LME49720 Dual High Performance, High Fidelity Audio Operational Amplifier

Check for Samples: LME49720

FEATURES

- Easily Drives 600Ω Loads
- Optimized for Superior Audio Signal Fidelity
- Output Short Circuit Protection
- PSRR and CMRR Exceed 120dB (typ)
- SOIC, PDIP, TO-99 Metal Can Packages

APPLICATIONS

- Ultra High Quality Audio Amplification
- High Fidelity Preamplifiers
- High Fidelity Multimedia
- State of the Art Phono Pre Amps
- High Performance Professional Audio
- High Fidelity Equalization and Crossover Networks
- High Performance Line Drivers
- High Performance Line Receivers
- High Fidelity Active Filters

KEY SPECIFICATIONS

- Power Supply Voltage Range: ±2.5 to ±17V
- THD+N (A_V = 1, V_{OUT} = $3V_{RMS}$, f_{IN} = 1kHz):
  - R_L = 2kΩ: 0.00003% (typ)
  - R_L = 600Ω: 0.00003% (typ)
- Input Noise Density: 2.7nV/√Hz (typ)
- Slew Rate: ±20V/μs (typ)
- Gain Bandwidth Product: 55MHz (typ)
- Open Loop Gain (R_L = 600Ω): 140dB (typ)
- Input Bias Current: 10nA (typ)
- Input Offset Voltage: 0.1mV (typ)
- DC Gain Linearity Error: 0.000009%

DESCRIPTION

The LME49720 is part of the ultra-low distortion, low noise, high slew rate operational amplifier series optimized and fully specified for high performance, high fidelity applications. Combining advanced leading-edge process technology with state-of-the-art circuit design, the LME49720 audio operational amplifiers deliver superior audio signal amplification for outstanding audio performance. The LME49720 combines extremely low voltage noise density (2.7nV/√Hz) with vanishingly low THD+N (0.00003%) to easily satisfy the most demanding audio applications.

TYPICAL APPLICATION

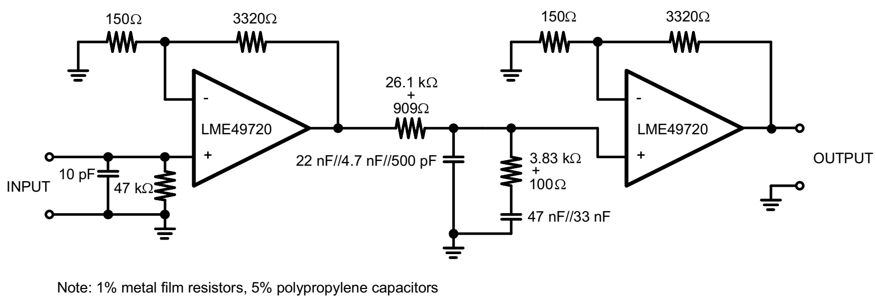


Figure 1. Passively Equalized RIAA Phono Preamplifier

DESCRIPTION (CONTINUED)

To ensure that the most challenging loads are driven without compromise, the LME49720 has a high slew rate of ±20V/μs and an output current capability of ±26mA. Further, dynamic range is maximized by an output stage that drives 2kΩ loads to within 1V of either power supply voltage and to within 1.4V when driving 600Ω loads.

The LME49720's outstanding CMRR (120dB), PSRR (120dB), and V_{OS} (0.1mV) give the amplifier excellent operational amplifier DC performance.

The LME49720 has a wide supply range of ±2.5V to ±17V. Over this supply range the LME49720's input circuitry maintains excellent common-mode and power supply rejection, as well as maintaining its low input bias current. The LME49720 is unity gain stable. This Audio Operational Amplifier achieves outstanding AC performance while driving complex loads with values as high as 100pF.

The LME49720 is available in 8–lead narrow body SOIC, 8–lead PDIP, and 8–lead TO-99. Demonstration boards are available for each package.

Connection Diagrams

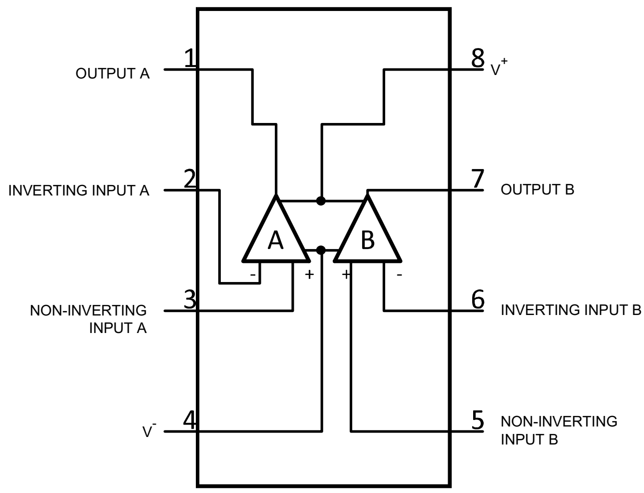


Figure 2. 8-Pin SOIC or PDIP See D or P Package

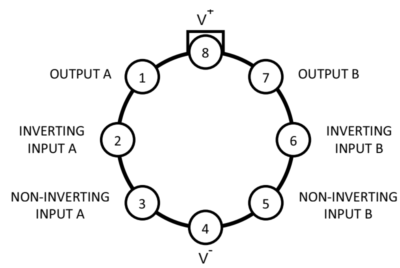


Figure 3. 8-Lead TO-99 See LMC Package

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

ABSOLUTE MAXIMUM RATINGS (1)(2)(3)

Power Supply Voltage	($V_S = V^+ - V^-$)	36V
Storage Temperature		−65°C to 150°C
Input Voltage		(V-) - 0.7V to (V+) + 0.7V
Output Short Circuit (4)		Continuous
Power Dissipation		Internally Limited
ESD Susceptibility (5)		2000V
ESD Susceptibility (6)	Pins 1, 4, 7 and 8	200V
	Pins 2, 3, 5 and 6	100V
Junction Temperature		150°C
Thermal Resistance	θ_{JA} (SOIC)	145°C/W
	θ_{JA} (PDIP)	102°C/W
	θ_{JA} (TO-99)	150°C/W
	θ_{JC} (TO-99)	35°C/W
Temperature Range	$T_{MIN} \le T_A \le T_{MAX}$	$-40°C \le T_A \le 85°C$
Supply Voltage Range		$\pm 2.5V \le V_S \le \pm 17V$

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.
(2) Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For enusred specifications and test conditions, see Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
(3) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
(4) Amplifier output connected to GND, any number of amplifiers within a package.
(5) Human body model, 100pF discharged through a 1.5kΩ resistor.
(6) Machine Model ESD test is covered by specification EIAJ IC-121-1981. A 200pF cap is charged to the specified voltage and then discharged directly into the IC with no external series resistor (resistance of discharge path must be under 50Ω).

ELECTRICAL CHARACTERISTICS FOR THE LME49720 (1)(2)

The following specifications apply for $V_S = \pm 15V$, $R_L = 2k\Omega$, $f_{IN} = 1kHz$, and $T_A = 25°C$, unless otherwise specified.

Symbol	Parameter	Conditions	LME49720		Units (Limits)
			Typical (3)	Limit (4)	
THD+N	Total Harmonic Distortion + Noise	$A_V = 1$, $V_{OUT} = 3V_{rms}$ $R_L = 2k\Omega$ $R_L = 600\Omega$	 0.00003 0.00003	 0.00009	% (max)
IMD	Intermodulation Distortion	$A_V = 1$, $V_{OUT} = 3V_{RMS}$ Two-tone, 60Hz & 7kHz 4:1	0.00005		%
GBWP	Gain Bandwidth Product		55	45	MHz (min)
SR	Slew Rate		±20	±15	V/μs (min)
FPBW	Full Power Bandwidth	$V_{OUT} = 1V_{P-P}$, –3dB referenced to output magnitude at f = 1kHz	10		MHz
t_s	Settling time	$A_V = -1$, 10V step, $C_L = 100pF$ 0.1% error range	1.2		μs
e_n	Equivalent Input Noise Voltage	f_{BW} = 20Hz to 20kHz	0.34	0.65	μV_{RMS} (max)
	Equivalent Input Noise Density	f = 1kHz f = 10Hz	2.7 6.4	4.7	$nV/\sqrt{Hz}$ (max)
i_n	Current Noise Density	f = 1kHz f = 10Hz	1.6 3.1		$pA/\sqrt{Hz}$
V_{OS}	Offset Voltage		±0.1	±0.7	mV (max)

(1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.
(2) Operating Ratings indicate conditions for which the device is functional, but do not ensure specific performance limits. For enusred specifications and test conditions, see Electrical Characteristics. The ensured specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.
(3) Typical specifications are specified at +25ºC and represent the most likely parametric norm.
(4) Tested limits are ensured to AOQL (Average Outgoing Quality Level).

ELECTRICAL CHARACTERISTICS FOR THE LME49720 (1)(2) (continued)

The following specifications apply for V_S = ±15V, R_L = 2kΩ, f_{IN} = 1kHz, and T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Conditions	LME49720 Typical (3)	LME49720 Limit (4)	Units (Limits)
$\Delta V_{OS}/\Delta Temp$	Average Input Offset Voltage Drift vs Temperature	–40°C ≤ T_A ≤ 85°C	0.2		μV/°C
PSRR	Average Input Offset Voltage Shift vs Power Supply Voltage	ΔV_S = 20V (5)	120	110	dB (min)
ISO_{CH-CH}	Channel-to-Channel Isolation	f_{IN} = 1kHz f_{IN} = 20kHz	118 112		dB
I_B	Input Bias Current	V_{CM} = 0V	10	72	nA (max)
$\Delta I_{OS}/\Delta Temp$	Input Bias Current Drift vs Temperature	–40°C ≤ T_A ≤ 85°C	0.1		nA/°C
I_{OS}	Input Offset Current	V_{CM} = 0V	11	65	nA (max)
V_{IN-CM}	Common-Mode Input Voltage Range		+14.1 –13.9	(V+) – 2.0 (V-) + 2.0	V (min)
CMRR	Common-Mode Rejection	–10V<Vcm<10V	120	110	dB (min)
Z_{IN}	Differential Input Impedance		30		kΩ
	Common Mode Input Impedance	–10V<Vcm<10V	1000		MΩ
A_{VOL}	Open Loop Voltage Gain	–10V<Vout<10V, R_L = 600Ω	140	125	dB (min)
		–10V<Vout<10V, R_L = 2kΩ	140		
		–10V<Vout<10V, R_L = 10kΩ	140		
V_{OUTMAX}	Maximum Output Voltage Swing	R_L = 600Ω	±13.6	±12.5	V (min)
		R_L = 2kΩ	±14.0		
		R_L = 10kΩ	±14.1		
I_{OUT}	Output Current	R_L = 600Ω, V_S = ±17V	±26	±23	mA (min)
I_{OUT-CC}	Instantaneous Short Circuit Current		+53 –42		mA
R_{OUT}	Output Impedance	f_{IN} = 10kHz Closed-Loop Open-Loop	0.01 13		Ω
C_{LOAD}	Capacitive Load Drive Overshoot	100pF	16		%
I_S	Total Quiescent Current	I_{OUT} = 0mA	10	12	mA (max)

(5) PSRR is measured as follows: V_{OS} is measured at two supply voltages, ±5V and ±15V. PSRR = | 20log($\Delta V_{OS}/\Delta V_S$) |.

TYPICAL PERFORMANCE CHARACTERISTICS

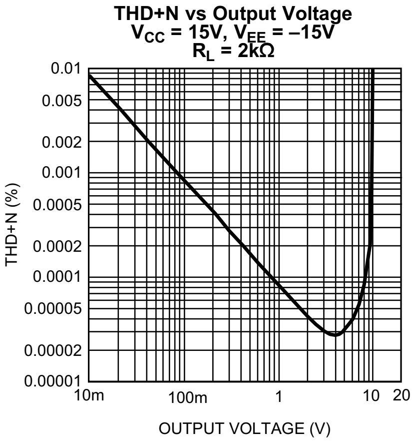


Figure 4.

