

MC33272A, MC33274A

Single Supply, High Slew Rate, Low Input Offset Voltage 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° 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 nA
- Low Input Offset Current: 3.0 nA
- High Input Resistance: $16\ \text{M}\Omega$
- Low Noise: $18\ \text{nV}/\sqrt{\text{Hz}}$ @ 1.0 kHz
- High Gain Bandwidth Product: 24 MHz @ 100 kHz
- High Slew Rate: $10\ \text{V}/\mu\text{s}$
- Power Bandwidth: 160 kHz
- Excellent Frequency Stability
- Unity Gain Stable: w/Capacitance Loads to 500 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 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

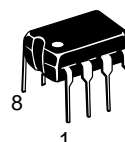


ON Semiconductor™

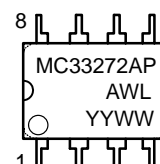
<http://onsemi.com>

MARKING DIAGRAMS

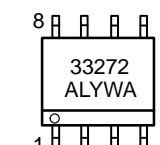
DUAL



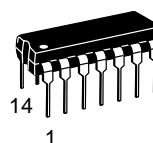
PDIP-8
P SUFFIX
CASE 626



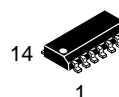
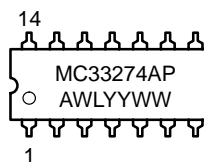
SO-8
D SUFFIX
CASE 751



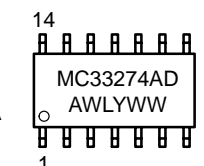
QUAD



PDIP-14
P SUFFIX
CASE 646



SO-14
D SUFFIX
CASE 751A



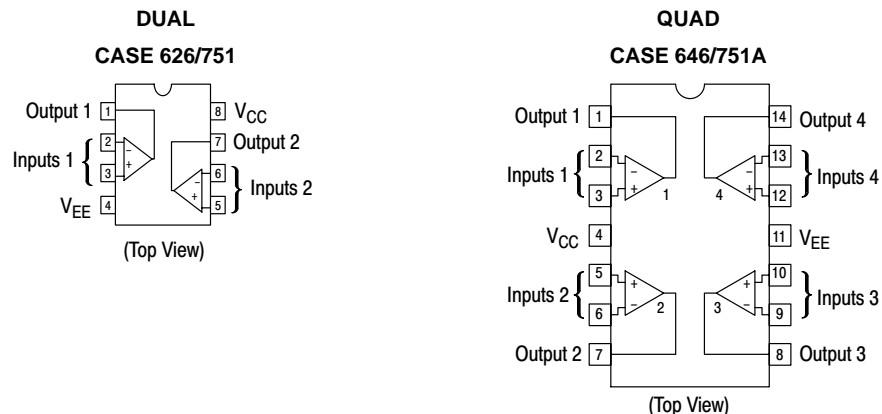
A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week

ORDERING INFORMATION

| Device | Package | Shipping |
|-------------|---------|------------------|
| MC33272AD | SO-8 | 98 Units/Rail |
| MC33272ADR2 | SO-8 | 2500 Tape & Reel |
| MC33272AP | PDIP-8 | 50 Units/Rail |
| MC33274AD | SO-14 | 55 Units/Rail |
| MC33274ADR2 | SO-14 | 2500 Tape & Reel |
| MC33274AP | PDIP-14 | 25 Units/Rail |

MC33272A, MC33274A

PIN CONNECTIONS



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 |

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).

MC33272A, MC33274A

DC 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 |
|--|------------------------------------|--|------------------------------|------------------------------|--------------------------|------------------------------|
| Input Offset Voltage ($R_S = 10\ \Omega$, $V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ\text{ to }+85^\circ\text{C}$ ($V_{CC} = 5.0\text{ V}$, $V_{EE} = 0$) $T_A = +25^\circ\text{C}$ | 3 | $ V_{IO} $ | – – – | 0.1 – – | 1.0 1.8 2.0 | mV |
| Average Temperature Coefficient of Input Offset Voltage $R_S = 10\ \Omega$, $V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$, $T_A = -40^\circ\text{ to }+85^\circ\text{C}$ | 3 | $\Delta V_{IO}/\Delta T$ | – | 2.0 | – | $\mu\text{V}/^\circ\text{C}$ |
| Input Bias Current ($V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ\text{ to }+85^\circ\text{C}$ | 4, 5 | I_{IB} | – – | 300 – | 650 800 | nA |
| Input Offset Current ($V_{CM} = 0\text{ V}$, $V_O = 0\text{ V}$) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ\text{ to }+85^\circ\text{C}$ | | $ I_{IO} $ | – – | 3.0 – | 65 80 | nA |
| Common Mode Input Voltage Range ($\Delta V_{IO} = 5.0\text{ mV}$, $V_O = 0\text{ V}$) $T_A = +25^\circ\text{C}$ | 6 | V_{ICR} | V_{EE} to $(V_{CC} - 1.8)$ | | | V |
| Large Signal Voltage Gain ($V_O = 0\text{ V to }10\text{ V}$, $R_L = 2.0\text{ k}\Omega$) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ\text{ to }+85^\circ\text{C}$ | 7 | A_{VOL} | 90 86 | 100 – | – – | dB |
| Output Voltage Swing ($V_{ID} = \pm 1.0\text{ V}$) ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$) $R_L = 2.0\text{ k}\Omega$ $R_L = 2.0\text{ k}\Omega$ $R_L = 10\text{ k}\Omega$ $R_L = 10\text{ k}\Omega$ ($V_{CC} = 5.0\text{ V}$, $V_{EE} = 0\text{ V}$) $R_L = 2.0\text{ k}\Omega$ $R_L = 2.0\text{ k}\Omega$ | 8, 9, 12 10, 11 | V_{O+} V_{O-} V_{O+} V_{O-} V_{OL} V_{OH} | 13.4 – 13.4 – | 13.9 –13.9 14 –14.7 | – –13.5 – –14.1 | V |
| Common Mode Rejection ($V_{in} = +13.2\text{ V to }-15\text{ V}$) | 13 | CMR | 80 | 100 | – | dB |
| Power Supply Rejection $V_{CC}/V_{EE} = +15\text{ V}/-15\text{ V}$, $+5.0\text{ V}/-15\text{ V}$, $+15\text{ V}/-5.0\text{ V}$ | 14, 15 | PSR | 80 | 105 | – | dB |
| Output Short Circuit Current ($V_{ID} = 1.0\text{ V}$, Output to Ground) Source Sink | 16 | I_{SC} | +25 –25 | +37 –37 | – – | mA |
| Power Supply Current Per Amplifier ($V_O = 0\text{ V}$) ($V_{CC} = +15\text{ V}$, $V_{EE} = -15\text{ V}$) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ\text{ to }+85^\circ\text{C}$ ($V_{CC} = 5.0\text{ V}$, $V_{EE} = 0\text{ V}$) $T_A = +25^\circ\text{C}$ | 17 | I_{CC} | – – – | 2.15 – – | 2.75 3.0 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 ($V_{in} = -10\text{ V}$ to $+10\text{ V}$, $R_L = 2.0\text{ k}\Omega$, $C_L = 100\text{ pF}$, $A_V = +1.0\text{ V}$) | 18, 33 | SR | 8.0 | 10 | – | $\text{V}/\mu\text{s}$ |
| 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 Bandwidth (Open Loop) | | BW | – | 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 | ϕ_m | – | 55 | – | Deg |
| Channel Separation ($f = 20\text{ Hz}$ to 20 kHz) | 27 | CS | – | -120 | – | dB |
| Power Bandwidth ($V_O = 20\text{ V}_{pp}$, $R_L = 2.0\text{ k}\Omega$, $\text{THD} \leq 1.0\%$) | | BW_P | – | 160 | – | kHz |
| Total Harmonic Distortion ($R_L = 2.0\text{ k}\Omega$, $f = 20\text{ Hz}$ to 20 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 | – | Ω |
| Differential Input Resistance ($V_{CM} = 0\text{ V}$) | | R_{in} | – | 16 | – | $\text{M}\Omega$ |
| 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 | – | $\text{pA}/\sqrt{\text{Hz}}$ |

