

LME49720

Dual High Performance, High Fidelity Audio Operational Amplifier

General 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 $(2.7\text{nV}/\sqrt{\text{Hz}})$ with vanishingly low THD+N (0.00003%) to easily satisfy the most demanding audio applications. To ensure that the most challenging loads are driven without compromise, the LME49720 has a high slew rate of $\pm 20\text{V}/\mu\text{s}$ and an output current capability of $\pm 26\text{mA}$. Further, dynamic range is maximized by an output stage that drives $2k\Omega$ 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 Plastic DIP, and 8-lead Metal Can TO-99. Demonstration boards are available for each package.

Key Specifications

	Power	Supply	Voltage	Range
--	-------	--------	---------	-------

±2.5V to ±17V

THD+N $(A_V = 1, V_{OUT} = 3V_{RMS}, f_{IN} = 1 \text{kHz})$

0.00003% (typ)
0.00003% (typ)
$2.7 \text{nV}/\sqrt{\text{Hz}} \text{ (typ)}$
±20V/µs (typ)
55MHz (typ)
140dB (typ)
10nA (typ)
0.1mV (typ)
0.000009%

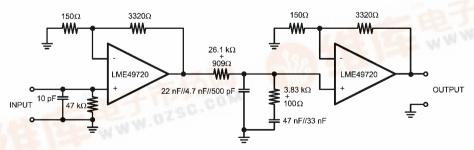
Features

- Easily drives 600Ω loads
- Optimized for superior audio signal fidelity
- Output short circuit protection
- PSRR and CMRR exceed 120dB (typ)
- SOIC, DIP, 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

Typical Application

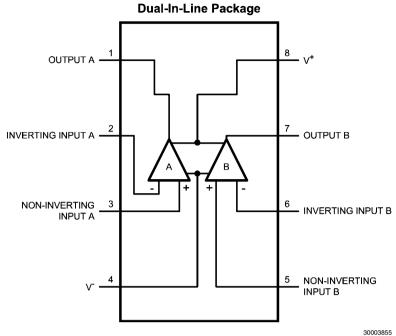


Note: 1% metal film resistors, 5% polypropylene capacitors

Passively Equalized RIAA Phono Preamplifier

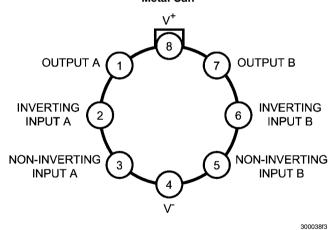
300038k5

<u> Ֆ</u>զ<u>դո**ւ**ection Diag</u>rams



Order Number LME49720MA See NS Package Number — M08A Order Number LME49720NA See NS Package Number — N08E

Metal Can



Order Number LME49720HA See NS Package Number — H08C

Absolute Maximum Ratings (Notes 1, 2) If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.		Pins 1, 4, 7 and 8 Pins 2, 3, 5 and 6 Junction Temperature Thermal Resistance	200V 100V 150°C
Power Supply Voltage (V _S = V ⁺ - V ⁻) Storage Temperature	36V –65°C to 150°C	θ _{JA} (SO) θ _{JA} (NA) θ _{JA} (HA)	145°C/W 102°C/W 150°C/W
Input Voltage Output Short Circuit (Note 3) Power Dissipation ESD Susceptibility (Note 4) ESD Susceptibility (Note 5)	(V-) - 0.7V to (V+) + 0.7V Continuous Internally Limited 2000V	$\theta_{\rm JC}$ (HA) Temperature Range $T_{\rm MIN} \le T_{\rm A} \le T_{\rm MAX}$ Supply Voltage Range	35°C/W $-40^{\circ}\text{C} \leq \text{T}_{\text{A}} \leq 85^{\circ}\text{C}$ $\pm 2.5\text{V} \leq \text{V}_{\text{S}} \leq \pm 17\text{V}$

Electrical Characteristics for the LME49720 (Notes 1, 2) The following specifications apply for $V_S = \pm 15V$, $R_L = 2k\Omega$, $f_{IN} = 1$ kHz, and $T_A = 25$ °C, unless otherwise specified.

			LME	LME49720	
Symbol	Parameter	Conditions	Typical	Limit	Units
•			(Note 6)	(Note 7)	(Limits)
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
_	Equivalent Input Noise Voltage	f _{BW} = 20Hz to 20kHz	0.34	0.65	μV _{RMS} (max)
e _n	Equivalent Input Noise Density	f = 1kHz f = 10Hz	2.7 6.4	4.7	nV/√ Hz (max)
i _n	Current Noise Density	f = 1kHz f = 10Hz	1.6 3.1		p A/ √Hz
V _{OS}	Offset Voltage		±0.1	±0.7	mV (max)
ΔV _{OS} /ΔTemp	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 (Note 8)	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)
ΔI _{OS} /ΔTemp	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< td=""><td>120</td><td>110</td><td>dB (min)</td></vcm<10v<>	120	110	dB (min)
7	Differential Input Impedance		30		kΩ
Z_{IN}	Common Mode Input Impedance	-10V <vcm<10v< td=""><td>1000</td><td></td><td>МΩ</td></vcm<10v<>	1000		МΩ

	4 <mark>9720"供应商</mark> rameter	Conditions	LME4	LME49720	
查询yihabdiE4			Typical	Limit	Units (Limits)
			(Note 6)	(Note 7)	
		$-10V < Vout < 10V, R_L = 600\Omega$	140	125	
A_{VOL}	Open Loop Voltage Gain	$-10V$ <vout<10v, <math="">R_L = 2k\Omega</vout<10v,>	140		dB (min)
		$-10V$ <vout<10v, r<sub="">L = $10k\Omega$</vout<10v,>	140		
	Maximum Output Voltage Swing	$R_L = 600\Omega$	±13.6	±12.5	V (min)
V_{OUTMAX}		$R_L = 2k\Omega$	±14.0		
		$R_L = 10k\Omega$	±14.1		
I _{OUT}	Output Current	$R_L = 600\Omega, V_S = \pm 17V$	±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)

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.

Note 2: Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Note 3: Amplifier output connected to GND, any number of amplifiers within a package.

Note 4: Human body model, 100pF discharged through a 1.5k Ω resistor.

Note 5: 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).

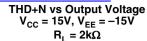
Note 6: Typical specifications are specified at +25°C and represent the most likely parametric norm.

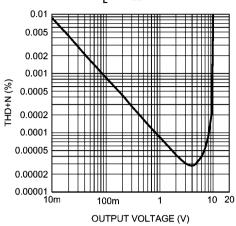
Note 7: Tested limits are guaranteed to National's AOQL (Average Outgoing Quality Level).

