CS       | —   | -120  | —   | dB                           |
| Power Bandwidth ( $V_O = 20\text{ V}_{pp}$ , $R_L = 2.0\text{ k}\Omega$ , $\text{THD} \leq 1.0\%$ )   |            | BWP      | —   | 160   | —   | kHz                          |
| Total Harmonic Distortion<br>( $R_L = 2.0\text{ k}\Omega$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$ , $V_O = 3.0\text{ V}_{rms}$ , $A_V = +1.0$ ) | 28         | THD      | —   | 0.003 | —   | %                            |
| Open Loop Output Impedance ( $V_O = 0\text{ V}$ , $f = 6.0\text{ MHz}$ )  | 29         | $ Z_O $  | —   | 35    | —   | $\Omega$                     |
| Differential Input Resistance ( $V_{CM} = 0\text{ V}$ )   |            | $R_{IN}$ | —   | 16    | —   | $M\Omega$                    |
| Differential Input Capacitance ( $V_{CM} = 0\text{ V}$ )  |            | $C_{IN}$ | —   | 3.0   | —   | pF                           |
| Equivalent Input Noise Voltage ( $R_S = 100\ \Omega$ , $f = 1.0\text{ kHz}$ )   | 30         | $e_n$    | —   | 18    | —   | $\text{nV}/\sqrt{\text{Hz}}$ |
| Equivalent Input Noise Current ( $f = 1.0\text{ kHz}$ )   | 31         | $i_n$    | —   | 0.5   | —   | $\text{pA}/\sqrt{\text{Hz}}$ |

**Figure 1. Equivalent Circuit Schematic  
(Each Amplifier)**

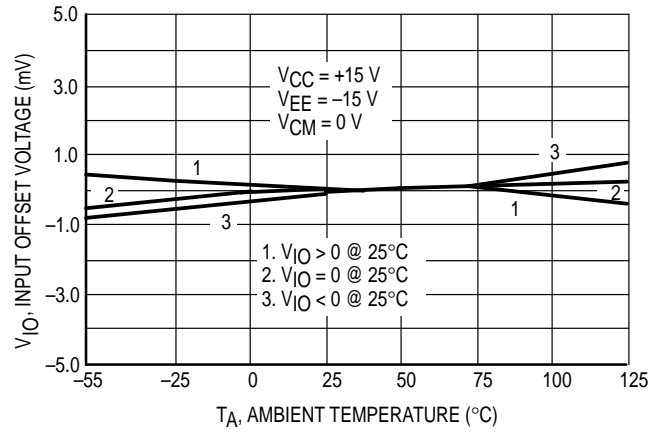


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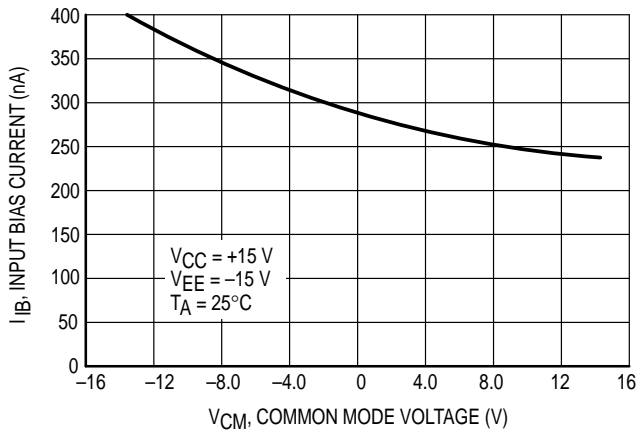
**Figure 2. Maximum Power Dissipation versus Temperature**



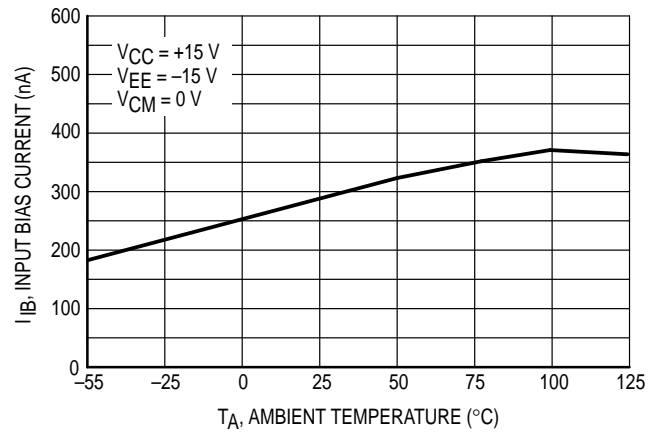
**Figure 3. Input Offset Voltage versus Temperature for Typical Units**



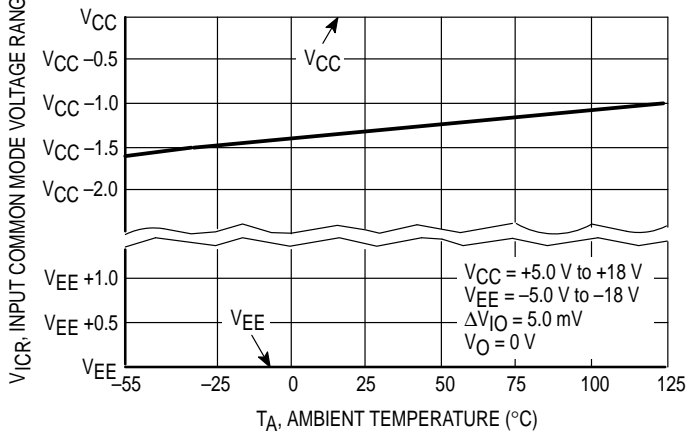
**Figure 4. Input Bias Current versus Common Mode Voltage**



