

**FEATURES**

- **Wide Dynamic Range:** >140dB
- **Low Input Noise Voltage:** 4.5nV/ $\sqrt{\text{Hz}}$
- **High Slew Rate:** 7 V/ $\mu\text{s}$  (typ); 5V/ $\mu\text{s}$  (Min)
- **High Gain Bandwidth:** 15MHz (typ); 10MHz (Min)
- **Wide Power Bandwidth:** 120KHz
- **Low Distortion:** 0.002%
- **Low Offset Voltage:** 0.3mV
- **Large Phase Margin:** 60°
- **Available in 8 Pin VSSOP Package**

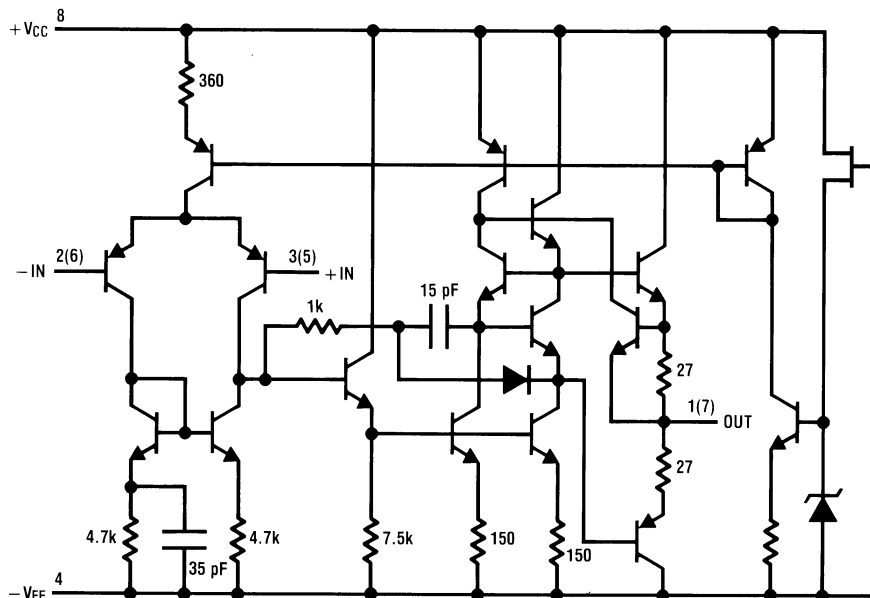
**DESCRIPTION**

The XDXL833 is a dual general purpose operational amplifier designed with particular emphasis on performance in audio systems.

This dual amplifier IC utilizes new circuit and processing techniques to deliver low noise, high speed and wide bandwidth without increasing external components or decreasing stability. The XDXL833 is internally compensated for all closed loop gains and is therefore optimized for all preamp and high level stages in PCM and HiFi systems.

**Schematic Diagram**

(1/2 XDXL833)



Connection Diagram

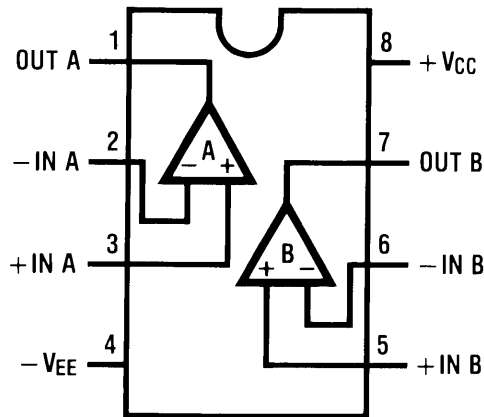


Figure 1. See Package Number D0008A, P0008E or DGK0008A

**ABSOLUTE MAXIMUM RATINGS**<sup>(1)(2)</sup>

Supply Voltage $V_{CC}-V_{EE}$		36V	
Differential Input Voltage <sup>(3)</sup> $V_I$		$\pm 30V$	
Input Voltage Range <sup>(3)</sup> $V_{IC}$		$\pm 15V$	
Power Dissipation <sup>(4)</sup> $P_D$		500 mW	
Operating Temperature Range $T_{OPR}$		$-40 \sim 85^{\circ}C$	
Storage Temperature Range $T_{STG}$		$-60 \sim 150^{\circ}C$	
Soldering Information	PDIP Package	Soldering (10 seconds)	260°C
	Small Outline Package (SOIC and VSSOP)	Vapor Phase (60 seconds)	215°C
		Infrared (15 seconds)	220°C
ESD tolerance <sup>(5)</sup>		1600V	

(1) *Absolute Maximum Ratings* indicate limits beyond which damage to the device may occur. *Operating Ratings* indicate conditions for which the device is functional, but do not ensure specific performance limits. *Electrical Characteristics* state DC and AC electrical specifications under particular test conditions which ensure specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not ensured for parameters where no limit is given, however, the typical value is a good indication of device performance.

(2) If supply voltage is less than  $\pm 15V$ , it is equal to supply voltage.

(3) This is the permissible value at  $T_A \leq 85^{\circ}C$ .

(4) Human body model, 1.5 k $\Omega$  in series with 100 pF.

## DC ELECTRICAL CHARACTERISTICS<sup>(1)(2)</sup>

( $T_A = 25^\circ\text{C}$ ,  $V_S = \pm 15\text{V}$ )

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{OS}$	Input Offset Voltage	$R_S = 10\Omega$		0.3	5	mV
$I_{OS}$	Input Offset Current			10	200	nA
$I_B$	Input Bias Current			500	1000	nA
$A_V$	Voltage Gain	$R_L = 2\text{ k}\Omega$ , $V_O = \pm 10\text{V}$	90	110		dB
$V_{OM}$	Output Voltage Swing	$R_L = 10\text{ k}\Omega$	$\pm 12$	$\pm 13.5$		V
		$R_L = 2\text{ k}\Omega$	$\pm 12$	$\pm 13.4$		V
$V_{CM}$	Input Common-Mode Range		$\pm 12$	$\pm 14.0$		V
CMRR	Common-Mode Rejection Ratio	$V_{IN} = \pm 12\text{V}$	80	100		dB
PSRR	Power Supply Rejection Ratio	$V_S = 15 \sim 5\text{V}$ , $-15 \sim -5\text{V}$	80	100		dB
$I_Q$	Supply Current	$V_O = 0\text{V}$ , Both Amps		5	8	mA

- (1) *Absolute Maximum Ratings* indicate limits beyond which damage to the device may occur. *Operating Ratings* indicate conditions for which the device is functional, but do not ensure specific performance limits. *Electrical Characteristics* state DC and AC electrical specifications under particular test conditions which ensure specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not ensured for parameters where no limit is given, however, the typical value is a good indication of device performance.
- (2) All voltages are measured with respect to the ground pin, unless otherwise specified.

## AC ELECTRICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$ ,  $V_S = \pm 15\text{V}$ ,  $R_L = 2\text{ k}\Omega$ )

Symbol	Parameter	Conditions	Min	Typ	Max	Units
SR	Slew Rate	$R_L = 2\text{ k}\Omega$	5	7		V/ $\mu\text{s}$
GBW	Gain Bandwidth Product	$f = 100\text{ kHz}$	10	15		MHz
$V_{NI}$	Equivalent Input Noise Voltage (XDXL833)	RIAA, $R_S = 2.2\text{ k}\Omega$ <sup>(1)</sup>			1.4	$\mu\text{V}$

- (1) RIAA Noise Voltage Measurement Circuit

## DESIGN ELECTRICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$ ,  $V_S = \pm 15\text{V}$ )

The following parameters are not tested or ensured.

