GX8009 1 GHz、5500 V/µs Low Distortion Amplifier

FEATURES

- Ultrahigh Speed:
  - 5,500 V/µs Slew Rate, 4 V Step, G = +2
  - 545 ps Rise Time, 2 V Step, G = +2
  - Large Signal Bandwidth:
    - 440 MHz, G = +2
    - 320 MHz, G = +10
  - Small Signal Bandwidth (–3 dB):
    - 1 GHz, G = +1
    - 700 MHz, G = +2
  - Settling Time 10 ns to 0.1%, 2 V Step, G = +2
- Low Distortion over Wide Bandwidth
  - SFDR:
    - –75 dBc @ 10 MHz, Second Harmonic
    - –88 dBc @ 10 MHz, Third Harmonic
    - –71 dBc @ 70 MHz, Second Harmonic
    - –69 dBc @70 MHz, Third Harmonic
- Good Video Specifications
  - Gain Flatness 0.1 dB to 75 MHz
  - 0.01% Differential Gain Error, $R_L = 150\Omega$
  - 0.01°Differential Phase Error, $R_L = 150\Omega$
- High Output Drive:
  - 175 mA Output Load Drive Current
  - 10 dBm with –38 dBc SFDR @ 70 MHz, G = +10
- Supply Operation:
  - +5 V to -5 V Voltage Supply
  - 20 mA (typ) Supply Current

APPLICATIONS

- Pulse Amplifier
- IF/RF Gain Stage/Amplifiers
- High Resolution Video Graphics
- High Speed Instrumentations
- CCD Imaging Amplifier

FUNCTIONAL BLOCK DIAGRAM

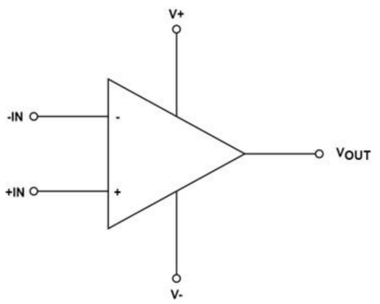

Figure 1. Functional block diagram

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PRODUCT DESCRIPTION

The GX8009 is an ultrahigh speed current feedback amplifier with a phenomenal 5,500 V/µs slew rate that results in a rise time of 545 ps, making it ideal as a pulse amplifier.

The high slew rate reduces the effect of slew rate limiting and results in the large signal bandwidth of 440 MHz required for high resolution video graphic systems. Signal quality is maintained over a wide bandwidth with worst-case distortion of –40 dBc @ 250 MHz (G = +10, 1 V p-p).

The GX8009 is capable of delivering over 175 mA of load current and will drive four back terminated video loads while maintaining low differential gain and phase error of 0.02% and 0.04°, respectively. The high drive capability is also reflected in the ability to deliver 10 dBm of output power @ 70 MHz with –38 dBc SFDR.

The GX8009 is available in a small SOIC-8 and an SOT23-5, and will operate over the temperature range –40°C to +85°C.

SPECIFICATIONS

Electrical Specifications

T_A = 25°C, V_S = ±5 V, R_L = 100Ω; R_F = 301Ω for G = +1, +2, R_F = 200Ω for G = +10; unless otherwise noted.

