

LM833, NCV833

Low Noise, Audio Dual Operational 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 V/ μs 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 dead-band 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.

For an improved performance dual/quad version, see the MC33079 family.

Features

- Low Voltage Noise: $4.5 \text{ nV}/\sqrt{\text{Hz}}$
- High Gain Bandwidth Product: 15 MHz
- High Slew Rate: 7.0 V/ μs
- 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
- NCV Prefix for Automotive and Other Applications Requiring Site and Change Controls
- These Devices are Pb-Free and are RoHS Compliant

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} | ± 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 | $^\circ\text{C}$ |
| ESD Protection at any Pin – Human Body Model – Machine Model | V_{esd} | 600 200 | V |
| Maximum Power Dissipation (Notes 2 and 3) | P_D | 500 | mW |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

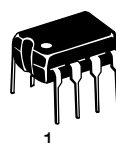
1. Either or both input voltages must not exceed the magnitude of V_{CC} or V_{EE} .
2. Power dissipation must be considered to ensure maximum junction temperature (T_J) is not exceeded (see power dissipation performance characteristic).
3. Maximum value at $T_A \leq 85^\circ\text{C}$.



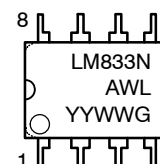
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MARKING DIAGRAMS



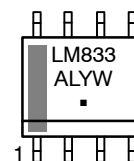
PDIP-8
N SUFFIX
CASE 626



LM833N = Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
G = Pb-Free Package

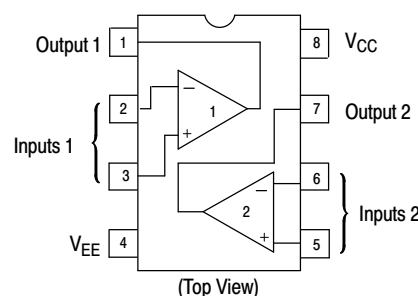


SOIC-8
D SUFFIX
CASE 751



LM833 = Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb-Free Package

PIN CONNECTIONS



ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

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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 V , -15 V to -5.0 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) | θ_m | - | 60 | - | $^\circ$ |
| 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 kHz , $V_O = 3.0\text{ V}_{rms}$, $A_V = +1.0$) | THD | - | 0.002 | - | % |
| Channel Separation ($f = 20\text{ Hz}$ to 20 kHz) | C_S | - | -120 | - | dB |

