



# LM833

## Dual Low Noise, Audio Amplifier

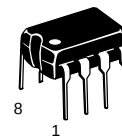
The LM833 is a standard low-cost monolithic dual general-purpose operational amplifier employing Bipolar technology with innovative high-performance concepts for audio systems applications. With high frequency PNP transistors, the LM833 offers low voltage noise ( $4.5 \text{ nV}/\sqrt{\text{Hz}}$ ), 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

### DUAL OPERATIONAL AMPLIFIER

#### SEMICONDUCTOR TECHNICAL DATA



**N SUFFIX**  
PLASTIC PACKAGE  
CASE 626



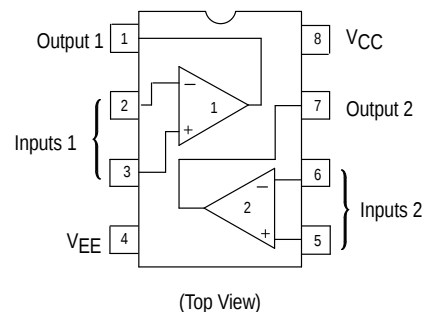
**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751  
(SO-8)

#### 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  $T_A \leq 85^\circ\text{C}$ .

#### PIN CONNECTIONS



#### ORDERING INFORMATION

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

**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<br>$R_S = 10\ \Omega$ , $V_O = 0\text{ V}$ , $T_A = T_{\text{low}}$ to $T_{\text{high}}$                                                                                                    | $\Delta V_{IO}/\Delta T$                     | –                  | 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                                                                                                                                                                                                                     | $V_{ICR}$                                    | –<br>–12           | +14<br>–14                     | +12<br>–             | 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:<br>$R_L = 2.0\text{ k}\Omega$ , $V_{ID} = 1.0\text{ V}$<br>$R_L = 2.0\text{ k}\Omega$ , $V_{ID} = 1.0\text{ V}$<br>$R_L = 10\text{ k}\Omega$ , $V_{ID} = 1.0\text{ V}$<br>$R_L = 10\text{ k}\Omega$ , $V_{ID} = 1.0\text{ V}$ | $V_{O+}$<br>$V_{O-}$<br>$V_{O+}$<br>$V_{O-}$ | 10<br>–<br>12<br>– | 13.7<br>–14.1<br>13.9<br>–14.7 | –<br>–10<br>–<br>–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                           |

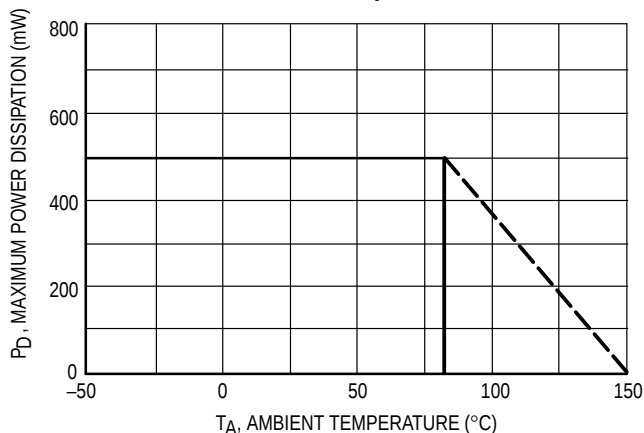
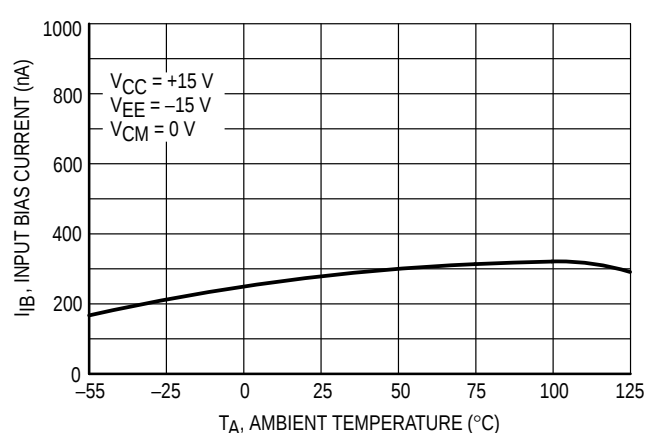
**Figure 1. Maximum Power Dissipation versus Temperature****Figure 2. Input Bias Current versus Temperature**

