

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° 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

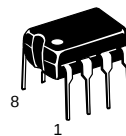
ORDERING INFORMATION

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

DUAL

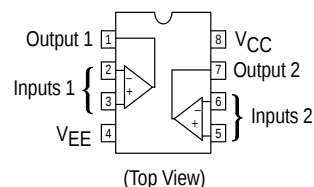


P SUFFIX
PLASTIC PACKAGE
CASE 626

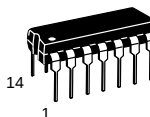


D SUFFIX
PLASTIC PACKAGE
CASE 751
(SO-8)

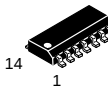
PIN CONNECTIONS



QUAD

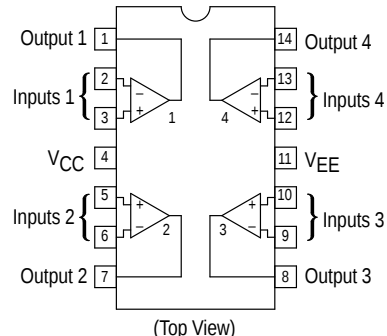


P SUFFIX
PLASTIC PACKAGE
CASE 646



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

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

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, $T_A = 25^\circ\text{C}$, 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) ($V_{CC} = +15$ V, $V_{EE} = -15$ V) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ$ to $+85^\circ\text{C}$ ($V_{CC} = 5.0$ 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 $R_S = 10\ \Omega$, $V_{CM} = 0$ V, $V_O = 0$ V, $T_A = -40^\circ$ to $+85^\circ\text{C}$	3	$\Delta V_{IO}/\Delta T$	—	2.0	—	$\mu\text{V}/^\circ\text{C}$
Input Bias Current ($V_{CM} = 0$ V, $V_O = 0$ V) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ$ to $+85^\circ\text{C}$	4, 5	I_{IB}	— —	300 —	650 800	nA
Input Offset Current ($V_{CM} = 0$ V, $V_O = 0$ V) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ$ to $+85^\circ\text{C}$		$ I_{IO} $	— —	3.0 —	65 80	nA
Common Mode Input Voltage Range ($\Delta V_{IO} = 5.0$ mV, $V_O = 0$ V) $T_A = +25^\circ\text{C}$	6	V_{ICR}	V_{EE} to $(V_{CC} - 1.8)$			V
Large Signal Voltage Gain ($V_O = 0$ V to 10 V, $R_L = 2.0$ k Ω) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ$ to $+85^\circ\text{C}$	7	A_{VOL}	90 86	100 —	— —	dB
Output Voltage Swing ($V_{ID} = \pm 1.0$ V) ($V_{CC} = +15$ V, $V_{EE} = -15$ V) $R_L = 2.0$ k Ω $R_L = 2.0$ k Ω $R_L = 10$ k Ω $R_L = 10$ k Ω ($V_{CC} = 5.0$ V, $V_{EE} = 0$ V) $R_L = 2.0$ k Ω $R_L = 2.0$ k Ω	8, 9, 12 10, 11	V_{O+} V_{O-} V_{O+} V_{O-} V_{OL} V_{OH}	13.4 — 13.4 — — 3.7	13.9 –13.9 14 –14.7 — —	— –13.5 — –14.1 0.2 5.0	V
Common Mode Rejection ($V_{IN} = +13.2$ V to -15 V)	13	CMR	80	100	—	dB
Power Supply Rejection $V_{CC}/V_{EE} = +15$ 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) Source Sink	16	I_{SC}	+25 –25	+37 –37	— —	mA
Power Supply Current Per Amplifier ($V_O = 0$ V) ($V_{CC} = +15$ V, $V_{EE} = -15$ V) $T_A = +25^\circ\text{C}$ $T_A = -40^\circ$ to $+85^\circ\text{C}$ ($V_{CC} = 5.0$ V, $V_{EE} = 0$ V) $T_A = +25^\circ\text{C}$	17	I_{CC}	— — —	2.15 — —	2.75 3.0 2.75	mA

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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	—	V/ μs
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	ϕ_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 ($R_L = 2.0\text{ k}\Omega$, $f = 20\text{ Hz to }20\text{ kHz}$, $V_O = 3.0\text{ V}_{rms}$, $A_V = +1.0$)	28	THD	—	0.003	—	%
Open Loop Output Impedance ($V_O = 0\text{ V}$, $f = 6.0\text{ MHz}$)	29	$ Z_O $	—	35	—	Ω
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 ($R_S = 100\text{ }\Omega$, $f = 1.0\text{ kHz}$)	30	e_n	—	18	—	$nV/\sqrt{\text{Hz}}$
Equivalent Input Noise Current ($f = 1.0\text{ kHz}$)	31	i_n	—	0.5	—	$pA/\sqrt{\text{Hz}}$