**Figure 5. Input Bias Current versus Temperature**



**Figure 6. Input Common Mode Voltage Range versus Temperature**



**Figure 7. Open Loop Voltage Gain versus Temperature**

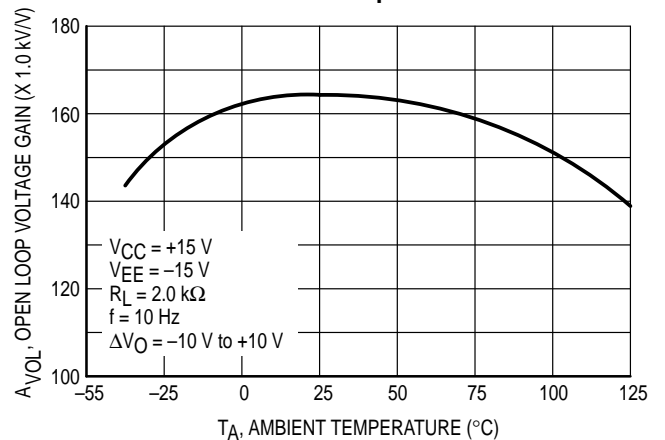


Figure 8. Split Supply Output Voltage Swing versus Supply Voltage

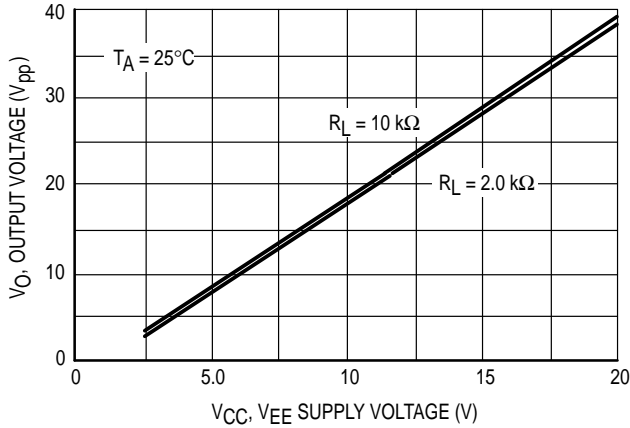


Figure 9. Split Supply Output Saturation Voltage versus Load Current

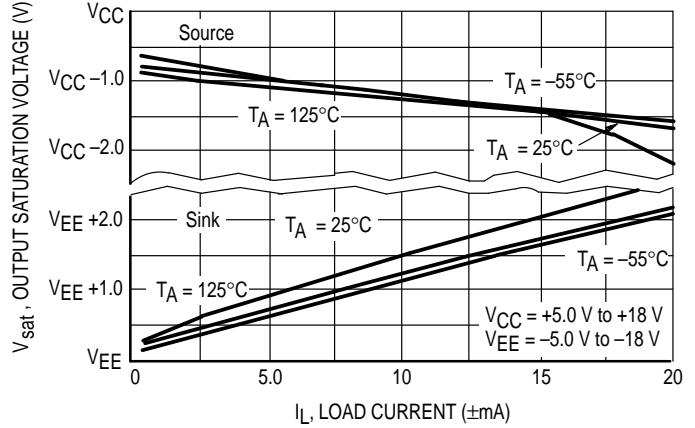


Figure 10. Single Supply Output Saturation Voltage versus Load Resistance to Ground

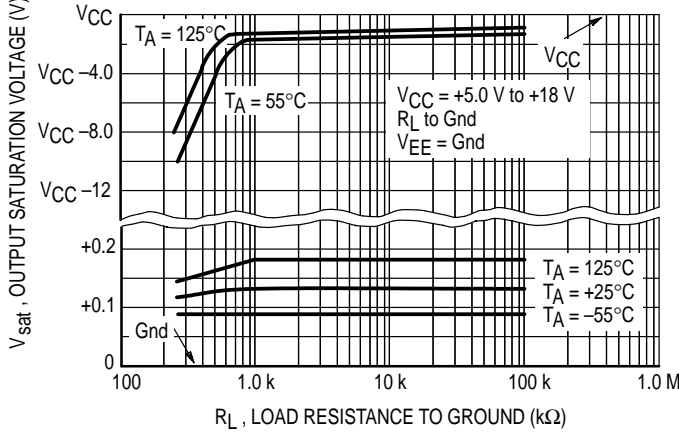


Figure 11. Single Supply Output Saturation Voltage versus Load Resistance to V<sub>CC</sub>