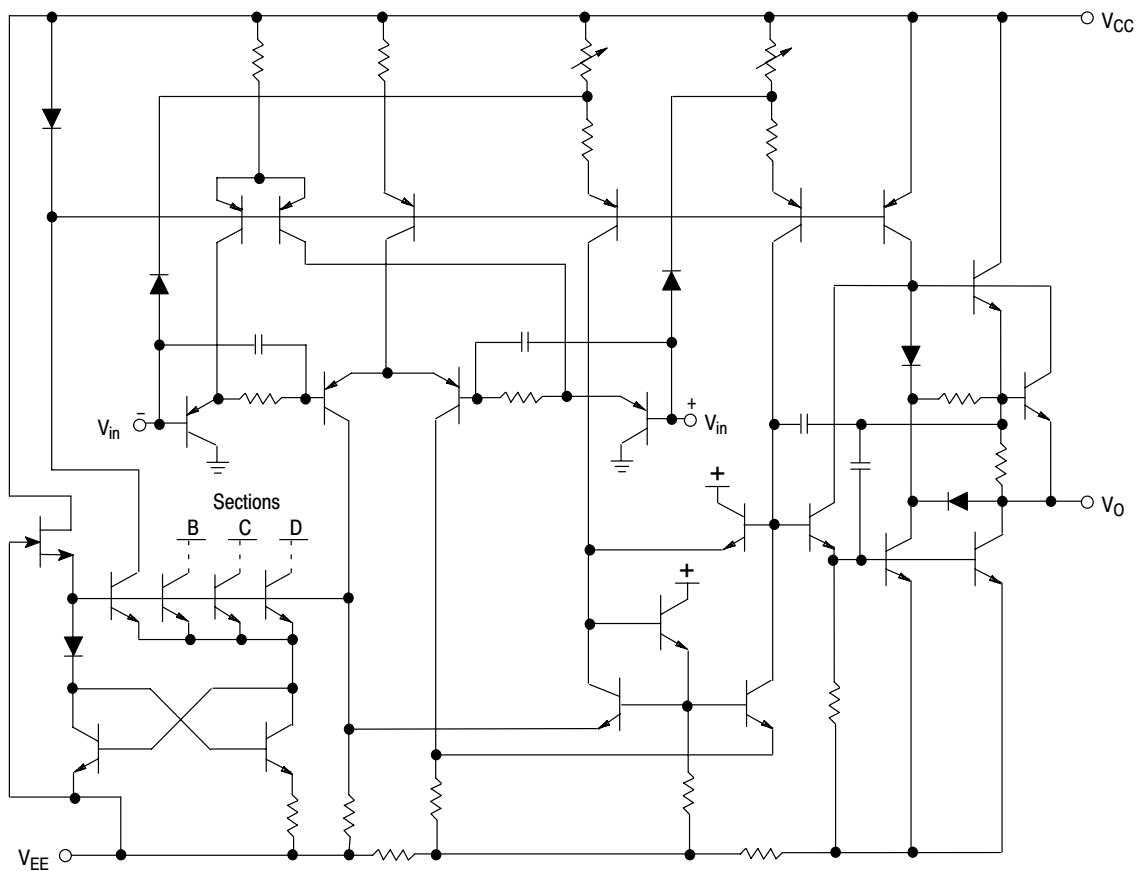


Figure 1. Equivalent Circuit Schematic
(Each Amplifier)