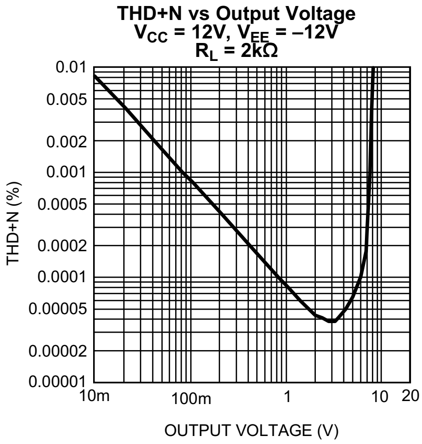
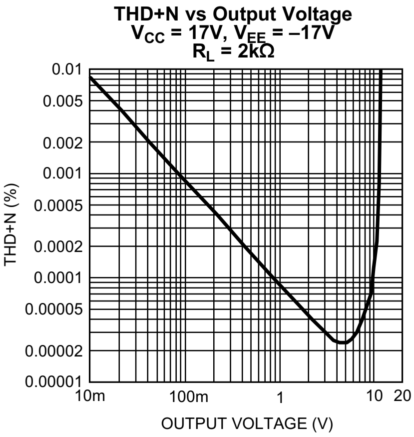


Figure 5.



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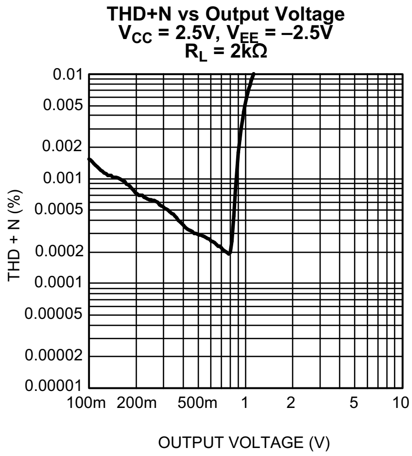

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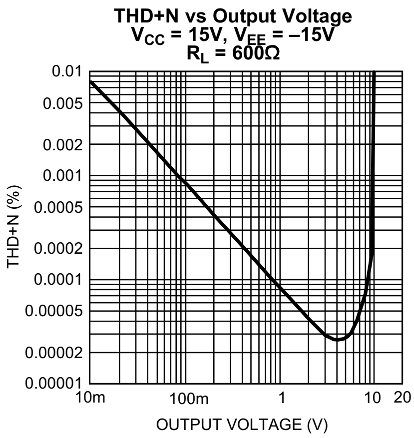

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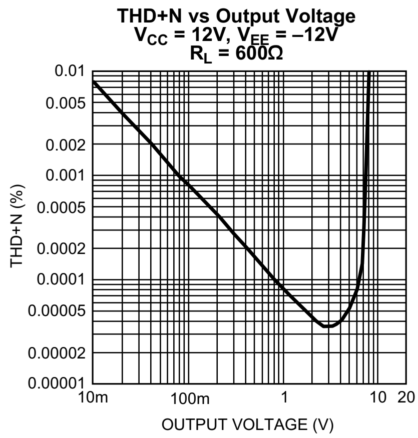


Figure 9.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

THD+N vs Output Voltage
V_{CC} = 17V, V_{EE} = –17V
R_L = 600Ω

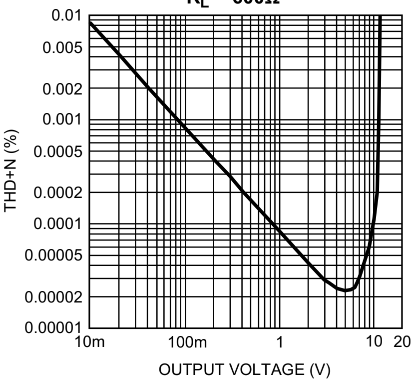


Figure 10.

THD+N vs Output Voltage
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 600Ω

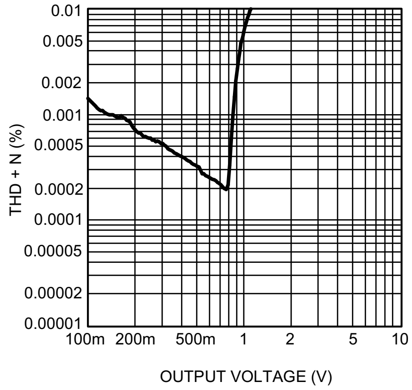


Figure 11.

THD+N vs Output Voltage
V_{CC} = 15V, V_{EE} = –15V
R_L = 10kΩ

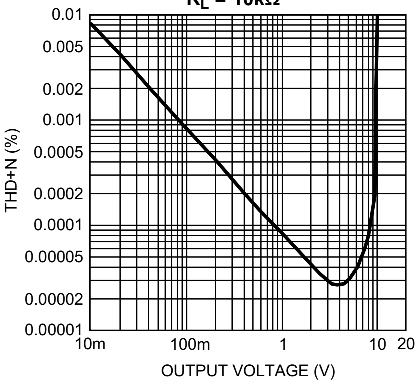


Figure 12.

THD+N vs Output Voltage
V_{CC} = 12V, V_{EE} = –12V
R_L = 10kΩ

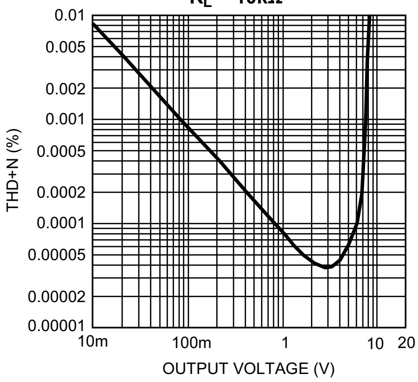


Figure 13.

THD+N vs Output Voltage
V_{CC} = 17V, V_{EE} = –17V
R_L = 10kΩ

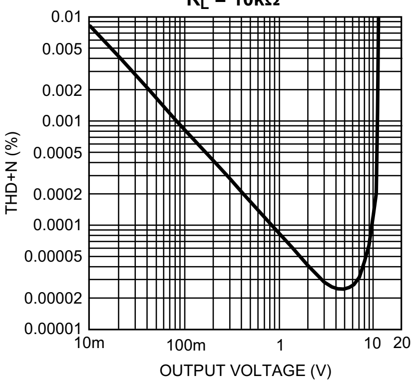


Figure 14.

THD+N vs Output Voltage
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 10kΩ

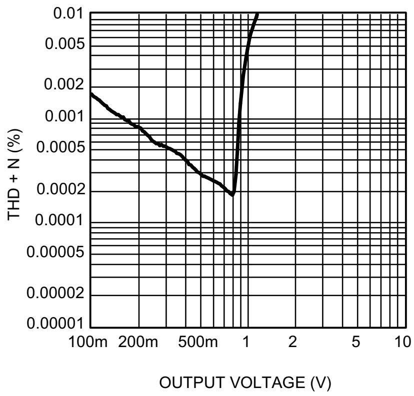


Figure 15.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

THD+N vs Frequency
V_{CC} = 15V, V_{EE} = –15V, V_{OUT} = 3V_{RMS}
R_L = 2kΩ

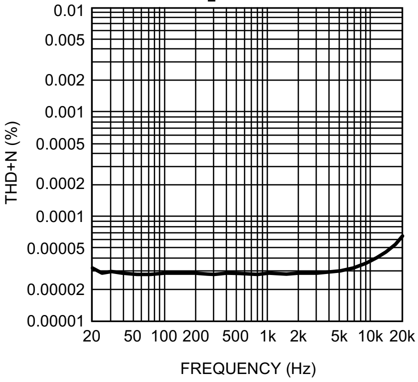


Figure 16.

THD+N vs Frequency
V_{CC} = 12V, V_{EE} = –12V, V_{OUT} = 3V_{RMS}
R_L = 2kΩ

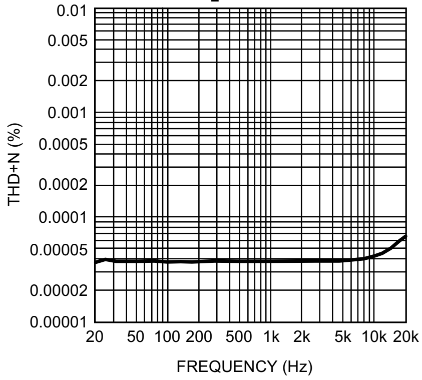


Figure 17.

THD+N vs Frequency
V_{CC} = 17V, V_{EE} = –17V, V_{OUT} = 3V_{RMS}
R_L = 2kΩ

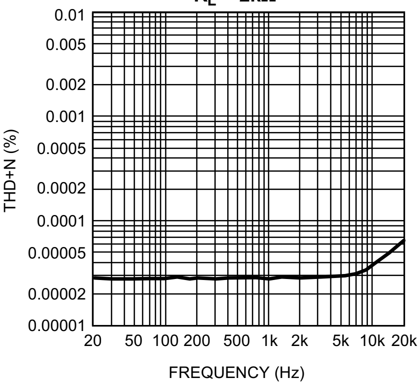


Figure 18.

THD+N vs Frequency
V_{CC} = 15V, V_{EE} = –15V, V_{OUT} = 3V_{RMS}
R_L = 600Ω

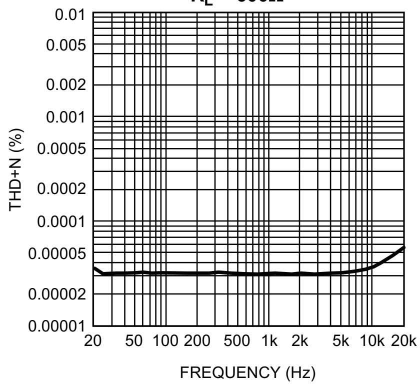


Figure 19.

THD+N vs Frequency
V_{CC} = 12V, V_{EE} = –12V, V_{OUT} = 3V_{RMS}
R_L = 600Ω

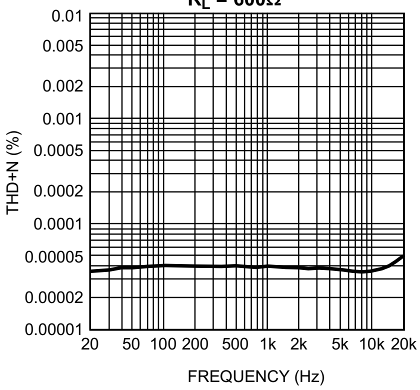


Figure 20.

THD+N vs Frequency
V_{CC} = 17V, V_{EE} = –17V, V_{OUT} = 3V_{RMS}
R_L = 600Ω

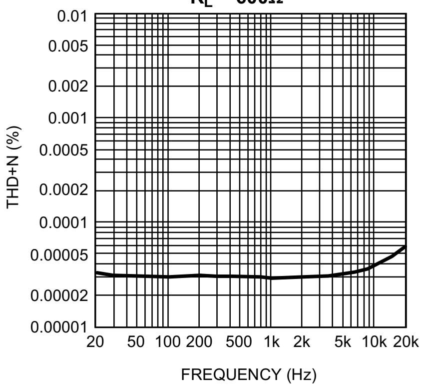


Figure 21.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

THD+N vs Frequency
V_{CC} = 15V, V_{EE} = –15V, V_{OUT} = 3V_{RMS}
R_L = 10kΩ

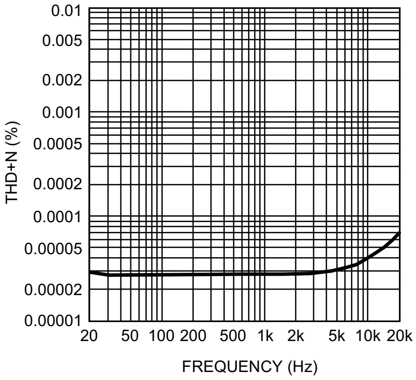


Figure 22.

