

# Dual Low Noise, Audio Amplifier

The LM833 is a standard low-cost monolithic dual general-purpose operational amplifier employing Bipolar technology with innovative high-performance concepts for audio systems applications. With high frequency PNP transistors, the LM833 offers low voltage noise ( $4.5 \text{ nV}/\sqrt{\text{Hz}}$ ), 15 MHz gain bandwidth product,  $7.0 \text{ V}/\mu\text{s}$  slew rate, 0.3 mV input offset voltage with  $2.0 \mu\text{V}/^\circ\text{C}$  temperature coefficient of input offset voltage. The LM833 output stage exhibits no deadband crossover distortion, large output voltage swing, excellent phase and gain margins, low open loop high frequency output impedance and symmetrical source/sink AC frequency response.

The LM833 is specified over the automotive temperature range and is available in the plastic DIP and SO-8 packages (P and D suffixes). For an improved performance dual/quad version, see the MC33079 family.

- Low Voltage Noise:  $4.5 \text{ nV}/\sqrt{\text{Hz}}$
- High Gain Bandwidth Product: 15 MHz
- High Slew Rate:  $7.0 \text{ V}/\mu\text{s}$
- Low Input Offset Voltage: 0.3 mV
- Low T.C. of Input Offset Voltage:  $2.0 \mu\text{V}/^\circ\text{C}$
- Low Distortion: 0.002%
- Excellent Frequency Stability
- Dual Supply Operation

## MAXIMUM RATINGS

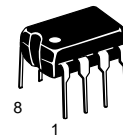
Rating	Symbol	Value	Unit
Supply Voltage ( $V_{CC}$ to $V_{EE}$ )	$V_S$	+36	V
Input Differential Voltage Range (Note 1)	$V_{IDR}$	30	V
Input Voltage Range (Note 1)	$V_{IR}$	$\pm 15$	V
Output Short Circuit Duration (Note 2)	$t_{SC}$	Indefinite	
Operating Ambient Temperature Range	$T_A$	$-40$ to $+85$	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	+150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$	$-60$ to $+150$	$^\circ\text{C}$
Maximum Power Dissipation (Notes 2 and 3)	$P_D$	500	mW

- NOTES:**
1. Either or both input voltages must not exceed the magnitude of  $V_{CC}$  or  $V_{EE}$ .
  2. Power dissipation must be considered to ensure maximum junction temperature ( $T_J$ ) is not exceeded (see power dissipation performance characteristic).
  3. Maximum value at  $T_A \leq 85^\circ\text{C}$ .

# LM833

## DUAL OPERATIONAL AMPLIFIER

### SEMICONDUCTOR TECHNICAL DATA

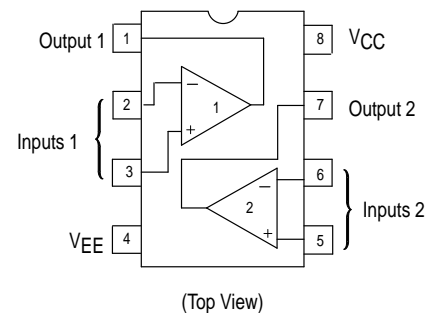


**N SUFFIX**  
PLASTIC PACKAGE  
CASE 626



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

## PIN CONNECTIONS



## ORDERING INFORMATION

Device	Operating Temperature Range	Package
LM833N	$T_A = -40^\circ$ to $+85^\circ\text{C}$	Plastic DIP
LM833D		SO-8