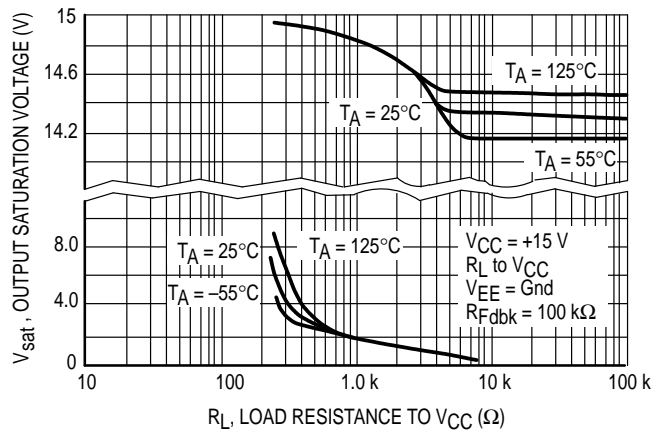


Figure 12. Output Voltage versus Frequency

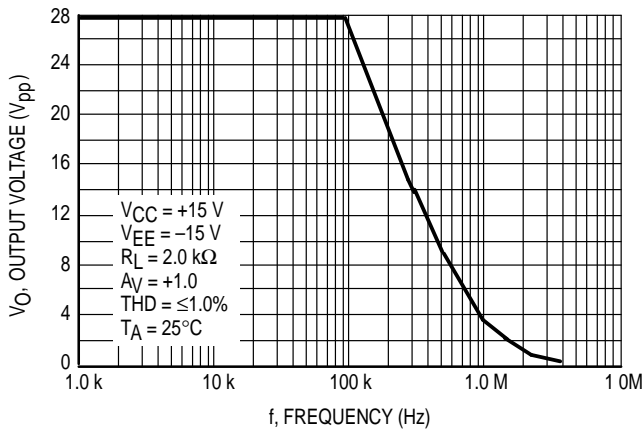


Figure 13. Common Mode Rejection versus Frequency

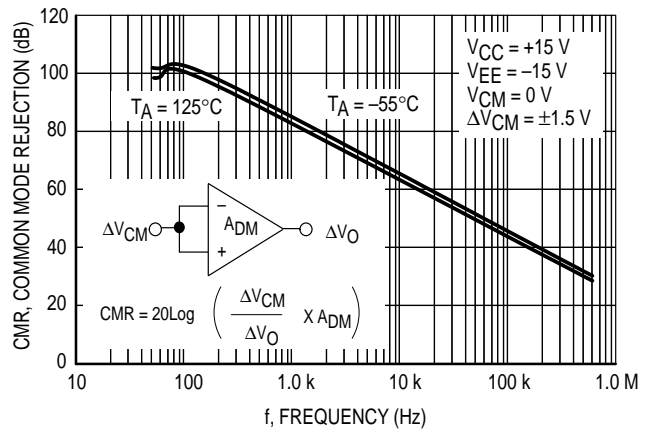


Figure 14. Positive Power Supply Rejection versus Frequency

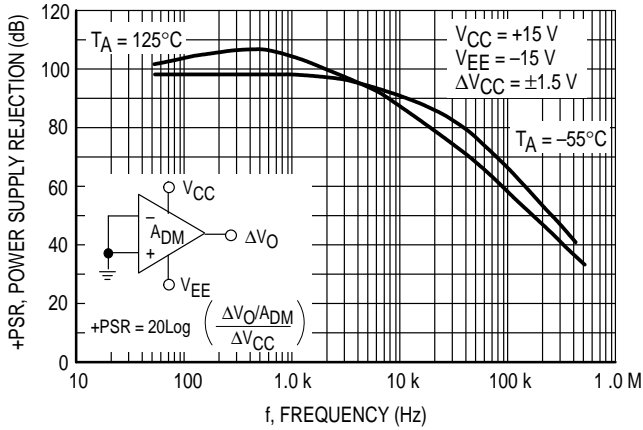


Figure 15. Negative Power Supply Rejection versus Frequency

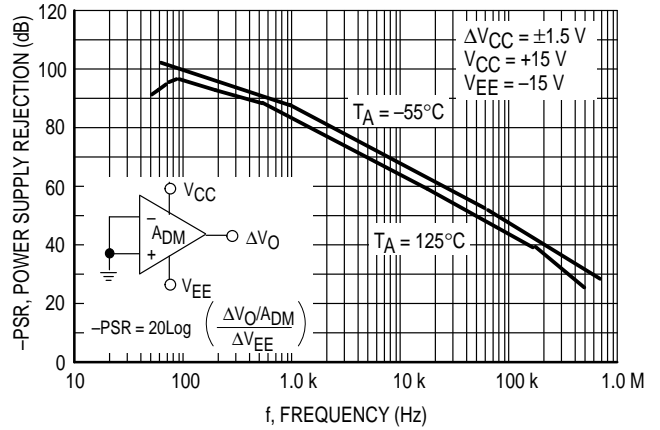


Figure 16. Output Short Circuit Current versus Temperature

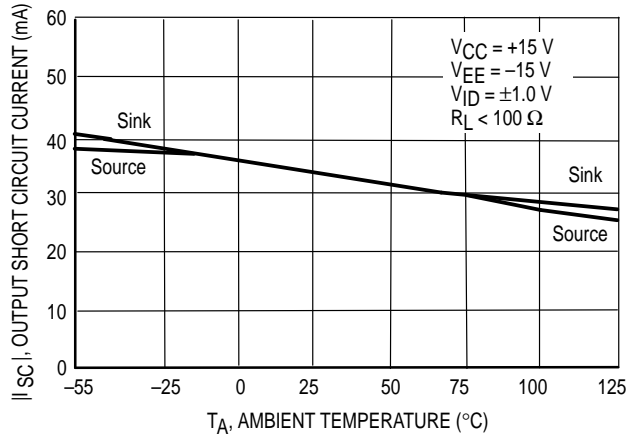