Model	Conditions	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
–3 dB Small Signal Bandwidth V_O = 0.2 V p-p	G=+1,R_F=301Ω		1000		MHz
	G=+2	480	700		MHz
	G=+10	300	350		MHz
Large Signal Bandwidth， V_O = 2 V p-p	G=+2	390	440		MHz
	G=+10	235	320		MHz
Gain Flatness 0.1 dB ， V_O = 0.2 V p-p	G=+2,R_L=150Ω	44.6	108.2		MHz
Slew Rate	G=+2,R_L=150Ω,4V Step	4200	5500	6700	V/μs
Settling Time to 0.1%	G=+2,R_L=150Ω,2V Step		10		ns
	G=+10,2V Step		25		ns
Rise and Fall Time	G=+2,R_L=150Ω,4V Step		0.526		ns
HARMONIC/NOISE PERFORMANCE					
Second Harmonic G=+2， V_O = 2 V p-p	1 kHz		-97		dBc
	10 MHz		-75		dBc
	70 MHz		-71		dBc
Third Harmonic	1 kHz		-103		dBc
	10 MHz		-88		dBc
	70 MHz		-69		dBc
Input Voltage Noise	f=10 MHz		1.0		nV/√Hz
Input Current Noise	f=10 MHz, +In		55		pA/√Hz
	-In		51		pA/√Hz
Differential Gain Error	NTSC, G=+2, R_L=150Ω		0.01	0.03	%
	R_L=37.5Ω		0.02	0005	%
Differential Phase Error	NTSC, G=+2, R_L=150Ω		0.01	0.03	°
	R_L=37.5Ω		0.04	0.08	°
DC PERFORMANCE					
Input Offset Voltage			1	3	mV
	T_{MIN} 至 T_{MAX}			5	mV
Offset Voltage Drift			4		μV/°C
Negative Input Bias Current			50	150	±μA
	T_{MIN} 至 T_{MAX}		75		±μA
Positive Input Bias Voltage			28	150	±μA
	T_{MIN} to T_{MAX}		75		±μA

Model	Conditions	Min	Typ	Max	Unit
Open-Loop Transresistance		90	250		kΩ
	T_{MIN} to T_{MAX}		170		kΩ
INPUT CHARACTERISTICS					
Input Resistance	Positive Input		80		kΩ
	Negative Input		8		Ω
Input Capacitance	Positive Input		2.6		pF
Input Common-Mode Voltage Range			3.8		±V
Common-Mode Rejection Ratio	V_{CM} = 2.5V		45		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing		±3.7	±3.8		V
Output Current	R_L = 10 Ω, PD Package = 0.7 W	150	175		mA
Short-Circuit Current			330		mA
POWER SUPPLY					
Operating Range		±4.5	±5	±6	V
Quiescent Current			20		mA
	T_{MIN} to T_{MAX}			35	mA
Power Supply Rejection Ratio	V_S=4V to 6V	64	70		dB

ABSOLUTE MAXIMUM RATINGS

Supply Voltage……………………………………………12.6V

Internal Power Dissipation[1]……………………………………………0.75W

Input Voltage (Common-Mode) ……………………………………………±VS

Differential Input Voltage……………………………………………±3.5V

Storage Temperature Range……………………………………………–65°C to +150°C

Operating Temperature Range ……………………………………………-40°C to 85°C

Lead Temperature Range……………………………………………300°C

NOTES:

1. Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

2. Specification is for device in free air:

   8-Lead SOIC Package: θ_{JA} = 155°C/W.

ESD CAUTION

This product is an electrostatic sensitive device. Therefore, proper ESD precaution measures should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTIONS

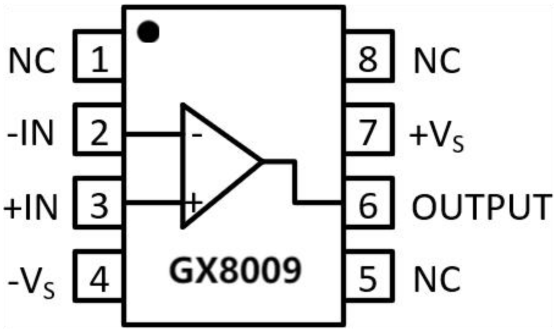


Figure 2 SOIC-8 Pin configuration

NO.	NAME	TYPE	DESCRIPTION
2	-IN	AI	Negative input
3	+IN	AI	Positive input
4	$-V_S$	P	Negative voltage supply
6	OUTPUT	AO	Output
7	$+V_S$	P	Positive voltage supply

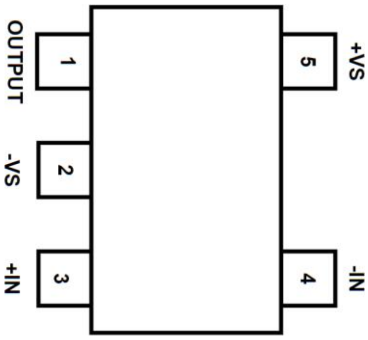


Figure 3 SOT23-5 configuration

NO.	NAME	TYPE	DESCRIPTION
1	OUTPUT	AO	Output
2	$-V_S$	P	Negative voltage supply
3	+IN	AI	Positive input
4	-IN	AI	Negative input
5	$+V_S$	P	Positive voltage supply

APPLICATIONS

Parasitic Capacitance of Negative Input

All current feedback op amps are sensitive to the parasitic capacitance at the negative input. The parasitic capacitance on the negative input can seriously affect stability and should be minimized for wideband applications, see PCB Layout Considerations.