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

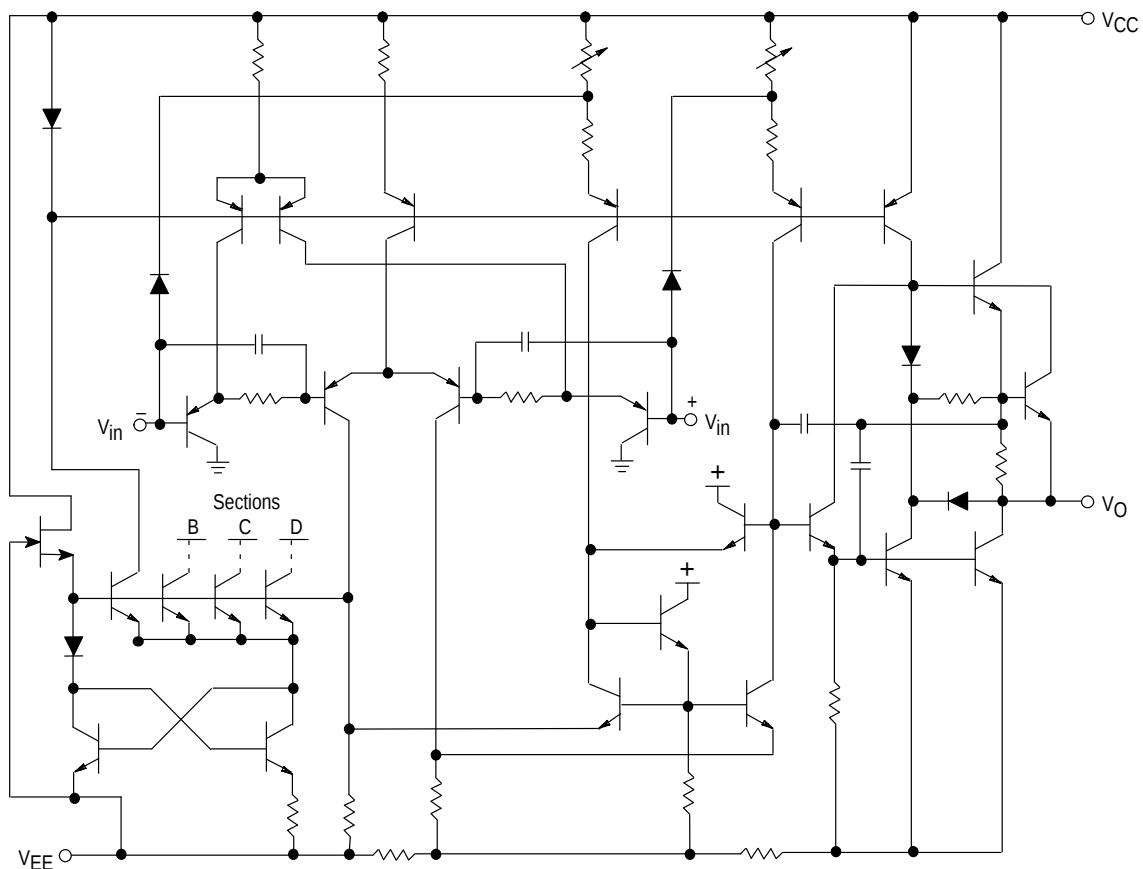


Figure 2. Maximum Power Dissipation versus Temperature

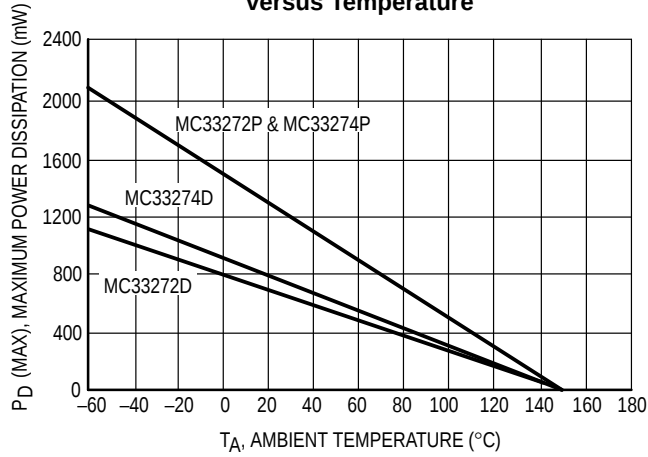


Figure 3. Input Offset Voltage versus Temperature for Typical Units

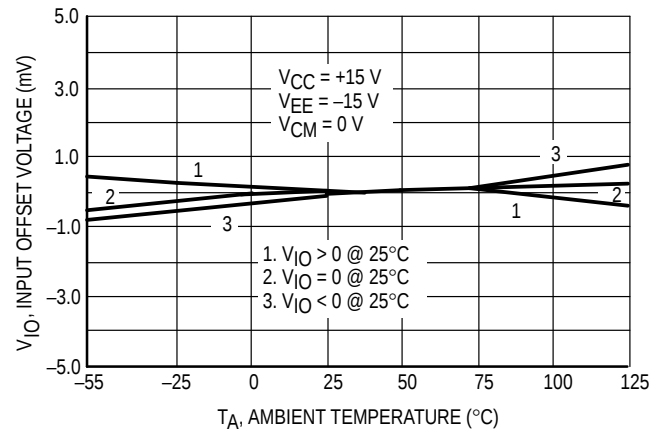


Figure 4. Input Bias Current versus Common Mode Voltage

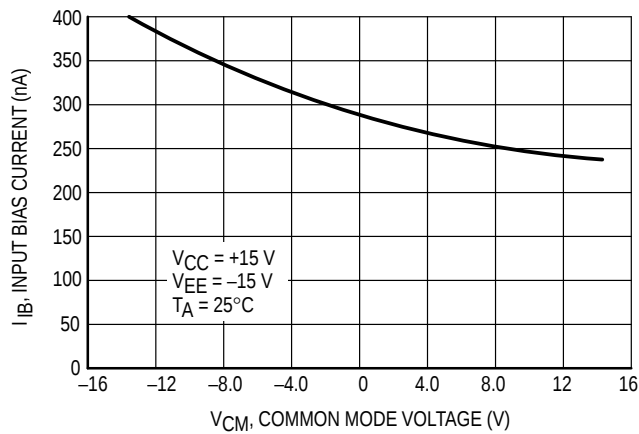


Figure 5. Input Bias Current versus Temperature