Figure 17. Supply Current versus Supply Voltage

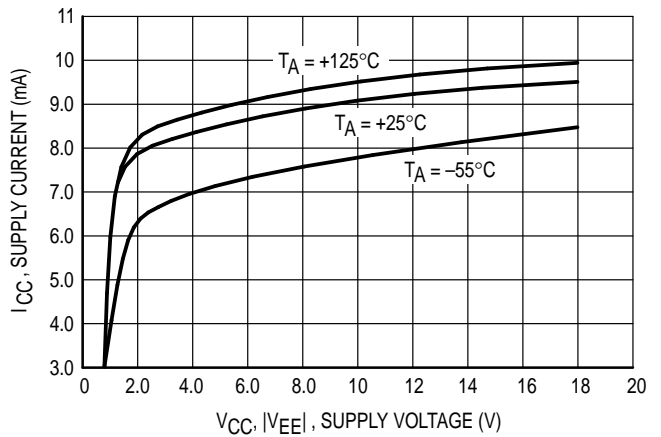


Figure 18. Normalized Slew Rate versus Temperature

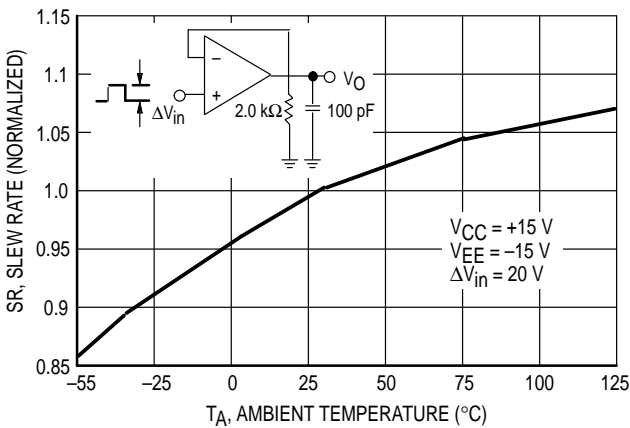


Figure 19. Gain Bandwidth Product versus Temperature

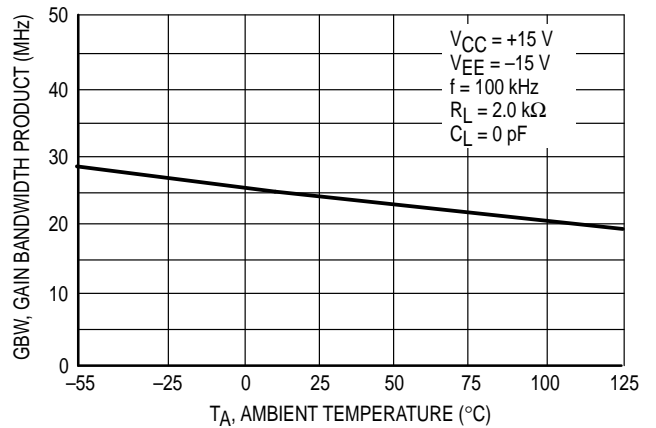


Figure 20. Voltage Gain and Phase versus Frequency

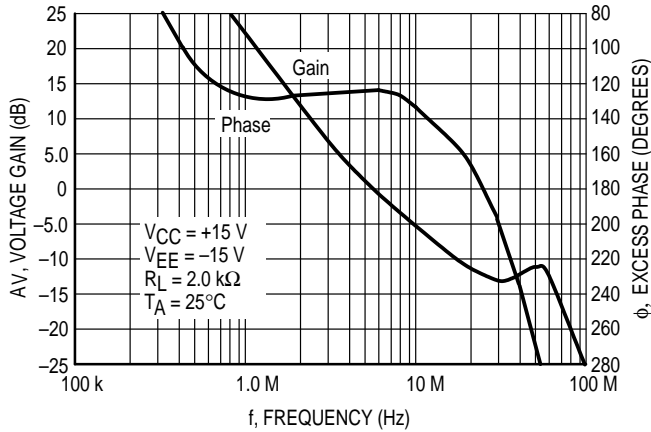


Figure 21. Gain and Phase versus Frequency

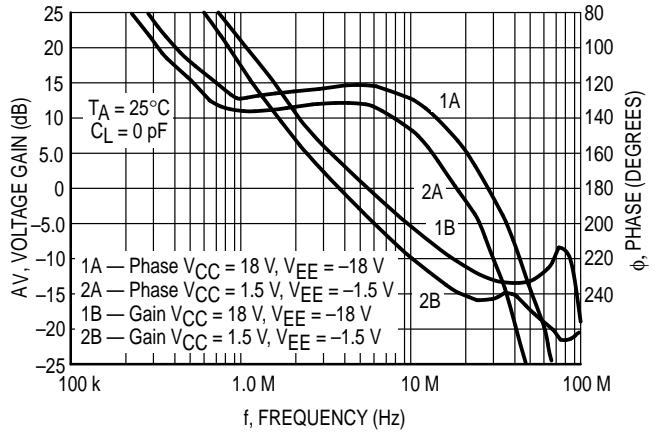


