# Low Current Quad Inverting Amplifiers

LX509 - DATA SHEET

## **FEATURES**

- 210 µA typical current drain
- · 4 inverting opamps; B with 6 dB greater drive current
- · minimum 46 dB open loop gain
- · ideal for active filtering
  - dual channel hearing aids
  - mixers
  - microphone / telecoil preamps

#### STANDARD PACKAGING

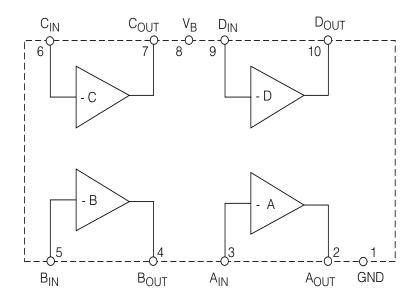
- 10 pin PLID®
- 10 pin SLT
- Chip (61 x 55 mils)

Au Bump

#### **DESCRIPTION**

The LX509 consists of 4 independent low noise, low current inverting operational amplifiers utilizing Gennum's low voltage bipolar JFET technology. Each amplifier has a minimum open loop gain of 46 dB with the closed loop gain set by the ratio of a feedback (R $_{\rm F}$ ) resistor to the source impedance (R $_{\rm S}$ ). For a well controlled gain tolerance from amplifier to amplifier, it is recommended that the closed loop gain is at least 20 dB below the open loop gain.

Three of the preamplifiers, A, C and D are capable of delivering typically 30  $\mu$ A of peak current drive while the fourth preamplifier B has 6 dB more current drive capability, allowing a 6 dB greater output into the same load impedance, or the same output level into one half the load impedance.



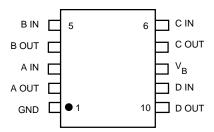
**BLOCK DIAGRAM** 

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#### ABSOLUTE MAXIMUM RATINGS

CAUTION CLASS 1 ESD SENSITIVITY	6.4		
Storage Temperature	-20° to +70°C		
Operating Temperature	-10° to +40°C		
Supply Voltage	5V DC		
PARAMETER	VALUE / UNITS		

# **PIN CONNECTION**



## **ELECTRICAL CHARACTERISTICS**

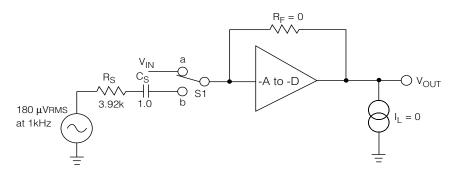
 $\rm V_{OUT}$  Pin voltage measured with conditions as shown in Test Circuit Positive Current corresponds to current INTO the pin Negative Current corresponds to current OUT of the pin

Conditions: Frequency = 1 kHz, Temperature =  $25^{\circ}$ C, Supply Voltage  $V_{B}$  = 1.3 VDC

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Total Current	I <sub>TOT</sub>		115	210	305	μА
Input Bias Voltage	V <sub>BIAS</sub>		500	570	620	mVDC
Input Bias Current	$I_{BIAS}$	$R_F = 1 M\Omega$	-50	0	50	nA
Output Voltage Swing - Hi	V <sub>OH</sub>	$V_{IN} = 0.4 \text{ VDC}, R_F = \infty$ $I_L = -10 \mu\text{A}, \text{ (Note 1)}$	200	580	-	mVDC
Output Voltage Swing - Lo	V <sub>OL</sub>	$I_{IN} = +1 \mu A, R_F = \infty$ $I_L = +10 \mu A, \text{ (Note 2)}$	200	280	-	mVDC
Open Loop Voltage Gain	A <sub>VOL</sub>		46	56	-	dB
Input Referred Noise	IRN	NFB 0.2 to 10kHz at 12dB/Oct	-	1	-	μVRMS
Harmonic Distortion	THD		-	1	-	%
Current Drive		A, C, D,	-	30	-	μА
Capability		В	-	60	-	μА

All Parameters and Switches remain as shown in Test Circuit unless otherwise stated in "Conditions" Column