MC33272A, MC33274A

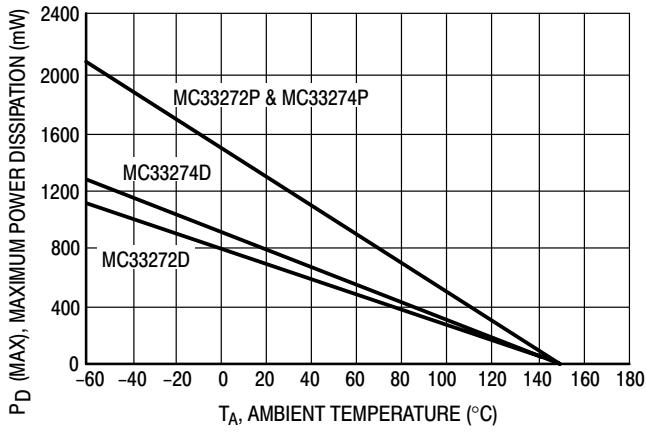


Figure 2. Maximum Power Dissipation versus Temperature

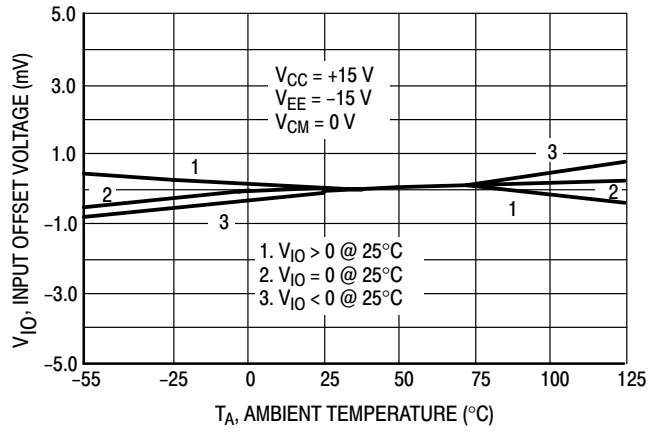


Figure 3. Input Offset Voltage versus Temperature for Typical Units

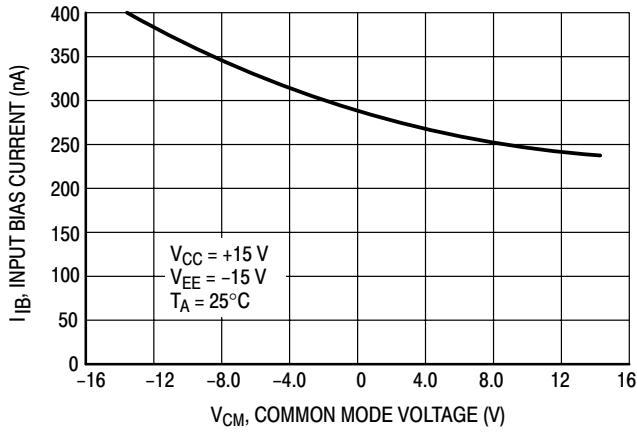


Figure 4. Input Bias Current versus Common Mode Voltage

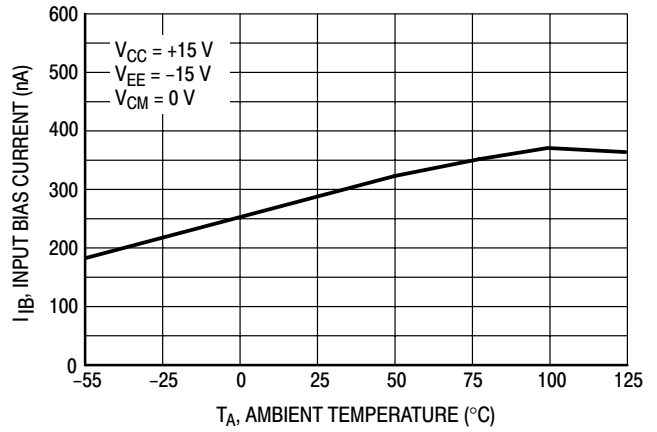


Figure 5. Input Bias Current versus Temperature

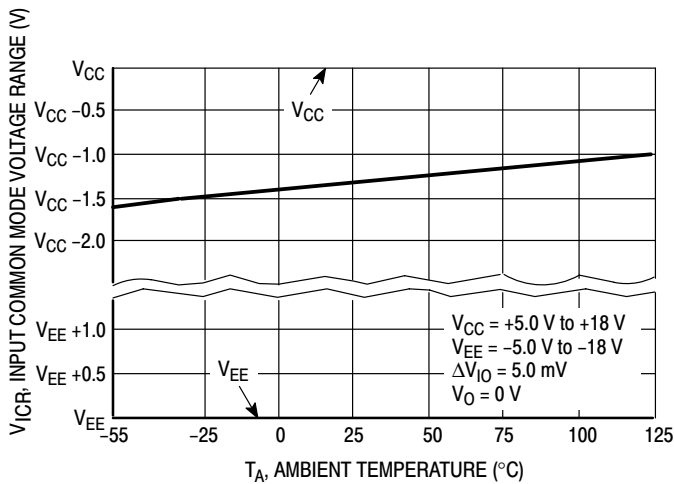


Figure 6. Input Common Mode Voltage Range versus Temperature

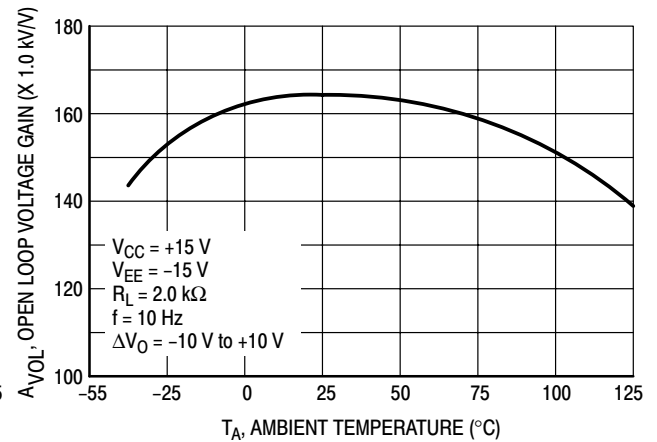


Figure 7. Open Loop Voltage Gain versus Temperature

MC33272A, MC33274A

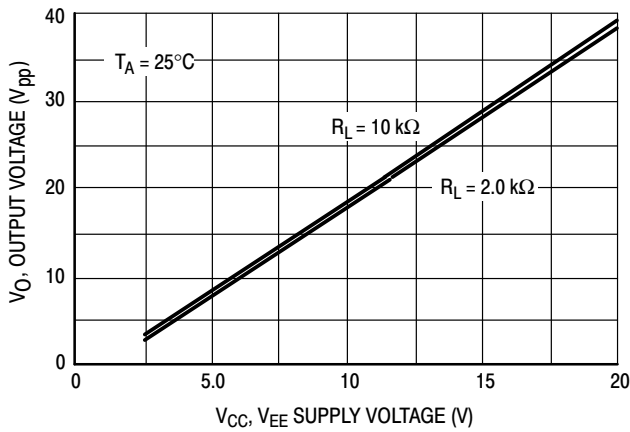


Figure 8. Split Supply Output Voltage Swing versus Supply Voltage

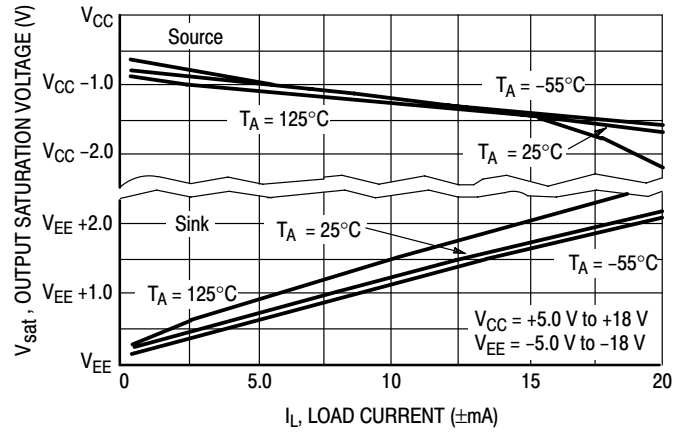


Figure 9. Split Supply Output Saturation Voltage versus Load Current

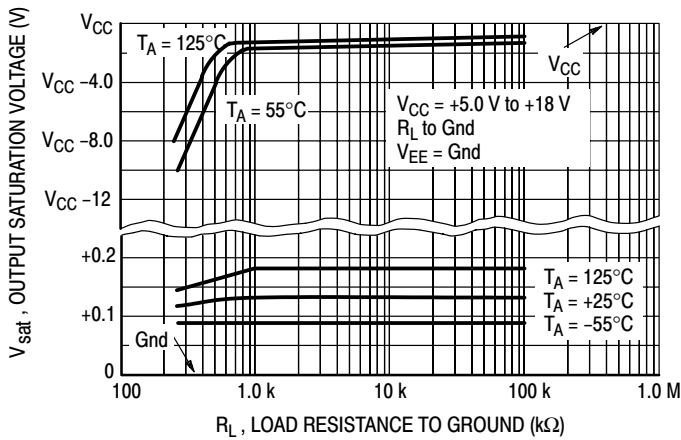


Figure 10. Single Supply Output Saturation Voltage versus Load Resistance to Ground