Figure 22. Open Loop Voltage Gain and Phase versus Frequency

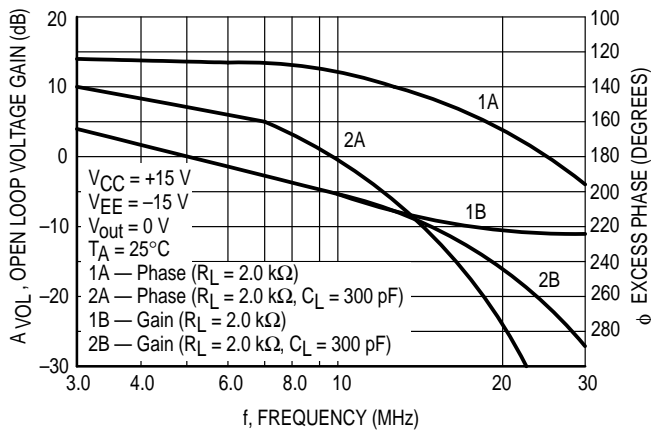


Figure 23. Open Loop Gain Margin and Phase Margin versus Output Load Capacitance

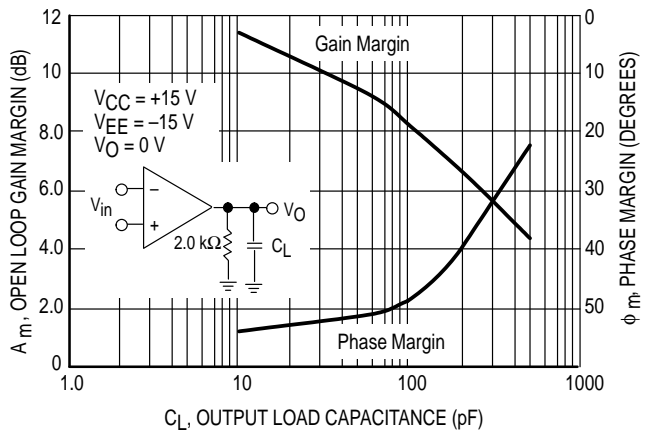


Figure 24. Open Loop Gain Margin versus Temperature

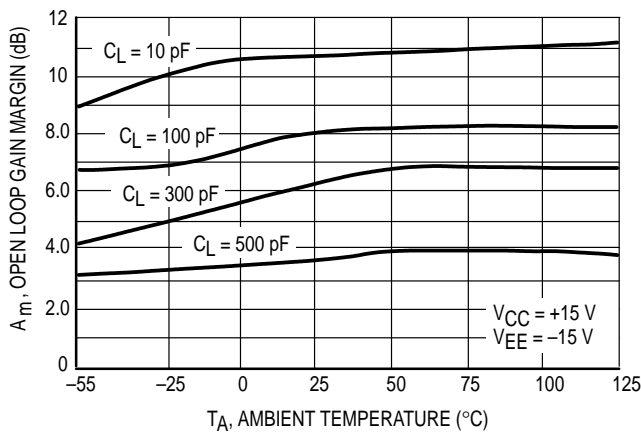


Figure 25. Phase Margin versus Temperature

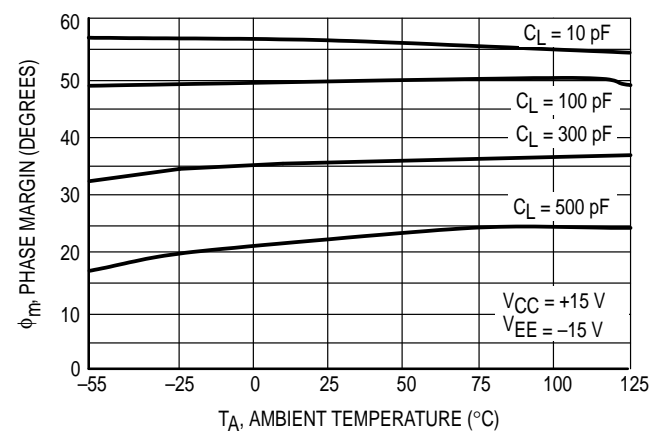


Figure 26. Phase Margin and Gain Margin versus Differential Source Resistance

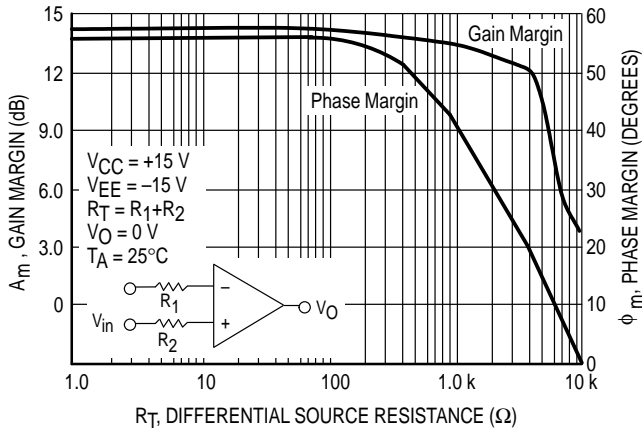