Figure 3. Input Bias Current versus Supply Voltage

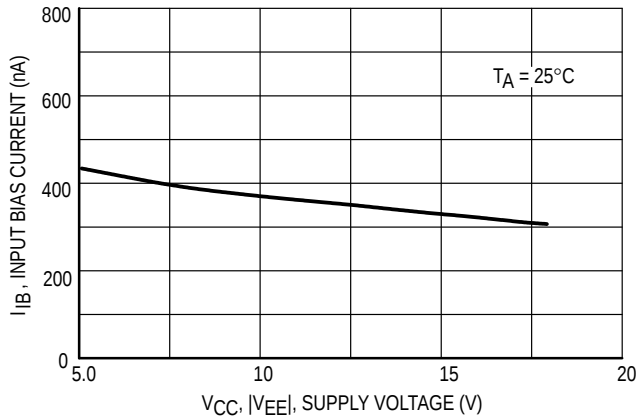


Figure 4. Supply Current versus Supply Voltage

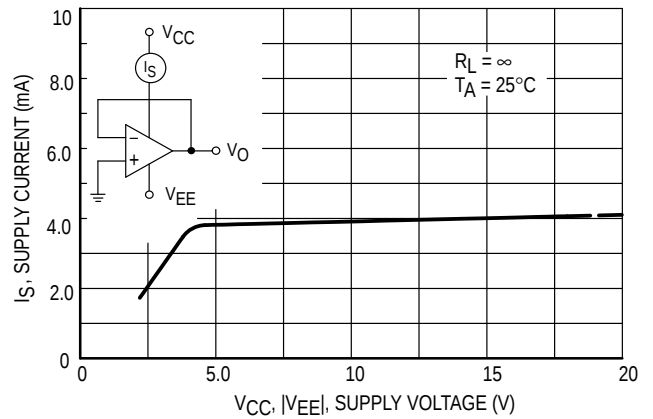


Figure 5. DC Voltage Gain versus Temperature

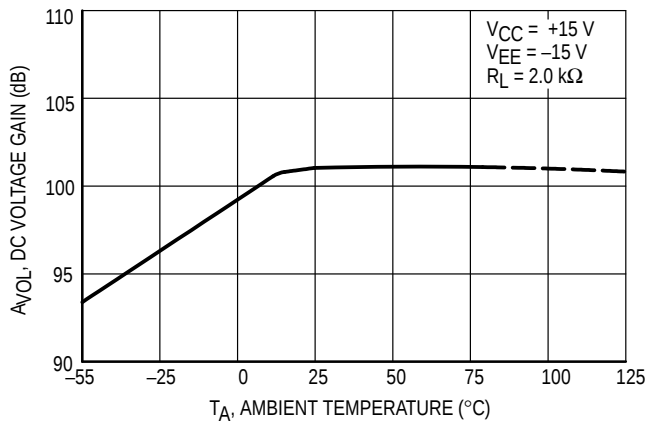


Figure 6. DC Voltage Gain versus Supply Voltage