 $\textbf{Note 8: PSRR is measured as follows: V_{OS} is measured at two supply voltages, $\pm 5V$ and $\pm 15V$. PSRR = $|$ 20log($\Delta V_{OS}/\Delta V_{S})$ | I.}$

Typical Performance Characteristics

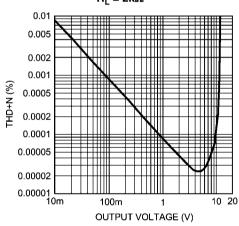
查询"LME49720"供应商





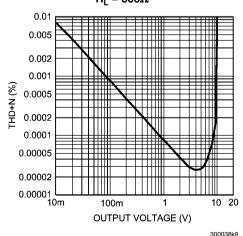
300038k6

THD+N vs Output Voltage V_{CC} = 17V, V_{EE} = -17V R_L = 2k Ω

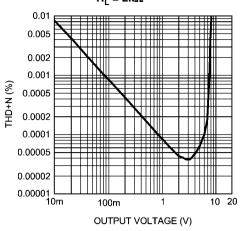


300038k8

THD+N vs Output Voltage $V_{\text{CC}} = 15 \text{V}, \, V_{\text{EE}} = -15 \text{V}$ $R_{\text{L}} = 600 \Omega$

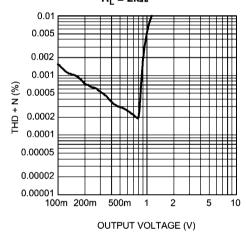


THD+N vs Output Voltage V_{CC} = 12V, V_{EE} = -12V R_L = 2k Ω



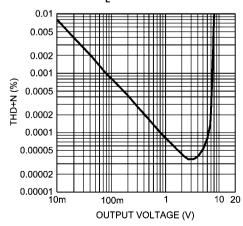
300038k7

THD+N vs Output Voltage V_{CC} = 2.5V, V_{EE} = -2.5V R_L = $2k\Omega$



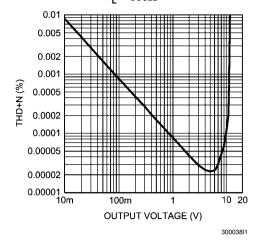
300038i4

THD+N vs Output Voltage V_{CC} = 12V, V_{EE} = -12V R_L = 600 Ω

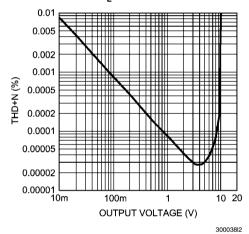


30003810

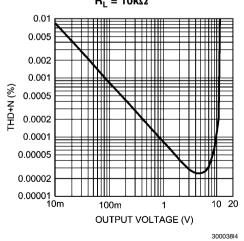
THD+N vs Output Voltage 查询"LME49720"换应商7V, V_{EE} = –17V R_I = 600Ω



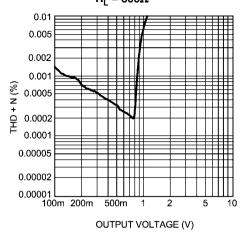
THD+N vs Output Voltage V_{CC} = 15V, V_{EE} = -15V R_L = 10k Ω



THD+N vs Output Voltage V_{CC} = 17V, V_{EE} = -17V R_{I} = 10k Ω

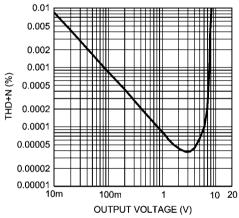


THD+N vs Output Voltage V_{CC} = 2.5V, V_{EE} = -2.5V R_{L} = 600 Ω



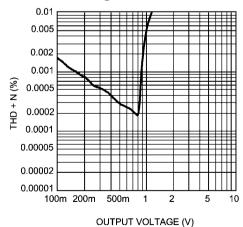
300038i6

THD+N vs Output Voltage $V_{CC} = 12V, \, V_{EE} = -12V \\ R_L = 10k\Omega$

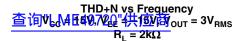


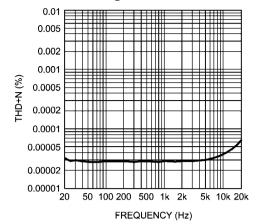
30003813

THD+N vs Output Voltage $V_{CC} = 2.5V$, $V_{EE} = -2.5V$ $R_{L} = 10k\Omega$



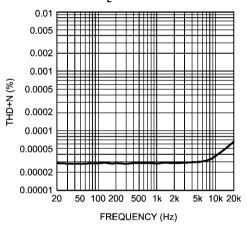
300038i5





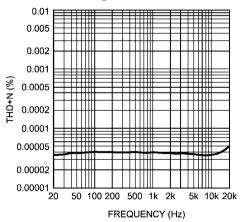
30003863

THD+N vs Frequency $\begin{aligned} \text{V}_{\text{CC}} &= \text{17V}, \, \text{V}_{\text{EE}} = -\text{17V}, \, \text{V}_{\text{OUT}} = \text{3V}_{\text{RMS}} \\ \text{R}_{\text{L}} &= 2k\Omega \end{aligned}$



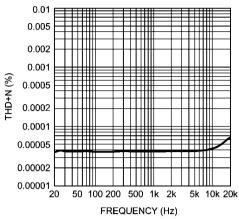
30003864

THD+N vs Frequency
$$\begin{aligned} \text{V}_{\text{CC}} &= \text{12V}, \, \text{V}_{\text{EE}} = -\text{12V}, \, \text{V}_{\text{OUT}} = \text{3V}_{\text{RMS}} \\ \text{R}_{\text{L}} &= 600\Omega \end{aligned}$$



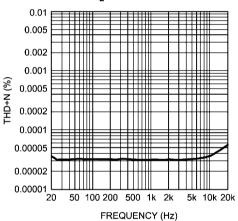
300038k3

THD+N vs Frequency
$$\begin{split} V_{CC} = 12V, \, V_{EE} = -12V, \, V_{OUT} = 3V_{RMS} \\ R_L = 2k\Omega \end{split}$$



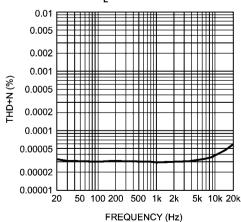
30003862

THD+N vs Frequency
$$\begin{aligned} V_{CC} &= 15V, \, V_{EE} = -15V, \, V_{OUT} = 3V_{RMS} \\ R_L &= 600\Omega \end{aligned}$$



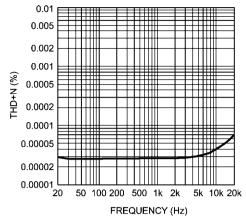
30003859

THD+N vs Frequency
$$\begin{aligned} \text{V}_{\text{CC}} &= \text{17V}, \text{V}_{\text{EE}} = -\text{17V}, \text{V}_{\text{OUT}} = \text{3V}_{\text{RMS}} \\ \text{R}_{\text{L}} &= 600\Omega \end{aligned}$$



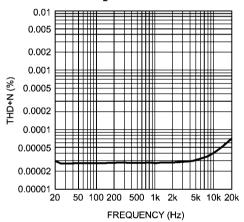
30003860





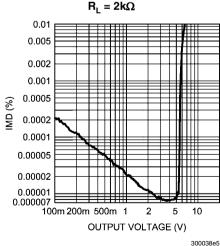
30003867

THD+N vs Frequency $\begin{aligned} \text{V}_{\text{CC}} &= 17\text{V}, \text{V}_{\text{EE}} = -17\text{V}, \text{V}_{\text{OUT}} = 3\text{V}_{\text{RMS}} \\ \text{R}_{\text{L}} &= 10\text{k}\Omega \end{aligned}$