THD+N vs Frequency
V_{CC} = 12V, V_{EE} = –12V, V_{OUT} = 3V_{RMS}
R_L = 10kΩ

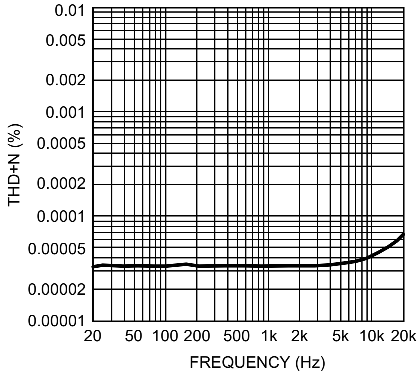


Figure 23.

THD+N vs Frequency
V_{CC} = 17V, V_{EE} = –17V, V_{OUT} = 3V_{RMS}
R_L = 10kΩ

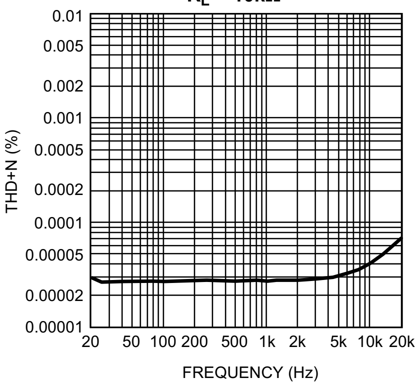


Figure 24.

IMD vs Output Voltage
V_{CC} = 15V, V_{EE} = –15V
R_L = 2kΩ

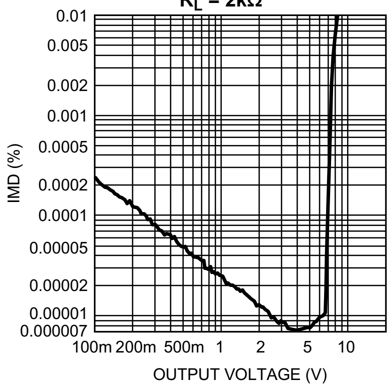


Figure 25.

IMD vs Output Voltage
V_{CC} = 12V, V_{EE} = –12V
R_L = 2kΩ

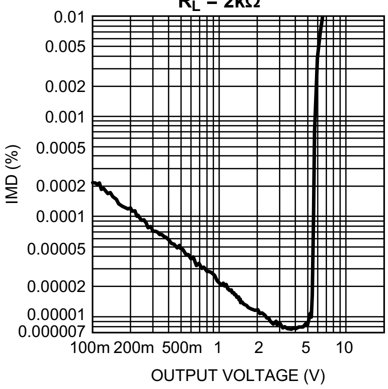


Figure 26.

IMD vs Output Voltage
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 2kΩ

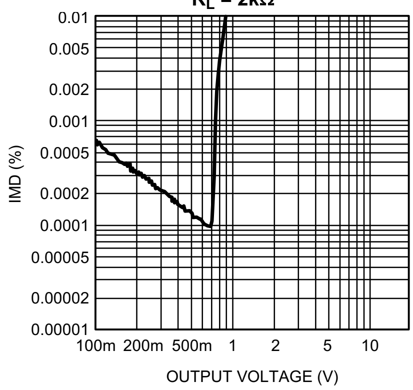
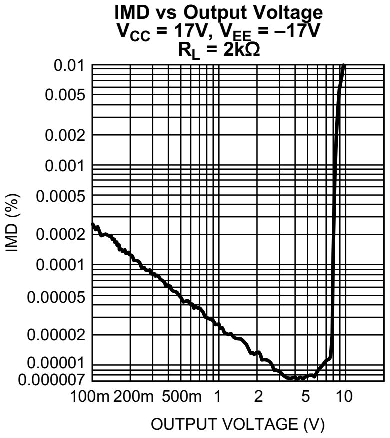


Figure 27.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)



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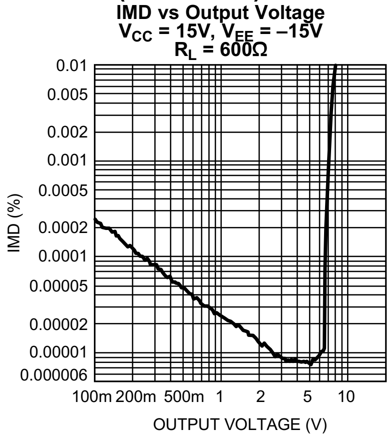

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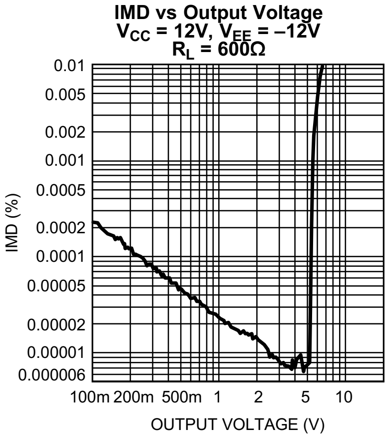
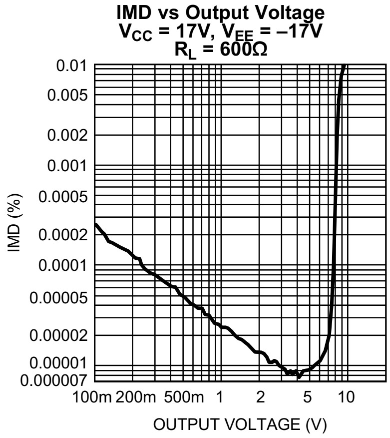


Figure 30.



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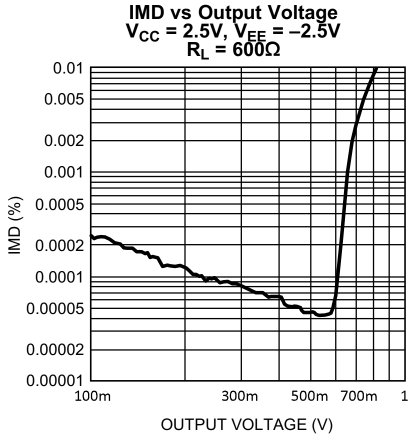

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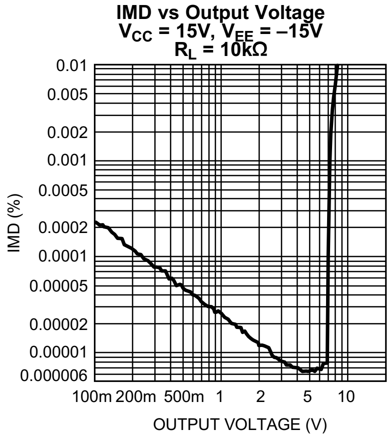


Figure 33.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

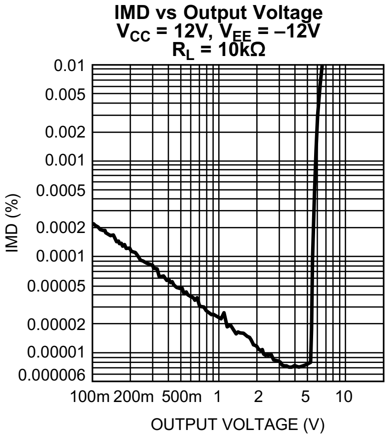


Figure 34.

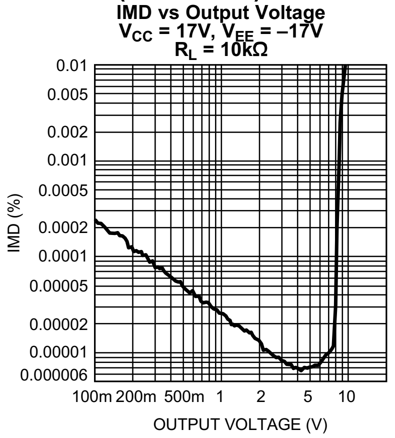
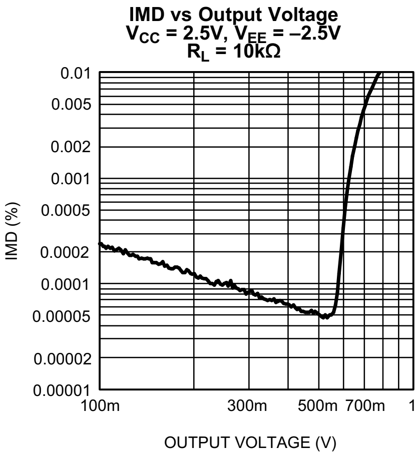


Figure 35.



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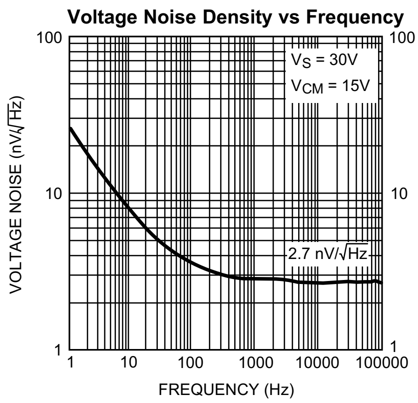

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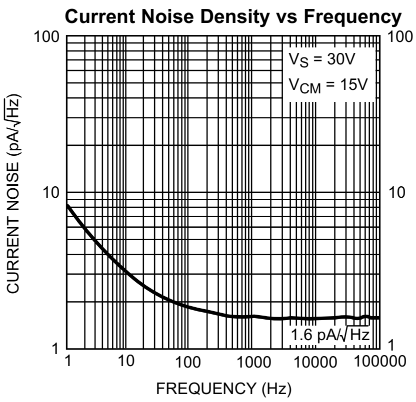

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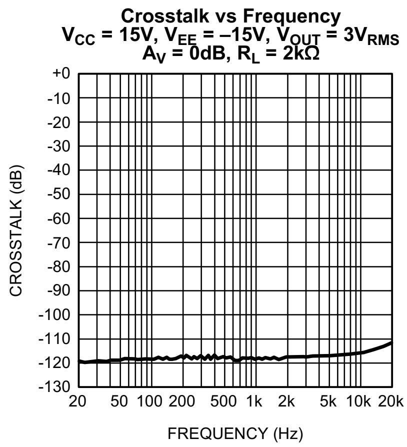


Figure 39.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Crosstalk vs Frequency
V_{CC} = 15V, V_{EE} = –15V, V_{OUT} = 10V_{RMS}
A_V = 0dB, R_L = 2kΩ

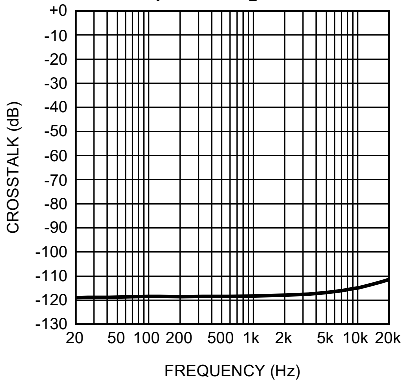


Figure 40.

Crosstalk vs Frequency
V_{CC} = 12V, V_{EE} = –12V, V_{OUT} = 3V_{RMS}
A_V = 0dB, R_L = 2kΩ

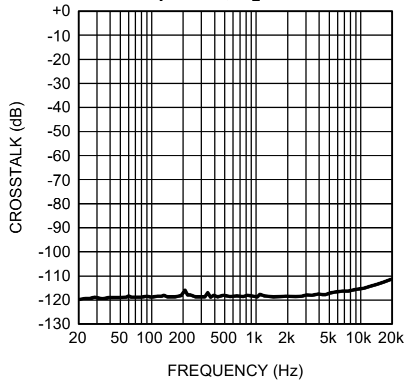


Figure 41.