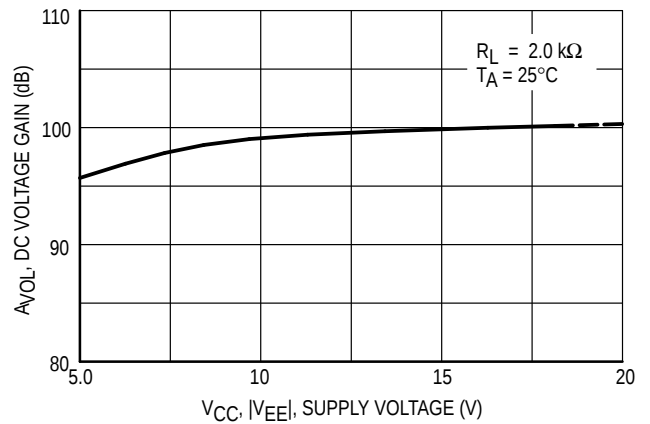


Figure 7. Open Loop Voltage Gain and Phase versus Frequency

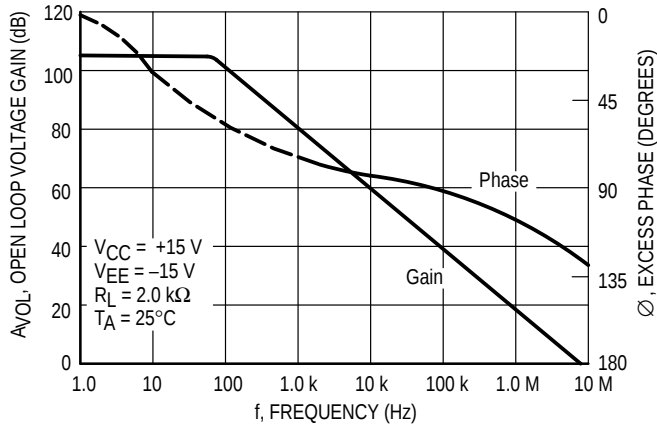
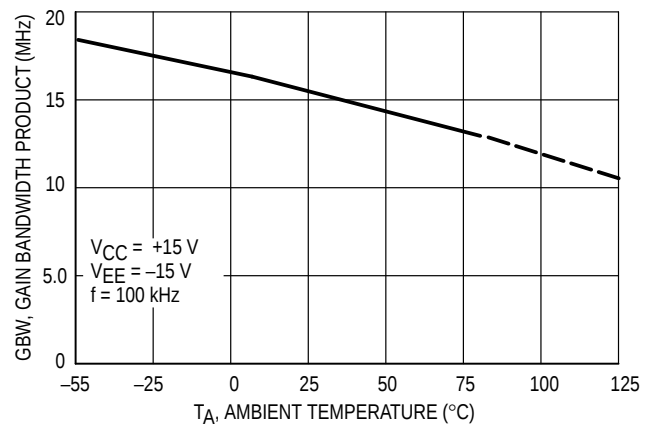
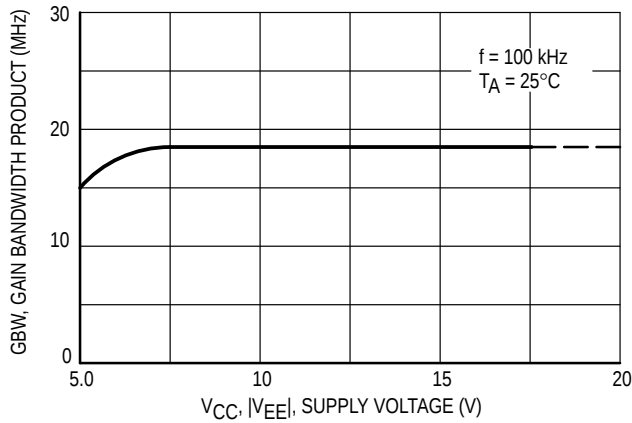


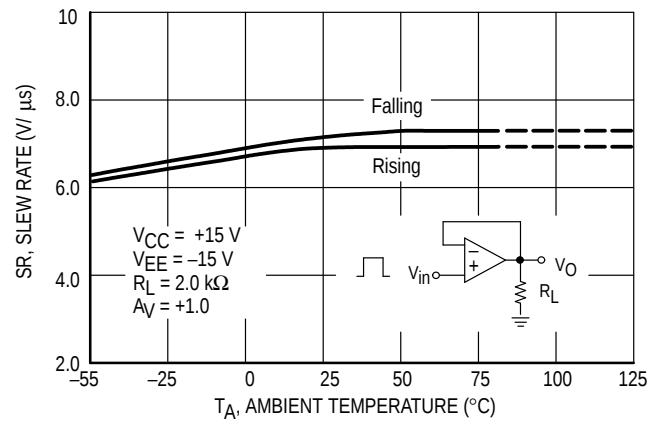
Figure 8. Gain Bandwidth Product versus Temperature