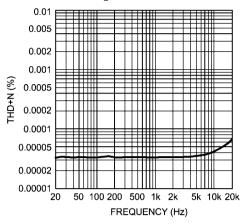


30003868

IMD vs Output Voltage $V_{CC} = 12V$, $V_{EE} = -12V$

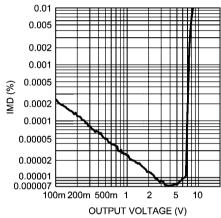


THD+N vs Frequency $\begin{aligned} V_{CC} &= 12V, \, V_{EE} = -12V, \, V_{OUT} = 3V_{RMS} \\ R_{_{I}} &= 10k\Omega \end{aligned}$



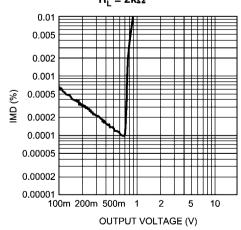
30003866

IMD vs Output Voltage V_{CC} = 15V, V_{EE} = -15V R_L = $2k\Omega$



300038e6

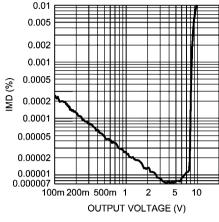
 $\begin{aligned} & \text{IMD vs Output Voltage} \\ & \text{V}_{\text{CC}} = 2.5\text{V}, \, \text{V}_{\text{EE}} = -2.5\text{V} \\ & \text{R}_{\text{L}} = 2\text{k}\Omega \end{aligned}$



300038e4

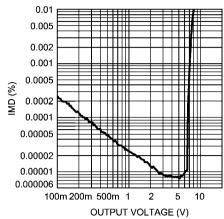
IMD vs Output Voltage 查询"LME\Q7207供收益商-17V



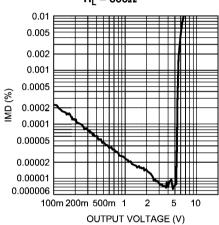


300038e7

IMD vs Output Voltage V_{CC} = 15V, V_{EE} = -15V R_L = 600 Ω

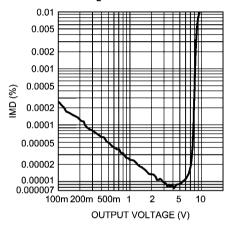


300038e2



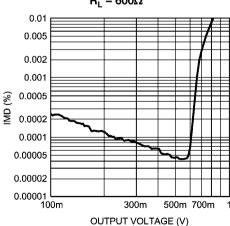
300038e0

IMD vs Output Voltage V_{CC} = 17V, V_{EE} = -17V R_L = 600 Ω



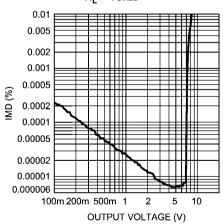
300038e3

IMD vs Output Voltage V_{CC} = 2.5V, V_{EE} = -2.5V R_L = 600 Ω



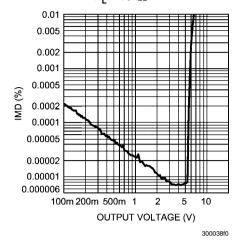
300038e1

IMD vs Output Voltage V_{CC} = 15V, V_{EE} = -15V R_L = 10k Ω

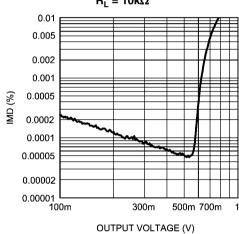


300038f1

IMD vs Output Voltage 查询"LME49720"(换应+前2V, V_{EE} = -12V R_I = 10kΩ

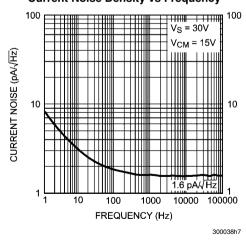


IMD vs Output Voltage $V_{CC} = 2.5V, V_{EE} = -2.5V$ $R_L = 10k\Omega$

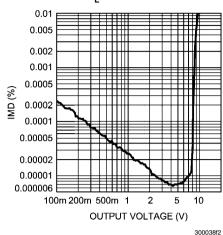


Current Noise Density vs Frequency

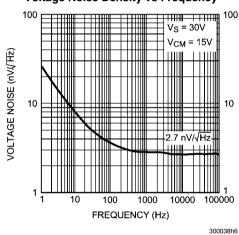
30003816



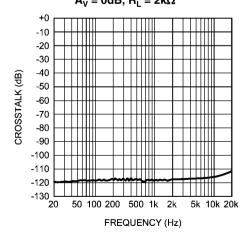
IMD vs Output Voltage V_{CC} = 17V, V_{EE} = -17V R_{L} = 10k Ω



Voltage Noise Density vs Frequency

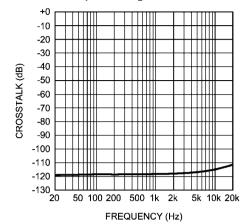


 $\begin{aligned} &\text{Crosstalk vs Frequency}\\ \textbf{V}_{\text{CC}} = 15\textbf{V}, \, \textbf{V}_{\text{EE}} = -15\textbf{V}, \, \textbf{V}_{\text{OUT}} = 3\textbf{V}_{\text{RMS}}\\ &\textbf{A}_{\text{V}} = 0\text{dB}, \, \textbf{R}_{\text{L}} = 2k\Omega \end{aligned}$

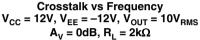


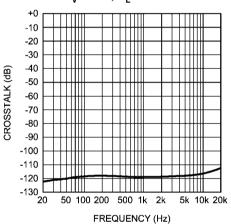
300038c8



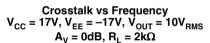


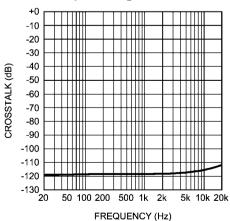
300038c9





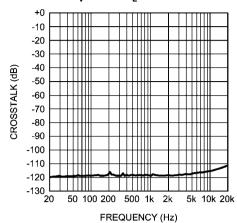
300038c7





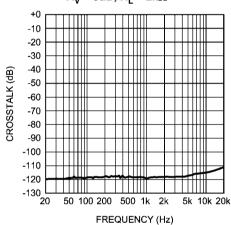
300038d1

 $\begin{array}{c} \text{Crosstalk vs Frequency} \\ \text{V}_{\text{CC}} = 12\text{V}, \, \text{V}_{\text{EE}} = -12\text{V}, \, \text{V}_{\text{OUT}} = 3\text{V}_{\text{RMS}} \\ \text{A}_{\text{V}} = 0\text{dB}, \, \text{R}_{\text{I}} = 2\text{k}\Omega \end{array}$



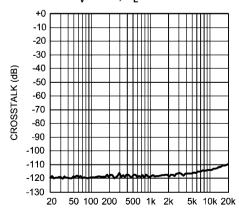
300038c6

 $\begin{aligned} & \text{Crosstalk vs Frequency} \\ V_{\text{CC}} &= 17V, V_{\text{EE}} = -17V, V_{\text{OUT}} = 3V_{\text{RMS}} \\ A_{_{V}} &= 0\text{dB}, R_{_{L}} = 2k\Omega \end{aligned}$