Symbol	Parameter	Conditions	Typ	Units
$\Delta V_{OS}/\Delta T$	Average Temperature Coefficient of Input Offset Voltage		2	$\mu\text{V}/^\circ\text{C}$
THD	Distortion	$R_L = 2\text{ k}\Omega$ , $f = 20\sim 20\text{ kHz}$ $V_{OUT} = 3\text{ V}_{rms}$ , $A_V = 1$	0.002	%
$e_n$	Input Referred Noise Voltage	$R_S = 100\Omega$ , $f = 1\text{ kHz}$	4.5	$\text{nV} / \sqrt{\text{Hz}}$
$i_n$	Input Referred Noise Current	$f = 1\text{ kHz}$	0.7	$\text{pA} / \sqrt{\text{Hz}}$
PBW	Power Bandwidth	$V_O = 27\text{ V}_{pp}$ , $R_L = 2\text{ k}\Omega$ , $\text{THD} \leq 1\%$	120	kHz
$f_U$	Unity Gain Frequency	Open Loop	9	MHz
$\Phi_M$	Phase Margin	Open Loop	60	deg
	Input Referred Cross Talk	$f = 20\sim 20\text{ kHz}$	-120	dB

TYPICAL PERFORMANCE CHARACTERISTICS

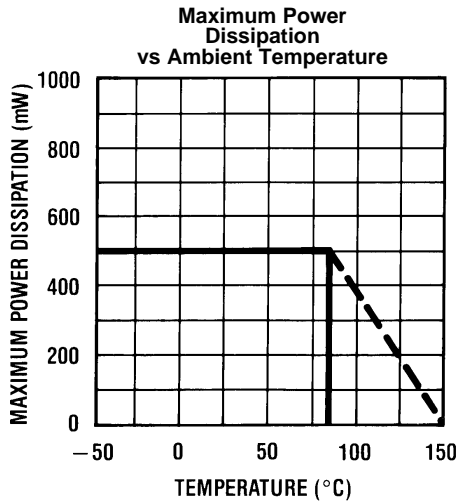


Figure 2.

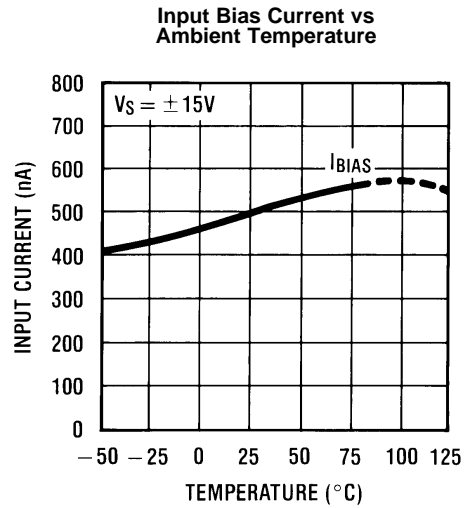


Figure 3.

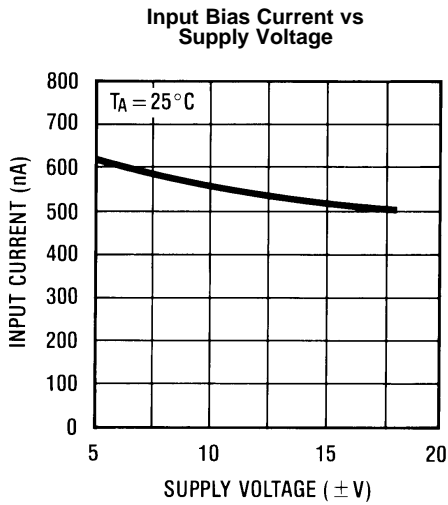


Figure 4.

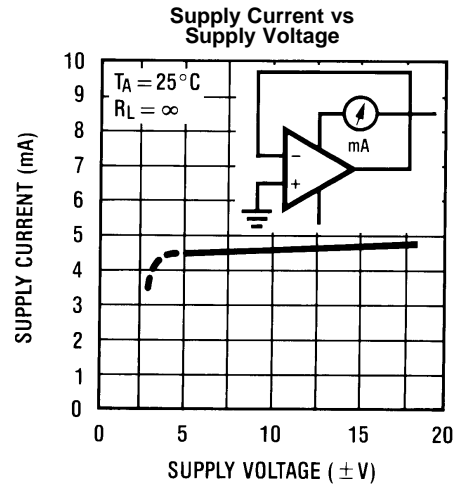


Figure 5.

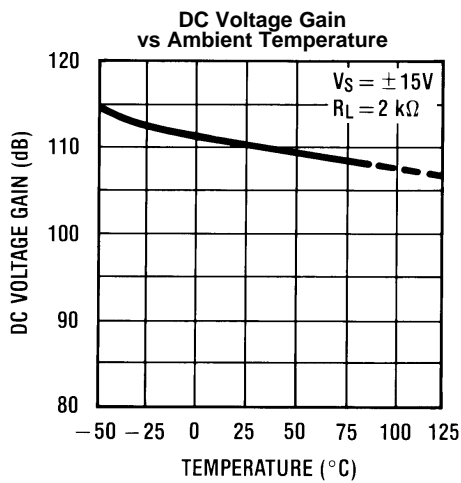


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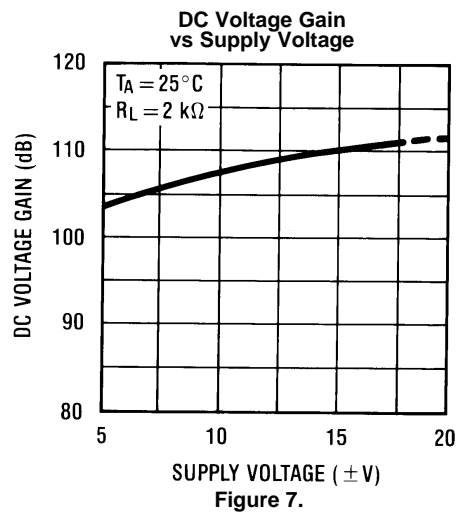


Figure 7.

**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

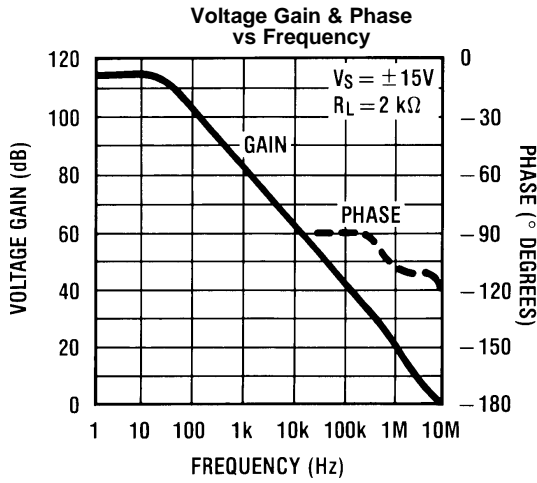


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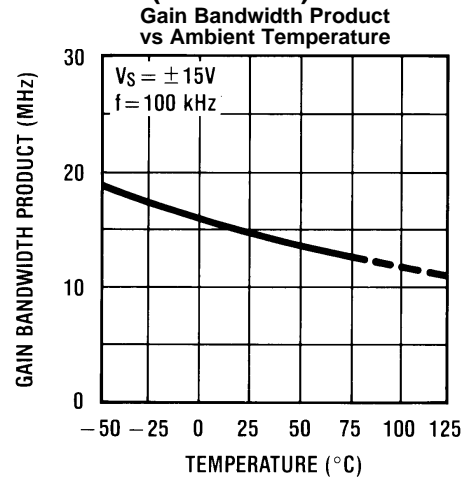


Figure 9.