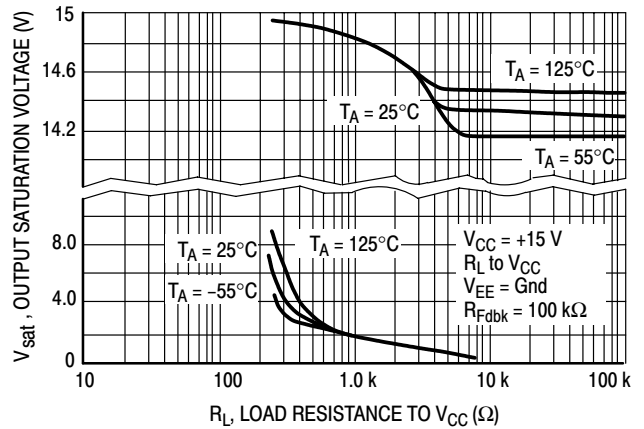


Figure 11. Single Supply Output Saturation Voltage versus Load Resistance to V_{CC}

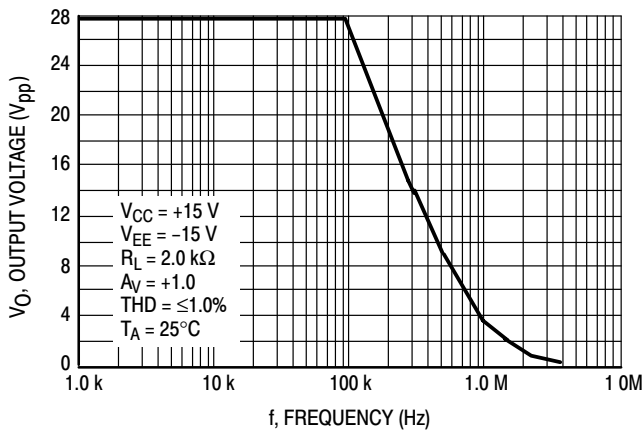


Figure 12. Output Voltage versus Frequency

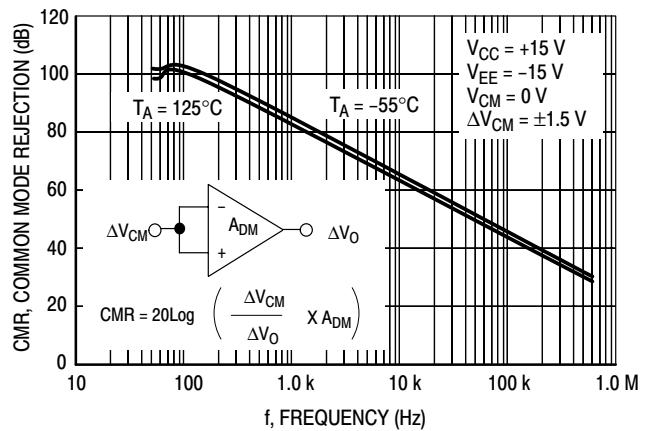


Figure 13. Common Mode Rejection versus Frequency

MC33272A, MC33274A

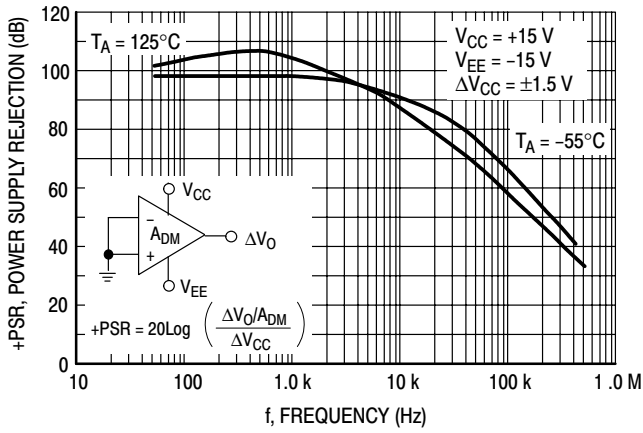


Figure 14. Positive Power Supply Rejection versus Frequency

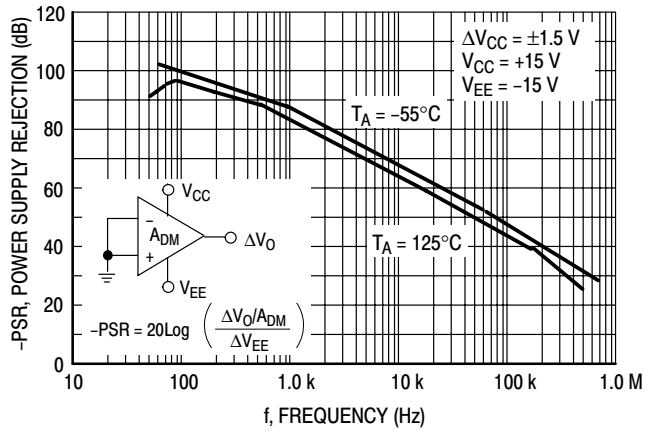


Figure 15. Negative Power Supply Rejection versus Frequency

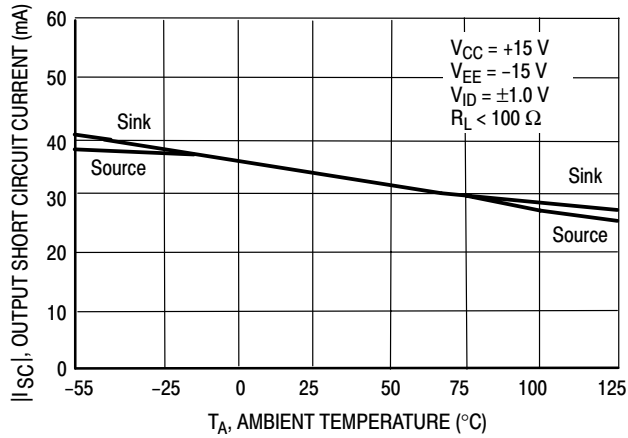


Figure 16. Output Short Circuit Current versus Temperature

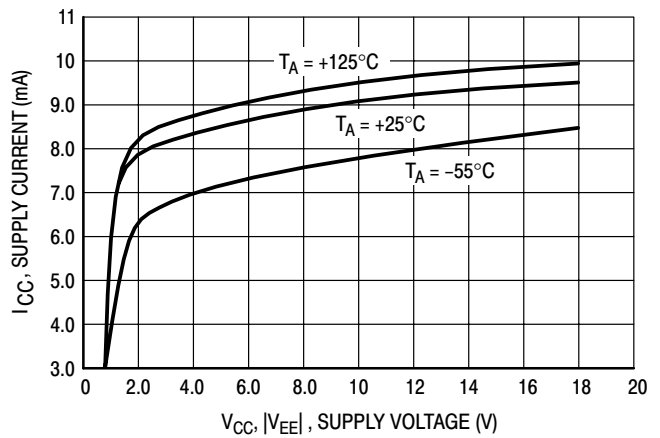


Figure 17. Supply Current versus Supply Voltage

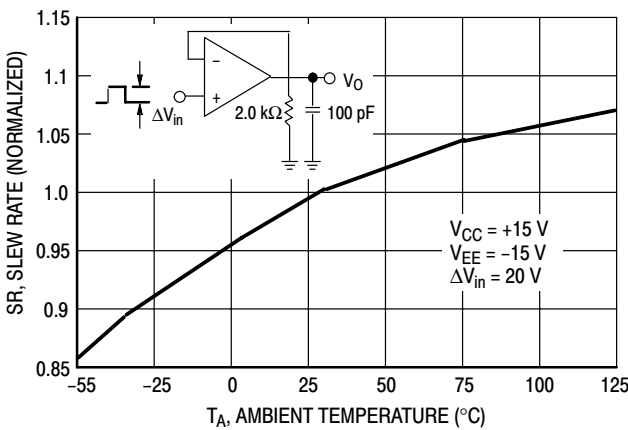


Figure 18. Normalized Slew Rate versus Temperature

