National Semiconductor

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 (2.7nV/$\sqrt{Hz}$) 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 ±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 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 ($A_V = 1$, $V_{OUT} = 3V_{RMS}$, $f_{IN} = 1kHz$)
  - $R_L = 2k\Omega$ 0.00003% (typ)
  - $R_L = 600\Omega$ 0.00003% (typ)
- Input Noise Density 2.7nV/$\sqrt{Hz}$ (typ)
- Slew Rate ±20V/µs (typ)
- Gain Bandwidth Product 55MHz (typ)
- Open Loop Gain ($R_L = 600\Omega$) 140dB (typ)
- Input Bias Current 10nA (typ)
- Input Offset Voltage 0.1mV (typ)
- DC Gain Linearity Error 0.000009%

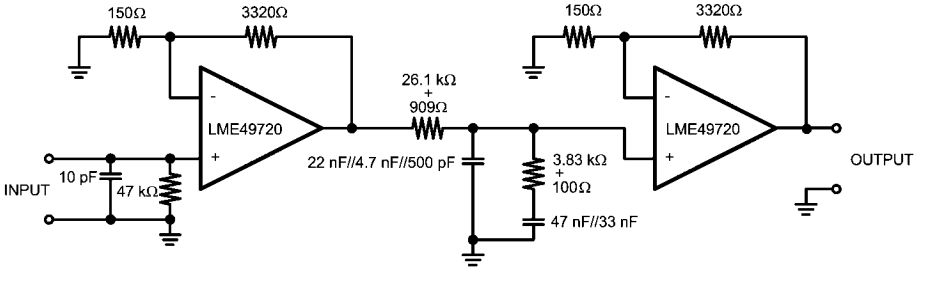
Features

- 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

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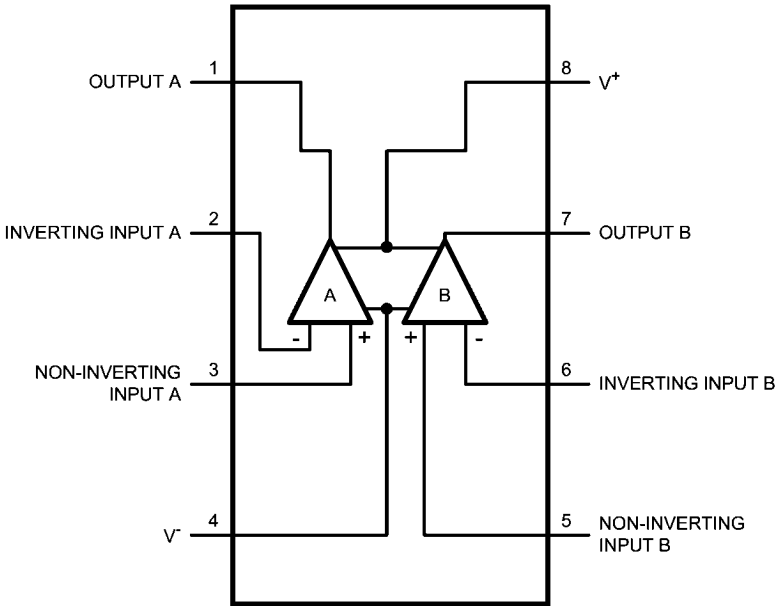
Passively Equalized RIAA Phono Preamplifier

Connection Diagrams

Dual-In-Line Package



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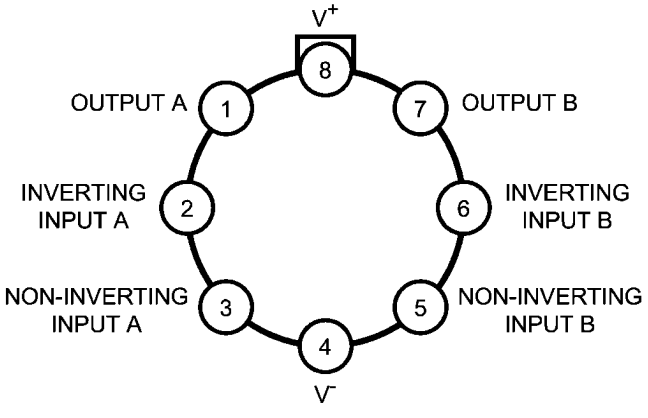
Order Number LME49720MA
See NS Package Number — M08A
Order Number LME49720NA
See NS Package Number — N08E

Metal Can



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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.