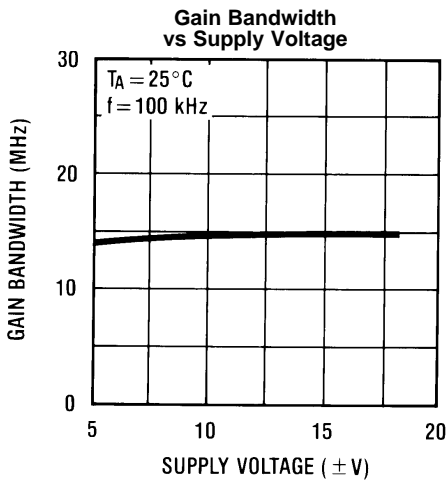


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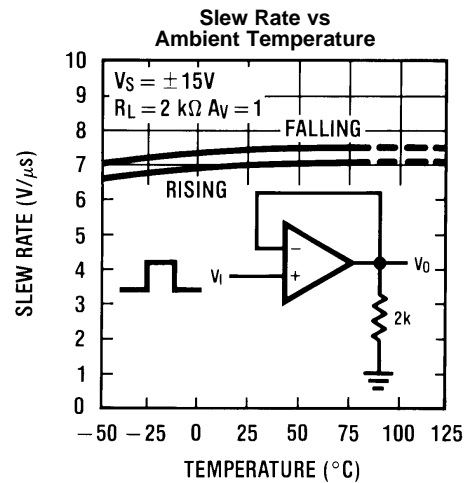


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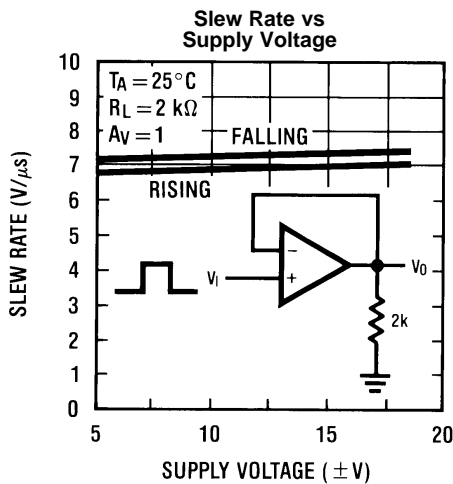


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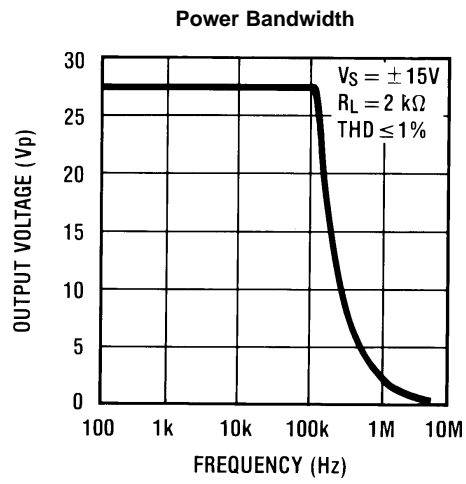
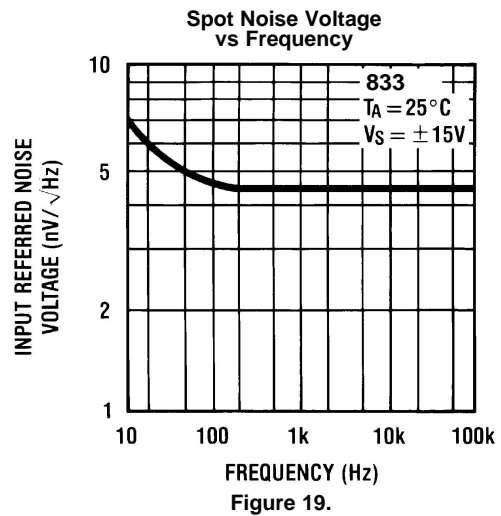
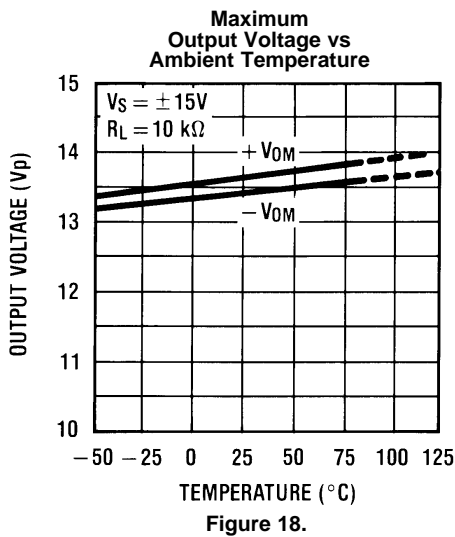
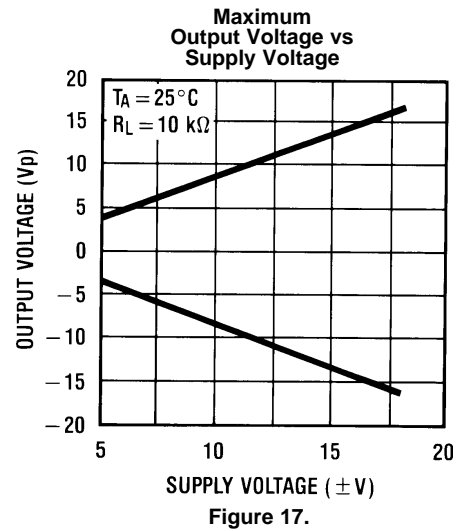
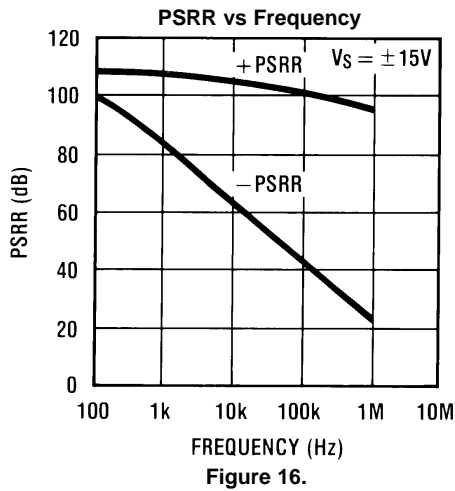
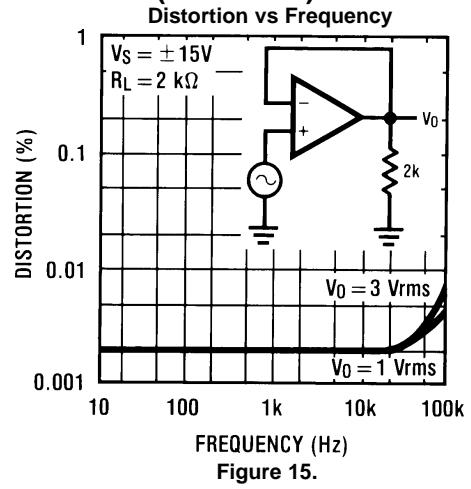
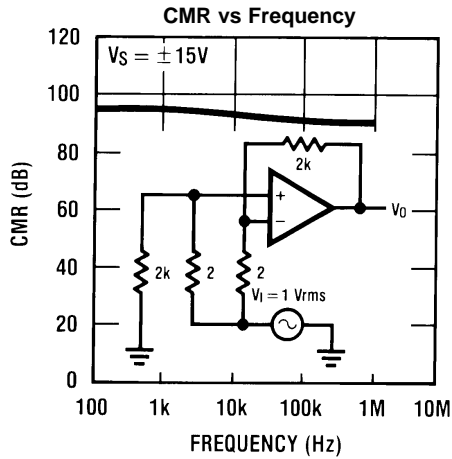