# LM833

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

Characteristic	Symbol	Min	Typ	Max	Unit
Input Offset Voltage ( $R_S = 10\ \Omega$ , $V_O = 0\text{ V}$ )	$V_{IO}$	–	0.3	5.0	mV
Average Temperature Coefficient of Input Offset Voltage $R_S = 10\ \Omega$ , $V_O = 0\text{ V}$ , $T_A = T_{low}$ to $T_{high}$	$\Delta V_{IO}/\Delta T$	–	2.0	–	$\mu\text{V}/^\circ\text{C}$
Input Offset Current ( $V_{CM} = 0\text{ V}$ , $V_O = 0\text{ V}$ )	$I_{IO}$	–	10	200	nA
Input Bias Current ( $V_{CM} = 0\text{ V}$ , $V_O = 0\text{ V}$ )	$I_{IB}$	–	300	1000	nA
Common Mode Input Voltage Range	$V_{ICR}$	– –12	+14 –14	+12 –	V
Large Signal Voltage Gain ( $R_L = 2.0\text{ k}\Omega$ , $V_O = \pm 10\text{ V}$ )	$A_{VOL}$	90	110	–	dB
Output Voltage Swing: $R_L = 2.0\text{ k}\Omega$ , $V_{ID} = 1.0\text{ V}$ $R_L = 2.0\text{ k}\Omega$ , $V_{ID} = 1.0\text{ V}$ $R_L = 10\text{ k}\Omega$ , $V_{ID} = 1.0\text{ V}$ $R_L = 10\text{ k}\Omega$ , $V_{ID} = 1.0\text{ V}$	$V_{O+}$ $V_{O-}$ $V_{O+}$ $V_{O-}$	10 – 12 –	13.7 –14.1 13.9 –14.7	– –10 – –12	V
Common Mode Rejection ( $V_{in} = \pm 12\text{ V}$ )	CMR	80	100	–	dB
Power Supply Rejection ( $V_S = 15\text{ V}$ to $5.0\text{ V}$ , $-15\text{ V}$ to $-5.0\text{ V}$ )	PSR	80	115	–	dB
Power Supply Current ( $V_O = 0\text{ V}$ , Both Amplifiers)	$I_D$	–	4.0	8.0	mA

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

Characteristic	Symbol	Min	Typ	Max	Unit
Slew Rate ( $V_{in} = -10\text{ V}$ to $+10\text{ V}$ , $R_L = 2.0\text{ k}\Omega$ , $A_V = +1.0$ )	$S_R$	5.0	7.0	–	$\text{V}/\mu\text{s}$
Gain Bandwidth Product ( $f = 100\text{ kHz}$ )	GBW	10	15	–	MHz
Unity Gain Frequency (Open Loop)	$f_U$	–	9.0	–	MHz
Unity Gain Phase Margin (Open Loop)	$\theta_m$	–	60	–	Deg
Equivalent Input Noise Voltage ( $R_S = 100\ \Omega$ , $f = 1.0\text{ kHz}$ )	$e_n$	–	4.5	–	$\text{nV}/\sqrt{\text{Hz}}$
Equivalent Input Noise Current ( $f = 1.0\text{ kHz}$ )	$i_n$	–	0.5	–	$\text{pA}/\sqrt{\text{Hz}}$
Power Bandwidth ( $V_O = 27\text{ V}_{pp}$ , $R_L = 2.0\text{ k}\Omega$ , $\text{THD} \leq 1.0\%$ )	BWP	–	120	–	kHz
Distortion ( $R_L = 2.0\text{ k}\Omega$ , $f = 20\text{ Hz}$ to $20\text{ kHz}$ , $V_O = 3.0\text{ V}_{rms}$ , $A_V = +1.0$ )	THD	–	0.002	–	%
Channel Separation ( $f = 20\text{ Hz}$ to $20\text{ kHz}$ )	$C_S$	–	–120	–	dB