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 (Note 3)	Continuous
Power Dissipation	Internally Limited
ESD Susceptibility (Note 4)	2000V
ESD Susceptibility (Note 5)	
Pins 1, 4, 7 and 8	200V
Pins 2, 3, 5 and 6	100V
Junction Temperature	150°C
Thermal Resistance	
θ_{JA} (SO)	145°C/W
θ_{JA} (NA)	102°C/W
θ_{JA} (HA)	150°C/W
θ_{JC} (HA)	35°C/W
Temperature Range	
$T_{MIN} \le T_A \le T_{MAX}$	$-40°C \le T_A \le 85°C$
Supply Voltage Range	$\pm 2.5V \le V_S \le \pm 17V$

Electrical Characteristics for the LME49720 (Notes 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 (Note 6)	Limit (Note 7)	
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)
$\Delta V_{OS}/\Delta Temp$	Average Input Offset Voltage Drift vs Temperature	$-40°C \le T_A \le 85°C$	0.2		µV/°C
PSRR	Average Input Offset Voltage Shift vs Power Supply Voltage	$\Delta V_S = 20V$ (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)
$\Delta I_{OS}/\Delta Temp$	Input Bias Current Drift vs Temperature	$-40°C \le T_A \le 85°C$	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

Symbol	Parameter	Conditions	LME49720		Units (Limits)
			Typical	Limit	
			(Note 6)	(Note 7)	
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)

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 1.5kΩ resistor.

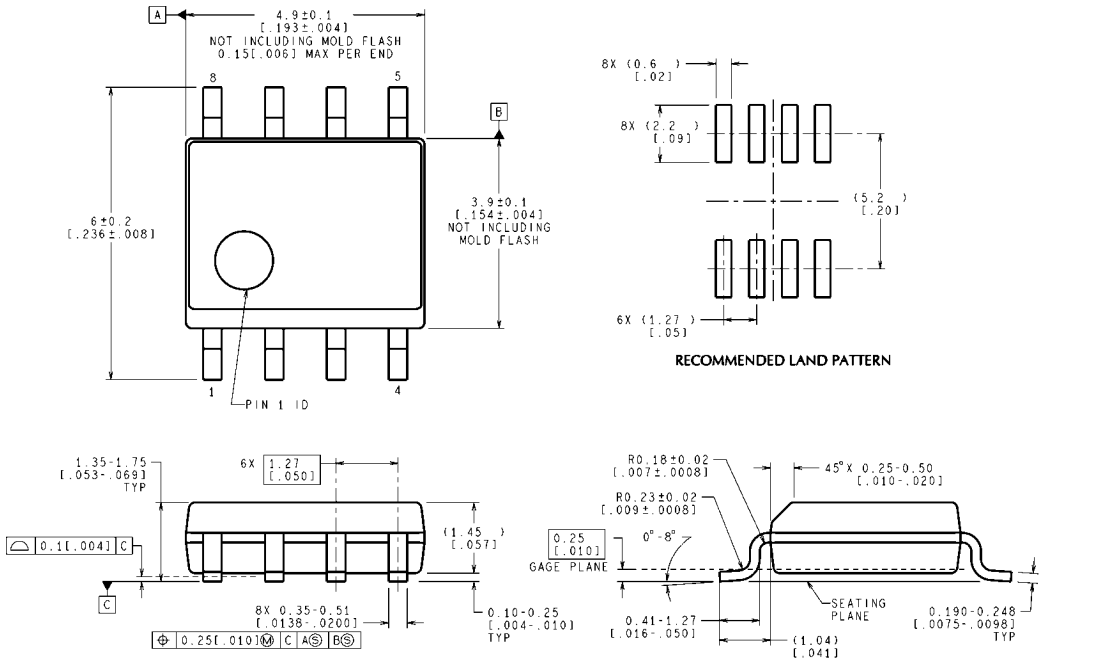
Note 5: Machine Model ESD test is covered by specification EIAJ IC-121-1981. A 200pF cap is charged to the specified voltage and then discharged directly into the IC with no external series resistor (resistance of discharge path must be under 50Ω).