Figure 13.

**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**



**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

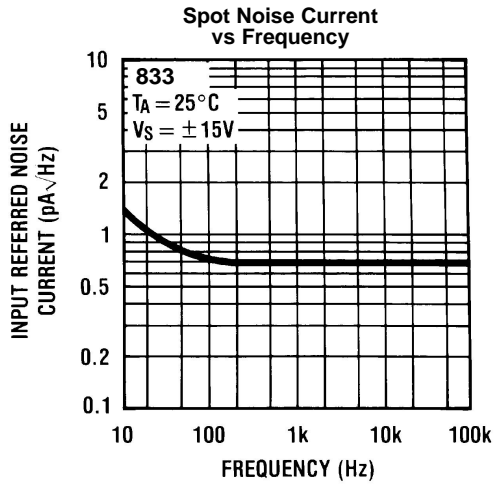


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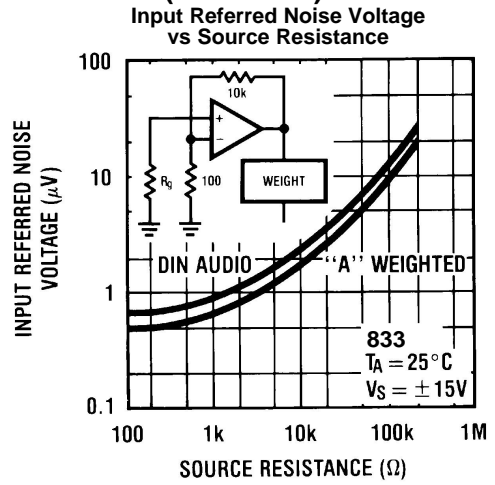


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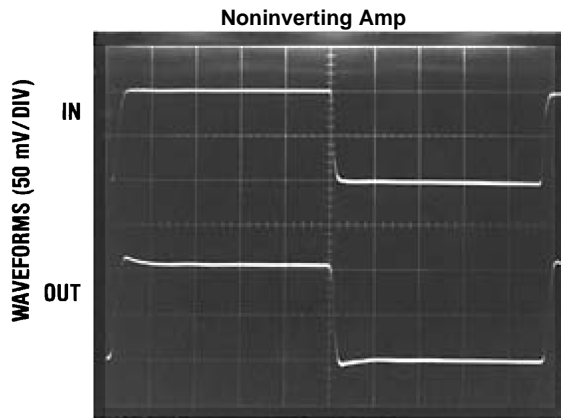


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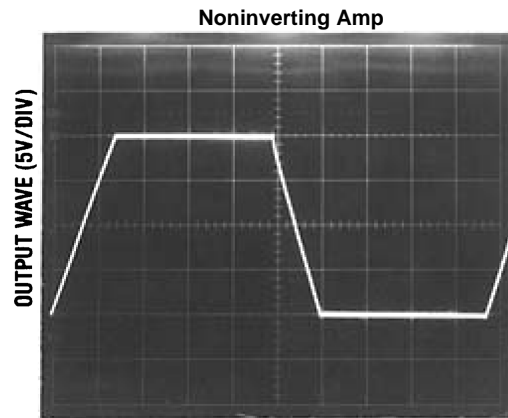


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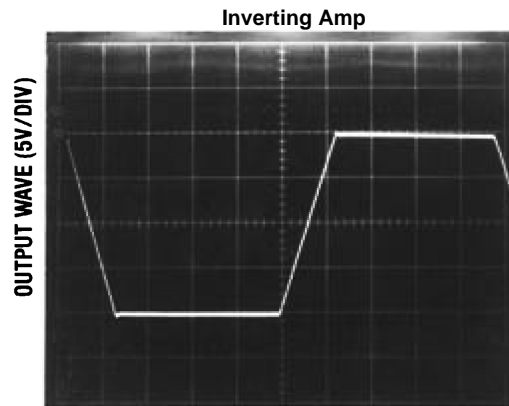


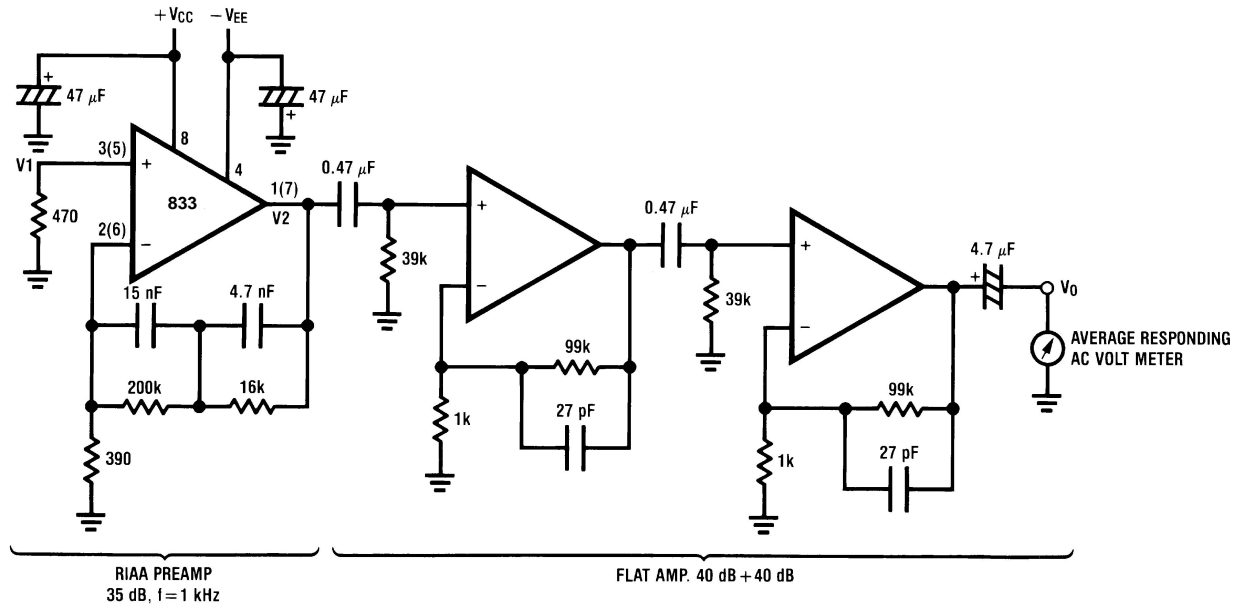
Figure 24.