Crosstalk vs Frequency
V_{CC} = 12V, V_{EE} = –12V, V_{OUT} = 10V_{RMS}
A_V = 0dB, R_L = 2kΩ

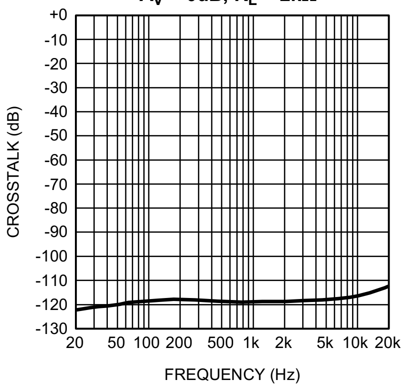


Figure 42.

Crosstalk vs Frequency
V_{CC} = 17V, V_{EE} = –17V, V_{OUT} = 3V_{RMS}
A_V = 0dB, R_L = 2kΩ

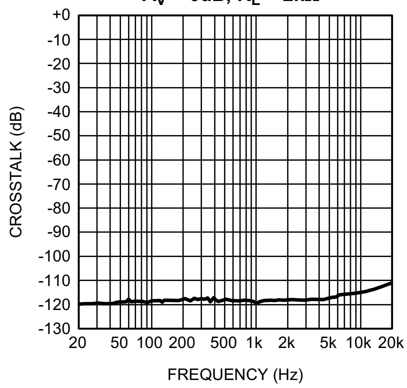


Figure 43.

Crosstalk vs Frequency
V_{CC} = 17V, V_{EE} = –17V, V_{OUT} = 10V_{RMS}
A_V = 0dB, R_L = 2kΩ

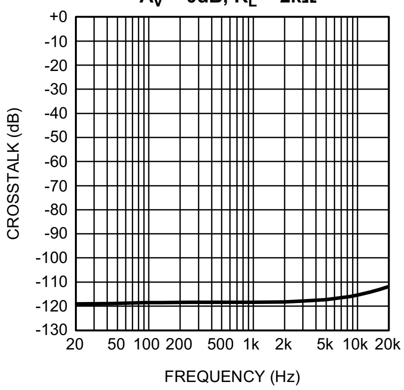


Figure 44.

Crosstalk vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V, V_{OUT} = 1V_{RMS}
A_V = 0dB, R_L = 2kΩ

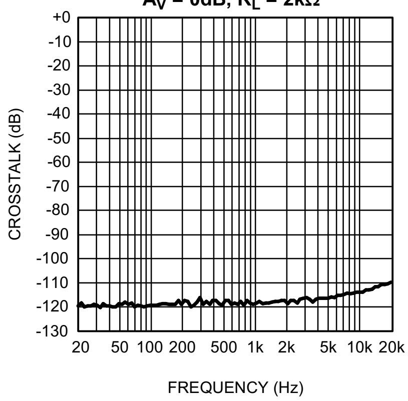


Figure 45.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

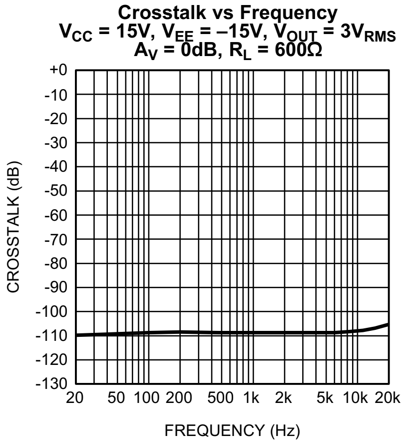


Figure 46.

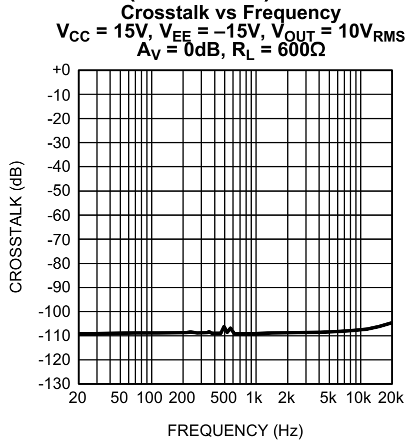


Figure 47.

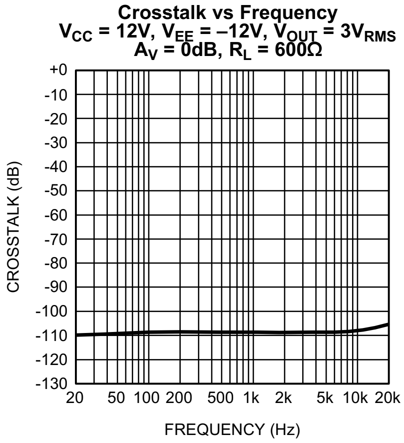


Figure 48.

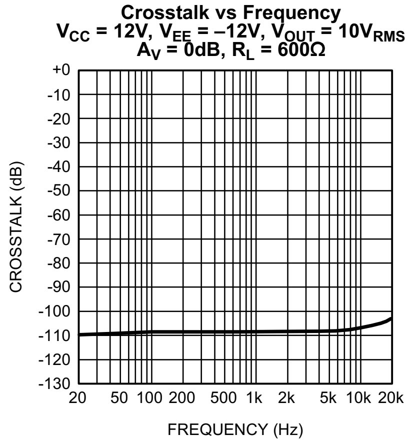


Figure 49.

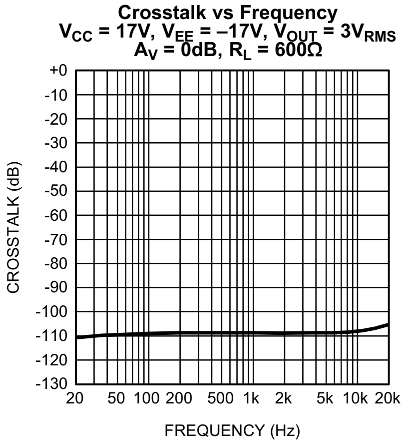


Figure 50.

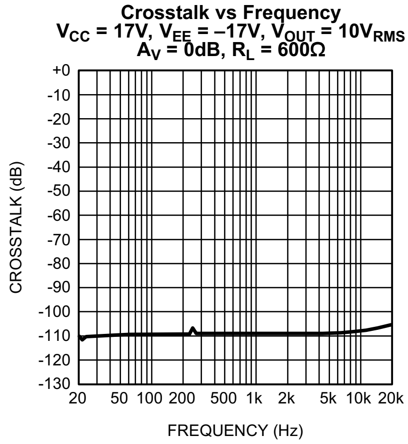


Figure 51.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Crosstalk vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V, V_{OUT} = 1V_{RMS}
A_V = 0dB, R_L = 600Ω

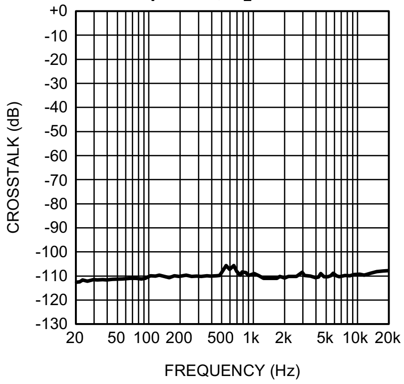


Figure 52.

Crosstalk vs Frequency
V_{CC} = 15V, V_{EE} = –15V, V_{OUT} = 3V_{RMS}
A_V = 0dB, R_L = 10kΩ

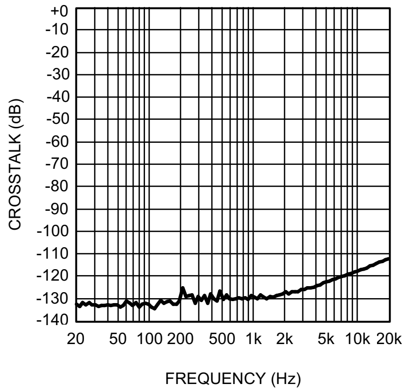


Figure 53.

Crosstalk vs Frequency
V_{CC} = 15V, V_{EE} = –15V, V_{OUT} = 10V_{RMS}
A_V = 0dB, R_L = 10kΩ

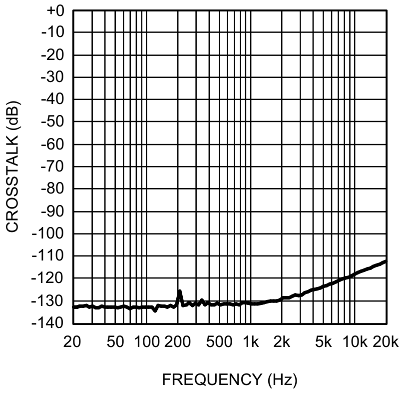


Figure 54.

Crosstalk vs Frequency
V_{CC} = 12V, V_{EE} = –12V, V_{OUT} = 3V_{RMS}
A_V = 0dB, R_L = 10kΩ

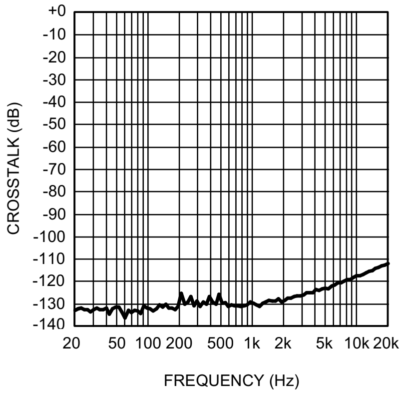


Figure 55.

Crosstalk vs Frequency
V_{CC} = 12V, V_{EE} = –12V, V_{OUT} = 10V_{RMS}
A_V = 0dB, R_L = 10kΩ

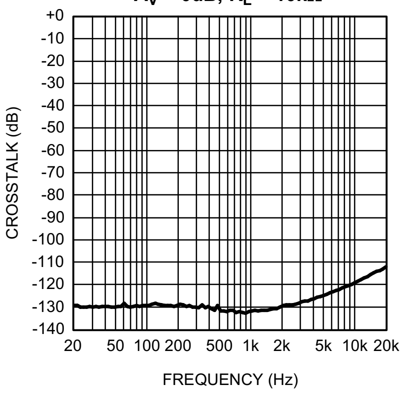


Figure 56.

Crosstalk vs Frequency
V_{CC} = 17V, V_{EE} = –17V, V_{OUT} = 3V_{RMS}
A_V = 0dB, R_L = 10kΩ

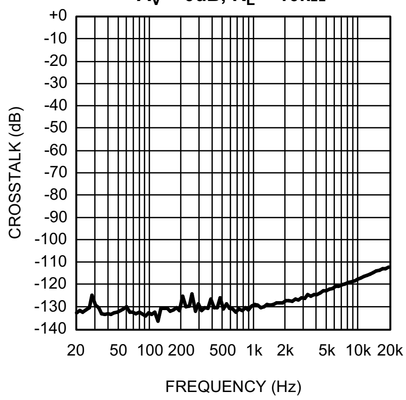


Figure 57.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Crosstalk vs Frequency
V_{CC} = 17V, V_{EE} = –17V, V_{OUT} = 10V_{RMS}
A_V = 0dB, R_L = 10kΩ

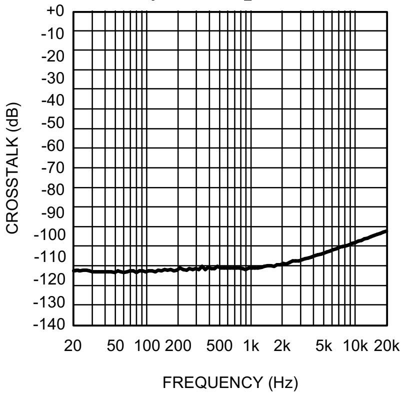


Figure 58.