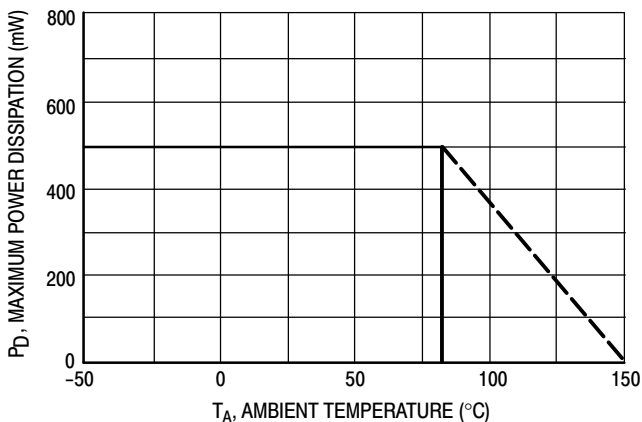


Figure 1. Maximum Power Dissipation versus Temperature

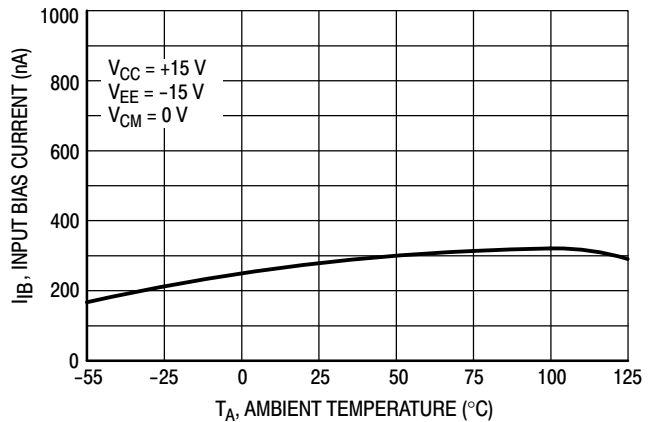


Figure 2. Input Bias Current versus Temperature

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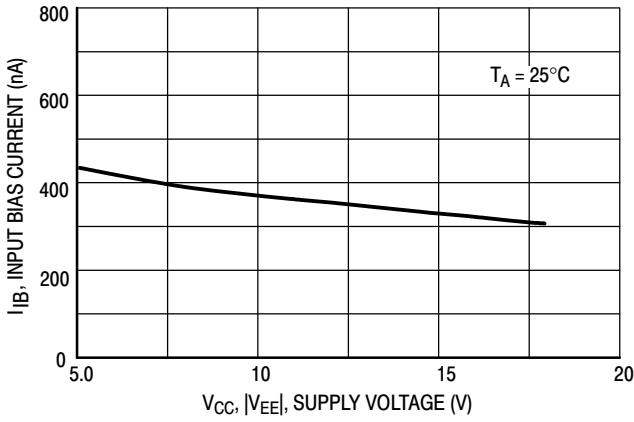