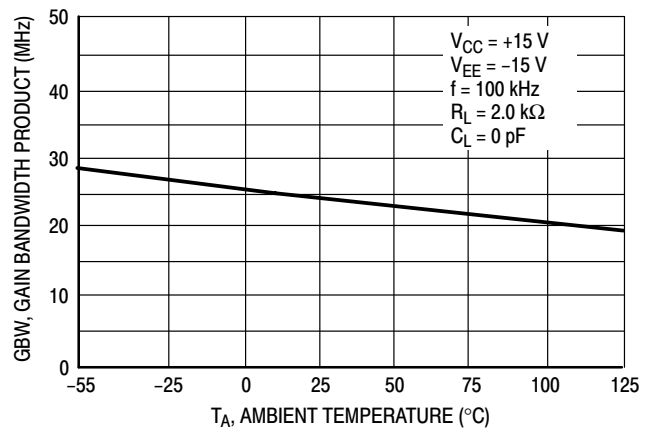


Figure 19. Gain Bandwidth Product versus Temperature

MC33272A, MC33274A

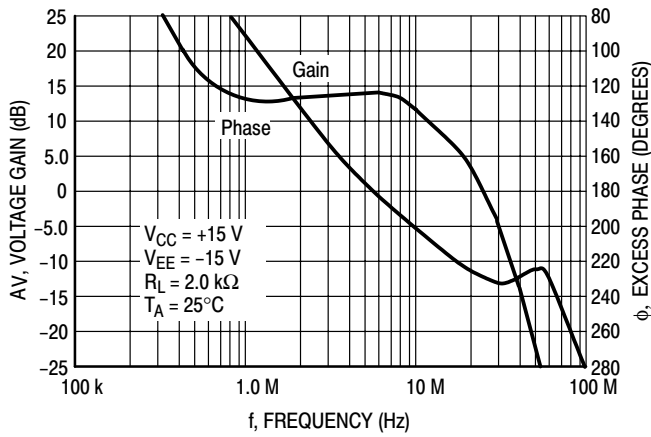


Figure 20. Voltage Gain and Phase versus Frequency

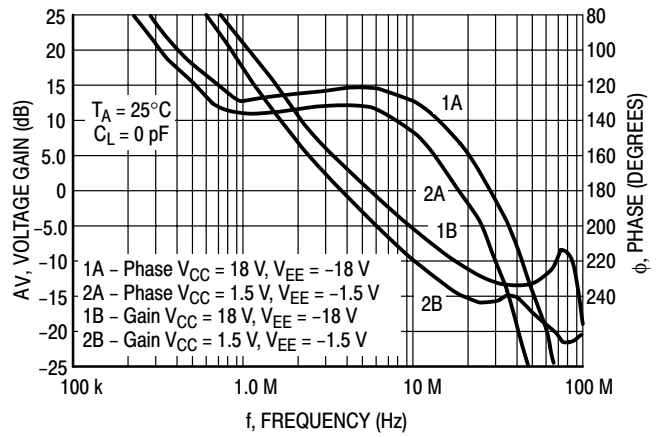


Figure 21. Gain and Phase versus Frequency

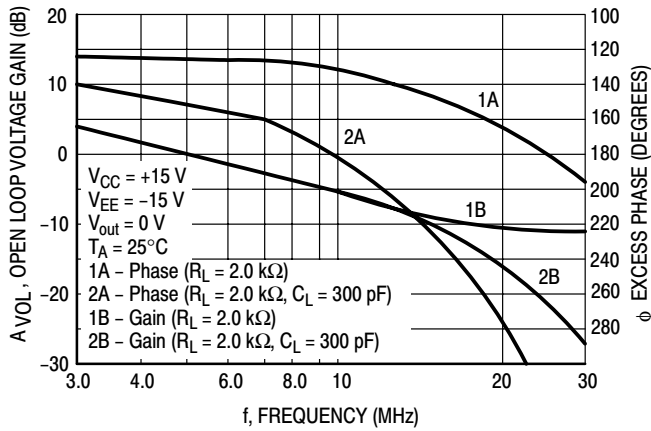


Figure 22. Open Loop Voltage Gain and Phase versus Frequency

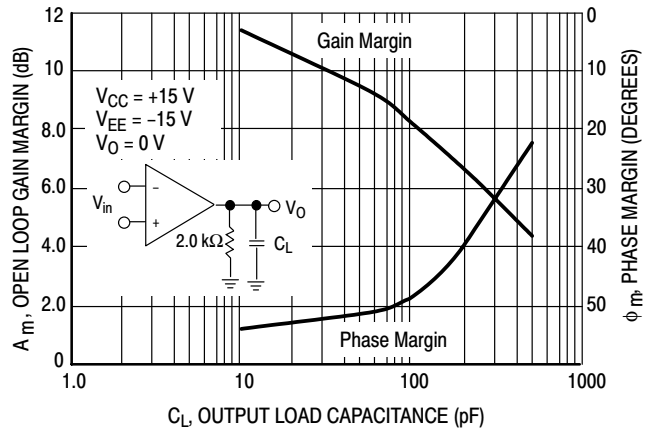


Figure 23. Open Loop Gain Margin and Phase Margin versus Output Load Capacitance

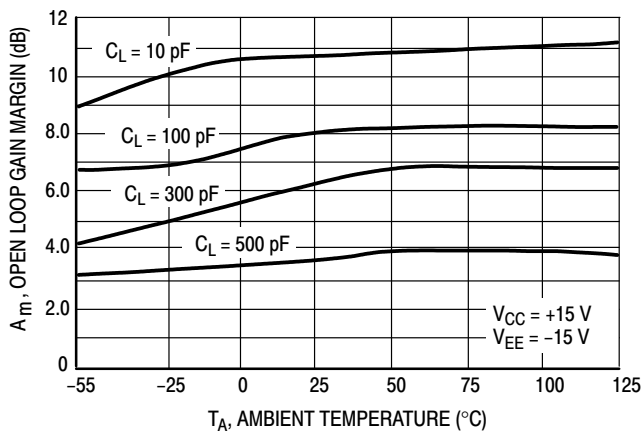


Figure 24. Open Loop Gain Margin versus Temperature

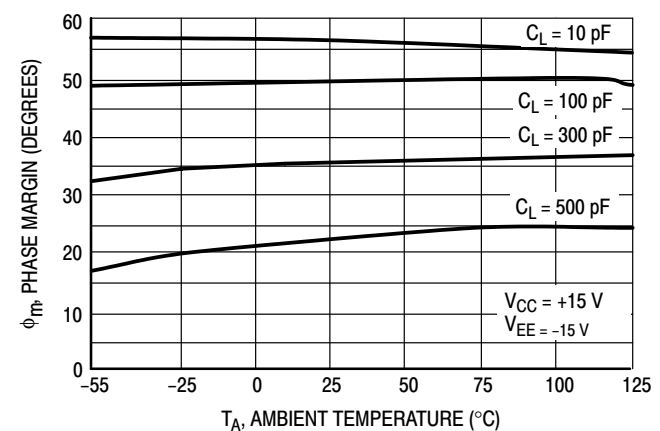


Figure 25. Phase Margin versus Temperature

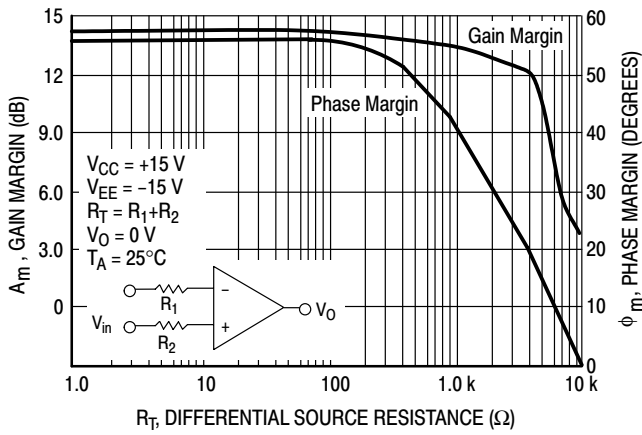


Figure 26. Phase Margin and Gain Margin versus Differential Source Resistance