Figure 1. Maximum Power Dissipation versus Temperature

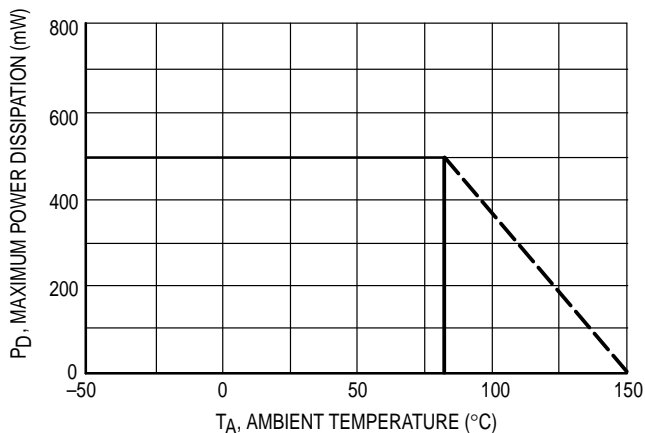


Figure 2. Input Bias Current versus Temperature

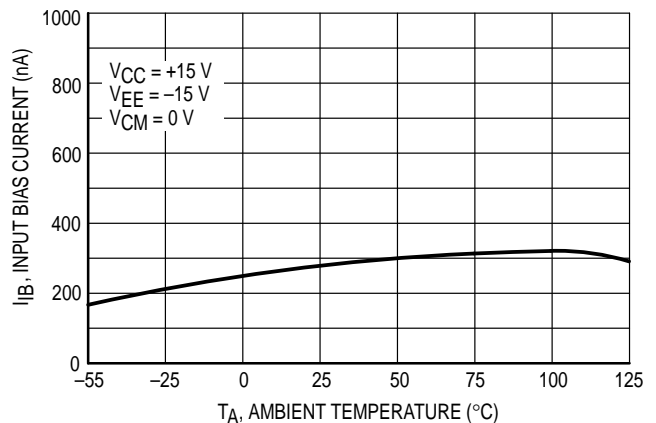


Figure 3. Input Bias Current versus Supply Voltage

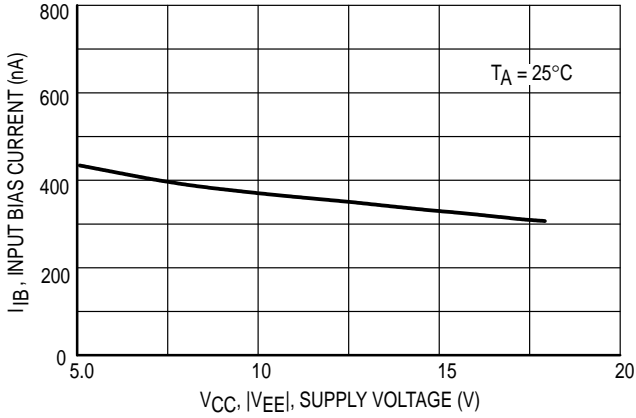


Figure 4. Supply Current versus Supply Voltage

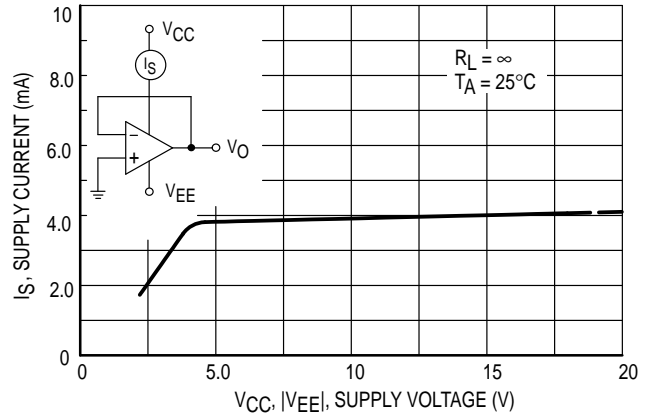


Figure 5. DC Voltage Gain versus Temperature