**APPLICATION HINTS**

The XD833 is a high speed op amp with excellent phase margin and stability. Capacitive loads up to 50 pF will cause little change in the phase characteristics of the amplifiers and are therefore allowable.

Capacitive loads greater than 50 pF must be isolated from the output. The most straightforward way to do this is to put a resistor in series with the output. This resistor will also prevent excess power dissipation if the output is accidentally shorted.

**Noise Measurement Circuit**



Complete shielding is required to prevent induced pick up from external sources. Always check with oscilloscope for power line noise.

**Figure 25. Total Gain: 115 dB @f = 1 kHz  
Input Referred Noise Voltage:  $e_n = V_0/560,000$  (V)**



RIAA Noise Voltage Measurement Circuit

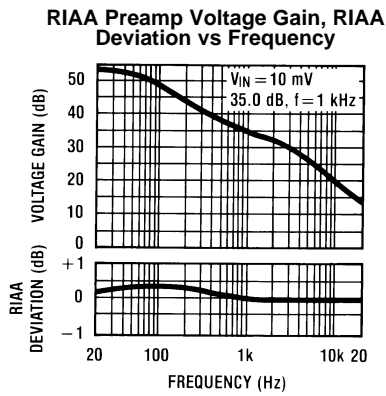
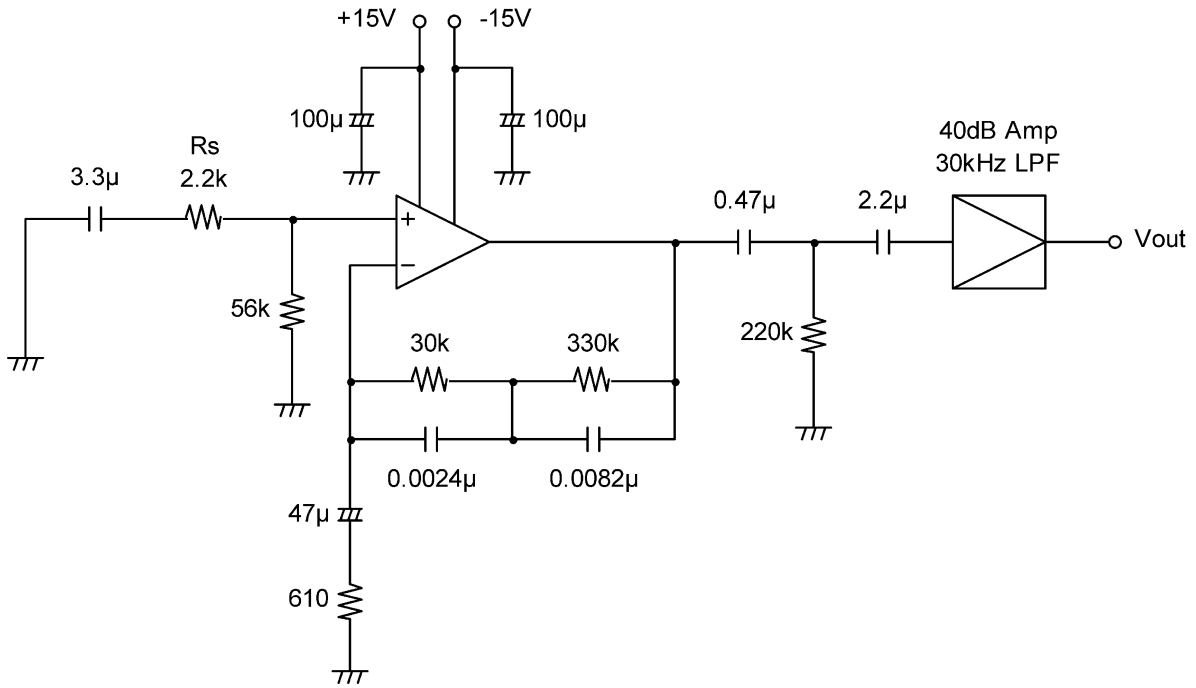


Figure 26.

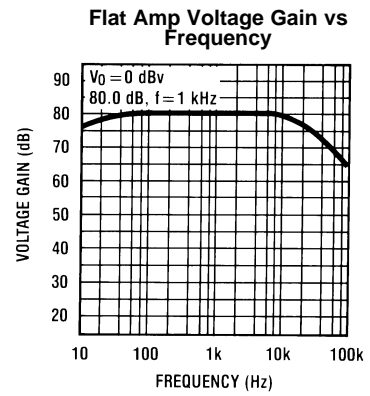
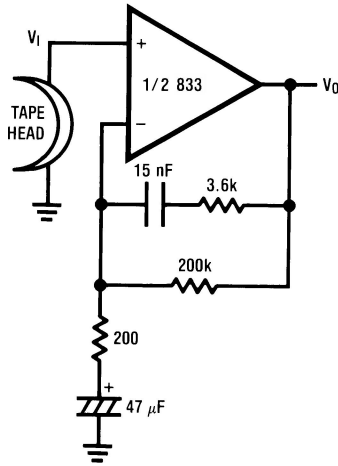


Figure 27.

Typical Applications



$A_V = 34.5$   
 $F = 1 \text{ kHz}$   
 $E_n = 0.38 \mu\text{V}$   
 A Weighted

Figure 28. NAB Preamp

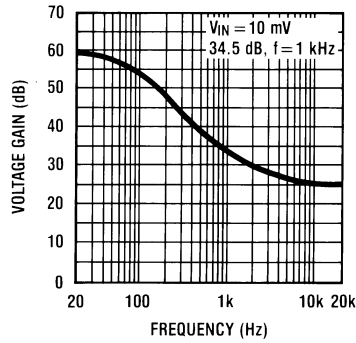
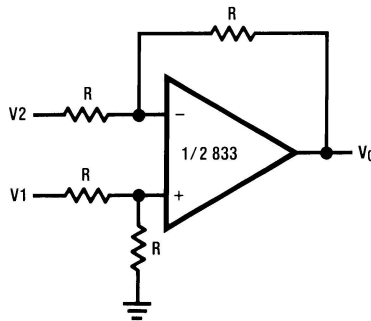
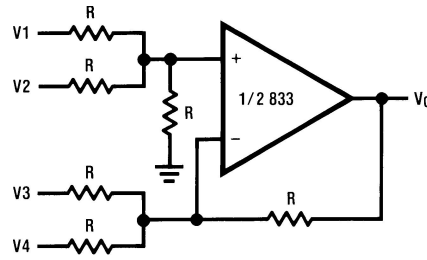