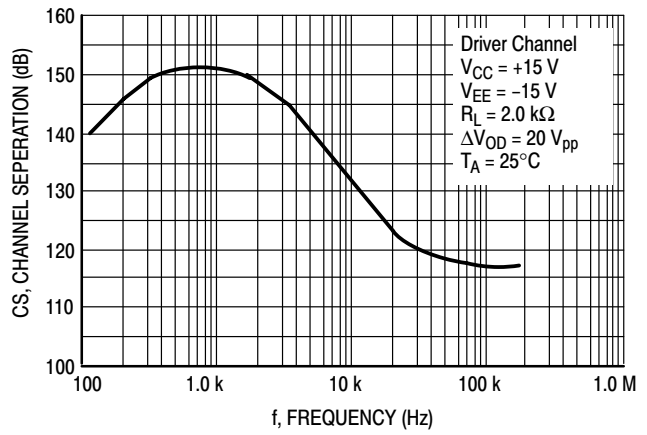


Figure 27. Channel Separation versus Frequency

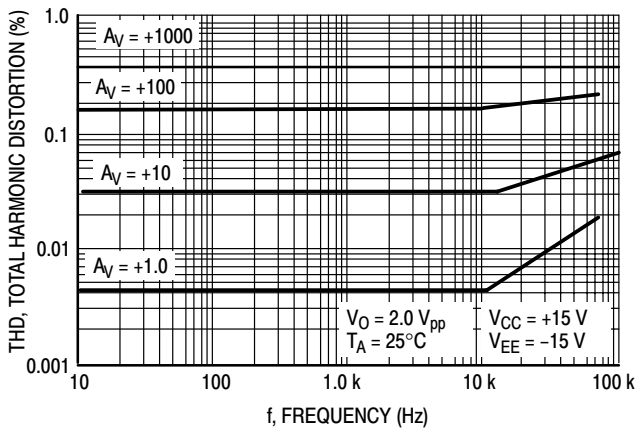


Figure 28. Total Harmonic Distortion versus Frequency

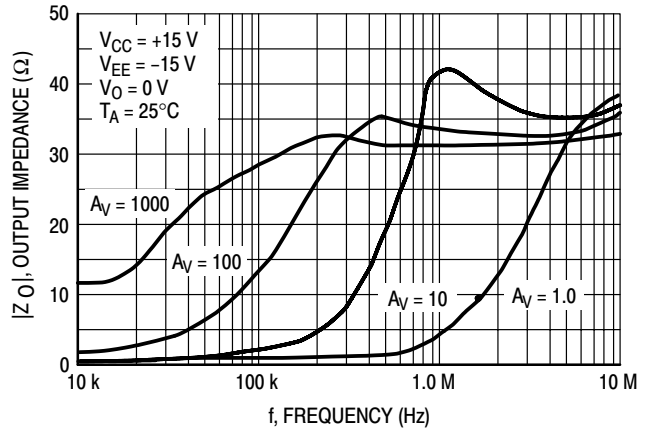


Figure 29. Output Impedance versus Frequency

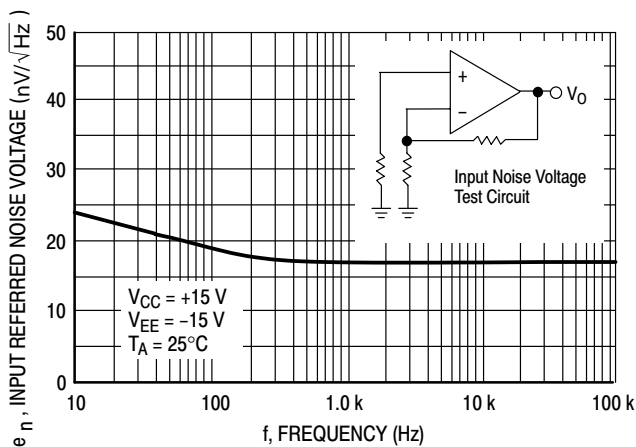


Figure 30. Input Referred Noise Voltage versus Frequency

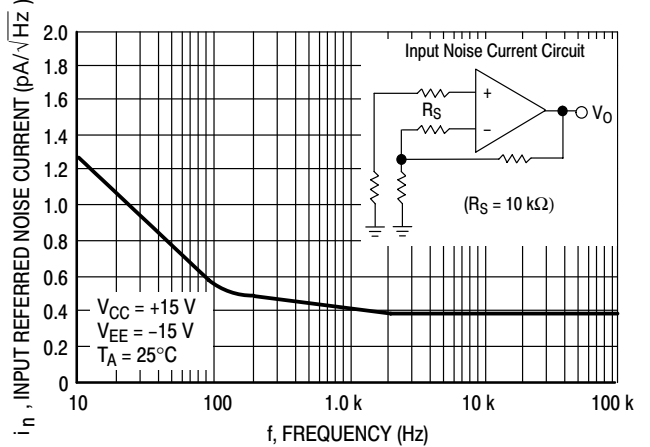


Figure 31. Input Referred Noise Current versus Frequency

MC33272A, MC33274A

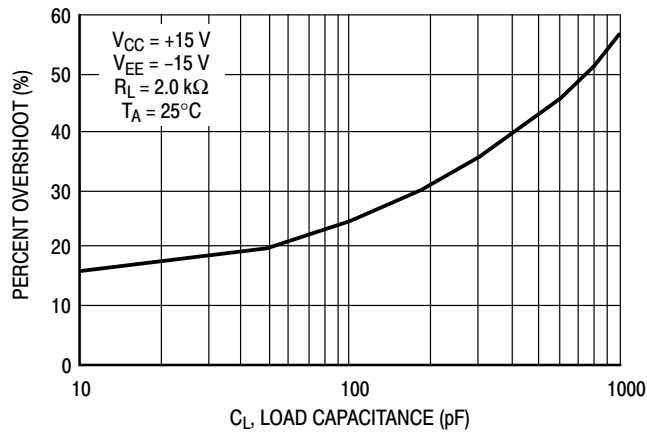


Figure 32. Percent Overshoot versus Load Capacitance

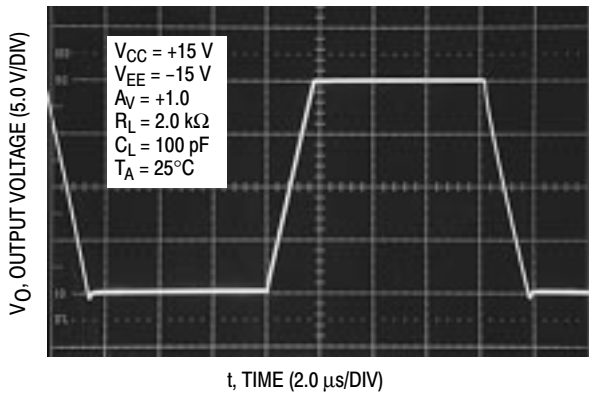


Figure 33. Non-inverting Amplifier Slew Rate for the MC33274

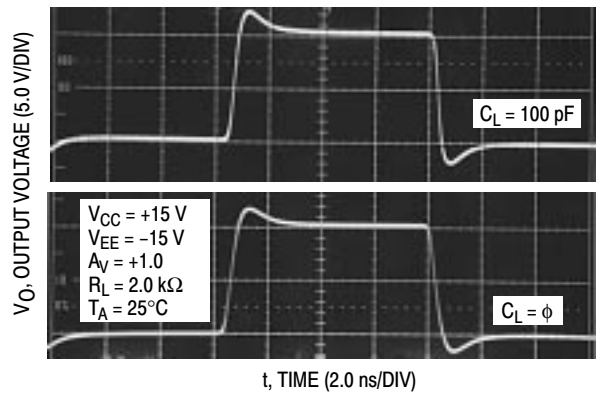


Figure 34. Non-inverting Amplifier Overshoot for the MC33274

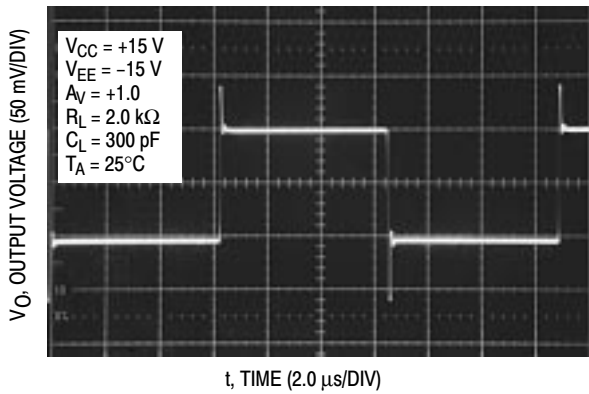