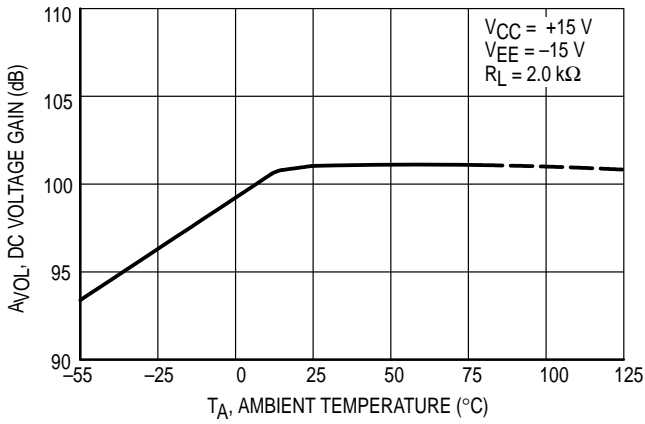


Figure 6. DC Voltage Gain versus Supply Voltage

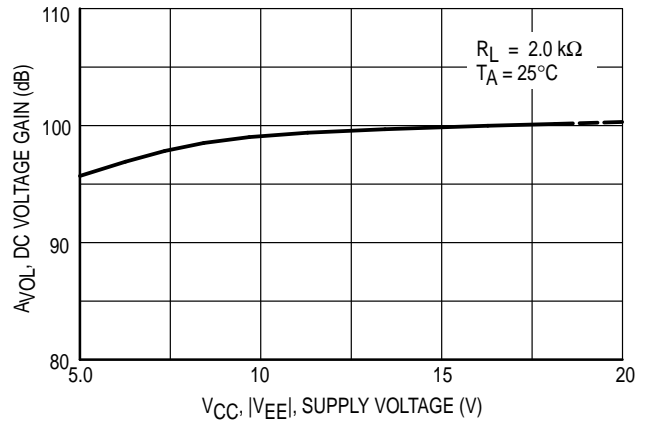


Figure 7. Open Loop Voltage Gain and Phase versus Frequency

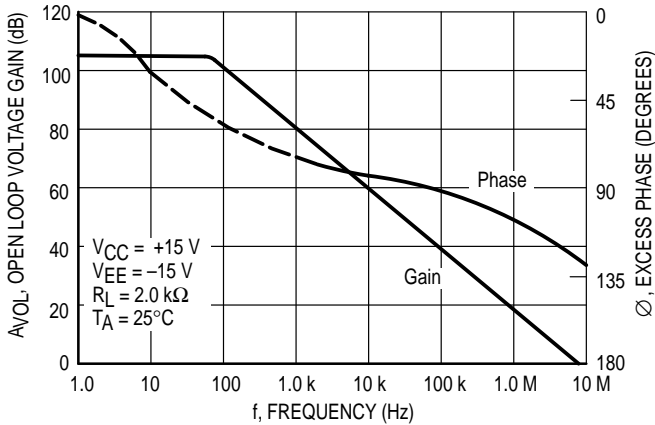


Figure 8. Gain Bandwidth Product versus Temperature

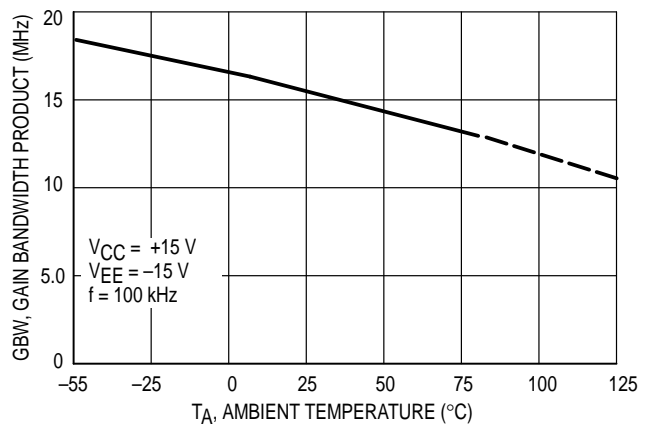


Figure 9. Gain Bandwidth Product versus Supply Voltage

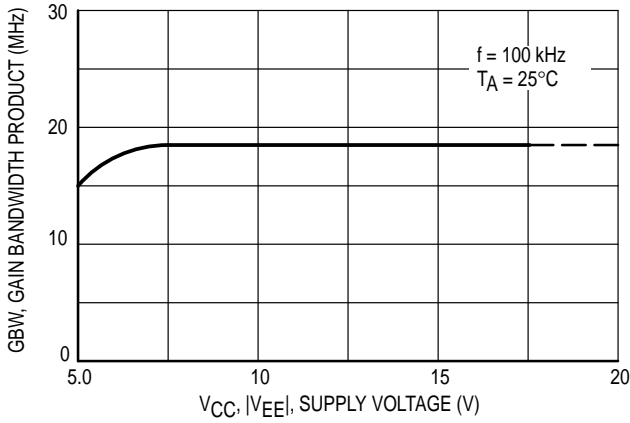