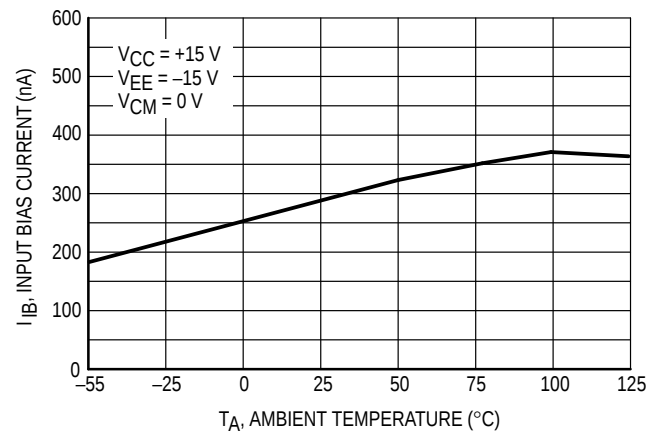


Figure 6. Input Common Mode Voltage Range versus Temperature

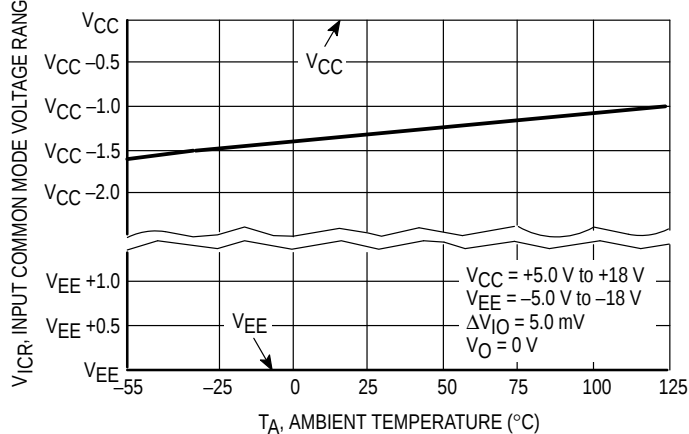


Figure 7. Open Loop Voltage Gain versus Temperature

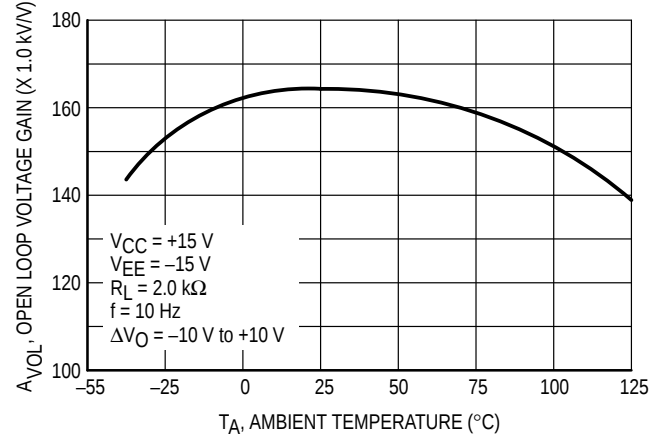


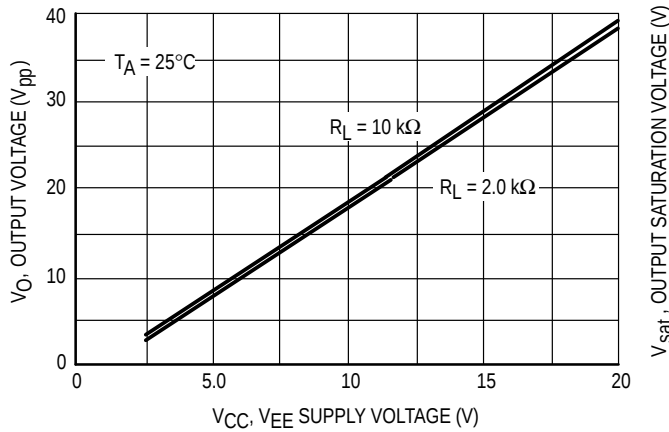
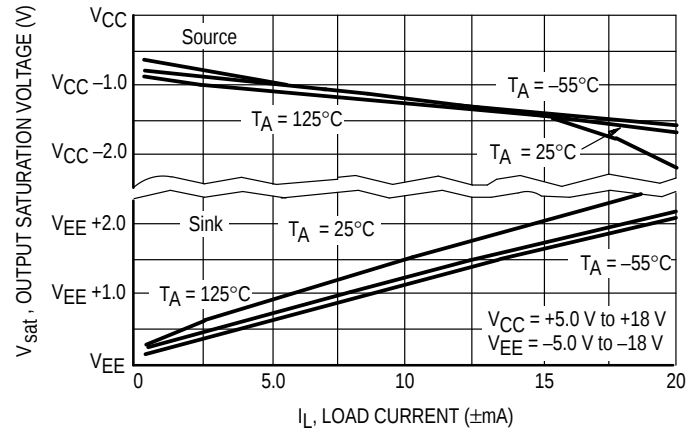
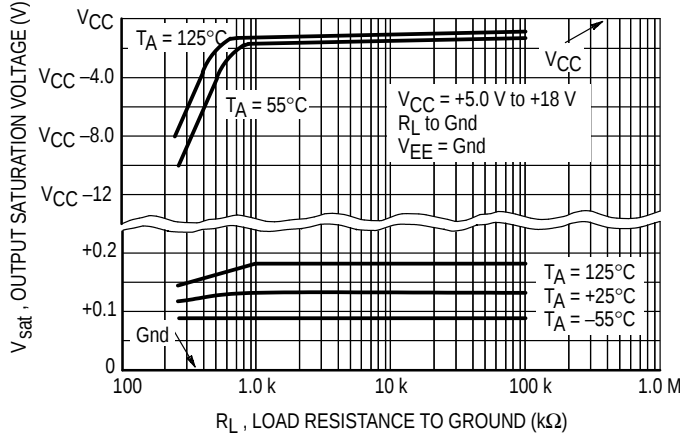
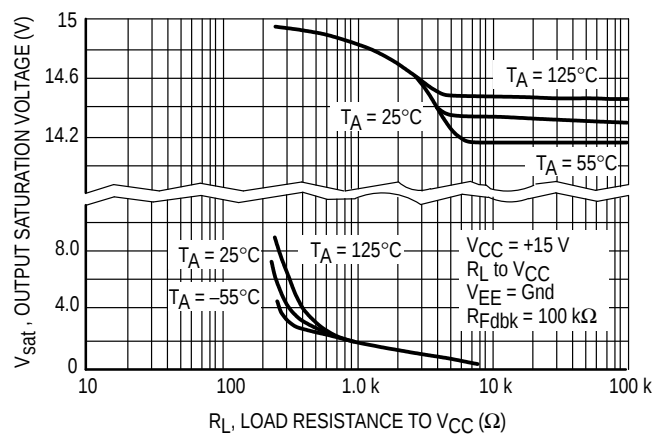
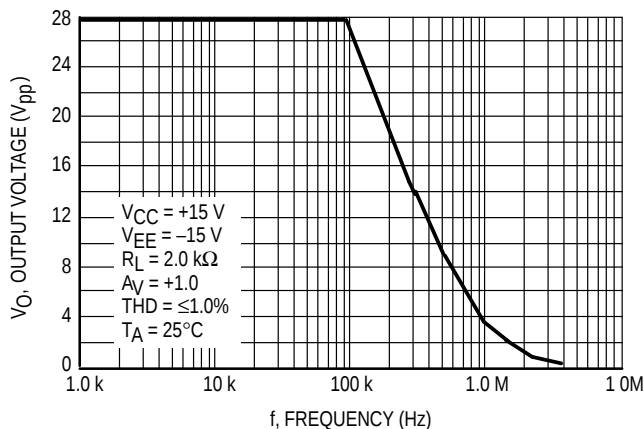