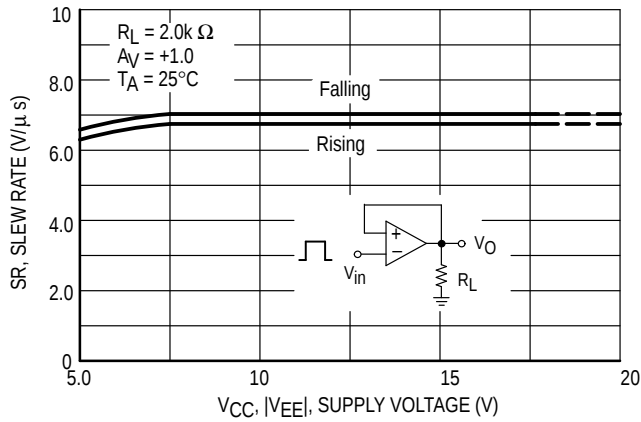
**Figure 9. Gain Bandwidth Product versus Supply Voltage**



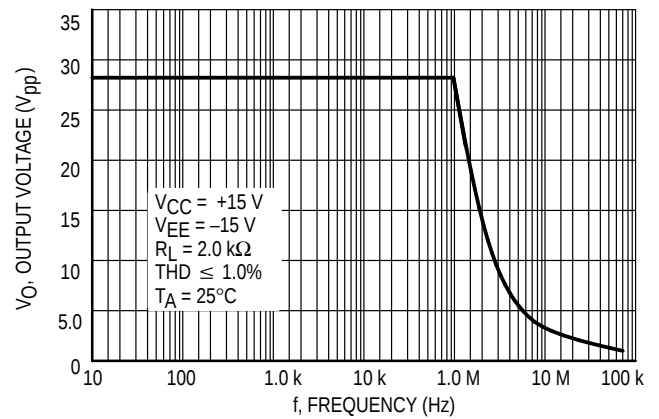
**Figure 10. Slew Rate versus Temperature**



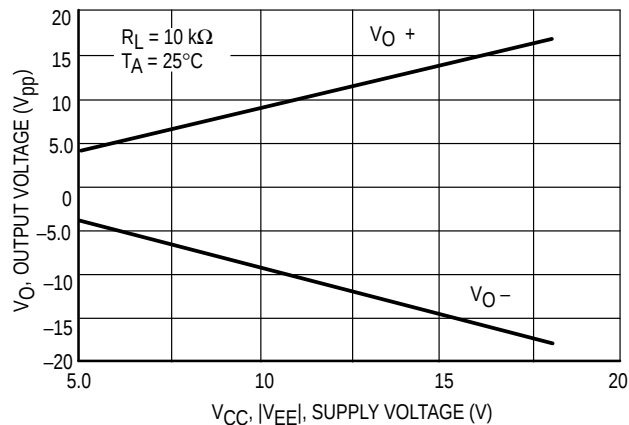
**Figure 11. Slew Rate versus Supply Voltage**



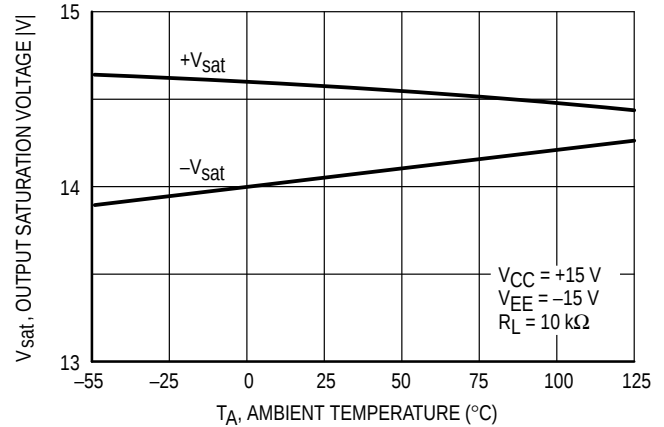
**Figure 12. Output Voltage versus Frequency**