Figure 10. Slew Rate versus Temperature

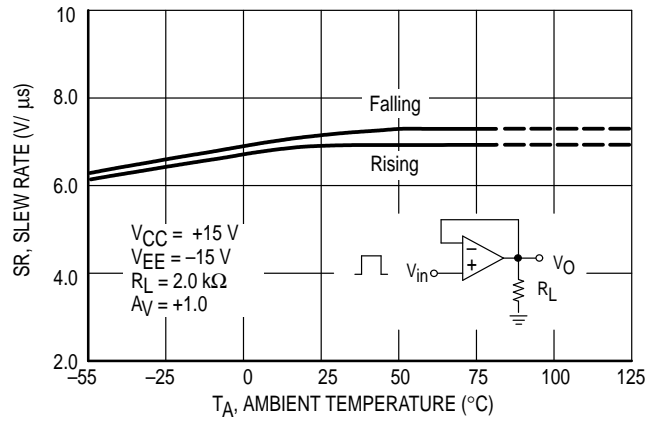


Figure 11. Slew Rate versus Supply Voltage

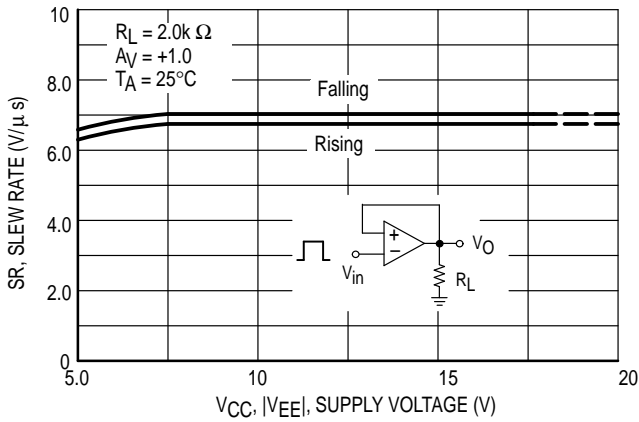


Figure 12. Output Voltage versus Frequency

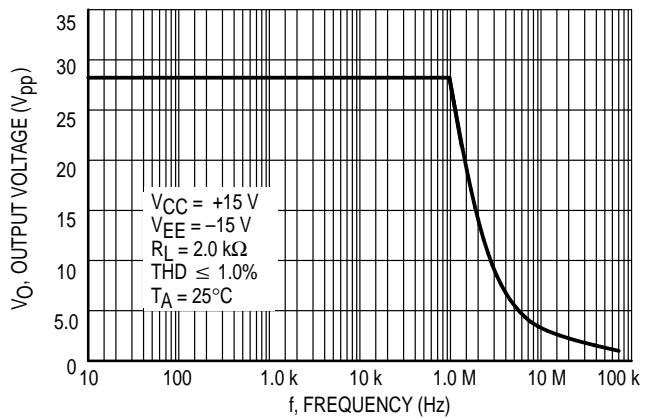


Figure 13. Maximum Output Voltage versus Supply Voltage

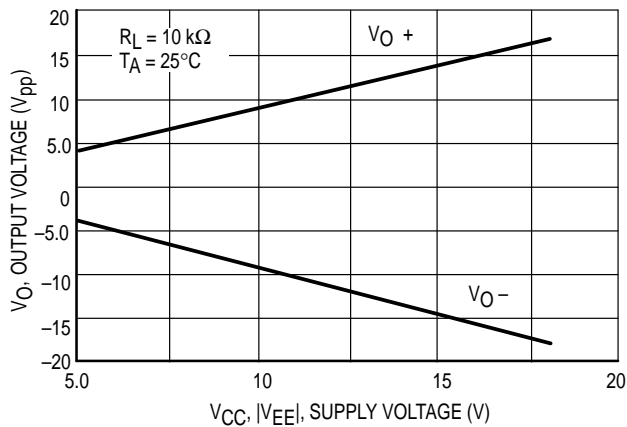


Figure 14. Output Saturation Voltage versus Temperature