Figure 27. Channel Separation versus Frequency

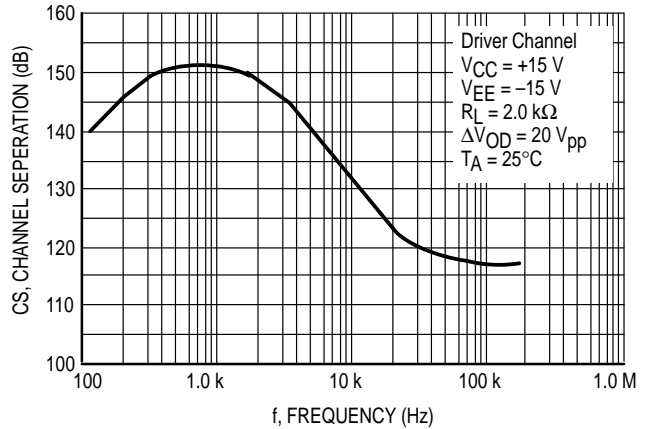


Figure 28. Total Harmonic Distortion versus Frequency

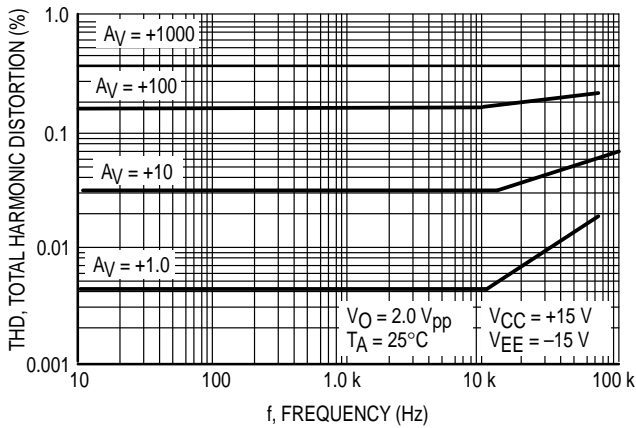


Figure 29. Output Impedance versus Frequency

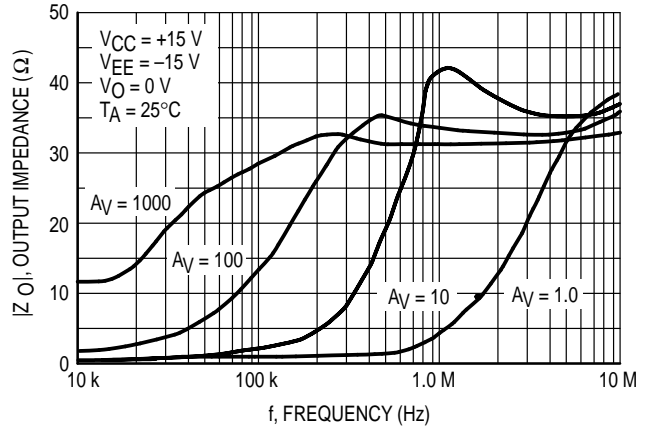


Figure 30. Input Referred Noise Voltage versus Frequency

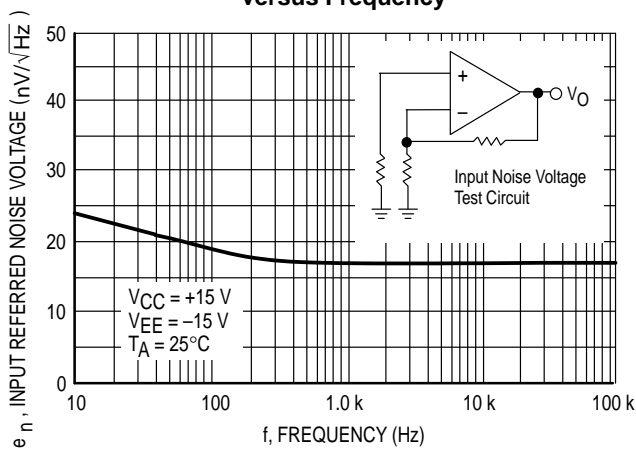
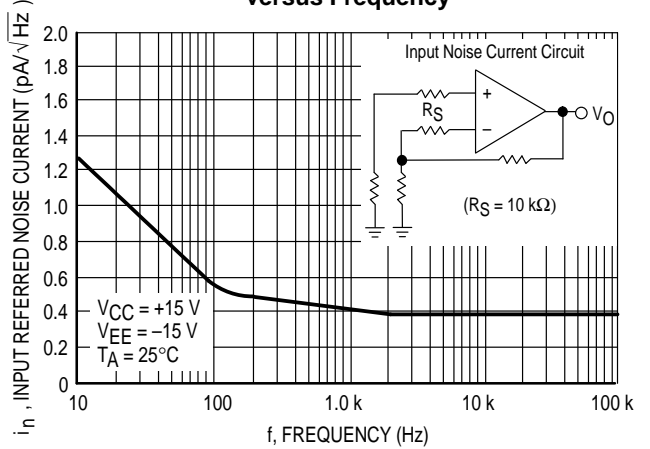


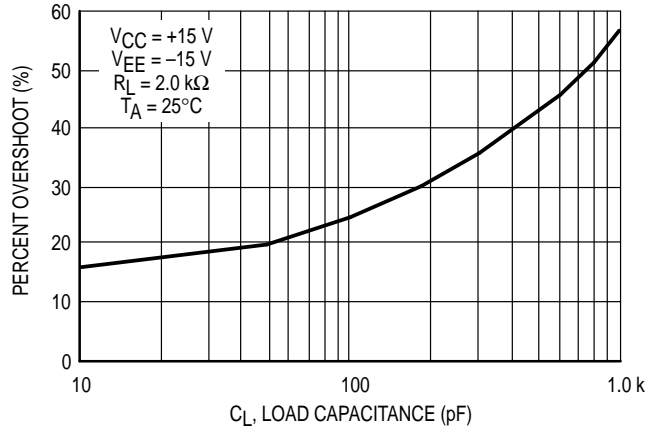
Figure 31. Input Referred Noise Current versus Frequency