Crosstalk vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V, V_{OUT} = 1V_{RMS}
A_V = 0dB, R_L = 10kΩ

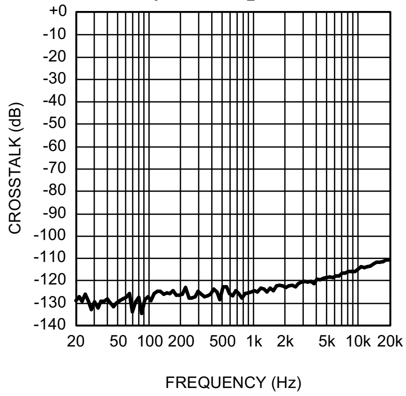


Figure 59.

PSRR+ vs Frequency
V_{CC} = 15V, V_{EE} = –15V
R_L = 10kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

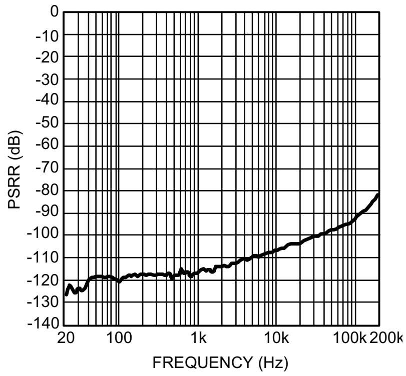


Figure 60.

PSRR- vs Frequency
V_{CC} = 15V, V_{EE} = –15V
R_L = 10kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

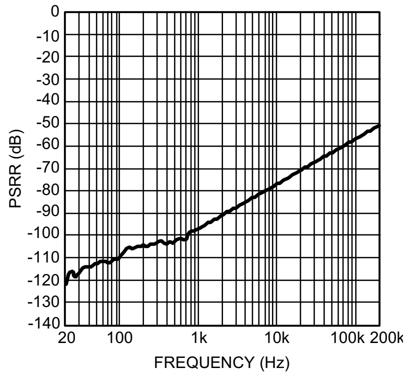


Figure 61.

PSRR+ vs Frequency
V_{CC} = 15V, V_{EE} = –15V
R_L = 2kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

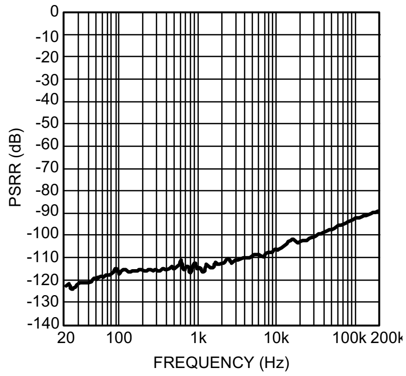


Figure 62.

PSRR- vs Frequency
V_{CC} = 15V, V_{EE} = –15V
R_L = 2kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

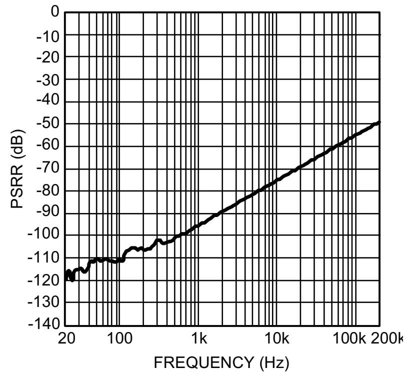


Figure 63.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

PSRR+ vs Frequency
V_{CC} = 15V, V_{EE} = –15V
R_L = 600Ω, f = 200kHz, V_{RIPPLE} = 200mVpp

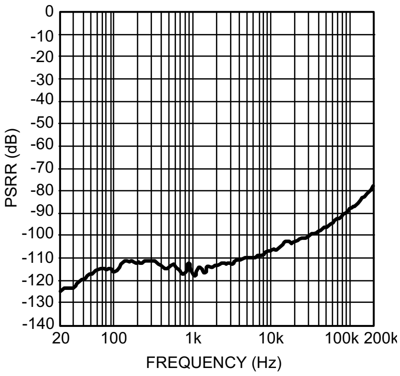


Figure 64.

PSRR- vs Frequency
V_{CC} = 15V, V_{EE} = –15V
R_L = 600Ω, f = 200kHz, V_{RIPPLE} = 200mVpp

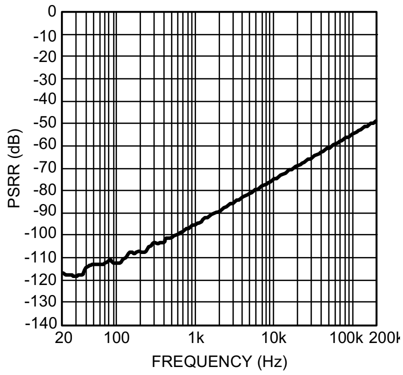


Figure 65.

PSRR+ vs Frequency
V_{CC} = 12V, V_{EE} = –12V
R_L = 10kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

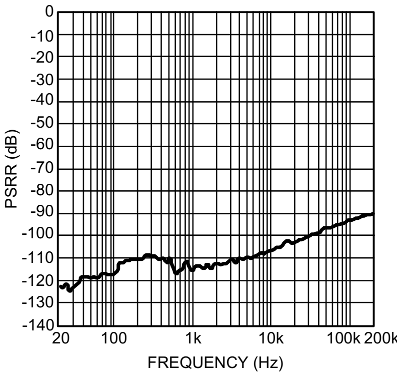


Figure 66.

PSRR– vs Frequency
V_{CC} = 12V, V_{EE} = –12V
R_L = 10kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

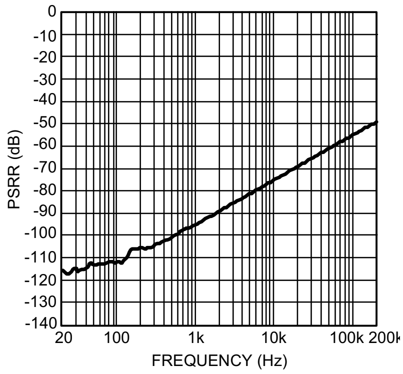


Figure 67.

PSRR+ vs Frequency
V_{CC} = 12V, V_{EE} = –12V
R_L = 2kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

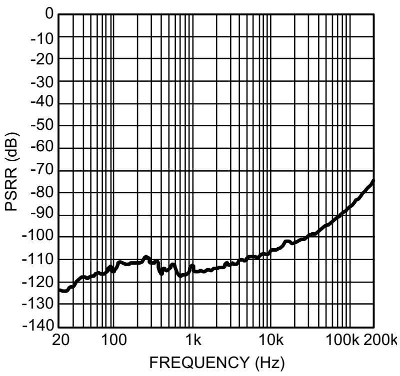


Figure 68.

PSRR– vs Frequency
V_{CC} = 12V, V_{EE} = –12V
R_L = 2kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

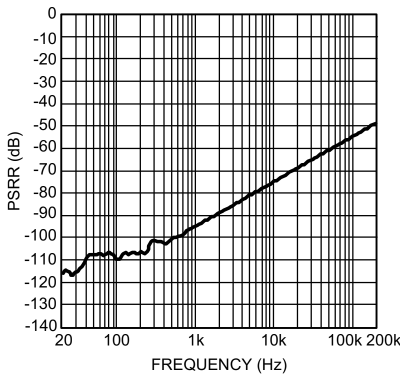


Figure 69.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

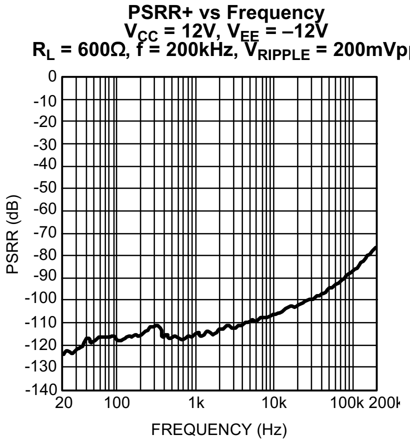


Figure 70.

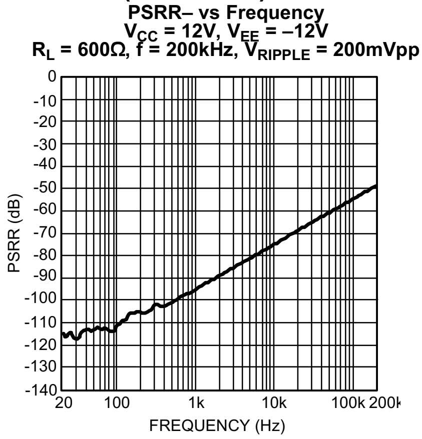


Figure 71.

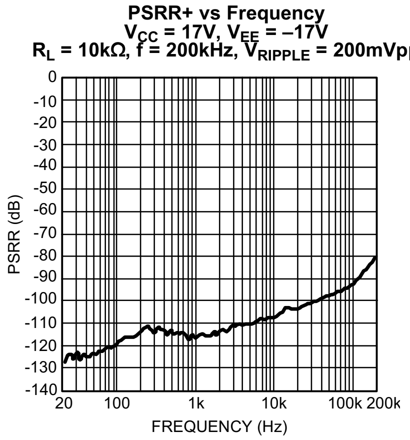


Figure 72.

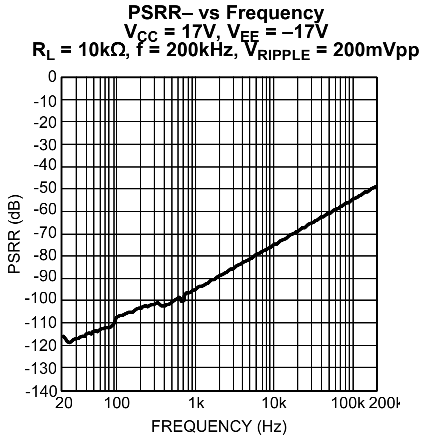


Figure 73.

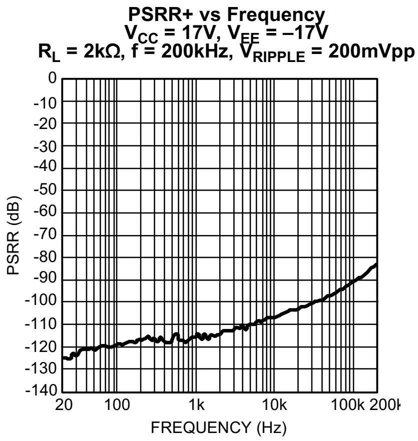


Figure 74.

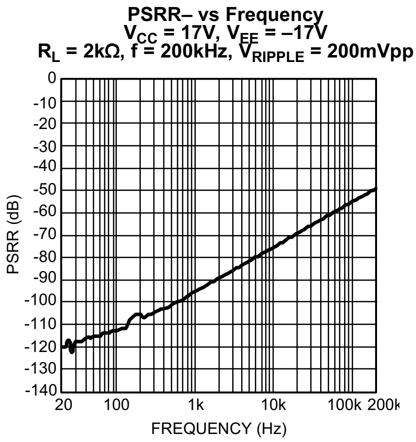


Figure 75.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

PSRR+ vs Frequency
V_{CC} = 17V, V_{EE} = –17V
R_L = 600Ω, f = 200kHz, V_{RIPPLE} = 200mVpp

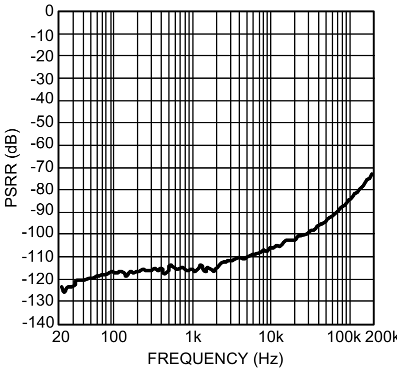


Figure 76.