Figure 29. NAB Preamp Voltage Gain vs Frequency



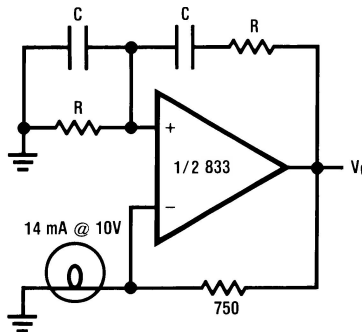
$V_O = V_1 - V_2$

Figure 30. Balanced to Single Ended Converter



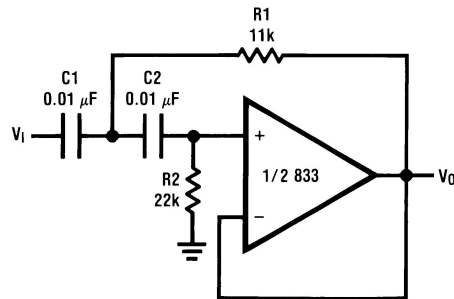
$$V_O = V_1 + V_2 - V_3 - V_4$$

Figure 31. Adder/Subtracter



$$f_o = \frac{1}{2\pi RC}$$

Figure 32. Sine Wave Oscillator



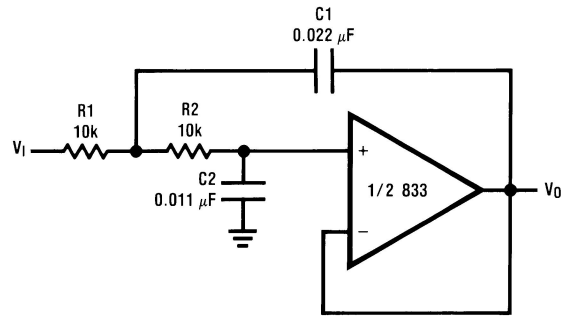
if  $C_1 = C_2 = C$

$$R_1 = \frac{\sqrt{2}}{2\omega_0 C}$$

$$R_2 = 2 \cdot R_1$$

Illustration is  $f_0 = 1 \text{ kHz}$

Figure 33. Second Order High Pass Filter (Butterworth)



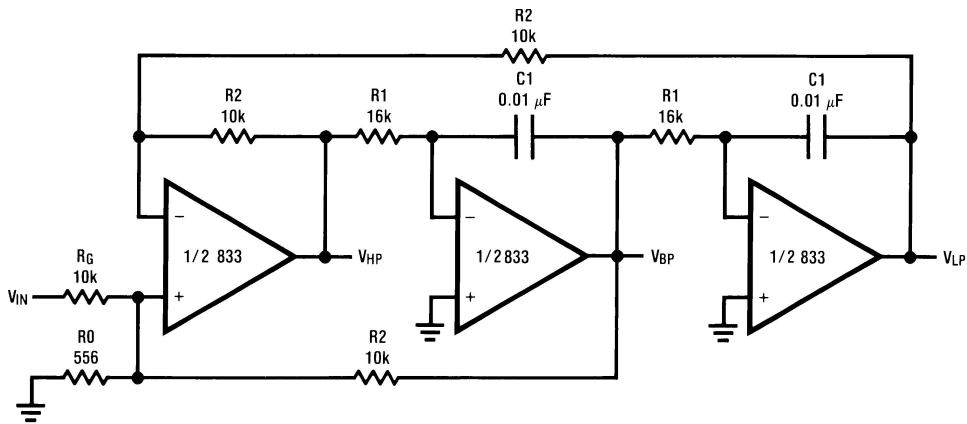
if  $R1 = R2 = R$

$$C1 = \frac{\sqrt{2}}{\omega_0 R}$$

$$C2 = \frac{C1}{2}$$

Illustration is  $f_0 = 1$  kHz

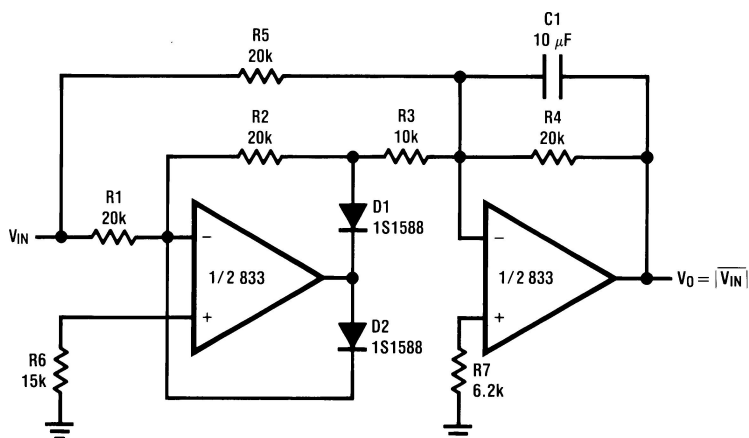
**Figure 34. Second Order Low Pass Filter (Butterworth)**



$$f_0 = \frac{1}{2\pi C1 R1}, Q = \frac{1}{2} \left( 1 + \frac{R2}{R0} + \frac{R2}{RG} \right), A_{BP} = QA_{LP} = QA_{LH} = \frac{R2}{RG}$$

Illustration is  $f_0 = 1$  kHz,  $Q = 10$ ,  $A_{BP} = 1$

**Figure 35. State Variable Filter**



**Figure 36. AC/DC Converter**

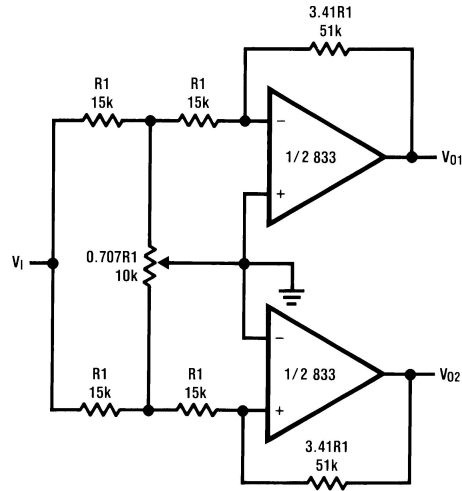


Figure 37. 2 Channel Panning Circuit (Pan Pot)

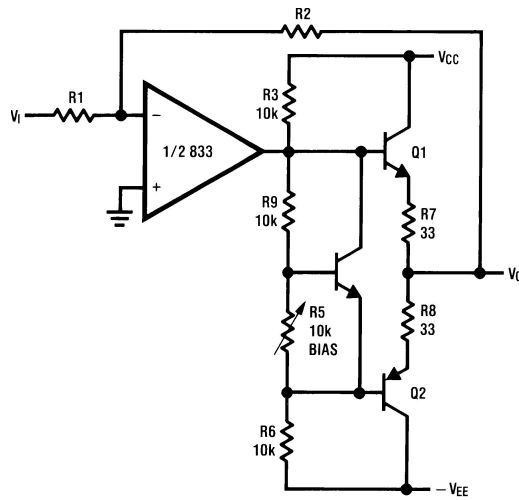
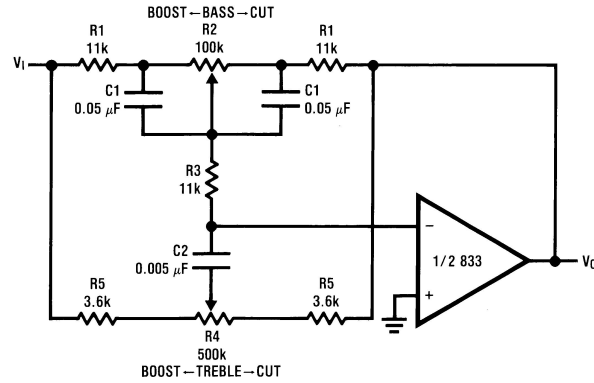