Figure 3. Input Bias Current versus Supply Voltage

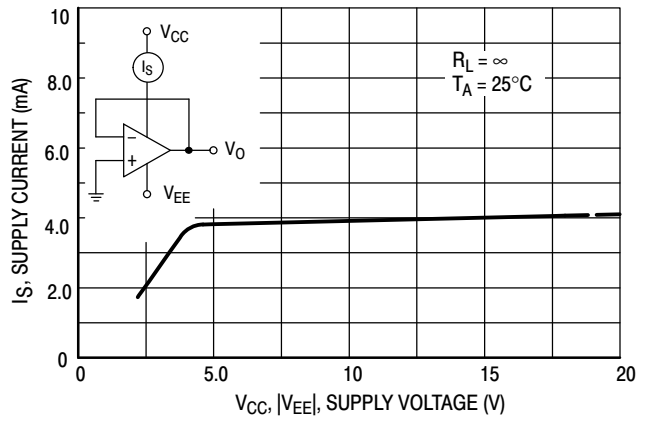


Figure 4. Supply Current versus Supply Voltage

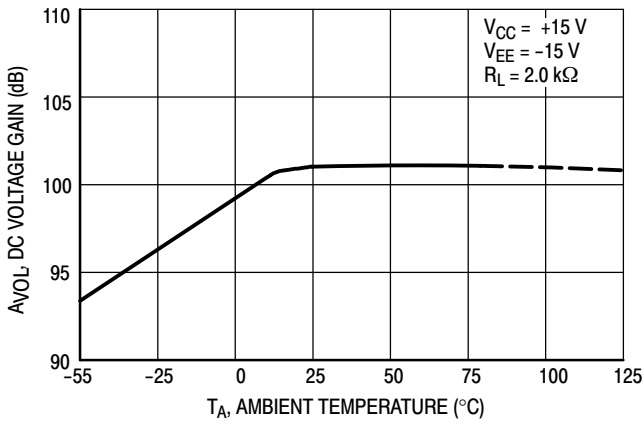


Figure 5. DC Voltage Gain versus Temperature

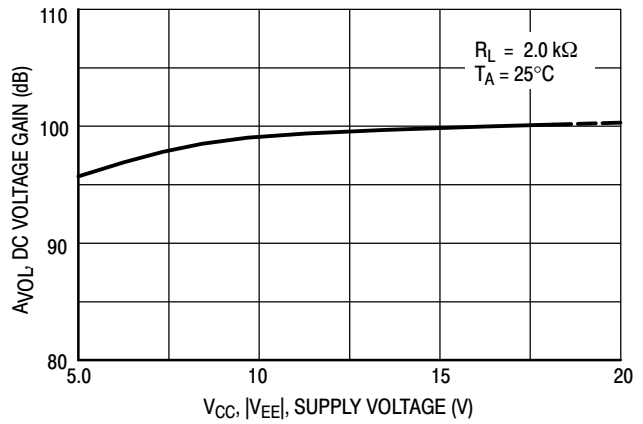


Figure 6. DC Voltage Gain versus Supply Voltage

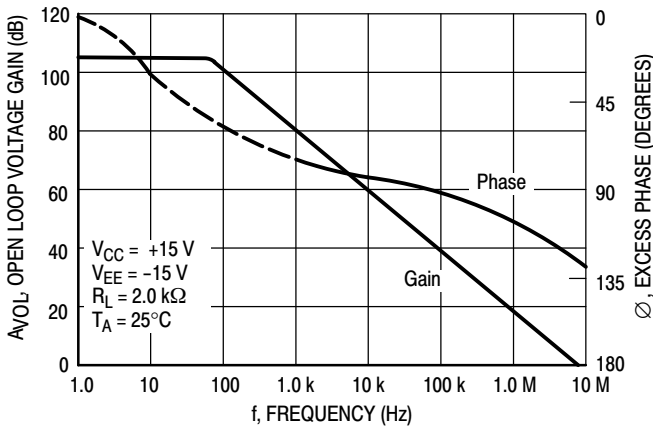


Figure 7. Open Loop Voltage Gain and Phase versus Frequency

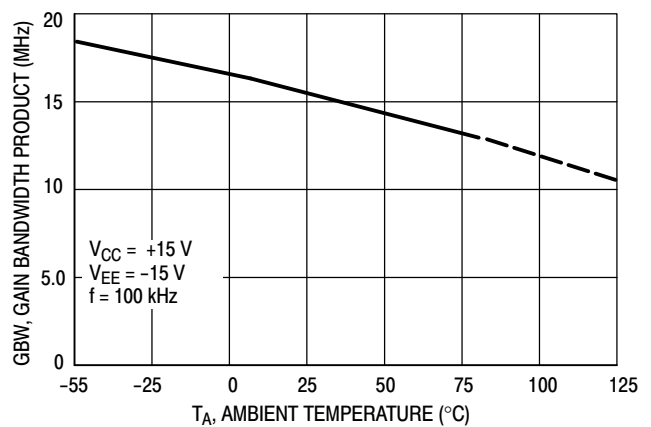


Figure 8. Gain Bandwidth Product versus Temperature

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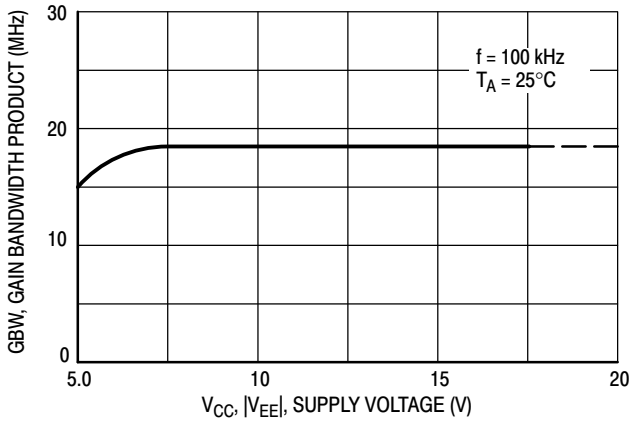