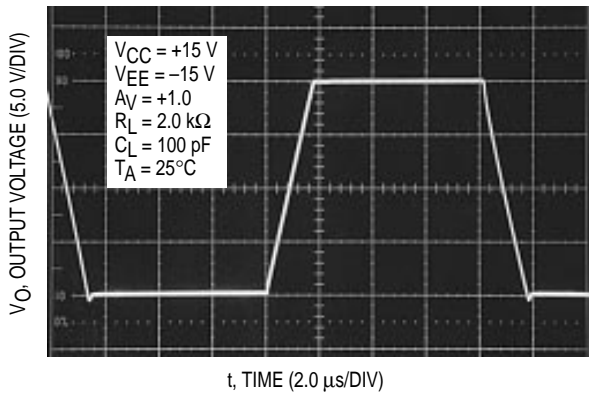


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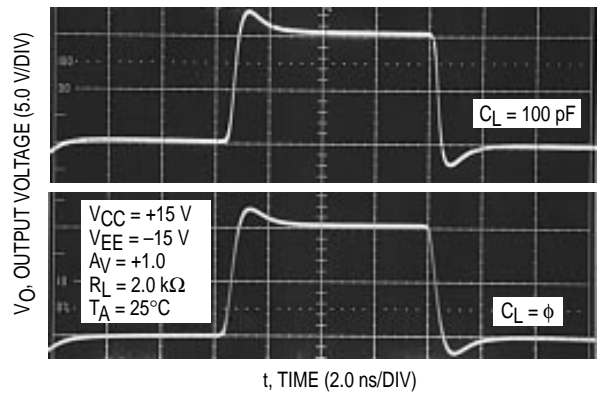
**Figure 32. Percent Overshoot versus Load Capacitance**



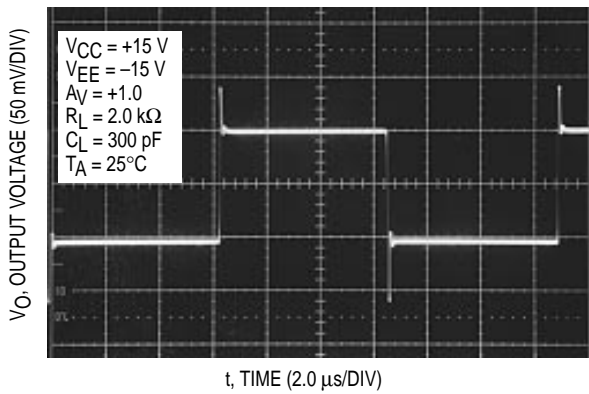
**Figure 33. Noninverting Amplifier Slew Rate for the MC33274**



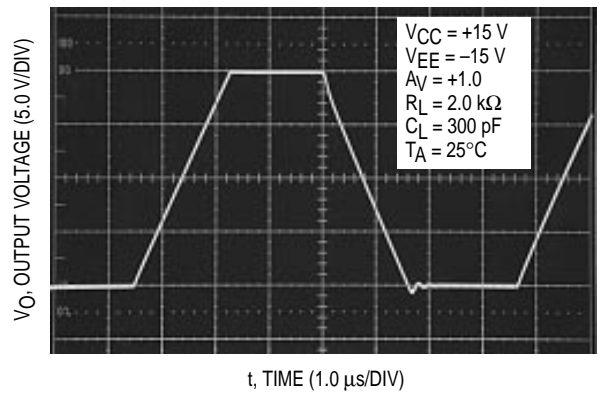
**Figure 34. Noninverting Amplifier Overshoot for the MC33274**



**Figure 35. Small Signal Transient Response for MC33274**



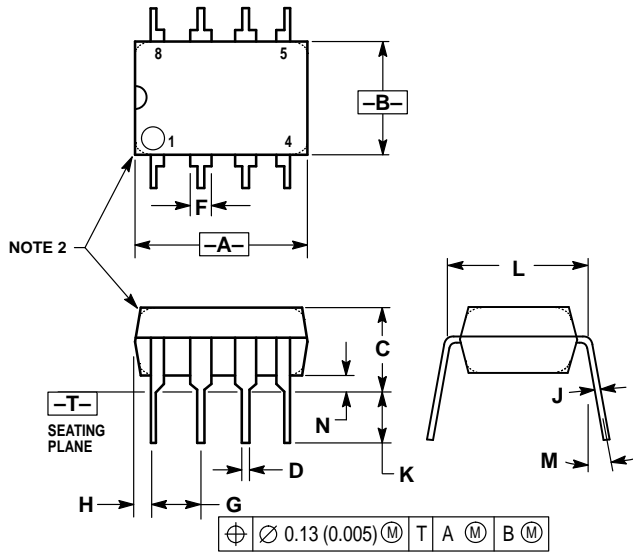
**Figure 36. Large Signal Transient Response for MC33274**