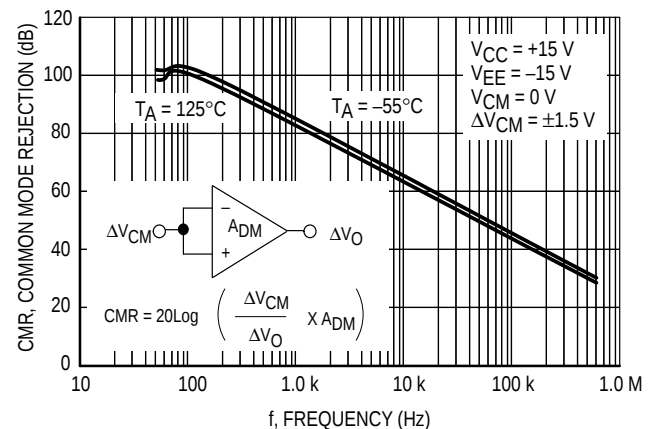
Figure 8. Split Supply Output Voltage Swing versus Supply Voltage**Figure 9. Split Supply Output Saturation Voltage versus Load Current****Figure 10. Single Supply Output Saturation Voltage versus Load Resistance to Ground****Figure 11. Single Supply Output Saturation Voltage versus Load Resistance to VCC****Figure 12. Output Voltage versus Frequency****Figure 13. Common Mode Rejection versus Frequency**