Figure 9. Gain Bandwidth Product versus Supply Voltage

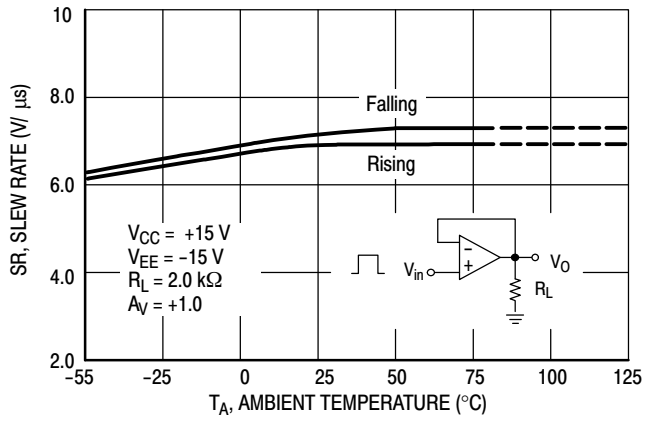


Figure 10. Slew Rate versus Temperature

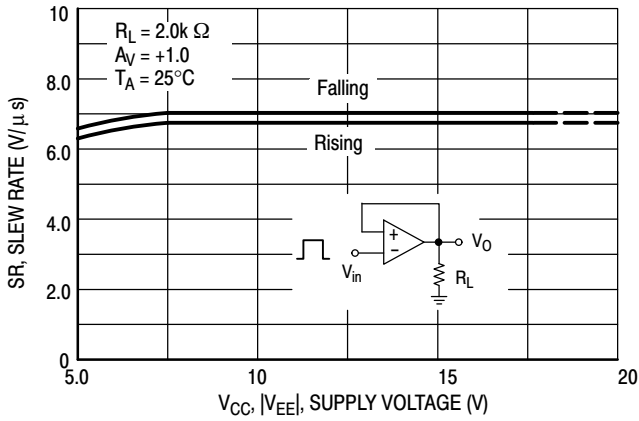


Figure 11. Slew Rate versus Supply Voltage

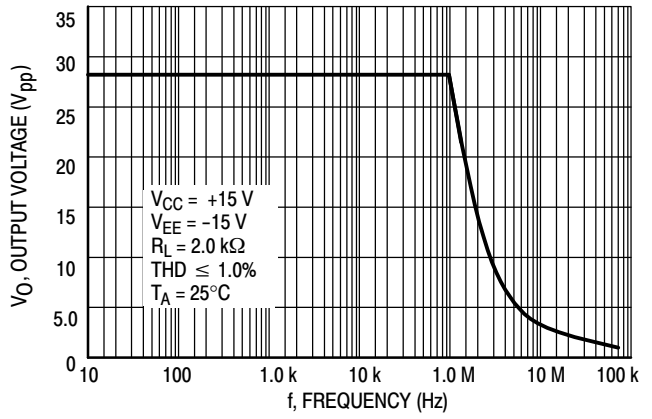


Figure 12. Output Voltage versus Frequency

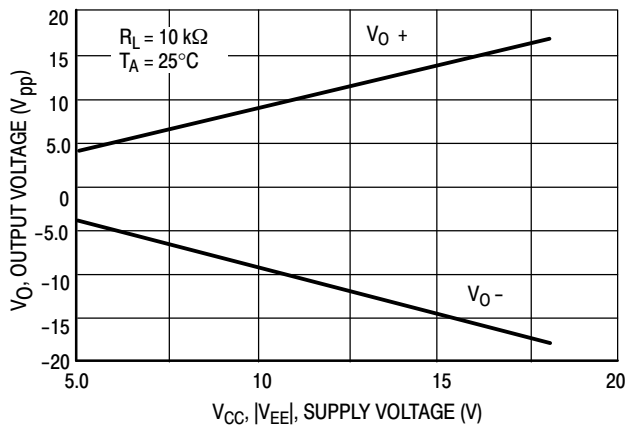


Figure 13. Maximum Output Voltage versus Supply Voltage

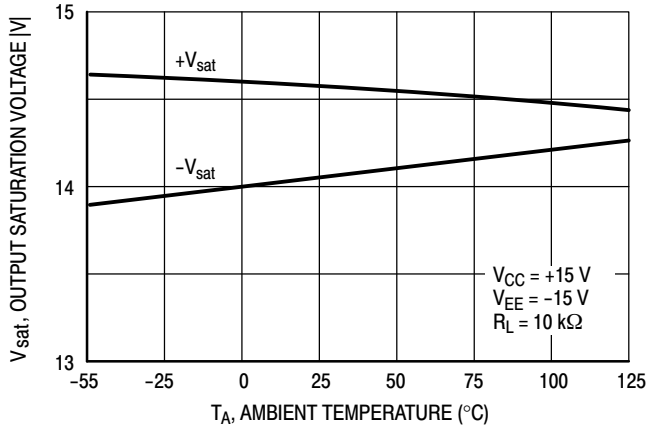


Figure 14. Output Saturation Voltage versus Temperature

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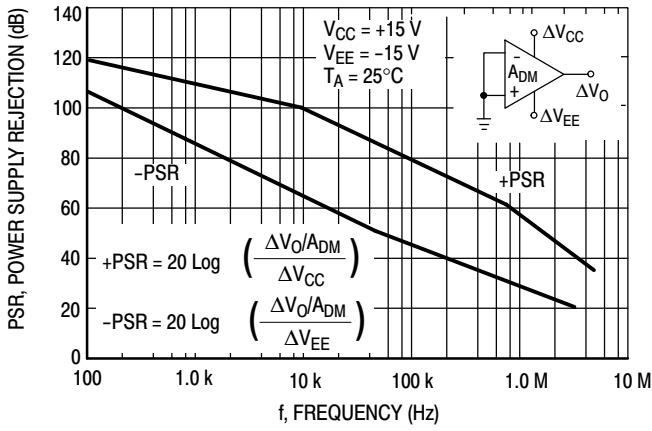