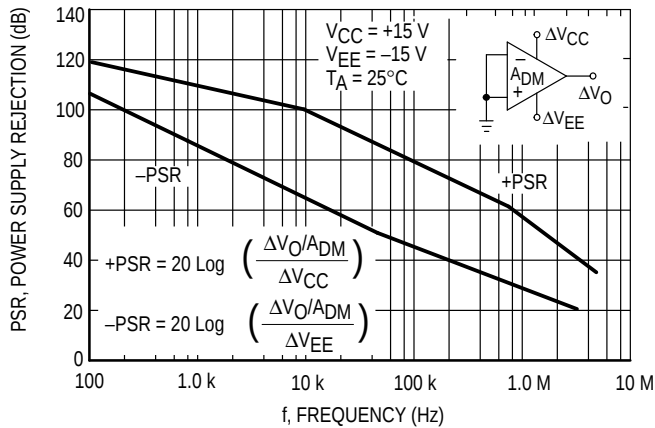
**Figure 13. Maximum Output Voltage versus Supply Voltage**



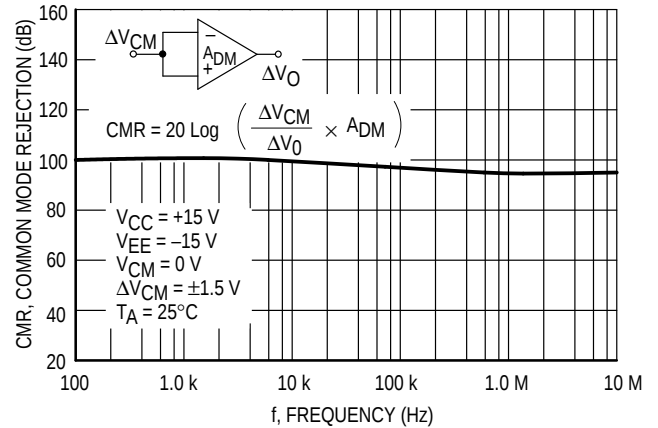
**Figure 14. Output Saturation Voltage versus Temperature**



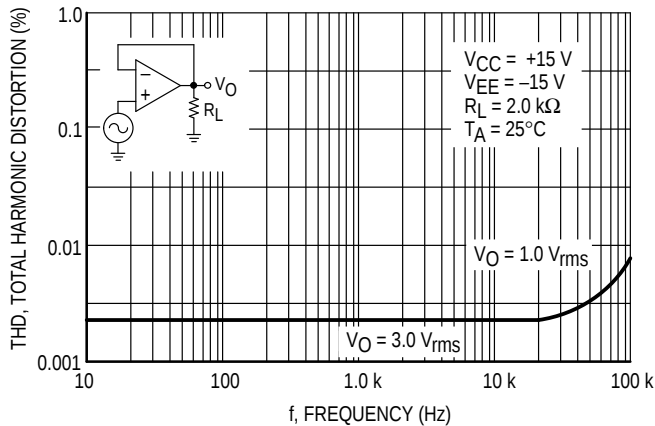
**Figure 15. Power Supply Rejection versus Frequency**



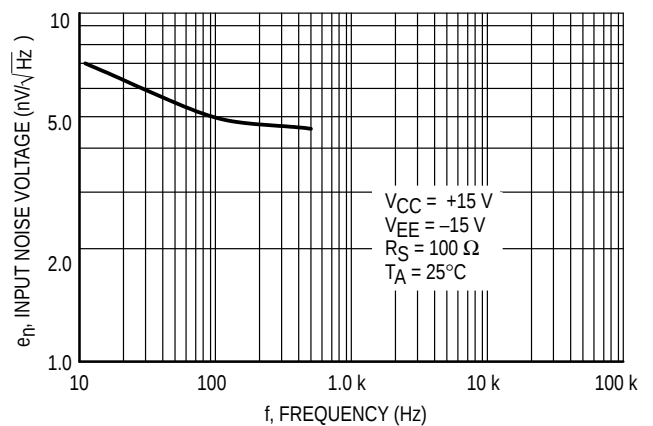
**Figure 16. Common Mode Rejection versus Frequency**