Figure 14. Positive Power Supply Rejection versus Frequency

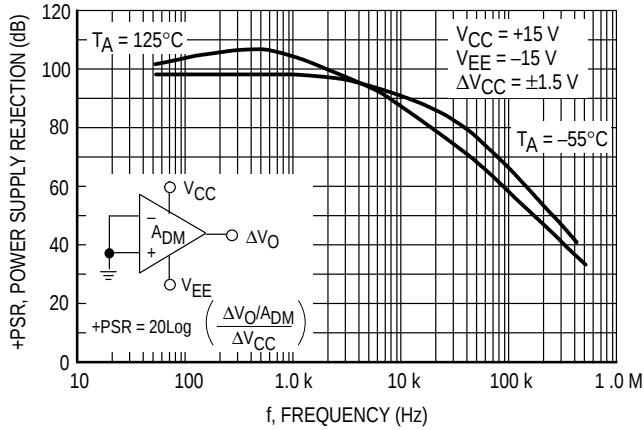


Figure 15. Negative Power Supply Rejection versus Frequency

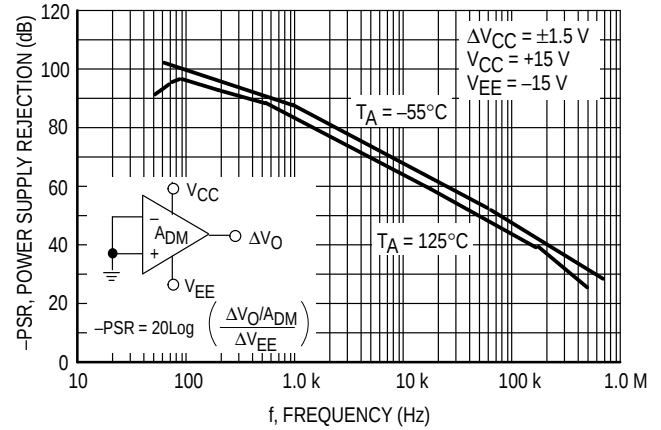


Figure 16. Output Short Circuit Current versus Temperature

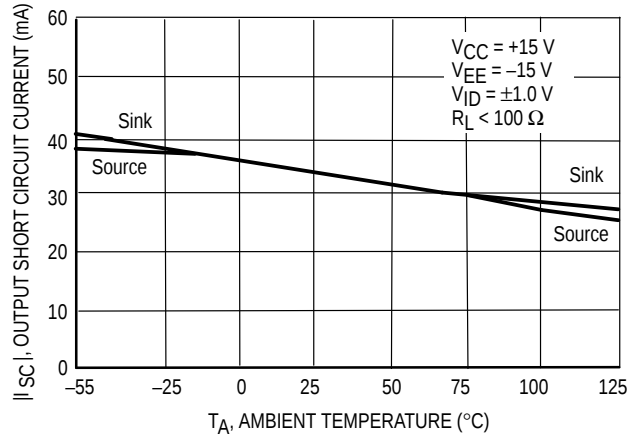


Figure 17. Supply Current versus Supply Voltage

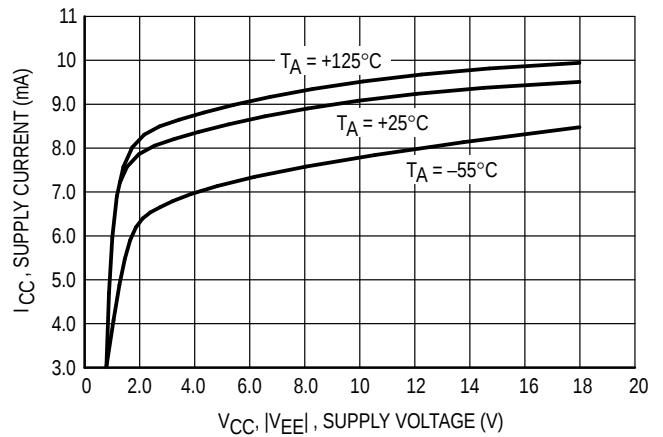


Figure 18. Normalized Slew Rate versus Temperature

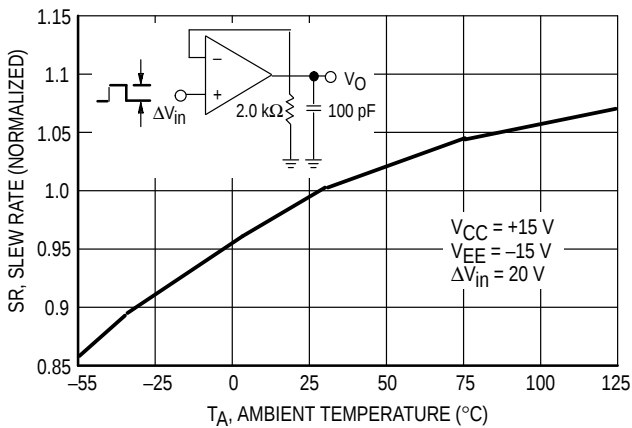


Figure 19. Gain Bandwidth Product versus Temperature

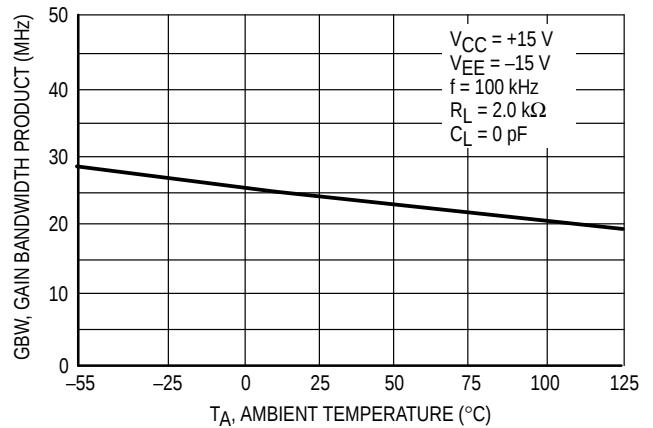


Figure 20. Voltage Gain and Phase versus Frequency