Figure 15. Power Supply Rejection versus Frequency

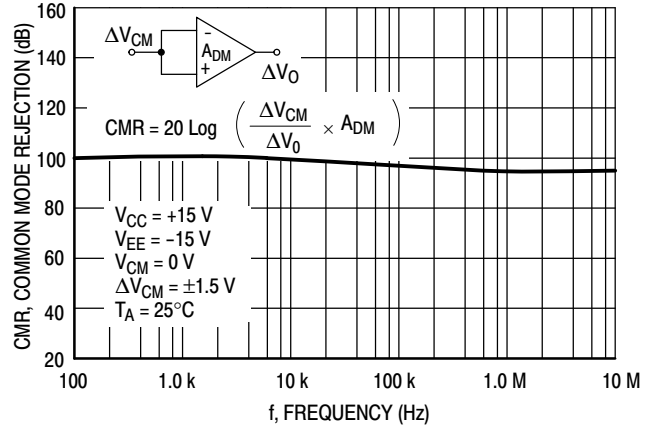


Figure 16. Common Mode Rejection versus Frequency

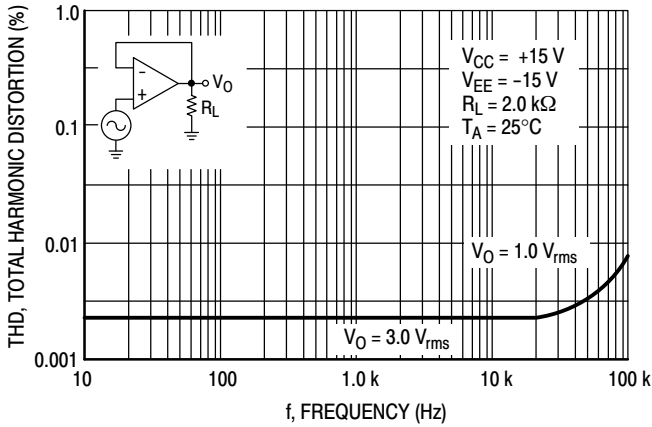


Figure 17. Total Harmonic Distortion versus Frequency

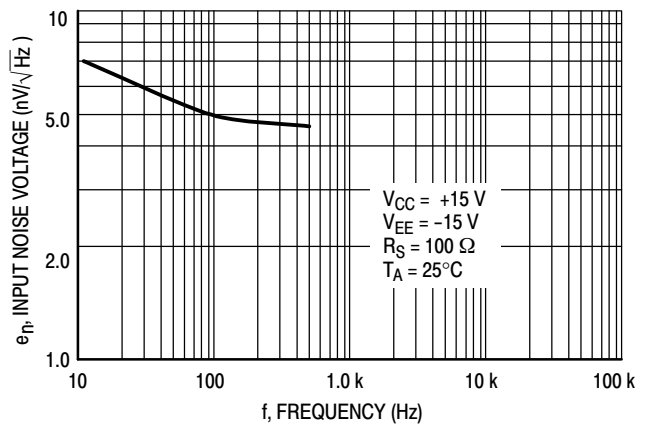


Figure 18. Input Referred Noise Voltage versus Frequency

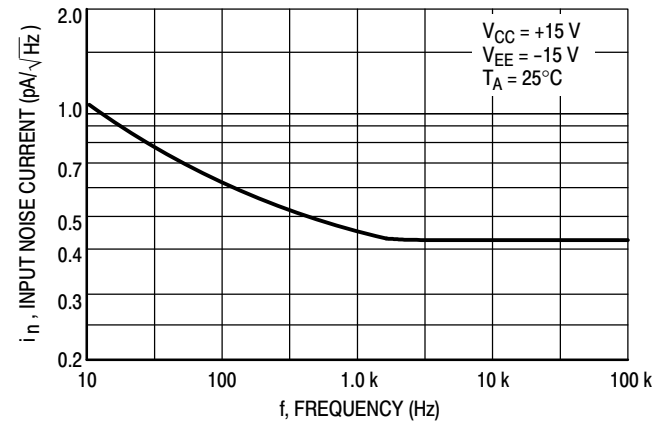


Figure 19. Input Referred Noise Current versus Frequency

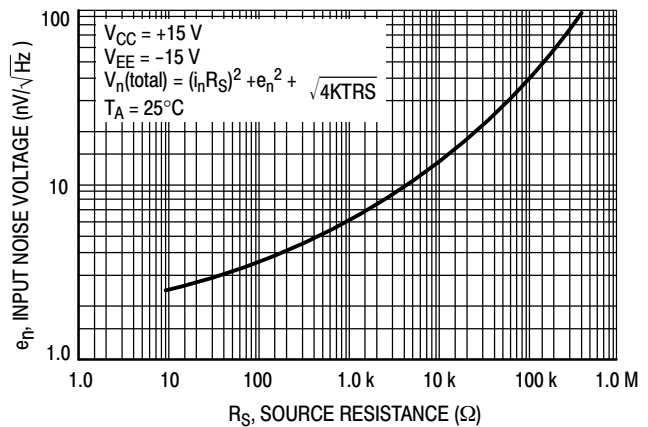


Figure 20. Input Referred Noise Voltage versus Source Resistance

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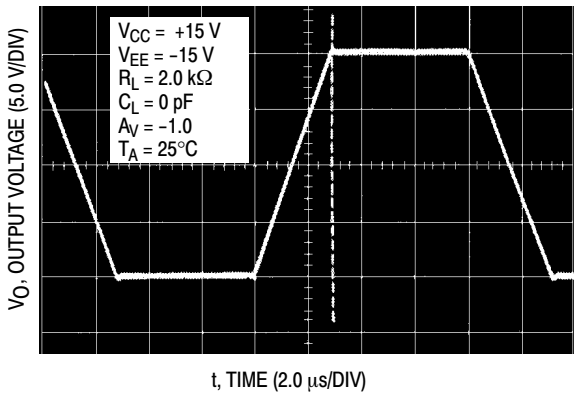


Figure 21. Inverting Amplifier

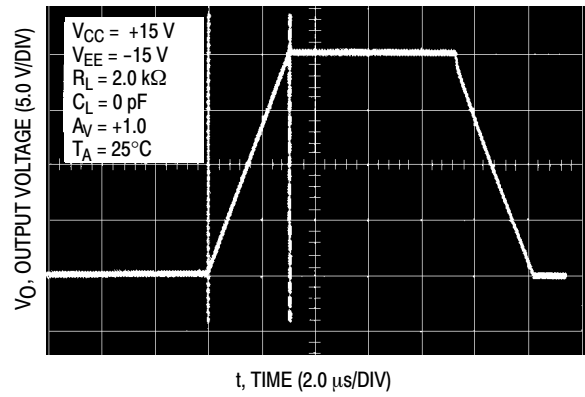