Figure 38. Line Driver



$$f_L = \frac{1}{2\pi R_2 C_1}, f_{LB} = \frac{1}{2\pi R_1 C_1}$$

$$f_H = \frac{1}{2\pi R_5 C_2}, f_{HB} = \frac{1}{2\pi (R_1 + R_5 + 2R_3) C_2}$$

Illustration is:

$f_L = 32 \text{ Hz}$ ,  $f_{LB} = 320 \text{ Hz}$   
 $f_H = 11 \text{ kHz}$ ,  $f_{HB} = 1.1 \text{ kHz}$

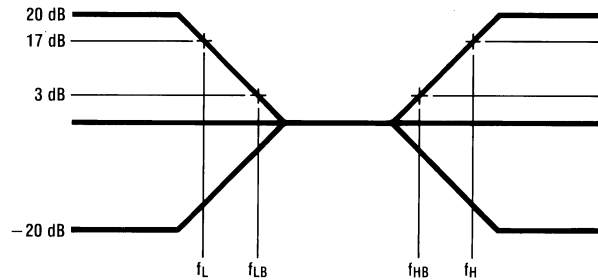
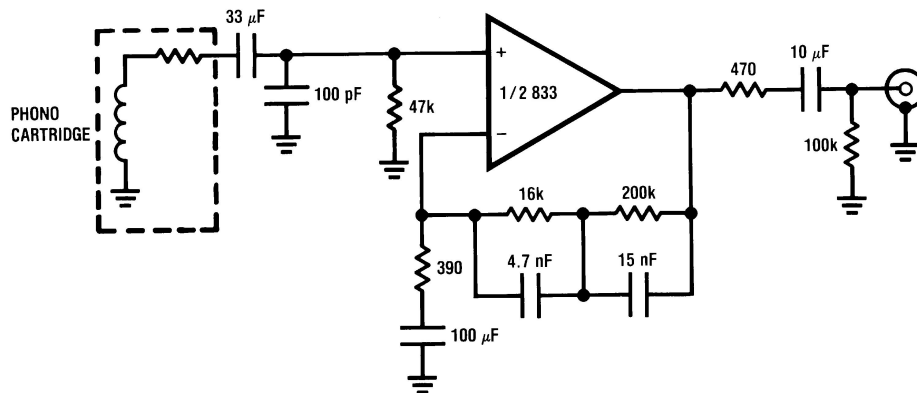
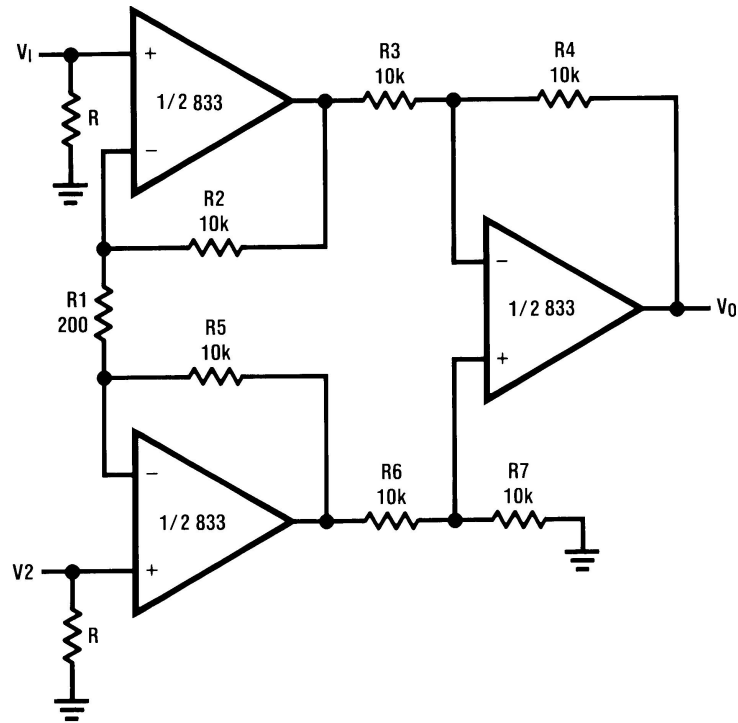


Figure 39. Tone Control



$A_v = 35 \text{ dB}$   
 $E_n = 0.33 \mu\text{V}$   
 $S/N = 90 \text{ dB}$   
 $f = 1 \text{ kHz}$   
A Weighted  
A Weighted,  $V_{IN} = 10 \text{ mV}$   
@  $f = 1 \text{ kHz}$

Figure 40. RIAA Preamp



If  $R_2 = R_5, R_3 = R_6, R_4 = R_7$   

$$V_0 = \left(1 + \frac{2R_2}{R_1}\right) \frac{R_4}{R_3} (V_2 - V_1)$$

Illustration is:  
 $V_0 = 101(V_2 - V_1)$

**Figure 41. Balanced Input Mic Amp**

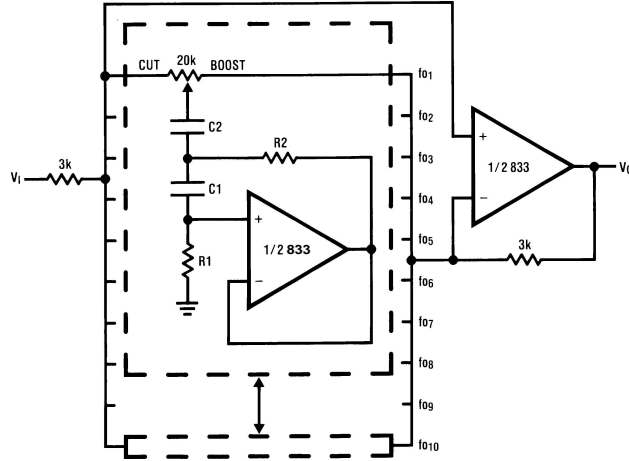


Figure 42. 10 Band Graphic Equalizer

fo (Hz)	C <sub>1</sub>	C <sub>2</sub>	R <sub>1</sub>	R <sub>2</sub>
32	0.12μF	4.7μF	75kΩ	500Ω
64	0.056μF	3.3μF	68kΩ	510Ω
125	0.033μF	1.5μF	62kΩ	510Ω
250	0.015μF	0.82μF	68kΩ	470Ω
500	8200pF	0.39μF	62kΩ	470Ω
1k	3900pF	0.22μF	68kΩ	470Ω
2k	2000pF	0.1μF	68kΩ	470Ω
4k	1100pF	0.056μF	62kΩ	470Ω
8k	510pF	0.022μF	68kΩ	510Ω
16k	330pF	0.012μF	51kΩ	510Ω