300038d0

Crosstalk vs Frequency V_{CC} = 2.5V, V_{EE} = -2.5V, V_{OUT} = 1 V_{RMS} A_V = 0dB, R_1 = 2 $k\Omega$



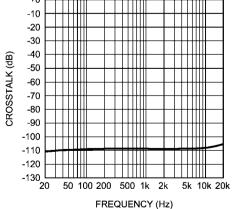
FREQUENCY (Hz)

300038n8

Crosstalk vs Frequency ≦询"LME497@0=悔呸Mi = −15V, V_{OUT} = 3V_{RMS} **Crosstalk vs Frequency** $V_{CC} = 15V$, $V_{EE} = -15V$, $V_{OUT} = 10V_{RMS}$ $A_V = 0$ dB, $R_I = 600\Omega$ $A_V = 0$ dB, $R_L = 600\Omega$ +0 +0 -10 -10 -20 -20 -30 -30 -40 -40 CROSSTALK (dB) -50 -50 -60 -60 -70 -70 -80 -80 -90 -90 -100 -100 -110 -110 -120 -120 -130 L 20 -130 L 20 50 100 200 500 1k 2k 5k 10k 20k 50 100 200 500 1k FREQUENCY (Hz) FREQUENCY (Hz) 300038d6 **Crosstalk vs Frequency** Crosstalk vs Frequency $V_{CC} = 12V, V_{EE} = -12V, V_{OUT} = 10V_{RMS}$ V_{CC} = 12V, V_{EE} = -12V, V_{OUT} = $3V_{RMS}$ $A_V = 0$ dB, $R_L = 600\Omega$ $A_V = 0$ dB, $R_L = 600\Omega$ +0 -10 -10 -20 -20 -30 -30 -40 -40 CROSSTALK (dB) CROSSTALK (dB) -50 -50 -60 -60 -70 -70 -80 -80 -90 -90 -100 -100 -110 -110 -120 -120 -130 L 20 -130 50 100 200 500 1k 2k 5k 10k 20k 50 100 200 500 1k 20 FREQUENCY (Hz) FREQUENCY (Hz) 300038d4 Crosstalk vs Frequency $V_{CC} = 17V$, $V_{EE} = -17V$, $V_{OUT} = 10V_{RMS}$ Crosstalk vs Frequency $V_{CC} = 17V, V_{EE} = -17V, \dot{V}_{OUT} = 3V_{RMS}$ $A_V = 0$ dB, $R_I = 600\Omega$ $A_V = 0$ dB, $R_I = 600\Omega$

+0 -10

300038d8



-40 CROSSTALK (dB) -50 -60 -70 -80 -90 -100 -110 -120 -130 50 100 200 500 1k 2k 20 5k 10k 20k

FREQUENCY (Hz)

+0

-10

-20

-30

2k

5k 10k 20k

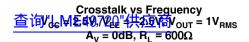
5k 10k 20k

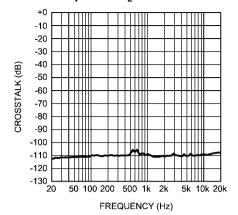
300038d5

2k

300038d7

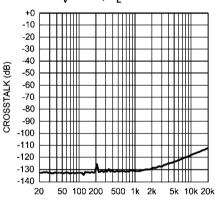
300038d9





300038d2

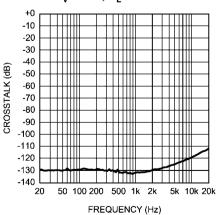
Crosstalk vs Frequency V_{CC} = 15V, V_{EE} = -15V, V_{OUT} = 10V $_{RMS}$ A_V = 0dB, R_L = 10k Ω



FREQUENCY (Hz)

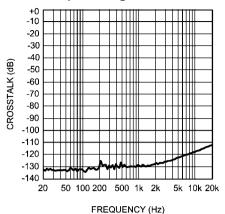
300038n7

$\begin{array}{l} \text{Crosstalk vs Frequency} \\ \text{V}_{\text{CC}} = 12\text{V}, \, \text{V}_{\text{EE}} = -12\text{V}, \, \text{V}_{\text{OUT}} = 10\text{V}_{\text{RMS}} \\ \text{A}_{\text{V}} = 0\text{dB}, \, \text{R}_{\text{L}} = 10\text{k}\Omega \end{array}$



300038n6

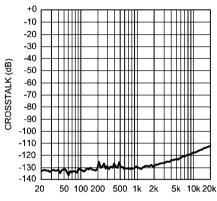
 $\begin{aligned} & \text{Crosstalk vs Frequency} \\ V_{\text{CC}} = 15V, \, V_{\text{EE}} = -15V, \, V_{\text{OUT}} = 3V_{\text{RMS}} \\ & A_{\text{V}} = 0\text{dB}, \, R_{\text{I}} = 10\text{k}\Omega \end{aligned}$



30003800

Crosstalk vs Frequency $V_{CC} = 12V$, $V_{EE} = -12V$, $V_{OUT} = 3V_{RMS}$

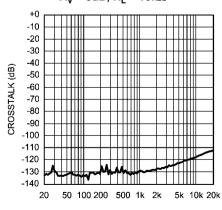
 $_{\rm C}$ = 12V, V_{EE} = -12V, V_{OUT} = 3V_{RM} A_V = 0dB, R_L = 10k Ω



300038n9

 $\begin{aligned} & \text{Crosstalk vs Frequency} \\ V_{\text{CC}} &= 17V, \, V_{\text{EE}} = -17V, \, V_{\text{OUT}} = 3V_{\text{RMS}} \\ & A_{\text{V}} = 0\text{dB}, \, R_{\text{L}} = 10\text{k}\Omega \end{aligned}$

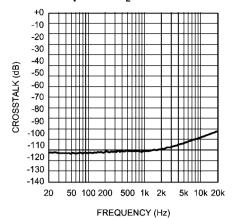
FREQUENCY (Hz)



FREQUENCY (Hz)

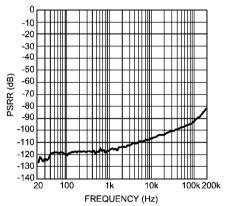
300038n5

Crosstalk vs Frequency 查询"LME497629"(內面面 –17V, V_{OUT} = 10V_{RMS} A_V = 0dB, R_L = 10kΩ



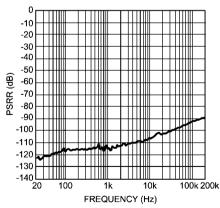
300038n3

$\begin{array}{c} \text{PSRR+ vs Frequency} \\ \text{V}_{\text{CC}} = 15\text{V}, \, \text{V}_{\text{EE}} = -15\text{V} \\ \text{R}_{\text{L}} = 10\text{k}\Omega, \, \text{f} = 200\text{kHz}, \, \text{V}_{\text{RIPPLE}} = 200\text{mVpp} \end{array}$



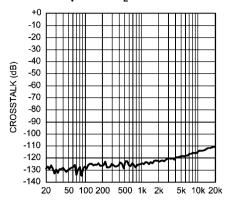
300038p2

 $\begin{array}{c} \text{PSRR+ vs Frequency} \\ \text{V}_{\text{CC}} = 15\text{V}, \, \text{V}_{\text{EE}} = -15\text{V} \\ \text{R}_{\text{L}} = 2k\Omega, \, \text{f} = 200\text{kHz}, \, \text{V}_{\text{RIPPLE}} = 200\text{mVpp} \end{array}$