Feedback Resistor Selection

As mentioned before, the parasitic capacitance at the negative input can seriously affect stability. The larger the parasitic capacitance at the negative input, the larger the feedback resistor (RF) is needed to reduce the bandwidth and ensure loop stability. However, a larger RF will not only cause the bandwidth to decrease, but also increase the output misalignment, which is the product of the negative input bias current and RF. The gain varies to some extent with the feedback resistor deviation. Therefore, a resistance accuracy of 1% or less is recommended if flatness is to be maintained in a production batch.

Gain Resistor Selection

According to the requirements of bandwidth and output misalignment, confirm the value of the feedback resistor as described in the previous section, and then calculate the resistance ratio based on the gain to confirm the resistance value of the gain resistor.

The gain varies to a certain extent with the deviation of the feedback resistor. Therefore, it is recommended that the resistance accuracy be within 1% if the flatness is to be maintained in the production lot.

Positive Input Series Resistor Selection

If a series resistance exists at the positive input, the series resistance should be equal to the feedback resistance divided by the gain.

Positive Input Shunt Resistor Selection

High-speed input signals are recommended to be input with a resistor in parallel to ground for impedance matching.

PCB Layout Considerations

As required for broadband amplifiers, PCB parasitic effects can affect closed-loop performance, such as parasitic inductive capacitance at the output and inverting input nodes. If a ground plane is used as the signal alignment on the same side of the board, space (≥5mm) should be left around the signal lines to minimize coupling. In addition, minimize the length of the feedback and gain resistor connections (≤6mm) to prevent instability.

RF Filter Driver

The output drive capability, wide bandwidth, and low distortion of the GX8009 are well suited for creating gain blocks that can drive RF filters. Many of these filters require that the input be driven by a 50 Ω source, while the output must be terminated in 50 Ω for the filters to exhibit their specified frequency response. The GX8009 is set at a gain of +2. The series 50 Ω resistor at the output, along with the 50 Ω termination provided by the filter and its termination, yield an overall unity gain for the measured path.