PSRR– vs Frequency
V_{CC} = 17V, V_{EE} = –17V
R_L = 600Ω, f = 200kHz, V_{RIPPLE} = 200mVpp

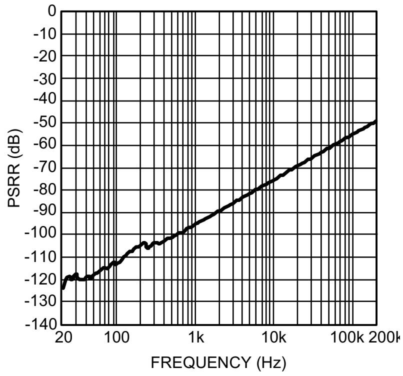


Figure 77.

PSRR+ vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 10kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

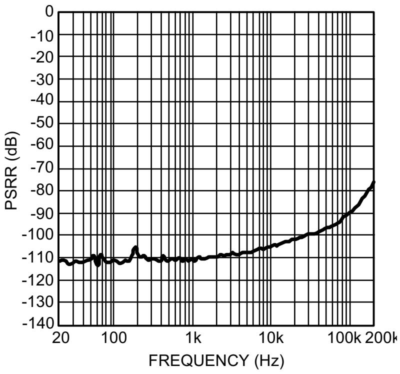


Figure 78.

PSRR– vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 10kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

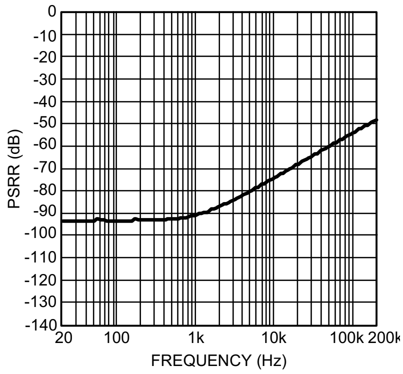


Figure 79.

PSRR+ vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 2kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

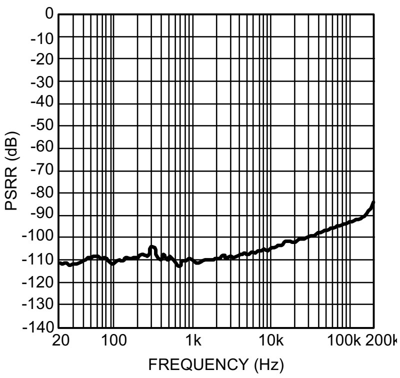


Figure 80.

PSRR– vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 2kΩ, f = 200kHz, V_{RIPPLE} = 200mVpp

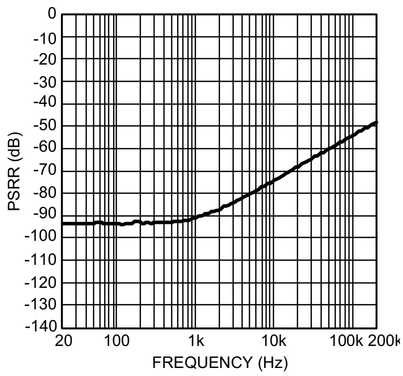


Figure 81.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

PSRR+ vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 600Ω, f = 200kHz, V_{RIPPLE} = 200mVpp

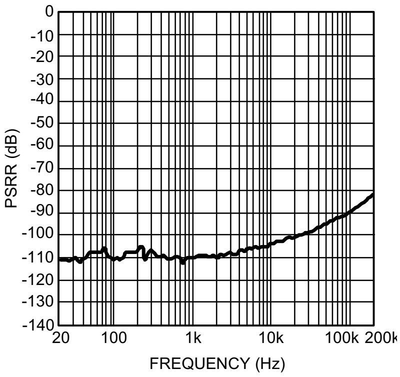


Figure 82.

PSRR– vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 600Ω, f = 200kHz, V_{RIPPLE} = 200mVpp

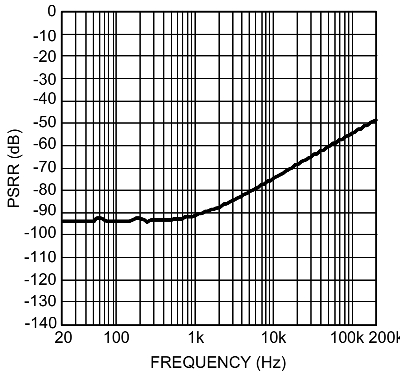


Figure 83.

CMRR vs Frequency
V_{CC} = 15V, V_{EE} = –15V
R_L = 2kΩ

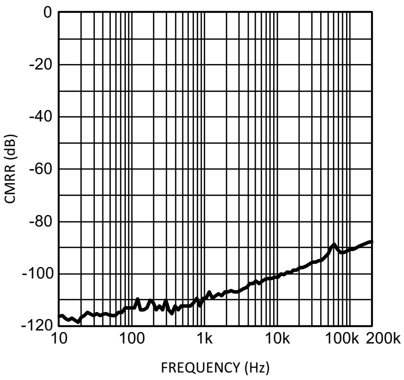


Figure 84.

CMRR vs Frequency
V_{CC} = 12V, V_{EE} = –12V
R_L = 2kΩ

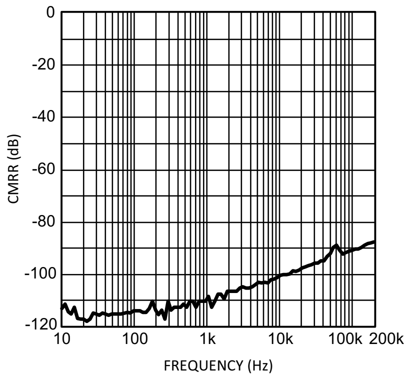


Figure 85.

CMRR vs Frequency
V_{CC} = 17V, V_{EE} = –17V
R_L = 2kΩ

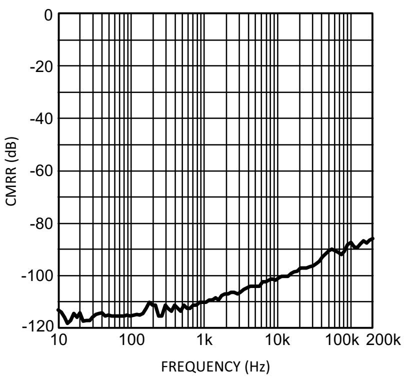


Figure 86.

CMRR vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 2kΩ

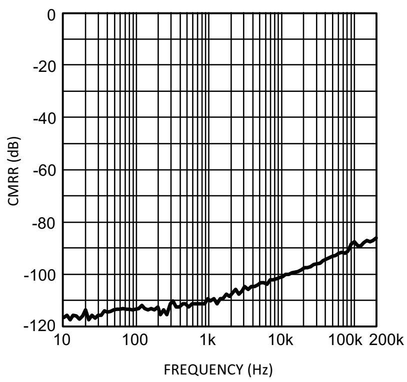


Figure 87.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

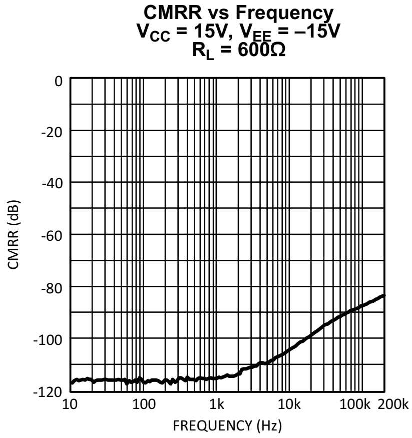


Figure 88.

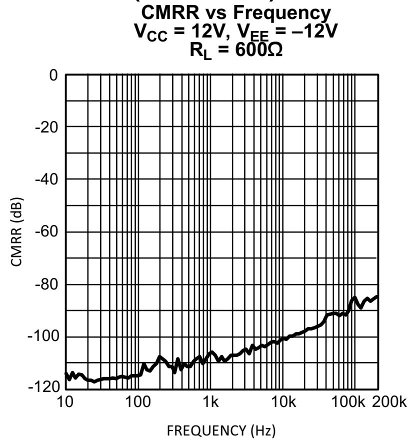


Figure 89.

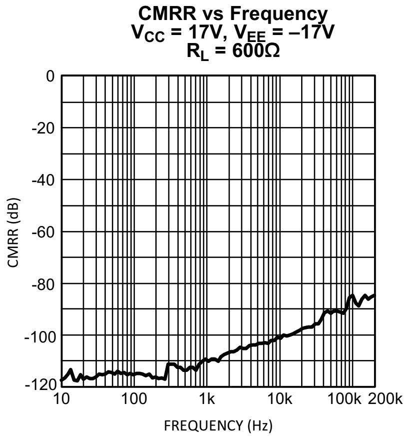


Figure 90.

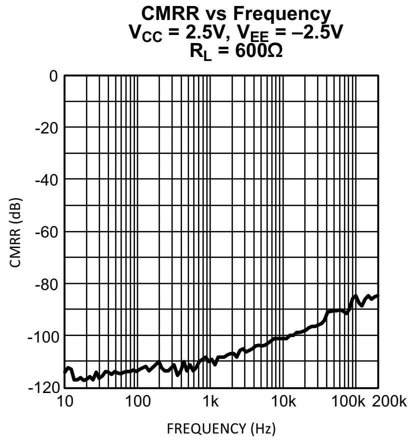


Figure 91.

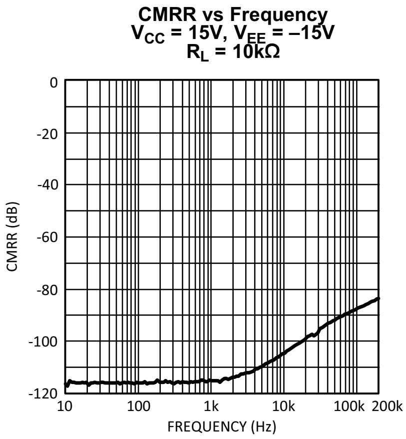


Figure 92.

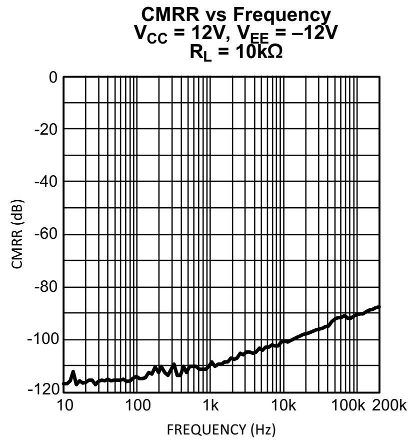


Figure 93.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

CMRR vs Frequency
V_{CC} = 17V, V_{EE} = –17V
R_L = 10kΩ

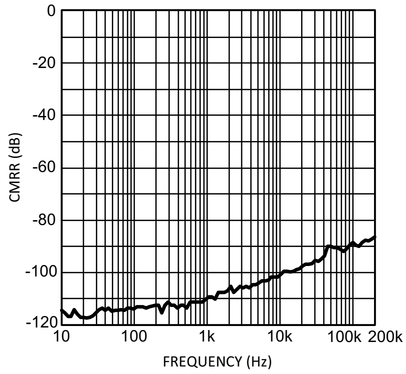


Figure 94.

CMRR vs Frequency
V_{CC} = 2.5V, V_{EE} = –2.5V
R_L = 10kΩ

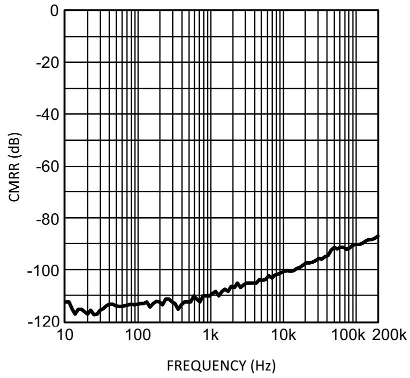


Figure 95.