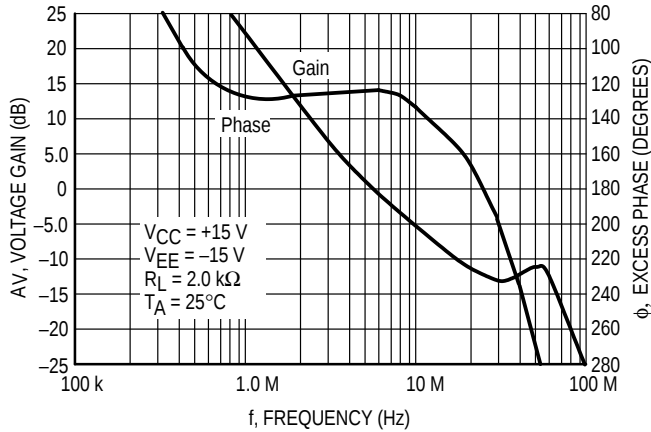


Figure 21. Gain and Phase versus Frequency

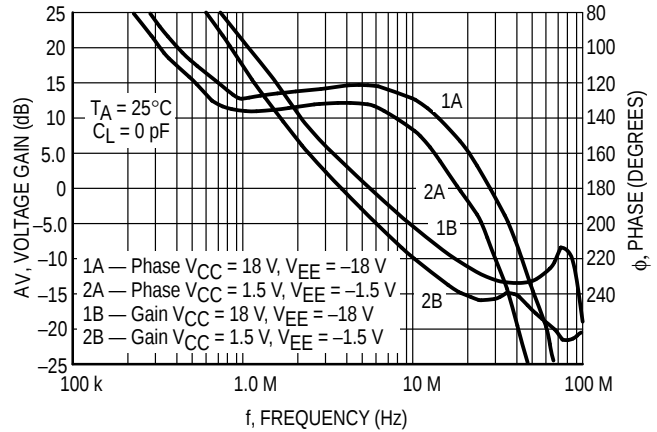


Figure 22. Open Loop Voltage Gain and Phase versus Frequency

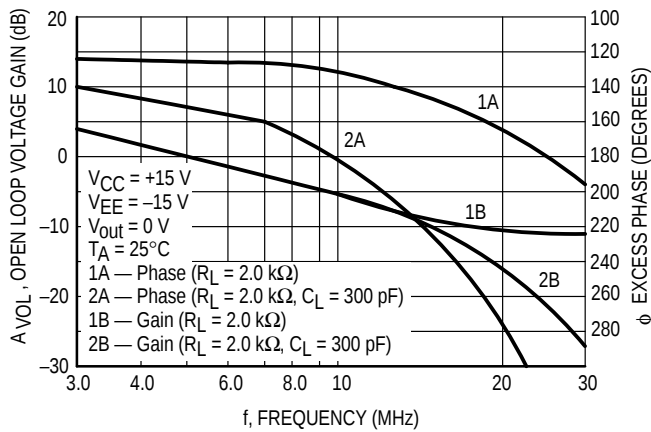


Figure 23. Open Loop Gain Margin and Phase Margin versus Output Load Capacitance

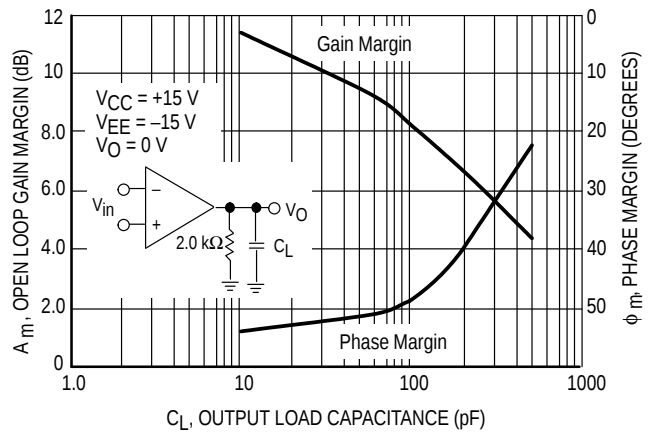


Figure 24. Open Loop Gain Margin versus Temperature

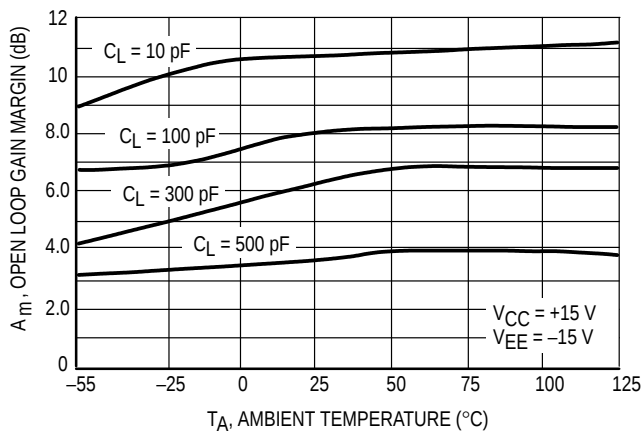


Figure 25. Phase Margin versus Temperature

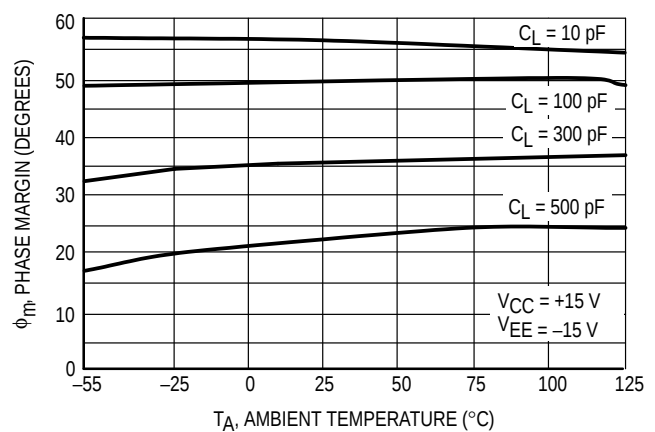


Figure 26. Phase Margin and Gain Margin versus Differential Source Resistance