300038p3

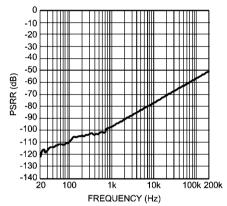
Crosstalk vs Frequency
$$V_{CC}$$
 = 2.5V, V_{EE} = -2.5V, V_{OUT} = 1 V_{RMS} A_V = 0dB, R_I = 10k Ω



FREQUENCY (Hz)

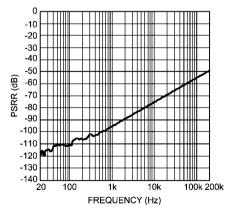
300038n4

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



300038p5

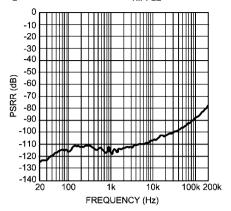
 $\begin{array}{c} \text{PSRR- vs Frequency} \\ \text{V}_{\text{CC}} = 15\text{V}, \, \text{V}_{\text{EE}} = -15\text{V} \\ \text{R}_{\text{L}} = 2\text{k}\Omega, \, \text{f} = 200\text{kHz}, \, \text{V}_{\text{RIPPLE}} = 200\text{mVpp} \end{array}$



300038p6

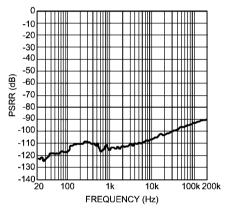


$R_L = 600\Omega$, f = 200kHz, $V_{RIPPLE} = 200$ mVpp



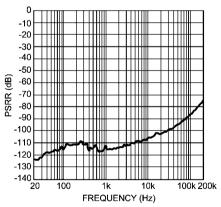
300038p1

PSRR+ vs Frequency $V_{CC} = 12V, V_{EE} = -12V$ $R_L = 10k\Omega$, f = 200kHz, $V_{RIPPLE} = 200mVpp$



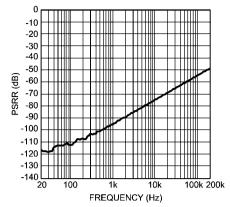
300038p8

PSRR+ vs Frequency $V_{CC} = 12V, V_{EE} = -12V$ $R_L = 2k\Omega$, f = 200kHz, $V_{RIPPLE} = 200mVpp$



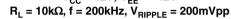
300038p9

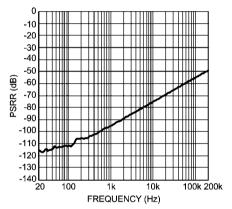
PSRR- vs Frequency $V_{CC} = 15V$, $V_{EE} = -15V$ $R_L = 600\Omega$, f = 200kHz, $V_{RIPPLE} = 200$ mVpp



300038p4

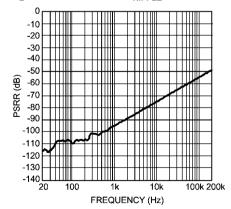
PSRR- vs Frequency $V_{CC} = 12V, V_{EE} = -12V$





300038q1

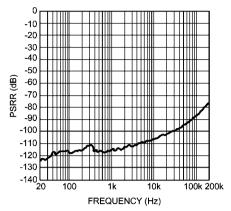
PSRR- vs Frequency $V_{CC} = 12V, V_{EE} = -12V$ $R_L = 2k\Omega$, f = 200kHz, $V_{RIPPLE} = 200mVpp$



300038q2

PSRR+ vs Frequency 查询"LME49720"快应商2V, V_{EE} = -12V

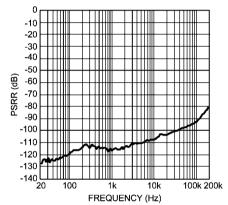
 $R_L = 600\Omega$, f = 200kHz, $V_{RIPPLE} = 200$ mVpp



300038p7

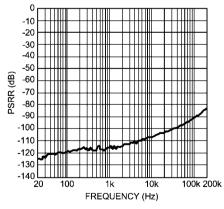
PSRR+ vs Frequency V_{CC} = 17V, V_{EE} = -17V

 $R_L = 10k\Omega$, f = 200kHz, $V_{RIPPLE} = 200mVpp$



300038r0

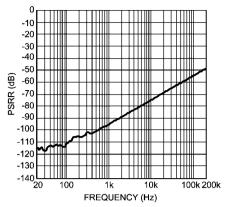
 $\begin{array}{c} \text{PSRR+ vs Frequency} \\ \text{V}_{\text{CC}} = 17\text{V}, \, \text{V}_{\text{EE}} = -17\text{V} \\ \text{R}_{\text{L}} = 2\text{k}\Omega, \, \text{f} = 200\text{kHz}, \, \text{V}_{\text{RIPPLE}} = 200\text{mVpp} \end{array}$



300038r1

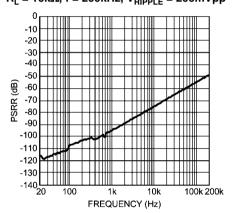
PSRR- vs Frequency V_{CC} = 12V, V_{EE} = -12V

 $R_L = 600\Omega$, f = 200kHz, $V_{RIPPLE} = 200mVpp$



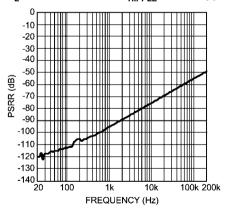
300038q0

PSRR- vs Frequency $V_{CC} = 17V,\, V_{EE} = -17V$ $R_L = 10k\Omega,\, f = 200kHz,\, V_{RIPPLE} = 200mVpp$



300038r3

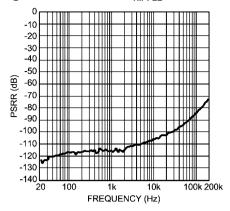
PSRR- vs Frequency $\begin{aligned} V_{CC} &= 17V, \, V_{EE} = -17V \\ R_L &= 2k\Omega, \, f = 200kHz, \, V_{RIPPLE} = 200mVpp \end{aligned}$



300038r4

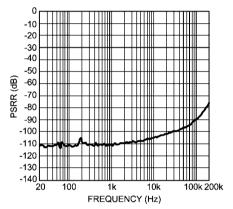
PSRR+ vs Frequency 查询"LME487207供证商-17V

$R_L = 600\Omega$, f = 200kHz, $V_{RIPPLE} = 200$ mVpp



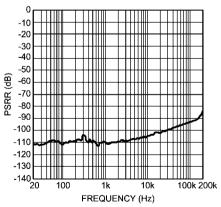
300038q9

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



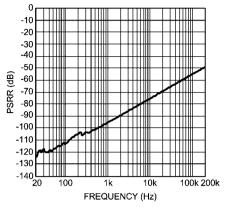
300038q4

 $\begin{aligned} & \text{PSRR+ vs Frequency} \\ & \text{V}_{\text{CC}} = 2.5\text{V}, \text{V}_{\text{EE}} = -2.5\text{V} \\ & \text{R}_{\text{L}} = 2\text{k}\Omega, \text{f} = 200\text{kHz}, \text{V}_{\text{RIPPLE}} = 200\text{mVpp} \end{aligned}$