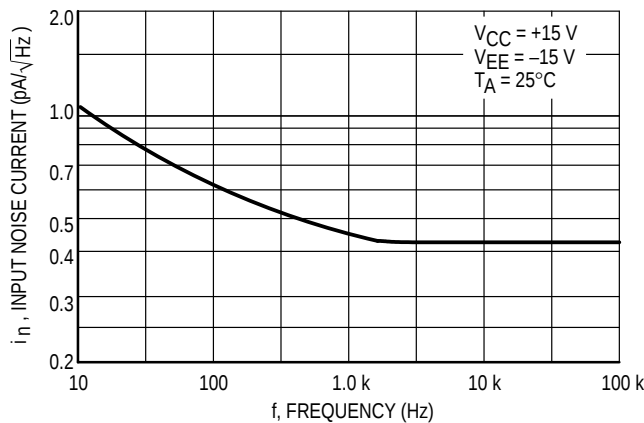
**Figure 17. Total Harmonic Distortion versus Frequency**



**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**

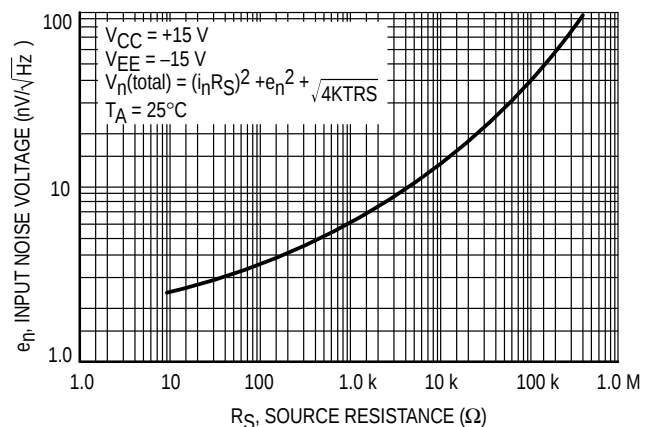


Figure 21. Inverting Amplifier

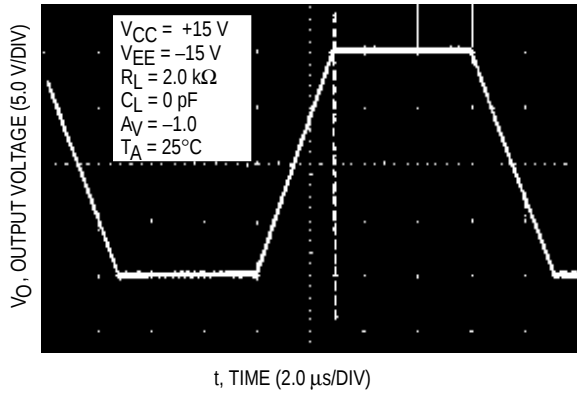


Figure 22. Noninverting Amplifier Slew Rate

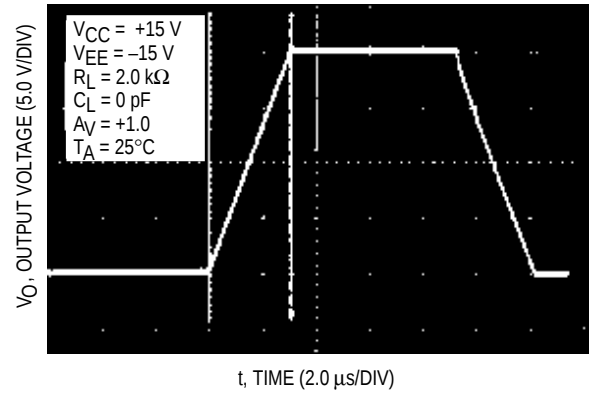
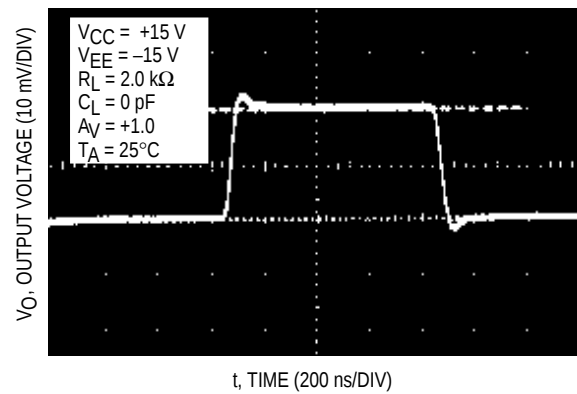
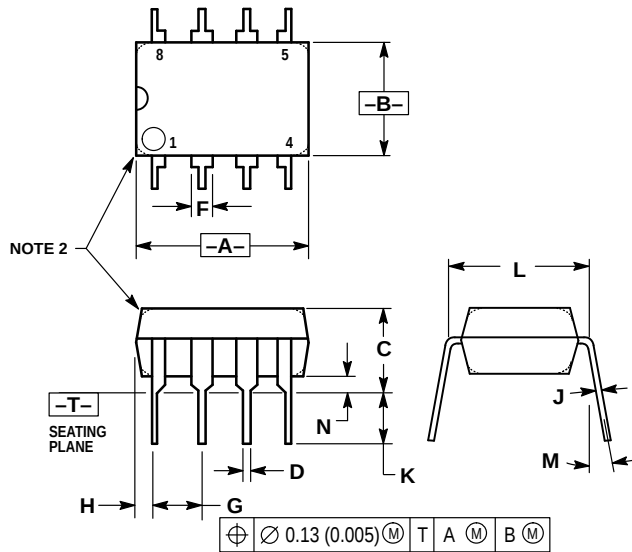


Figure 23. Noninverting Amplifier Overshoot



## OUTLINE DIMENSIONS

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

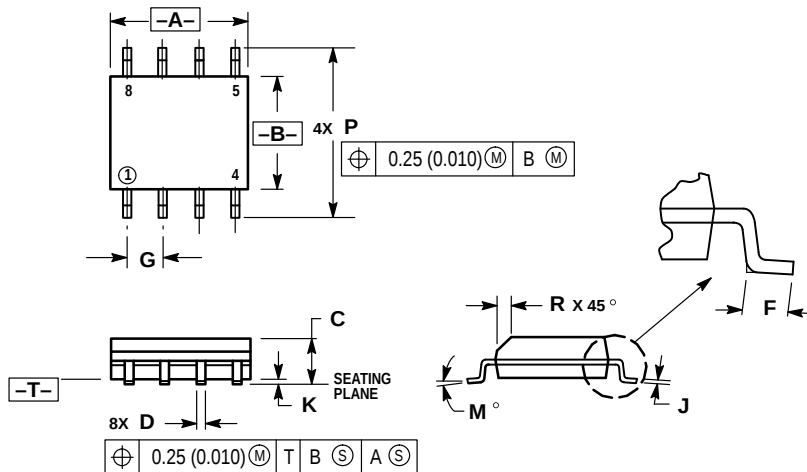


## NOTES:

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 N



## 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   | 4.80        | 5.00      | 0.189  | 0.196 |
| 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   | 0.18        | 0.25      | 0.007  | 0.009 |
| K   | 0.10        | 0.25      | 0.004  | 0.009 |
| M   | 0°          | 7°        | 0°     | 7°    |
| P   | 5.80        | 6.20      | 0.229  | 0.244 |
| R   | 0.25        | 0.50      | 0.010  | 0.019 |

# LM833

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**MOTOROLA**



CODELINE TO BE PLACED HERE

LM833/D