Figure 35. Small Signal Transient Response for MC33274

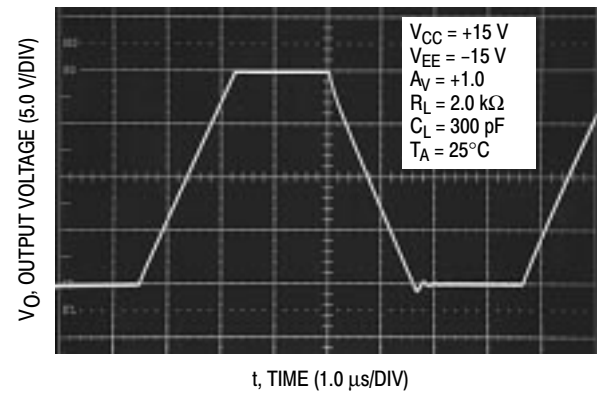
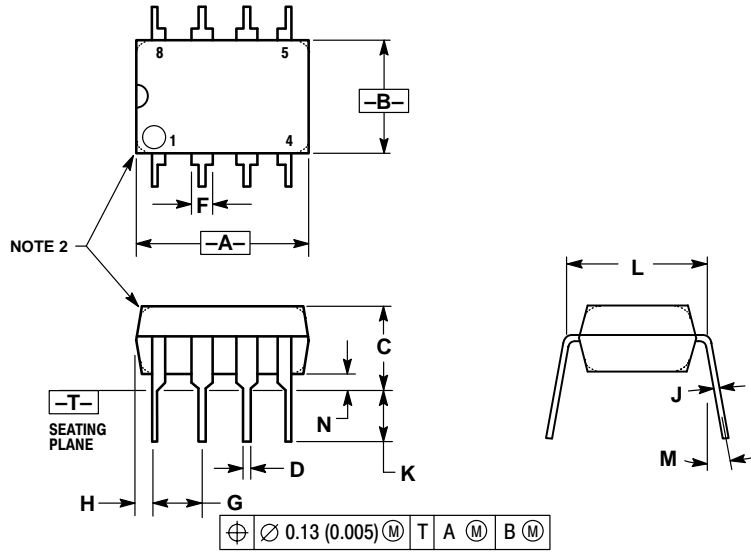


Figure 36. Large Signal Transient Response for MC33274

MC33272A, MC33274A

PACKAGE DIMENSIONS

PDIP-8
P SUFFIX
CASE 626-05
ISSUE L

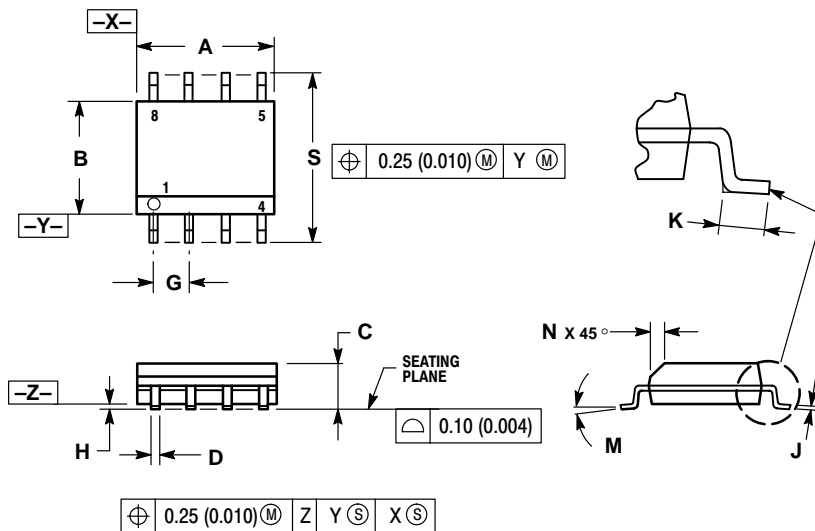


NOTES:

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° | --- | 10° |
| N | 0.76 | 1.01 | 0.030 | 0.040 |

SO-8
D SUFFIX
CASE 751-07
ISSUE W



NOTES:

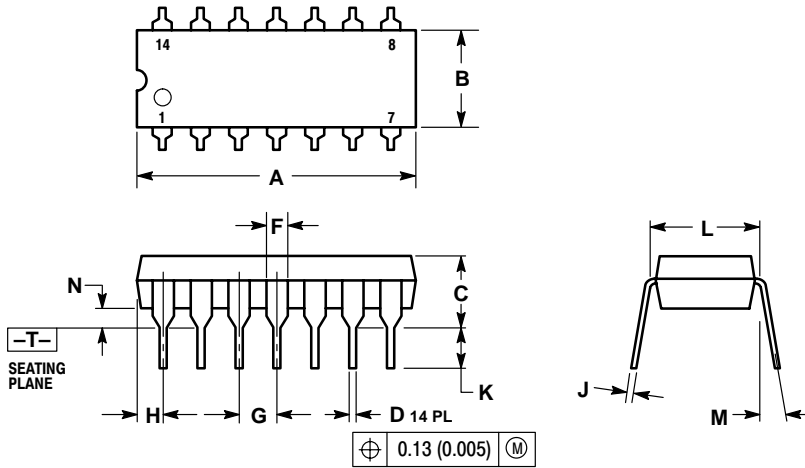
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL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

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.80 | 5.00 | 0.189 | 0.197 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.053 | 0.069 |
| D | 0.33 | 0.51 | 0.013 | 0.020 |