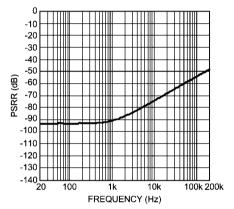
300038q5

 $\begin{array}{c} \text{PSRR- vs Frequency} \\ \text{V}_{\text{CC}} = 17\text{V}, \, \text{V}_{\text{EE}} = -17\text{V} \\ \text{R}_{\text{L}} = 600\Omega, \, \text{f} = 200\text{kHz}, \, \text{V}_{\text{RIPPLE}} = 200\text{mVpp} \end{array}$



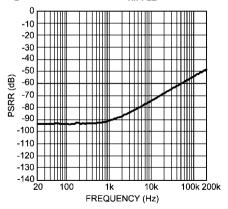
300038r2

 $\begin{array}{c} \text{PSRR- vs Frequency} \\ \text{V}_{\text{CC}} = 2.5\text{V}, \text{V}_{\text{EE}} = -2.5\text{V} \\ \text{R}_{\text{L}} = 10\text{k}\Omega, \text{f} = 200\text{kHz}, \text{V}_{\text{RIPPLE}} = 200\text{mVpp} \end{array}$

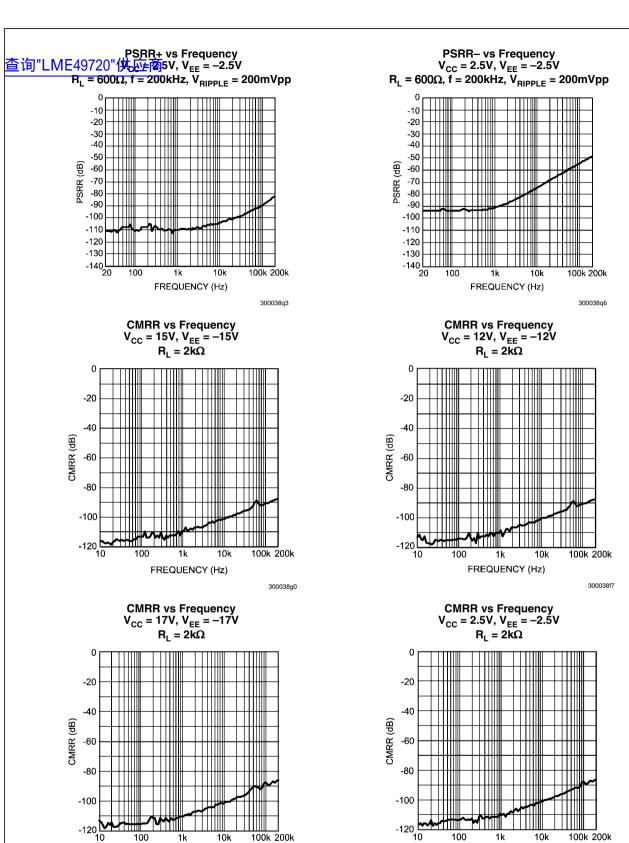


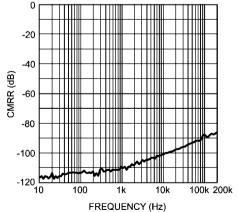
300038q7

 $\begin{array}{c} \text{PSRR- vs Frequency} \\ \text{V}_{\text{CC}} = 2.5\text{V}, \, \text{V}_{\text{EE}} = -2.5\text{V} \\ \text{R}_{\text{L}} = 2\text{k}\Omega, \, \text{f} = 200\text{kHz}, \, \text{V}_{\text{RIPPLE}} = 200\text{mVpp} \end{array}$



300038q8





300038f4

18 www.national.com

10k

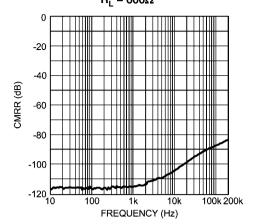
FREQUENCY (Hz)

100k 200k

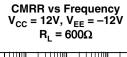
300038g3

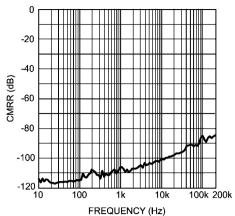
100

CMRR vs Frequency 查询"LMEVQ7全05快收高-15V R₁ = 600Ω

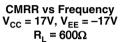


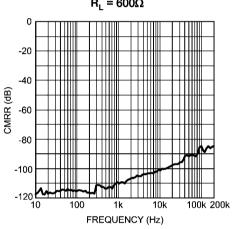
30003809





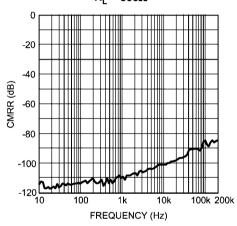
300038f9





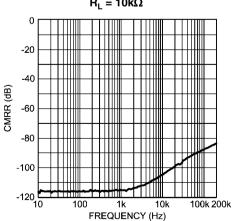
300038g5

CMRR vs Frequency
$$V_{CC}$$
 = 2.5V, V_{EE} = -2.5V R_L = 600 Ω



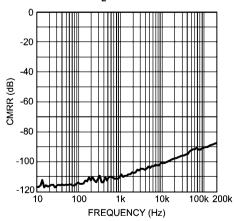
300038f6

CMRR vs Frequency V_{CC} = 15V, V_{EE} = -15V R_L = 10k Ω



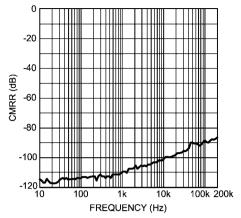
30003808

CMRR vs Frequency V_{CC} = 12V, V_{EE} = -12V R_L = 10k Ω



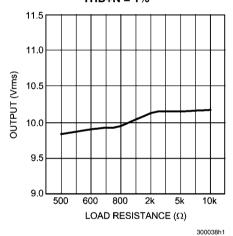
300038f8

CMRR vs Frequency 查询"LME49720"<mark>换应</mark>每7V, V_{EE} = −17V R_L = 10kΩ

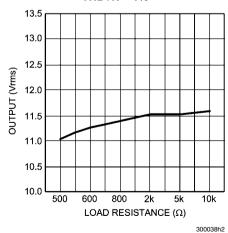


300038q4

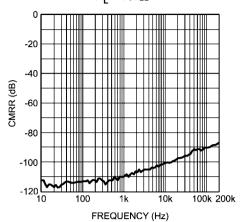
Output Voltage vs Load Resistance $V_{DD} = 15V, \, V_{EE} = -15V$ THD+N = 1%