Figure 22. Noninverting Amplifier Slew Rate

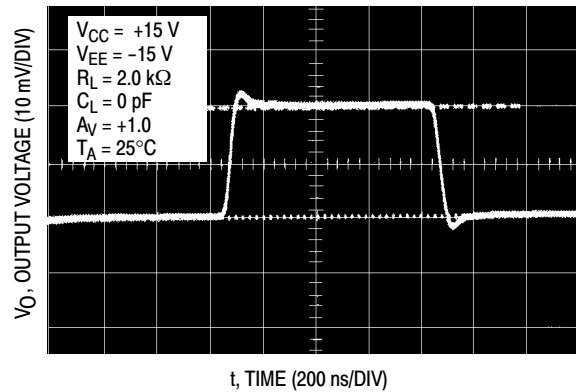


Figure 23. Noninverting Amplifier Overshoot

ORDERING INFORMATION

| Device | Package | Shipping [†] |
|-------------|---------------------|-----------------------|
| LM833NG | PDIP-8 (Pb-Free) | 50 Units / Rail |
| LM833DG | SOIC-8 (Pb-Free) | 98 Units / Rail |
| LM833DR2G | SOIC-8 (Pb-Free) | 2500 / Tape & Reel |
| NCV833DR2G* | SOIC-8 (Pb-Free) | 2500 / Tape & Reel |

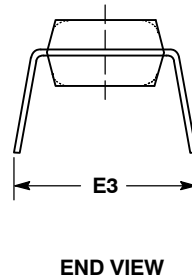
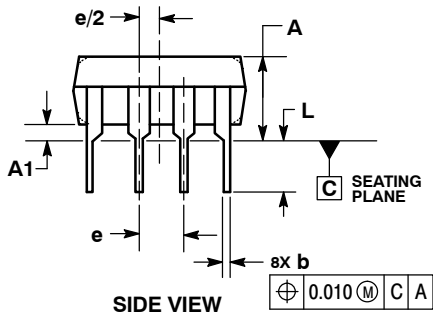
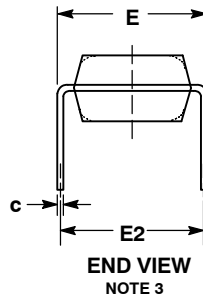
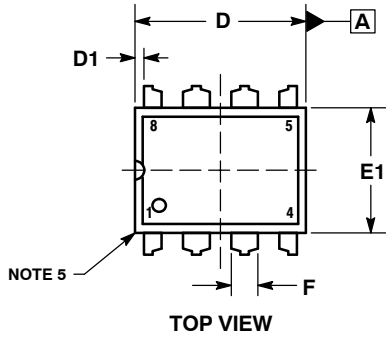
[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NCV prefix indicates qualified for automotive use.