Output Voltage vs Load Resistance
V_{DD} = 15V, V_{EE} = –15V
THD+N = 1%

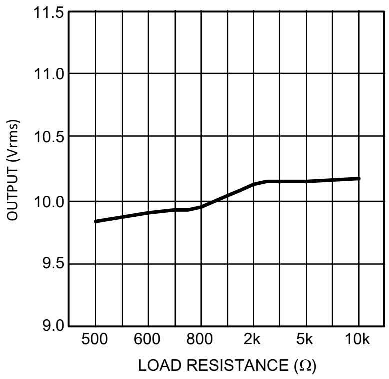


Figure 96.

Output Voltage vs Load Resistance
V_{DD} = 12V, V_{EE} = –12V
THD+N = 1%

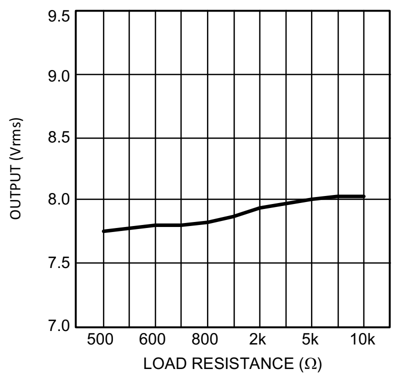


Figure 97.

Output Voltage vs Load Resistance
V_{DD} = 17V, V_{EE} = –17V
THD+N = 1%

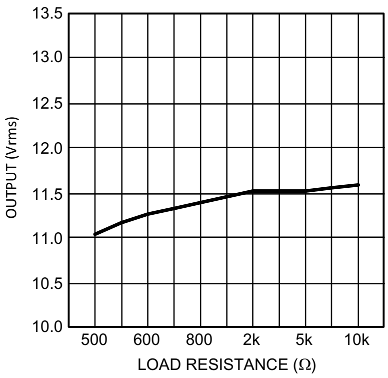


Figure 98.

Output Voltage vs Load Resistance
V_{DD} = 2.5V, V_{EE} = –2.5V
THD+N = 1%

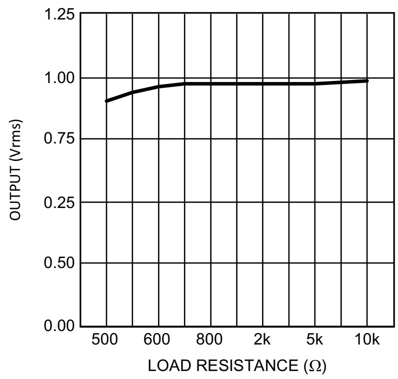


Figure 99.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

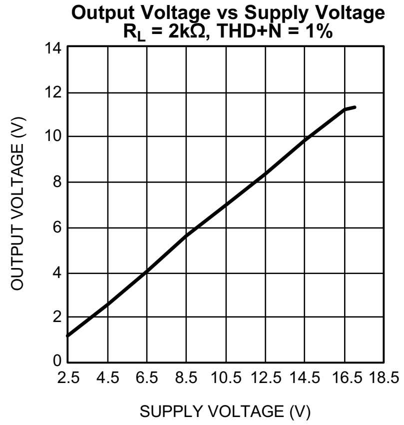


Figure 100.

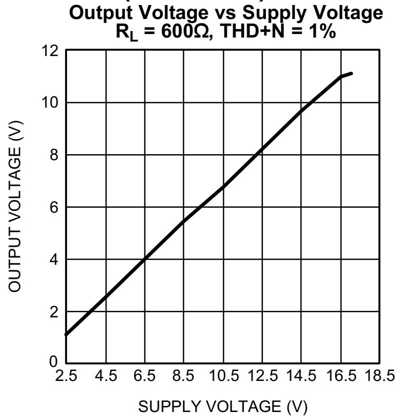


Figure 101.

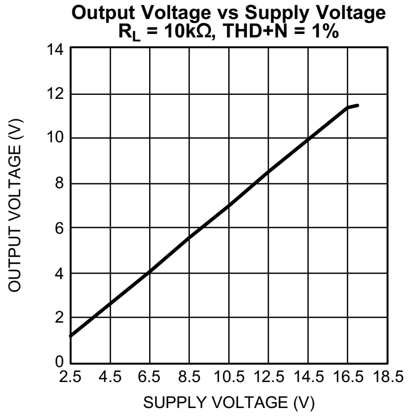


Figure 102.

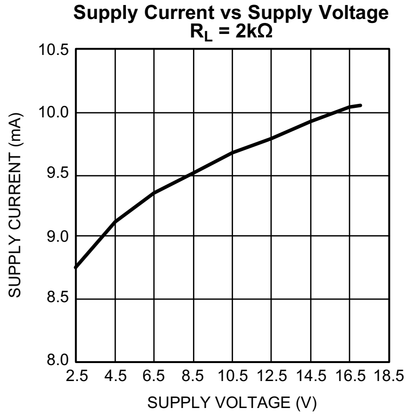


Figure 103.

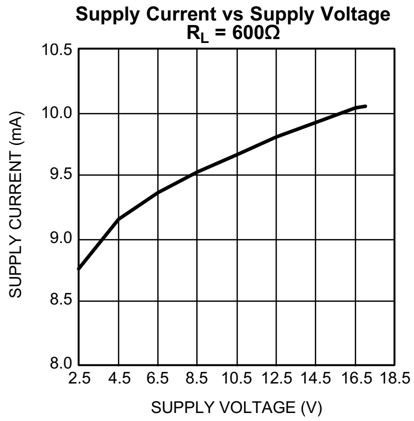


Figure 104.

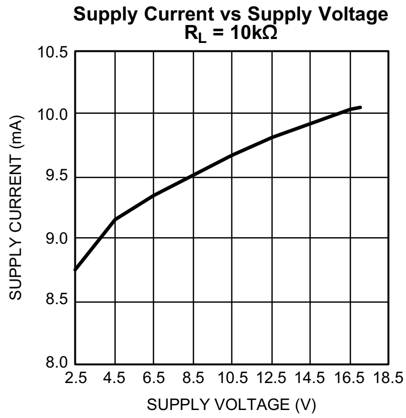


Figure 105.

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

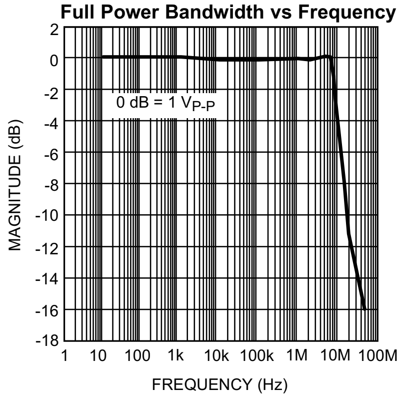


Figure 106.

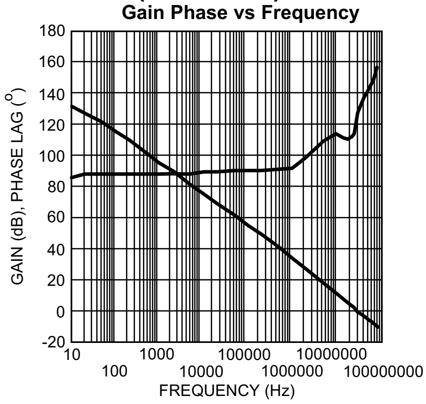


Figure 107.

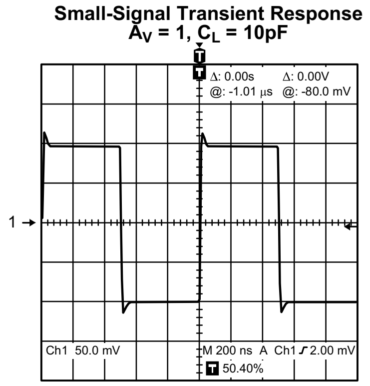


Figure 108.

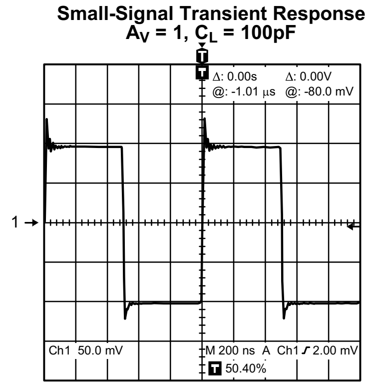


Figure 109.

APPLICATION INFORMATION

DISTORTION MEASUREMENTS

The vanishingly low residual distortion produced by LME49720 is below the capabilities of all commercially available equipment. This makes distortion measurements just slightly more difficult than simply connecting a distortion meter to the amplifier's inputs and outputs. The solution, however, is quite simple: an additional resistor. Adding this resistor extends the resolution of the distortion measurement equipment.

The LME49720's low residual distortion is an input referred internal error. As shown in Figure 110, adding the 10Ω resistor connected between the amplifier's inverting and non-inverting inputs changes the amplifier's noise gain. The result is that the error signal (distortion) is amplified by a factor of 101. Although the amplifier's closed-loop gain is unaltered, the feedback available to correct distortion errors is reduced by 101, which means that measurement resolution increases by 101. To ensure minimum effects on distortion measurements, keep the value of R1 low as shown in Figure 110.

This technique is verified by duplicating the measurements with high closed loop gain and/or making the measurements at high frequencies. Doing so produces distortion components that are within the measurement equipment's capabilities. This datasheet's THD+N and IMD values were generated using the above described circuit connected to an Audio Precision System Two Cascade.

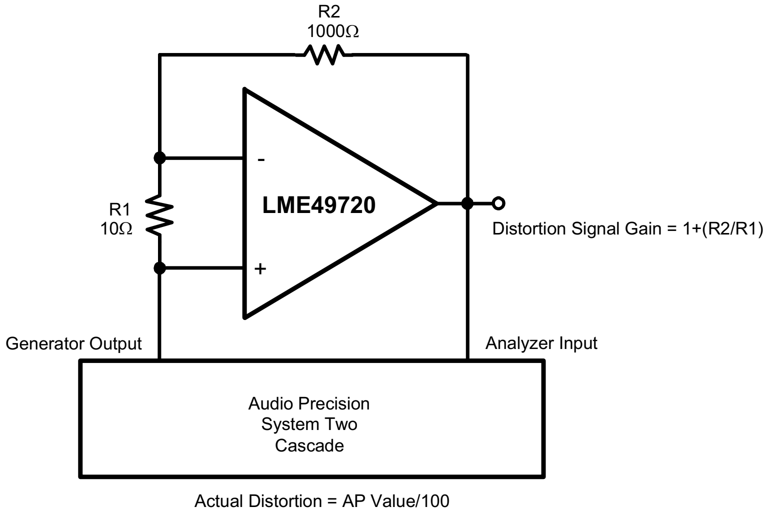
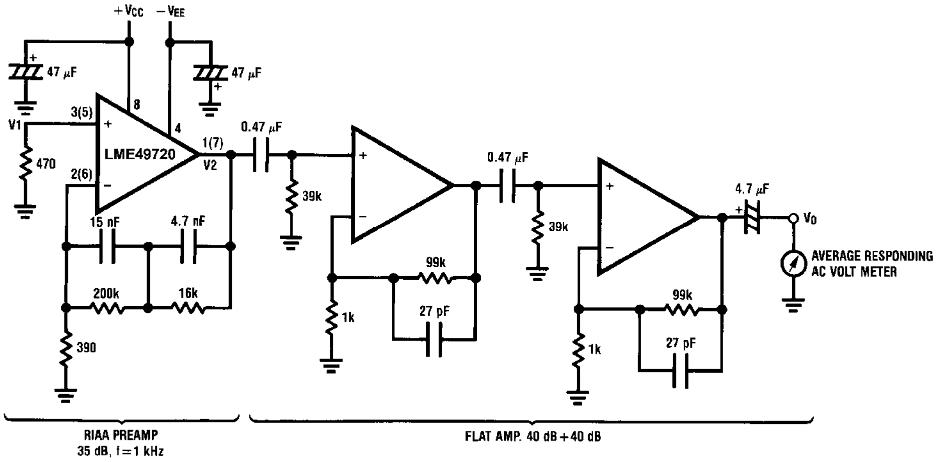


Figure 110. THD+N and IMD Distortion Test Circuit

The LME49720 is a high speed op amp with excellent phase margin and stability. Capacitive loads up to 100pF will cause little change in the phase characteristics of the amplifiers and are therefore allowable.