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

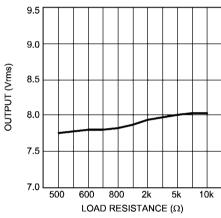


CMRR vs Frequency V_{CC} = 2.5V, V_{EE} = -2.5V R_L = 10k Ω



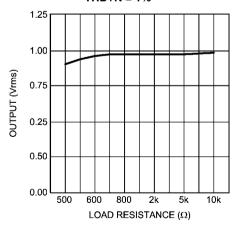
300038f5

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



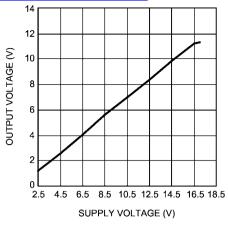
300038h0

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



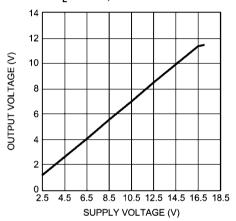
300038g9

Output Voltage vs Supply Voltage 查询"LM 四,972k以其他确 = 1%



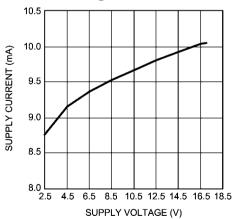
300038j9

Output Voltage vs Supply Voltage $R_L = 10k\Omega, THD + N = 1\%$



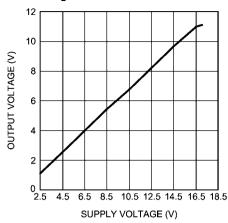
300038k0

Supply Current vs Supply Voltage $R_L = 600\Omega$



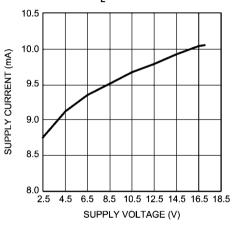
300038i5

Output Voltage vs Supply Voltage $R_1 = 600\Omega$, THD+N = 1%



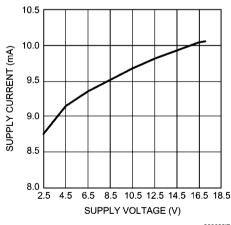
300038j8

Supply Current vs Supply Voltage $R_L = 2k\Omega \label{eq:RL}$



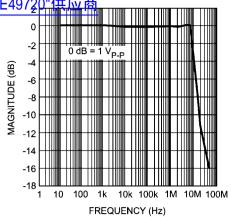
300038i6

Supply Current vs Supply Voltage $R_L = 10k\Omega$

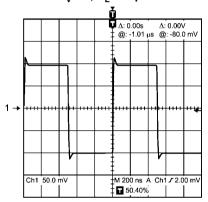


300038j7





Small-Signal Transient Response $A_V = 1, C_L = 10pF$

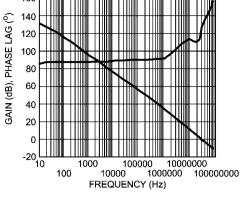


300038i7

300038j0

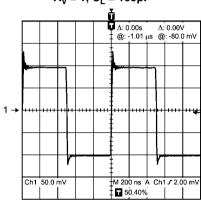
180 160 140 120 100

Gain Phase vs Frequency



300038j1

Small-Signal Transient Response $A_V = 1$, $C_L = 100pF$



300038i8

Application Information 查询"LME49720"供应商

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 1, 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 1.

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.

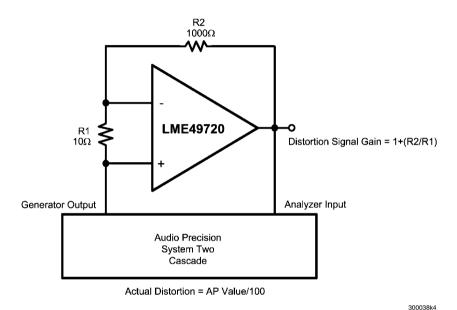
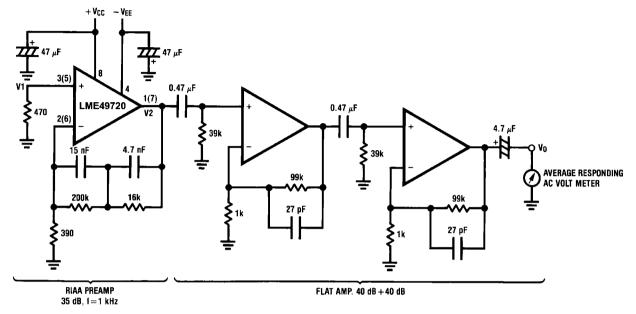


FIGURE 1. THD+N and IMD Distortion Test Circuit

The LME49720 is a high speed op amp with excellent phase partial phase 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

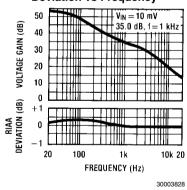


30003827

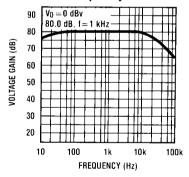
Complete shielding is required to prevent induced pick up from external sources. Always check with oscilloscope for power line noise.

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

RIAA Preamp Voltage Gain, RIAA Deviation vs Frequency



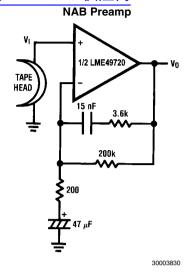
Flat Amp Voltage Gain vs Frequency



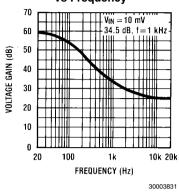
30003829

TYPICAL APPLICATIONS

查询"LME49720"供应商

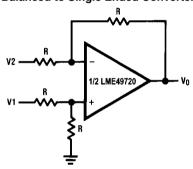


NAB Preamp Voltage Gain vs Frequency

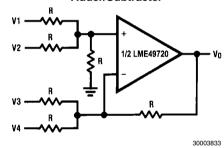


 $A_V = 34.5$ F = 1 kHz $E_n = 0.38 \text{ }\mu\text{V}$ A Weighted

Balanced to Single Ended Converter



Adder/Subtracter

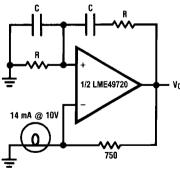


 $V_0 = V1 + V2 - V3 - V4$

 $V_0 = V1 - V2$

Sine Wave Oscillator

30003832



30003834

$$f_0 = \frac{1}{2\pi RC}$$

Second Order High Pass Filter 查询"LME49720"供应(**p**utterworth)

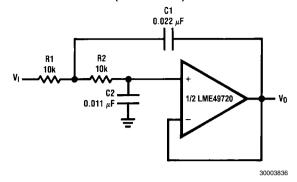
R1 11k C1 0.01 µF 0.01 µF 1/2 LME49720 V0 30003835

if C1 = C2 = C

$$R1 = \frac{\sqrt{2}}{2w-C}$$

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

Second Order Low Pass Filter (Butterworth)



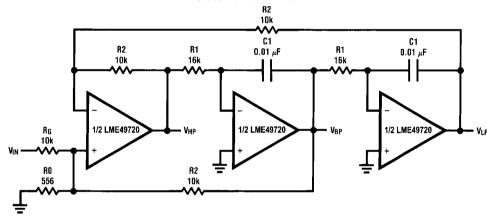
if R1 = R2 = R

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

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

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

State Variable Filter

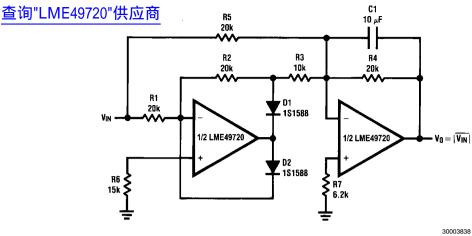


30003837

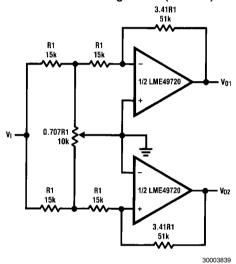
$$f_0 = \frac{1}{2\pi C1 R1}, Q = \frac{1}{2} \left(1 + \frac{R2}{R0} + \frac{R2}{RG} \right), A_{BP} = QA_{LP} = QA_{LH} = \frac{R2}{RG}$$