Notes: 1  $V_{OH} = V_{OUT} - V_{OUT}$  ( $I_L = -10 \, \mu A$  for Blocks A, C, D,  $I_L = -20 \, \mu A$  for Block B) 2  $V_{OL} = V_{OUT} - V_{OUT}$  ( $I_L = +10 \, \mu A$  for Blocks A, C, D,  $I_L = +20 \, \mu A$  for Block B)



All resistors in ohms, all capacitors in  $\mu\text{F}$  unless otherwise stated

Fig. 1 LX509 Test Circuit

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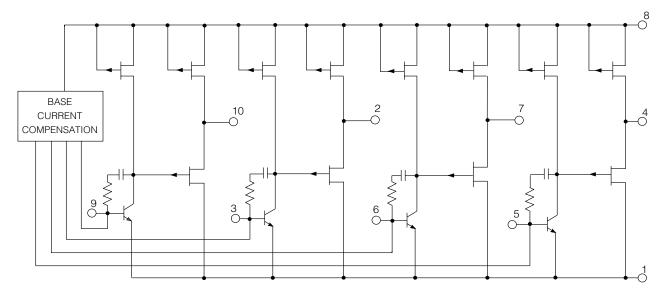


Fig. 2 Functional Schematic

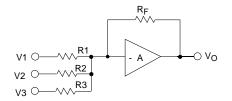
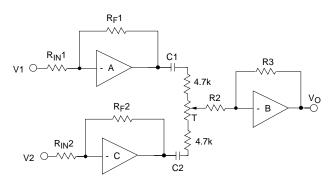
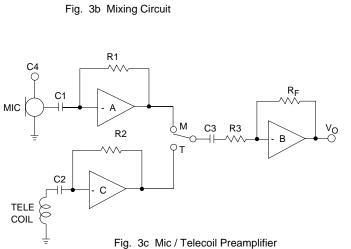


Fig. 3a Summing Amplifier





C11 R12 C10 R10 C1 C1 ₹R2 High Pass C2 R11 R5 V<sub>O</sub> - B V2 C4 R3 C9 R9 C3 - C **≩** R4 Band Pass R1 C5 V3 C7 R6 ○—|->>>> - D  $\frac{\bar{1}}{T}$ C6 Low Pass

Fig. 3d Multi-Band Filtering

(for Filter Design refer to Note 600-9, Active Filtering for Hearing Aids) All resistors in ohms, all capacitors in  $\mu\text{F}$  unless otherwise stated

Fig. 3 LX509 Application Circuits

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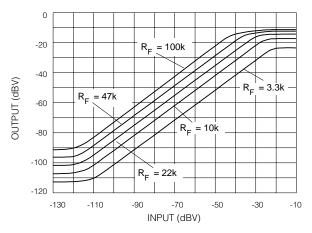


Fig. 4 I/O Characteristics for Various  $R_F$  Values

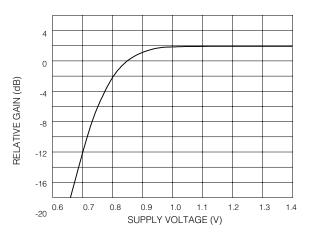


Fig. 6 Gain vs Supply Voltage

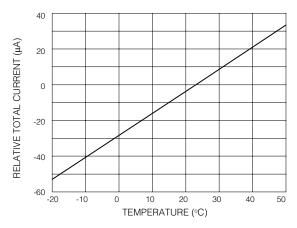


Fig.8 Total Current vs Temperature

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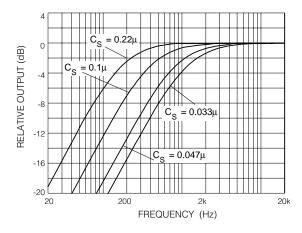


Fig. 5 Closed Loop Frequency Response for Various  $C_S$  Values

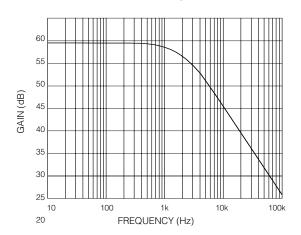


Fig. 7 Preamplifier Open Loop Frequency Response

#### **DOCUMENT IDENTIFICATION:** DATA SHEET

The product is in production. Gennum reserves the right to make changes at any time to improve reliability, function or design, in order to provide the best product possible.

#### **REVISION NOTES:**

Changes to standard packaging information.