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PACKAGE DIMENSIONS

PDIP-8
N SUFFIX
CASE 626-05
ISSUE M



NOTES:

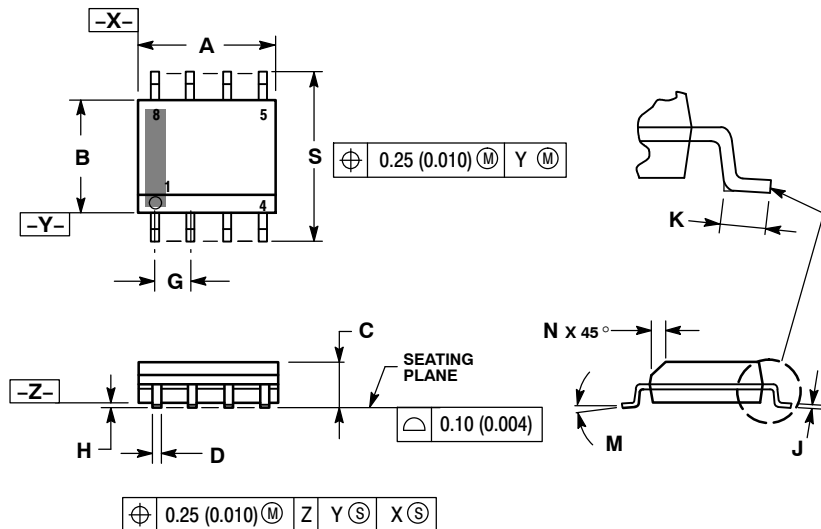
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. DIMENSION E IS MEASURED WITH THE LEADS RESTRAINED PARALLEL AT WIDTH E2.
4. DIMENSION E1 DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES | | | MILLIMETERS | | |
|-----|-----------|-------|-------|-------------|------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | ---- | ---- | 0.210 | ---- | ---- | 5.33 |
| A1 | 0.015 | ---- | ---- | 0.38 | ---- | ---- |
| b | 0.014 | 0.018 | 0.022 | 0.35 | 0.46 | 0.56 |
| C | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 |
| D | 0.355 | 0.365 | 0.400 | 9.02 | 9.27 | 10.02 |
| D1 | 0.005 | ---- | ---- | 0.13 | ---- | ---- |
| E | 0.300 | 0.310 | 0.325 | 7.62 | 7.87 | 8.26 |
| E1 | 0.240 | 0.250 | 0.280 | 6.10 | 6.35 | 7.11 |
| E2 | 0.300 BSC | | | 7.62 BSC | | |
| E3 | ---- | ---- | 0.430 | ---- | ---- | 10.92 |
| e | 0.100 BSC | | | 2.54 BSC | | |
| L | 0.115 | 0.130 | 0.150 | 2.92 | 3.30 | 3.81 |

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PACKAGE DIMENSIONS

SOIC-8
D SUFFIX
CASE 751-07
ISSUE AK

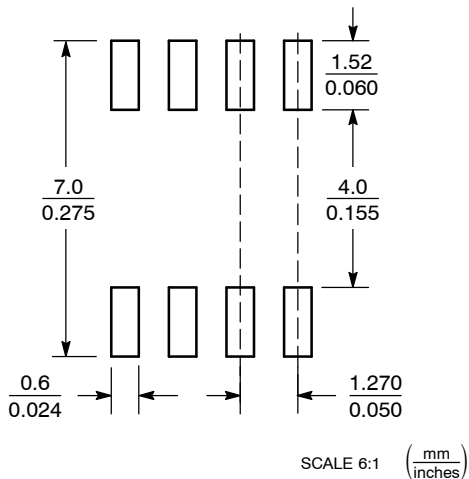


NOTES:

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.
6. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.

| 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 |

SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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