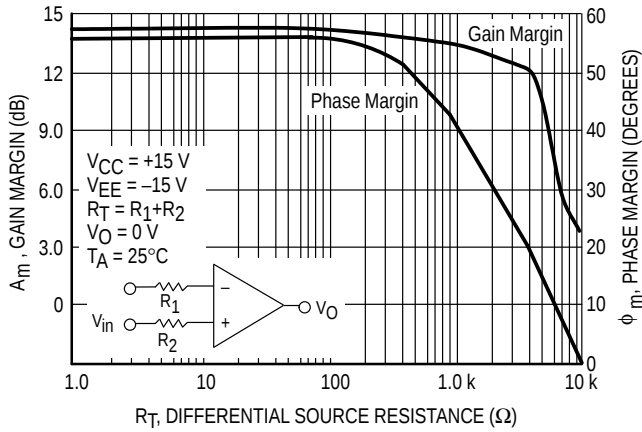


Figure 27. Channel Separation versus Frequency

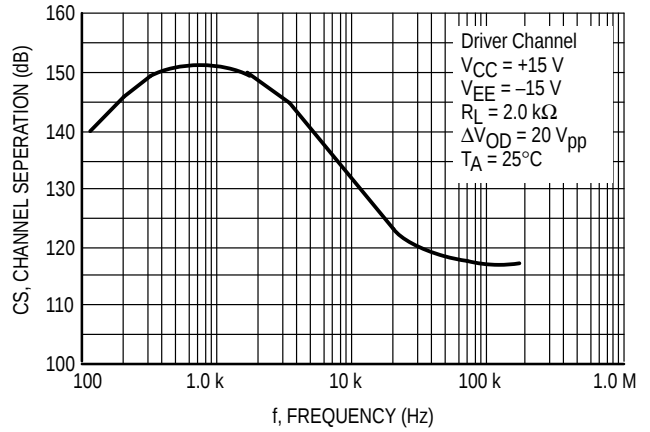


Figure 28. Total Harmonic Distortion versus Frequency

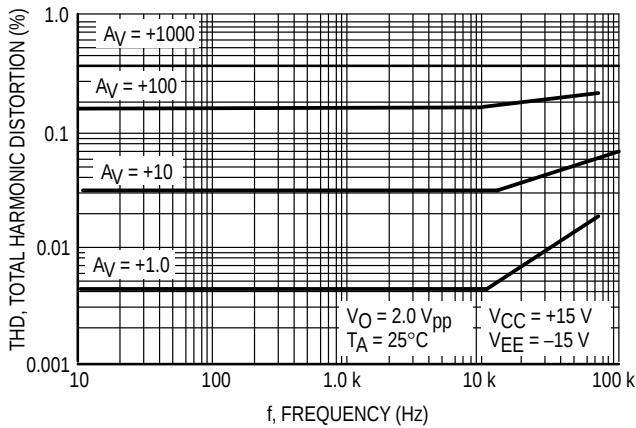


Figure 29. Output Impedance versus Frequency

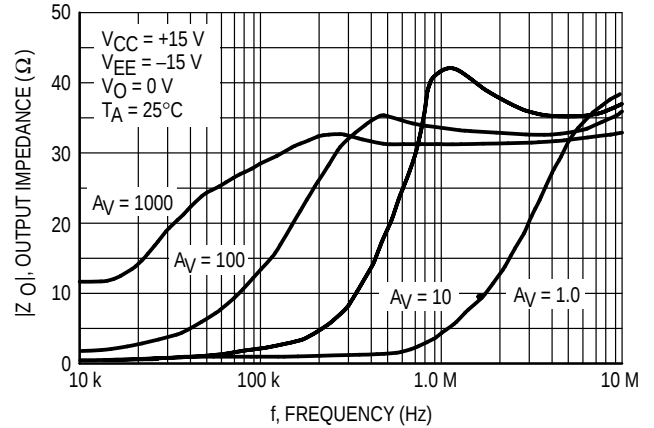


Figure 30. Input Referred Noise Voltage versus Frequency

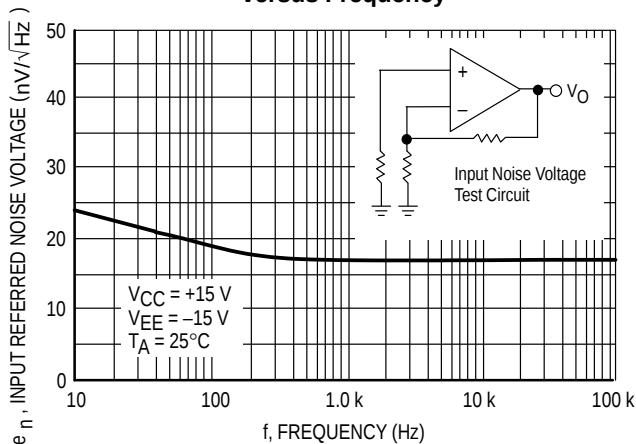
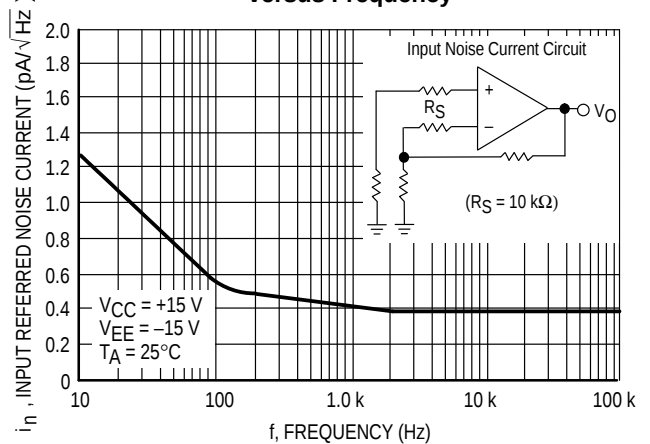


Figure 31. Input Referred Noise Current versus Frequency



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Figure 32. Percent Overshoot versus Load Capacitance