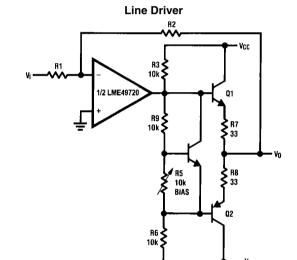
Illustration is $f_0 = 1 \text{ kHz}$, Q = 10, $A_{BP} = 1$

AC/DC Converter



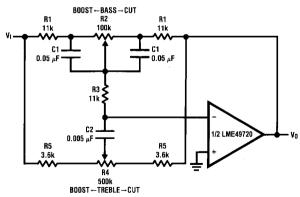
2 Channel Panning Circuit (Pan Pot)





30003840

Tone Control

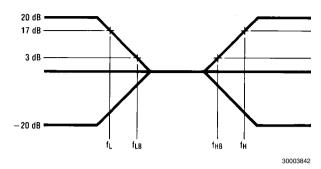


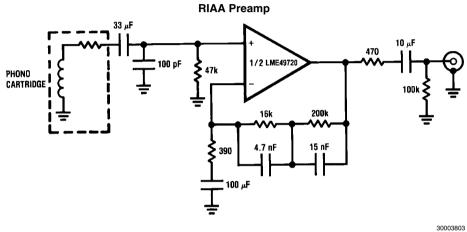
300038p0

$$\begin{split} f_L &= \frac{1}{2\pi R2C1}, f_{LB} = \frac{1}{2\pi R1C1} \\ f_H &= \frac{1}{2\pi R5C2}, f_{HB} = \frac{1}{2\pi (R1 + R5 + 2R3)C2} \end{split}$$

Illustration is:

查询"Lifter497270"供应商





 $A_{v} = 35 \text{ dB}$

 $E_n^{\nu} = 0.33 \, \mu V$

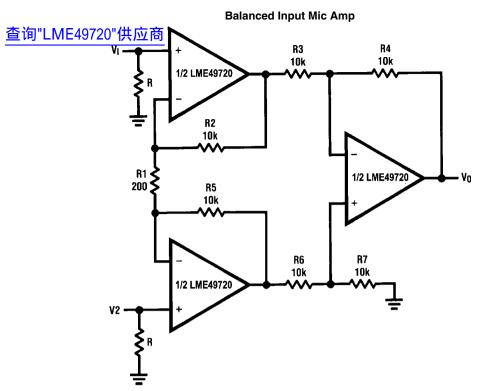
S/N = 90 dB

f = 1 kHz

A Weighted

A Weighted, $V_{IN} = 10 \text{ mV}$

@f = 1 kHz



30003843

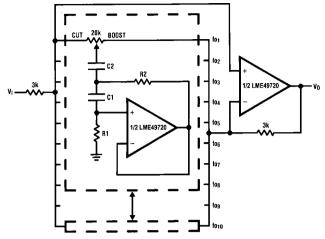
If R2 = R5, R3 = R6, R4 = R7

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

Illustration is: V0 = 101(V2 - V1)

查询"LME49720"供应商

10 Band Graphic Equalizer



30003844

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

Note 9: At volume of change = $\pm 12 \text{ dB}$

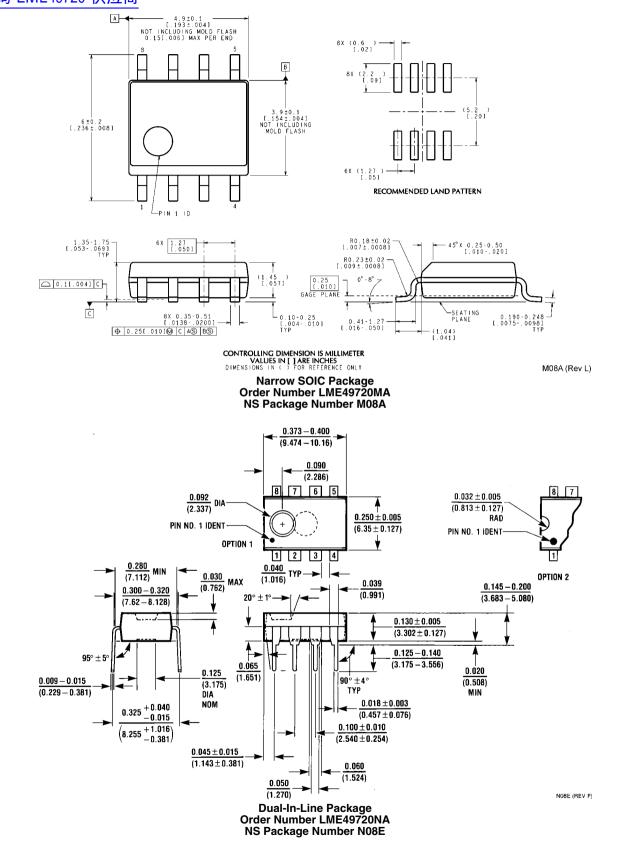
Q = 1.7

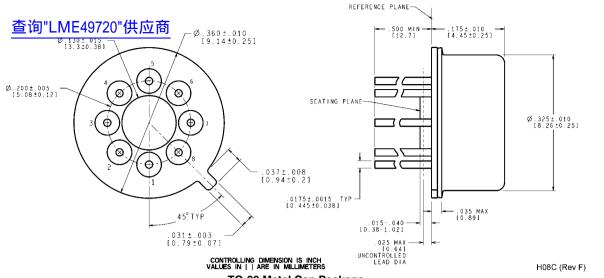
Reference: "AUDIO/RADIO HANDBOOK", National Semiconductor, 1980, Page 2-61

Revision History 查询"LME49720"供应商

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.		

Physical Dimensions inches (millimeters) unless otherwise noted 查询"LME49720"供应商





TO-99 Metal Can Package Order Number LME49720HA NS Package Number H08C

≦询"LME49720"供应商

Notes

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

Life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

National Semiconductor and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright@ 2007 National Semiconductor Corporation

For the most current product information visit us at www.national.com



National Semiconductor **Americas Customer** Support Center Email: new.feedback@nsc.com Tel: 1-800-272-9959

National Semiconductor Europe Customer Support Center Fax: +49 (0) 180-530-85-86 Email: europe.support@nsc.com Deutsch Tel: +49 (0) 69 9508 6208 English Tel: +49 (0) 870 24 0 2171 Français Tel: +33 (0) 1 41 91 8790 National Semiconductor Asia Pacific Customer Support Center Email: ap.support@nsc.com

National Semiconductor Japan Customer Support Center Fax: 81-3-5639-7507 Email: jpn.feedback@nsc.com Tel: 81-3-5639-7560