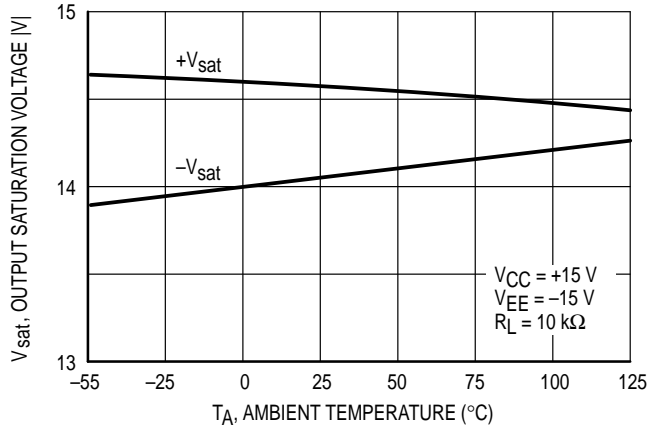


Figure 15. Power Supply Rejection versus Frequency

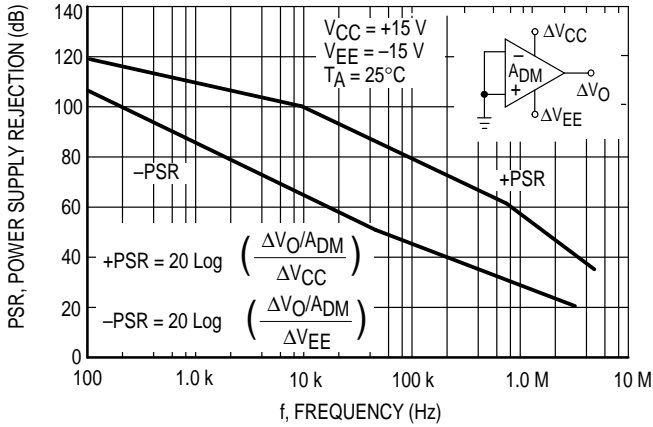


Figure 16. Common Mode Rejection versus Frequency

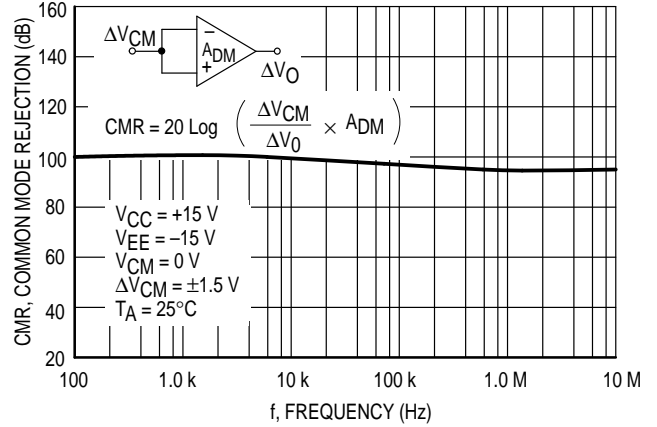


Figure 17. Total Harmonic Distortion versus Frequency

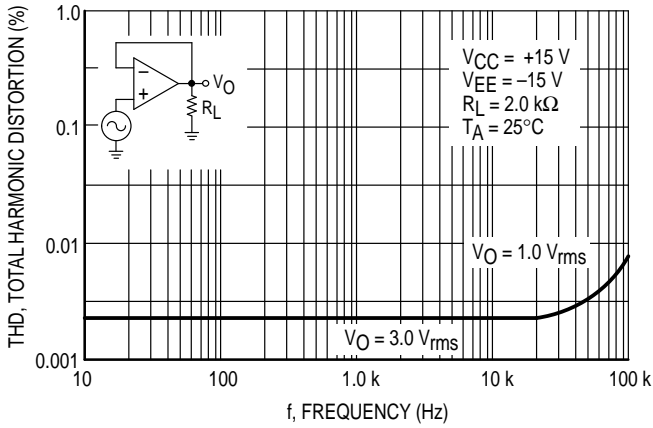


Figure 18. Input Referred Noise Voltage versus Frequency

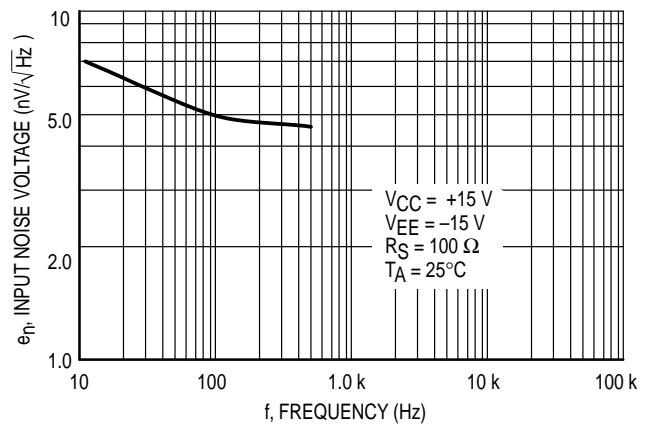