# MC33272A MC33274A

## OUTLINE DIMENSIONS

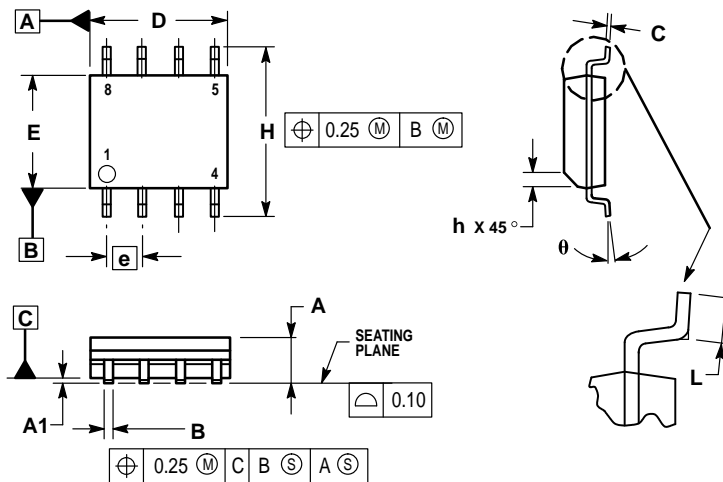
### P SUFFIX PLASTIC PACKAGE CASE 626-05 ISSUE K



- 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 |
| F   | 1.02        | 1.78  | 0.040     | 0.070 |
| G   | 2.54 BSC    |       | 0.100 BSC |       |
| H   | 0.76        | 1.27  | 0.030     | 0.050 |
| J   | 0.20        | 0.30  | 0.008     | 0.012 |
| K   | 2.92        | 3.43  | 0.115     | 0.135 |
| L   | 7.62 BSC    |       | 0.300 BSC |       |
| M   | —           |       | 10°       |       |
| N   | 0.76        | 1.01  | 0.030     | 0.040 |

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



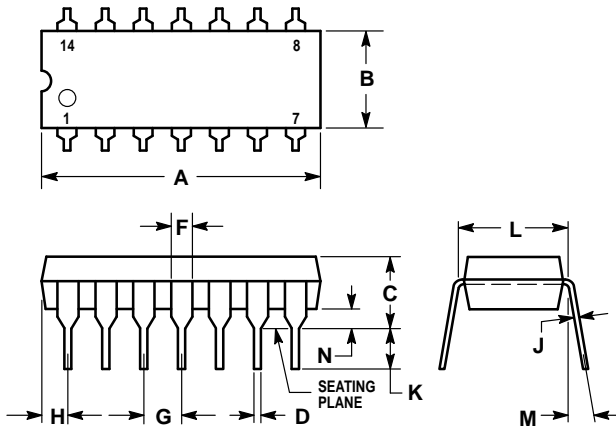
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. DIMENSIONS ARE IN MILLIMETERS.
  3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
  5. DIMENSION B DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN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

### P SUFFIX PLASTIC PACKAGE CASE 646-06 ISSUE L

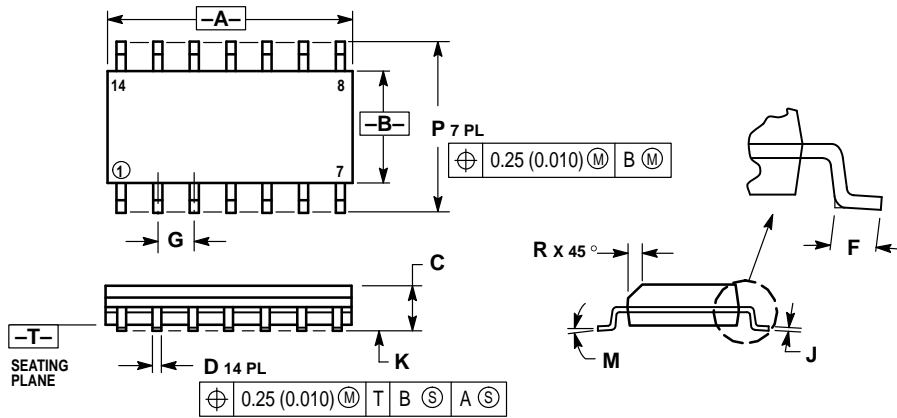


NOTES:

- LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION B DOES NOT INCLUDE MOLD FLASH.
- ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.715     | 0.770 | 18.16       | 19.56 |
| B   | 0.240     | 0.260 | 6.10        | 6.60  |
| C   | 0.145     | 0.185 | 3.69        | 4.69  |
| D   | 0.015     | 0.021 | 0.38        | 0.53  |
| F   | 0.040     | 0.070 | 1.02        | 1.78  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.052     | 0.095 | 1.32        | 2.41  |
| J   | 0.008     | 0.015 | 0.20        | 0.38  |
| K   | 0.115     | 0.135 | 2.92        | 3.43  |
| L   | 0.300 BSC |       | 7.62 BSC    |       |
| M   | 0°        | 10°   | 0°          | 10°   |
| N   | 0.015     | 0.039 | 0.39        | 1.01  |

### D SUFFIX PLASTIC PACKAGE CASE 751A-03 (SO-14) ISSUE F




NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 8.55        | 8.75 | 0.337     | 0.344 |
| B   | 3.80        | 4.00 | 0.150     | 0.157 |
| C   | 1.35        | 1.75 | 0.054     | 0.068 |
| D   | 0.35        | 0.49 | 0.014     | 0.019 |
| F   | 0.40        | 1.25 | 0.016     | 0.049 |
| G   | 1.27 BSC    |      | 0.050 BSC |       |
| J   | 0.19        | 0.25 | 0.008     | 0.009 |
| K   | 0.10        | 0.25 | 0.004     | 0.009 |
| M   | 0°          | 7°   | 0°        | 7°    |
| P   | 5.80        | 6.20 | 0.228     | 0.244 |
| R   | 0.25        | 0.50 | 0.010     | 0.019 |

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