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

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

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

Physical Dimensions inches (millimeters) unless otherwise noted



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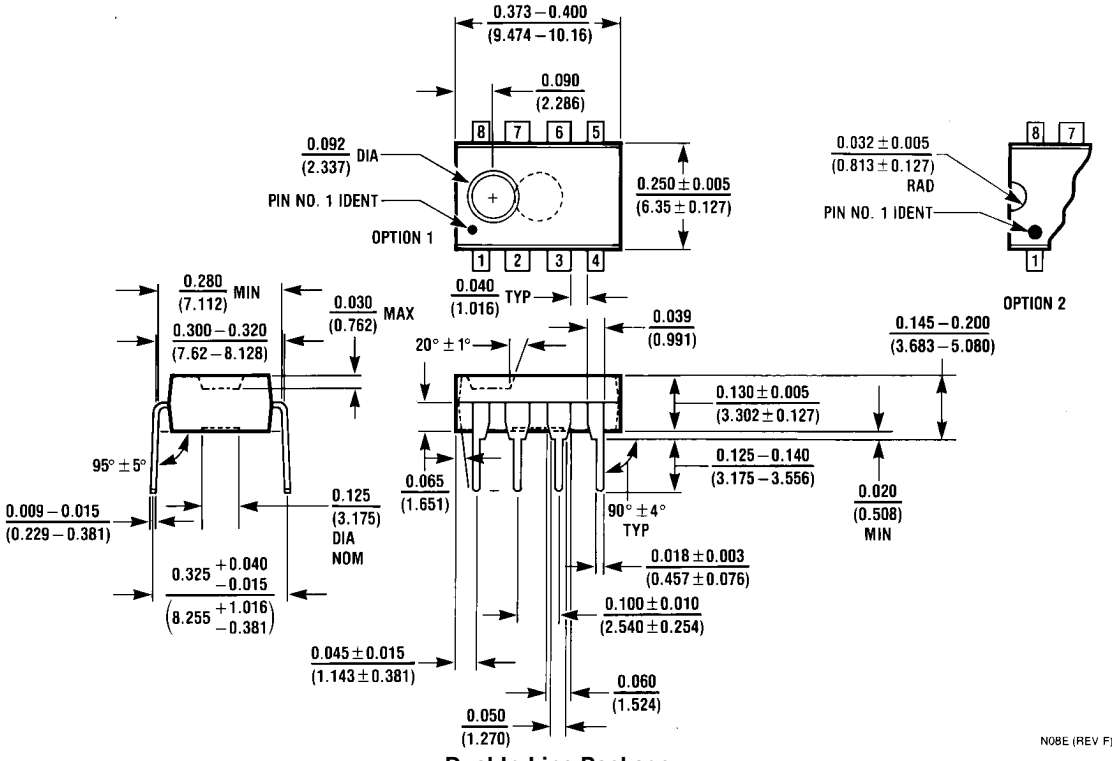
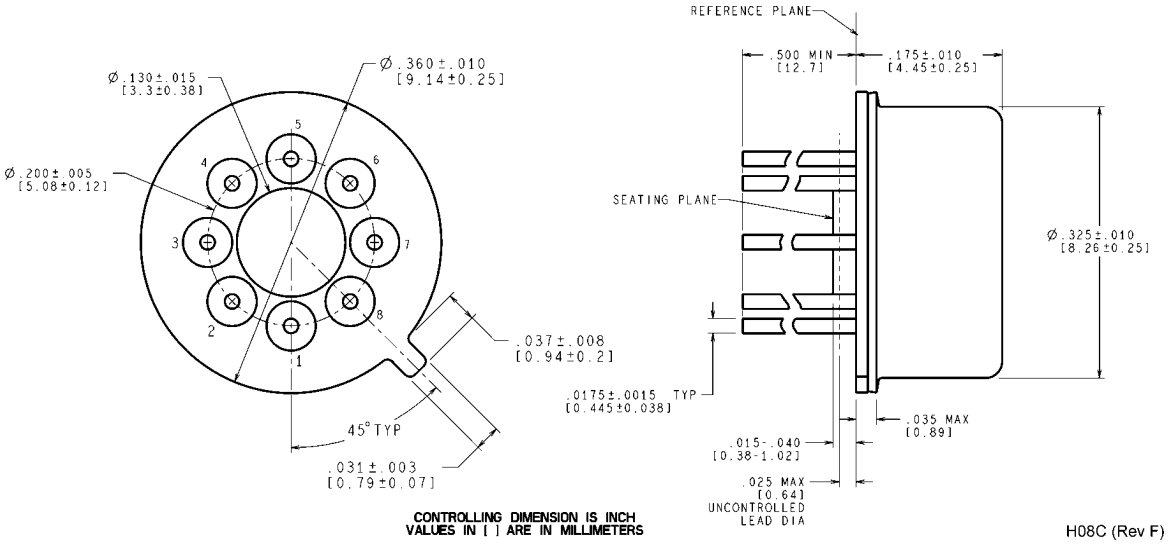
M08A (Rev L)

Narrow SOIC Package
Order Number LME49720MA
NS Package Number M08A



N08E (REV F)

Dual-In-Line Package
Order Number LME49720NA
NS Package Number N08E



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H08C (Rev F)

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