Figure 19. Input Referred Noise Current versus Frequency

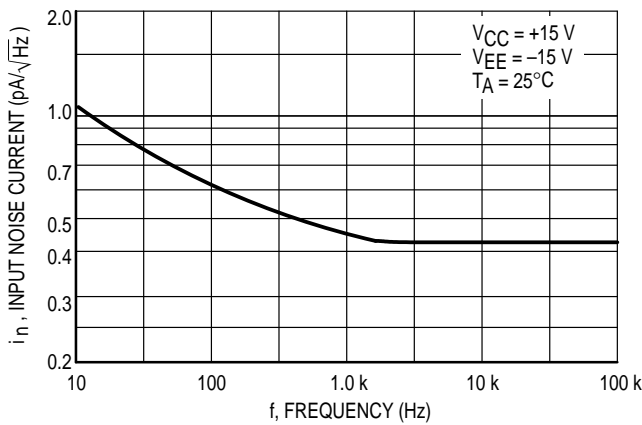


Figure 20. Input Referred Noise Voltage versus Source Resistance

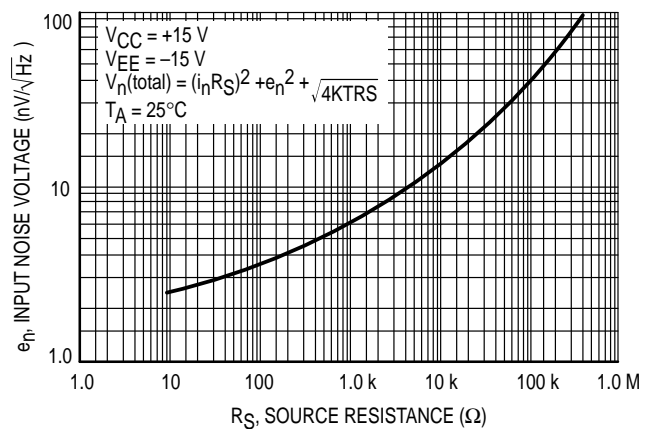


Figure 21. Inverting Amplifier

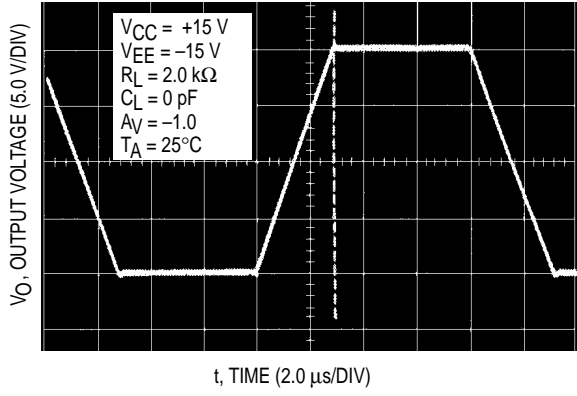


Figure 22. Noninverting Amplifier Slew Rate

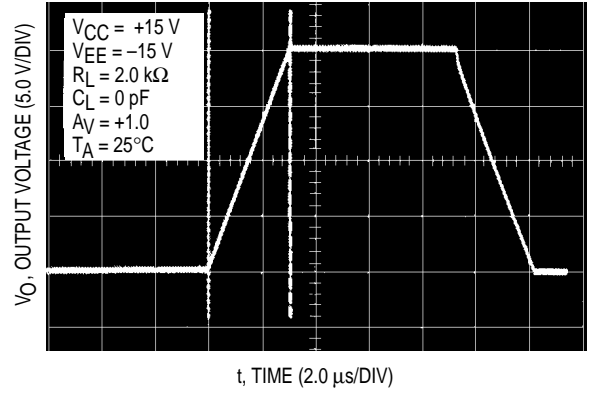
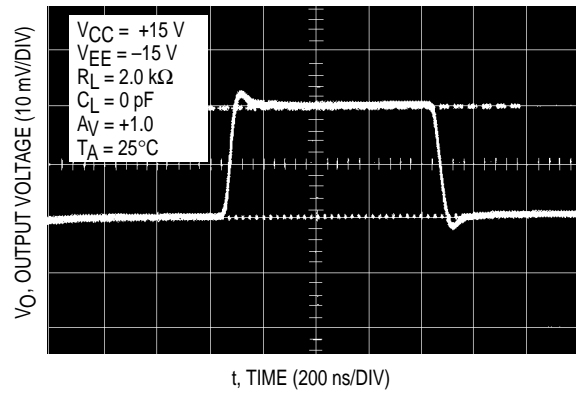