**Note:** At volume of change = ±12  
dB Q = 1.

**LM833-N MDC MWC DUAL AUDIO OPERATIONAL AMPLIFIER**

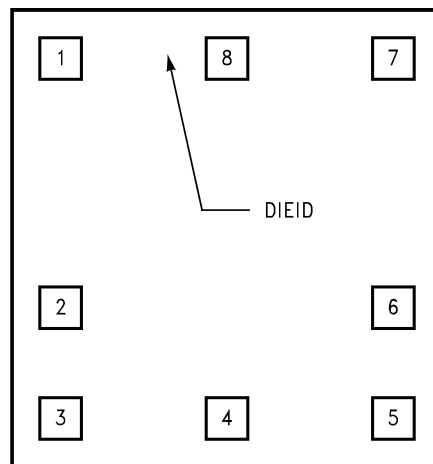
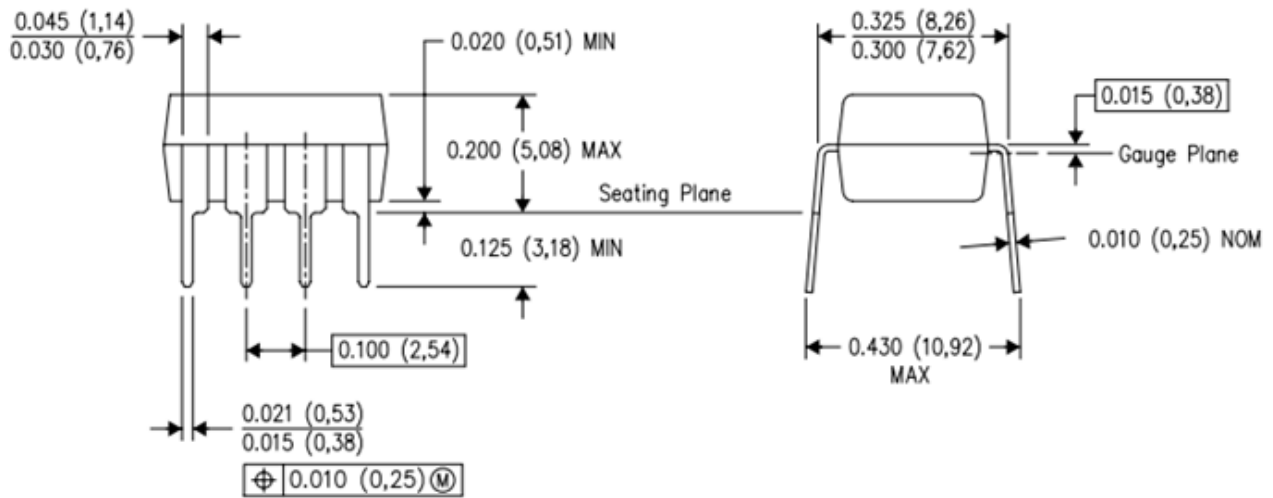
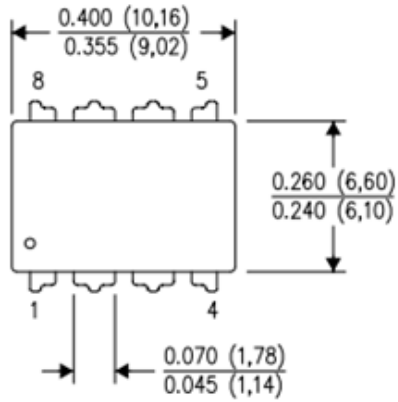


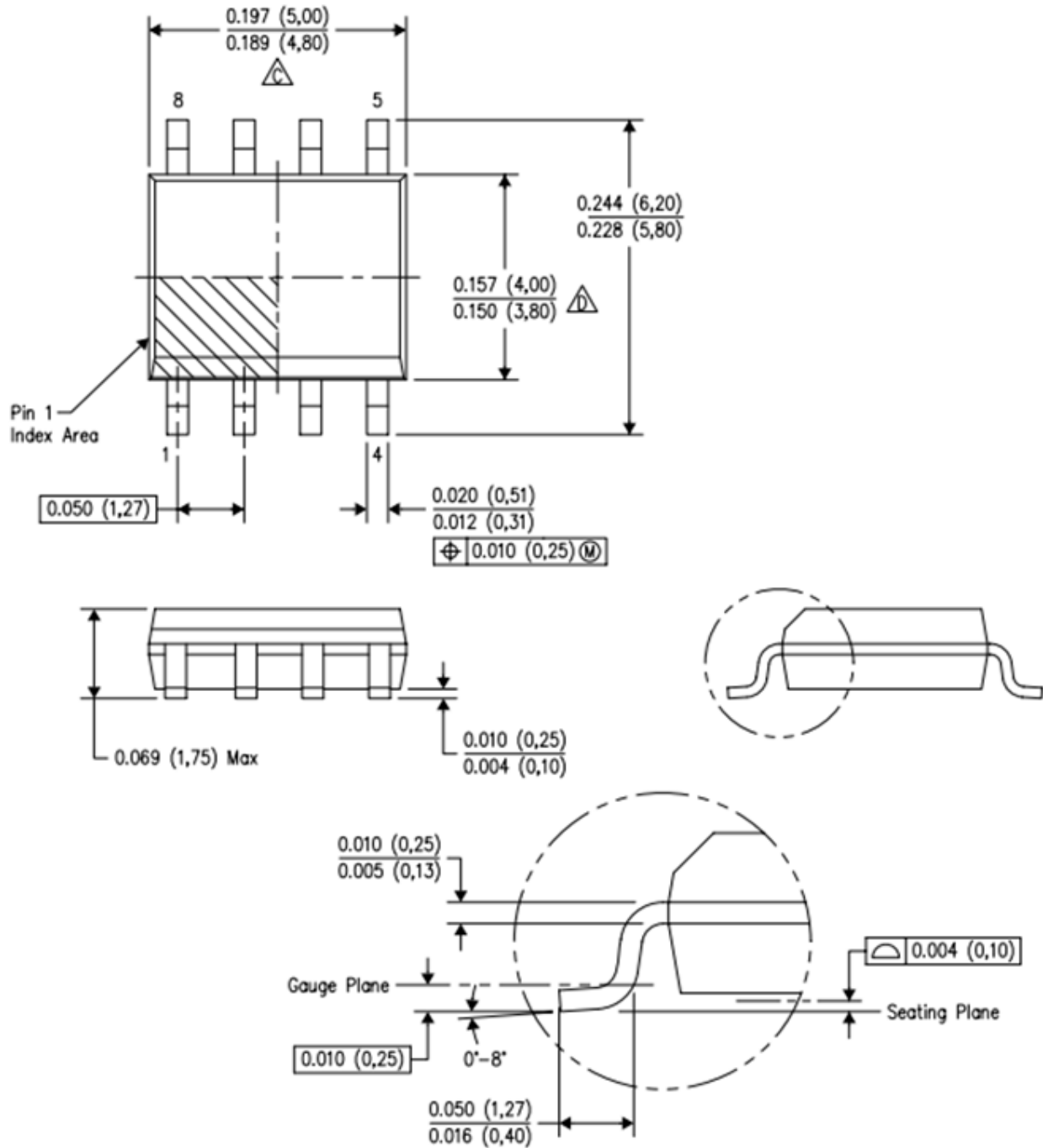
Figure 43. Die Layout (A - Step)



DIP-8



### SOP-8



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