Capacitive loads greater than 100pF 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.



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

Figure 111. Noise Measurement Circuit
Total Gain: 115 dB @f = 1 kHz
Input Referred Noise Voltage: e_n = V0/560,000 (V)

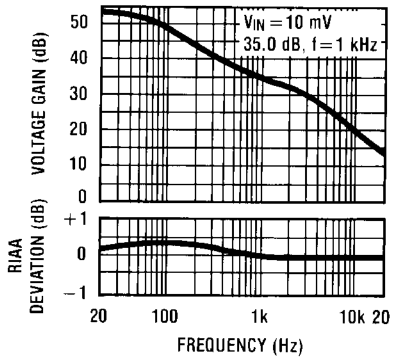


Figure 112. RIAA Preamp Voltage Gain, RIAA Deviation vs Frequency

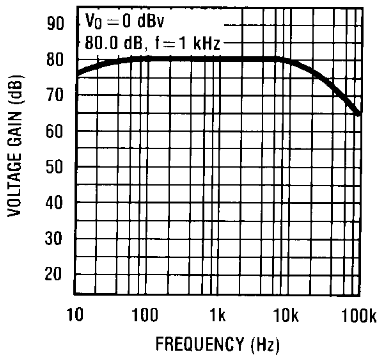
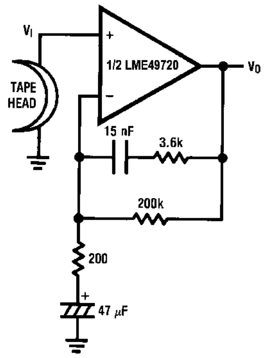


Figure 113. Flat Amp Voltage Gain vs Frequency

TYPICAL APPLICATIONS



$A_V = 34.5$
F = 1 kHz
$E_n = 0.38$ μV
A Weighted

Figure 114. NAB Preamp

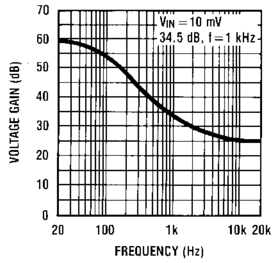
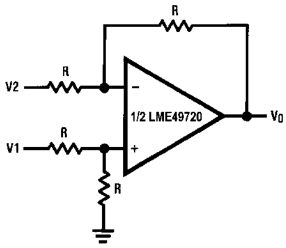
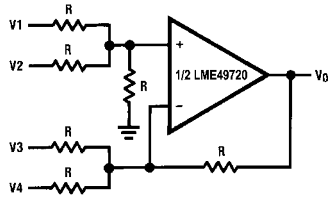


Figure 115. NAB Preamp Voltage Gain vs Frequency



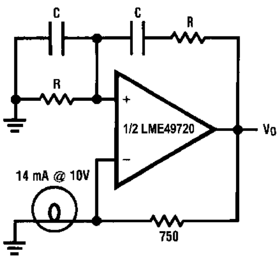
$V_O = V1–V2$

Figure 116. Balanced to Single Ended Converter



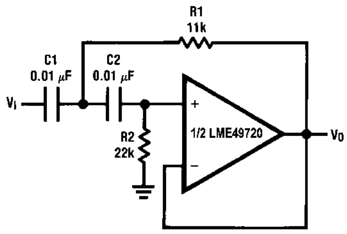
$V_O = V1 + V2 − V3 − V4$

Figure 117. Adder/Subtracter



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

Figure 118. Sine Wave Oscillator



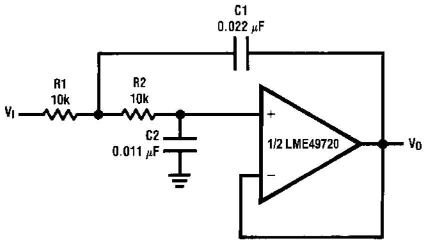
if C1 = C2 = C

$R1 = \frac{\sqrt{2}}{2\omega_0 C}$

$R2 = 2 \bullet R1$

Illustration is f_0 = 1 kHz

Figure 119. Second Order High Pass Filter (Butterworth)



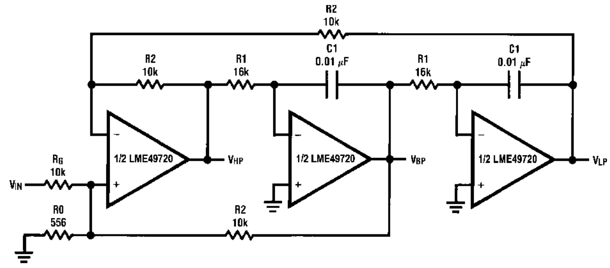
if R1 = R2 = R

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

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

Illustration is f_0 = 1 kHz

Figure 120. Second Order Low Pass Filter (Butterworth)



$$f_0 = \frac{1}{2\pi C1R1}, Q = \frac{1}{2}\left(1 + \frac{R2}{R0} + \frac{R2}{RG}\right), A_{BP} = QA_{LP} = QA_{LH} = \frac{R2}{RG}$$

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

Figure 121. State Variable Filter

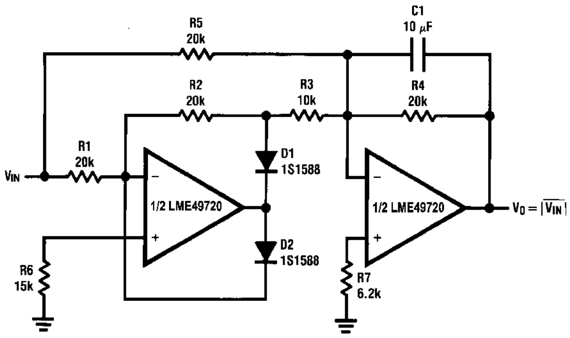


Figure 122. AC/DC Converter

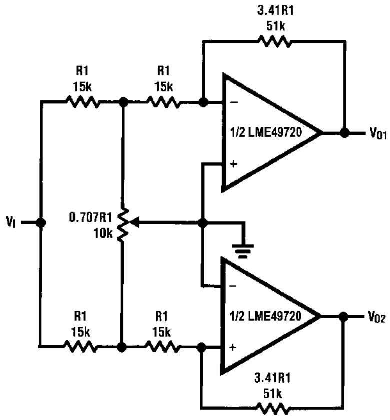


Figure 123. 2 Channel Panning Circuit (Pan Pot)

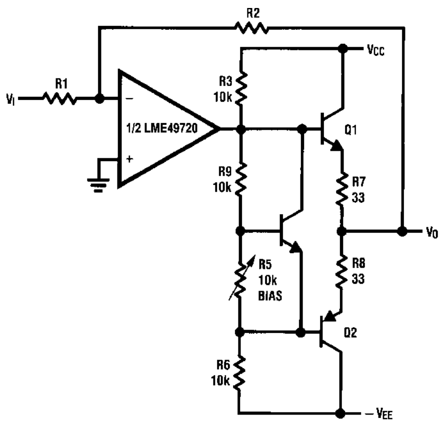
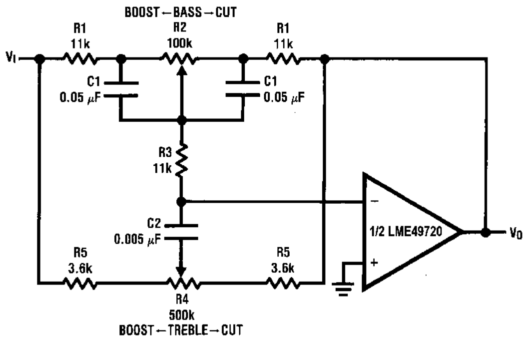


Figure 124. Line Driver



$$f_L = \frac{1}{2\pi R2C1}, f_{LB} = \frac{1}{2\pi R1C1}$$

$$f_H = \frac{1}{2\pi R5C2}, f_{HB} = \frac{1}{2\pi(R1 + R5 + 2R3)C2}$$

Illustration is:

f_L = 32 Hz, f_{LB} = 320 Hz

f_H =11 kHz, f_{HB} = 1.1 kHz

Figure 125. Tone Control

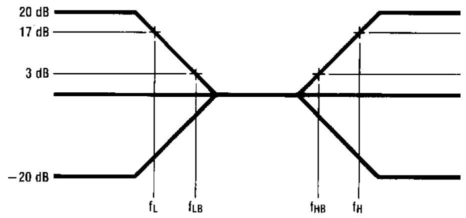
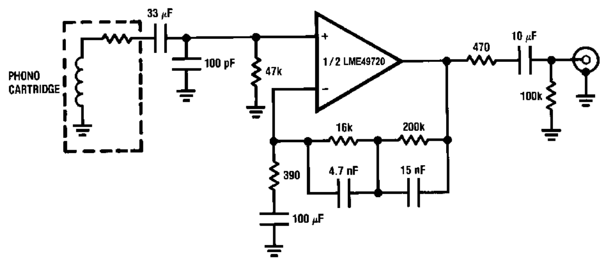
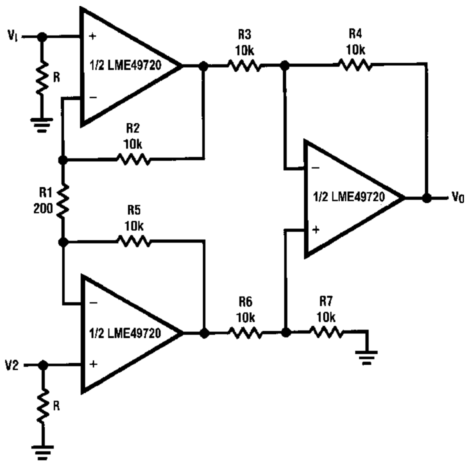


Figure 126.



A_V = 35 dB
E_n = 0.33 μV
S/N = 90 dB
f = 1 kHz
A Weighted
A Weighted, V_{IN} = 10 mV
@f = 1 kHz

Figure 127. RIAA Preamp



If R2 = R5, R3 = R6, R4 = R7

$$V0 = \left(1 + \frac{2R2}{R1}\right)\frac{R4}{R3}(V2 - V1)$$

Illustration is:
V0 = 101(V2 − V1)

Figure 128. Balanced Input Mic Amp

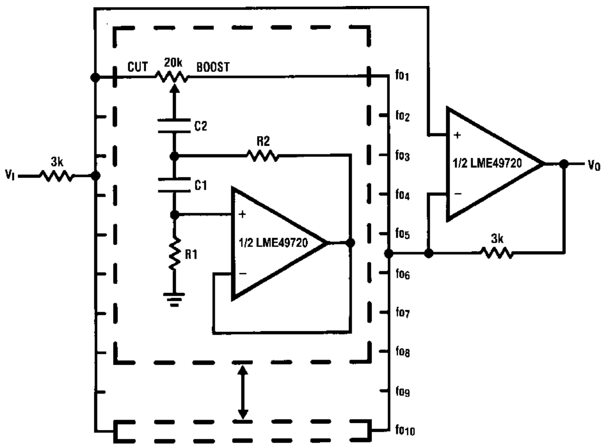


Figure 129. 10 Band Graphic Equalizer

fo (Hz)	C_1	C_2	R_1	R_2
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

REVISION HISTORY

Rev	Date	Description
1.0	03/30/07	Initial release.
1.1	05/03/07	Put the “general note” under the EC table.
1.2	10/22/07	Replaced all the PSRR curves.
C	04/05/13	Changed layout of National Data Sheet to TI format.