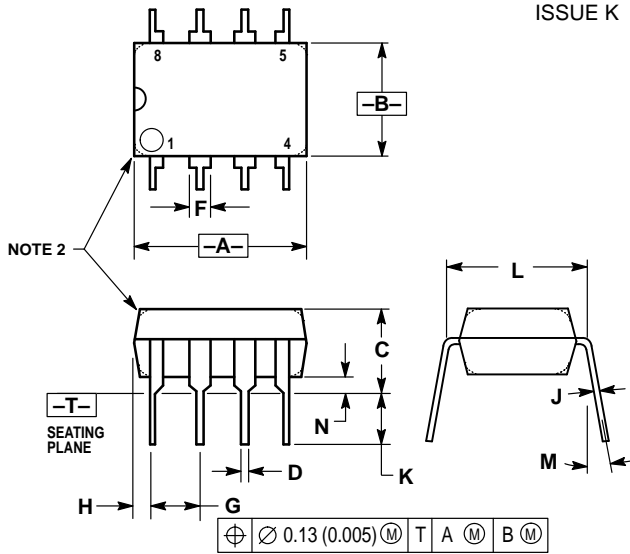
Figure 23. Noninverting Amplifier Overshoot



# LM833

## OUTLINE DIMENSIONS

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

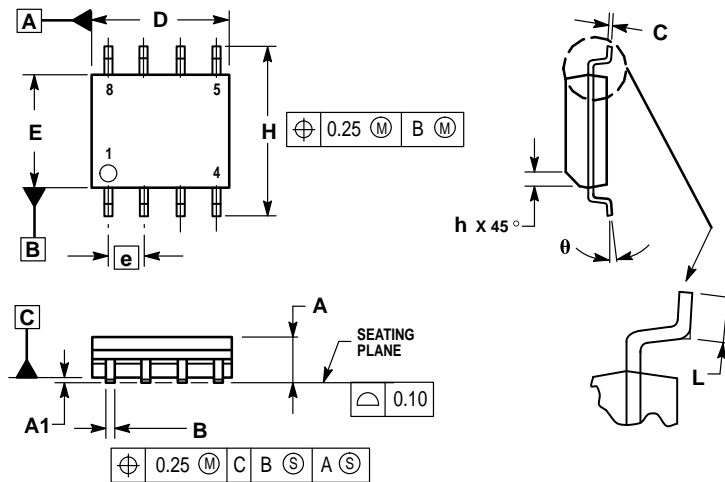


NOTES:

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
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°

# LM833

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**MOTOROLA**



LM833/D