| G | 1.27 BSC | | 0.050 BSC | |
| H | 0.10 | 0.25 | 0.004 | 0.010 |
| J | 0.19 | 0.25 | 0.007 | 0.010 |
| K | 0.40 | 1.27 | 0.016 | 0.050 |
| M | 0° | 8° | 0° | 8° |
| N | 0.25 | 0.50 | 0.010 | 0.020 |
| S | 5.80 | 6.20 | 0.228 | 0.244 |

MC33272A, MC33274A

PACKAGE DIMENSIONS

PDIP-14
P SUFFIX
CASE 646-06
ISSUE M

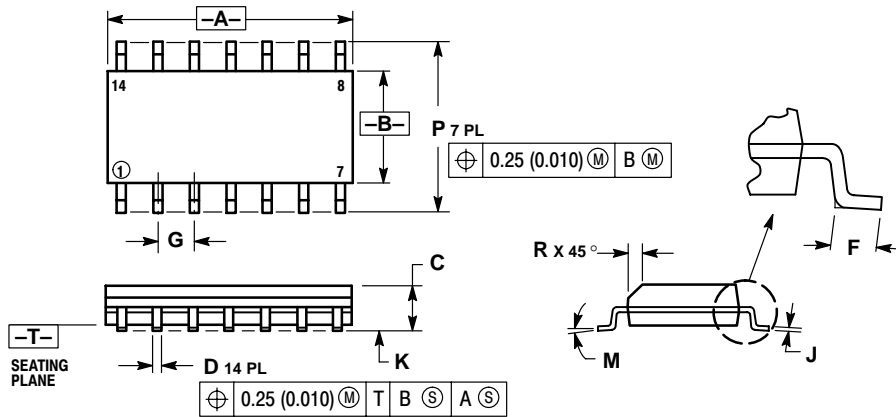


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.715 | 0.770 | 18.16 | 18.80 |
| 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 | 0.290 | 0.310 | 7.37 | 7.87 |
| M | --- | 10° | --- | 10° |
| N | 0.015 | 0.039 | 0.38 | 1.01 |

SO-14
D SUFFIX
CASE 751A-03
ISSUE F



NOTES:


1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. 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 |

Notes

Notes

Notes

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