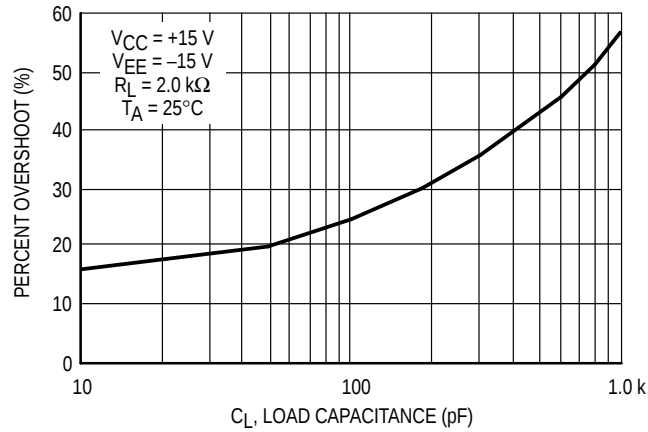


Figure 33. Noninverting Amplifier Slew Rate for the MC33274

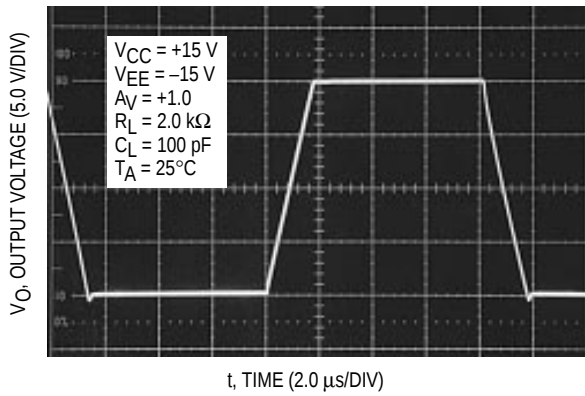


Figure 34. Noninverting Amplifier Overshoot for the MC33274

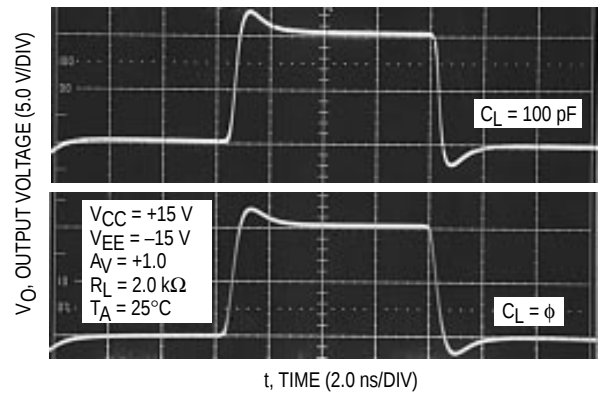


Figure 35. Small Signal Transient Response for MC33274

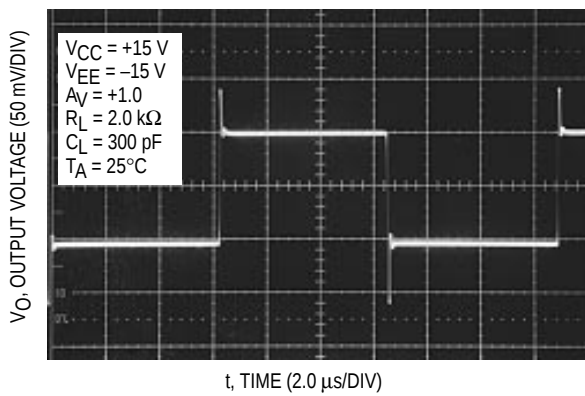
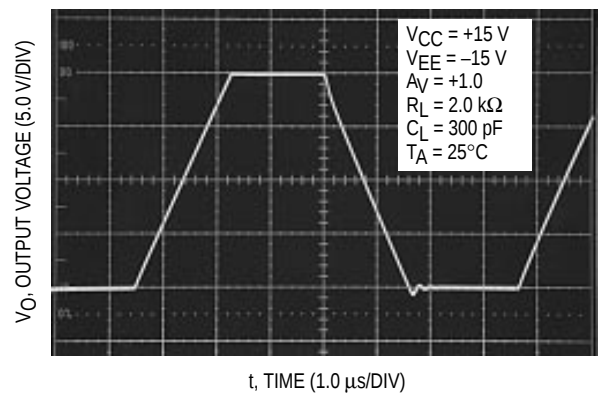


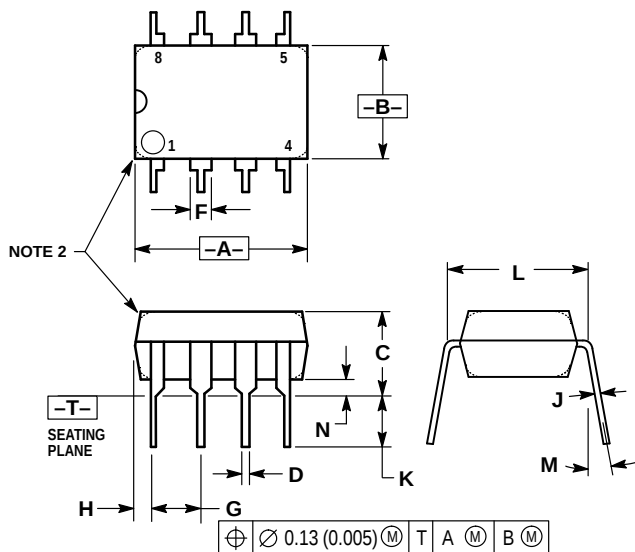
Figure 36. Large Signal Transient Response for MC33274



MC33272A MC33274A

OUTLINE DIMENSIONS

P SUFFIX PLASTIC PACKAGE CASE 626-05 ISSUE K

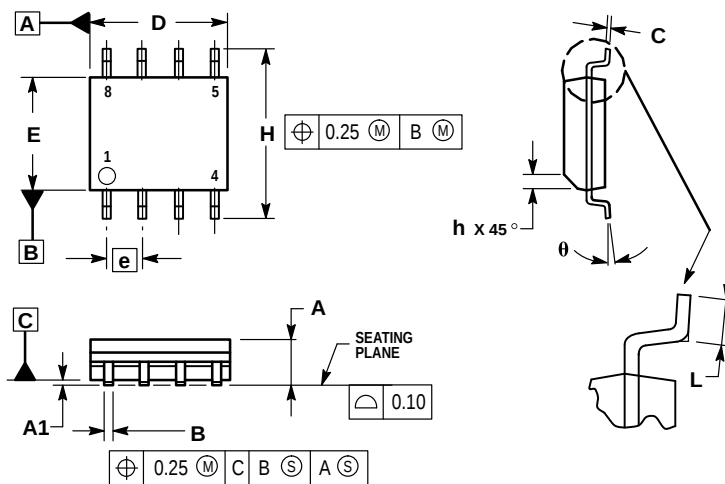


NOTES:

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°		10°	
N	0.76	1.01	0.030	0.040

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



NOTES:

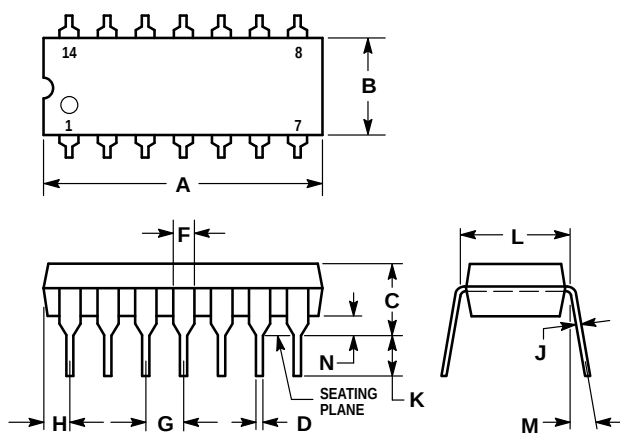
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B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

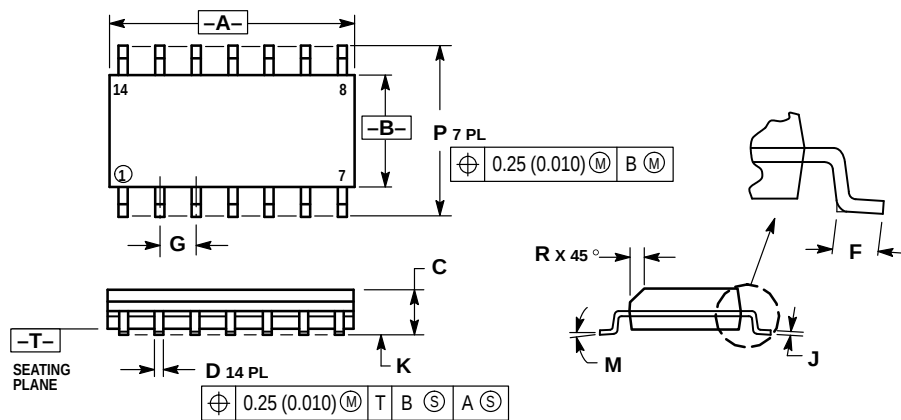


NOTES:

- 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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