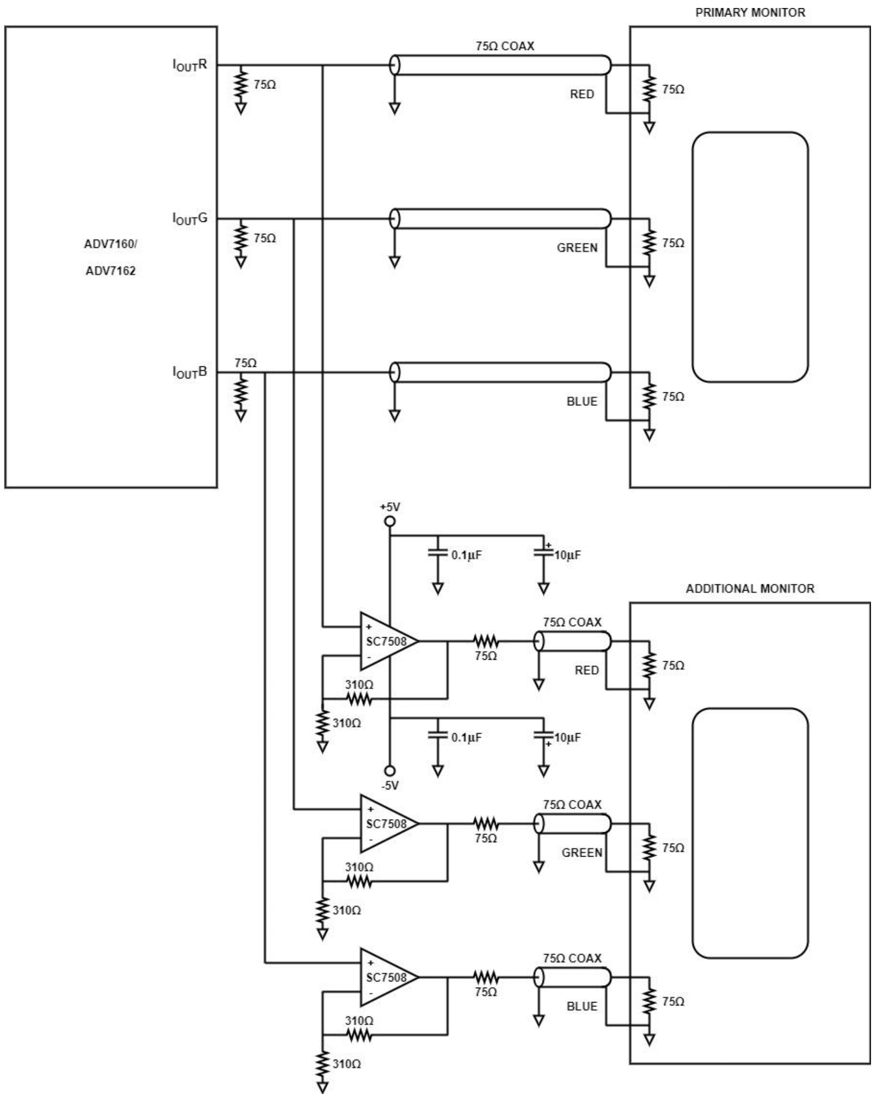


Figure 4. Driving an Additional High Resolution Monitor Using Three GX8009s

Driving a Capacitive Load

A capacitive load, like that presented by some A/D converters, can sometimes be a challenge for an op amp to drive depending on the architecture of the op amp. Most of the problem is caused by the pole created by the output impedance of the op amp and the capacitor that is driven. This creates extra phase shift that can eventually cause the op amp to become unstable.

One way to prevent instability and improve settling time when driving a capacitor is to insert a resistor in series between the op amp output and the capacitor. The feedback resistor is still connected directly to the output of the op amp, while the series resistor provides some isolation of the capacitive load from the op amp output.

Figure 5 shows such a circuit with an GX8009 driving a 50 pF load. With RS = 0, the GX8009 circuit will be unstable. For a gain of +2 and +10, it was found experimentally that setting RS to 42.2 Ω will minimize the 0.1% settling time with a 2 V step at the output. The 0.1% settling time was measured to be 40 ns with this circuit.

For smaller capacitive loads, a smaller RS will yield optimal settling time, while a larger RS will be required for larger capacitive loads. Of course, a larger capacitance will always require more time for settling to a given accuracy than a smaller one, and this will be lengthened by the increase in RS required. At best, a given RC combination will require about seven time constants by itself to settle to 0.1%.

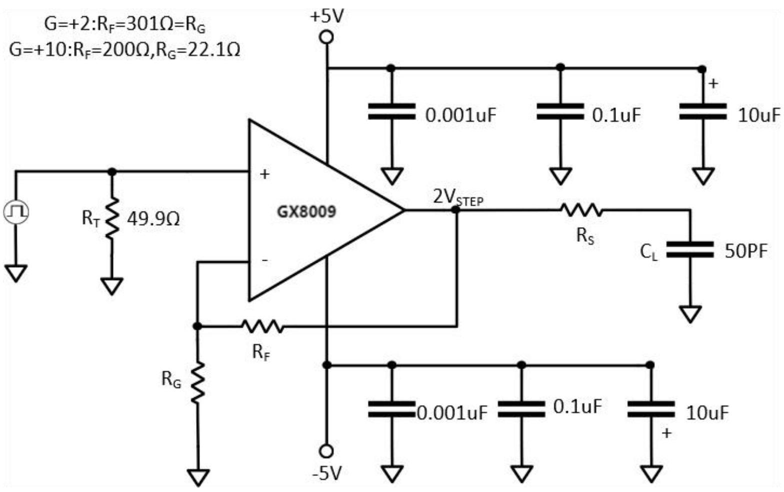
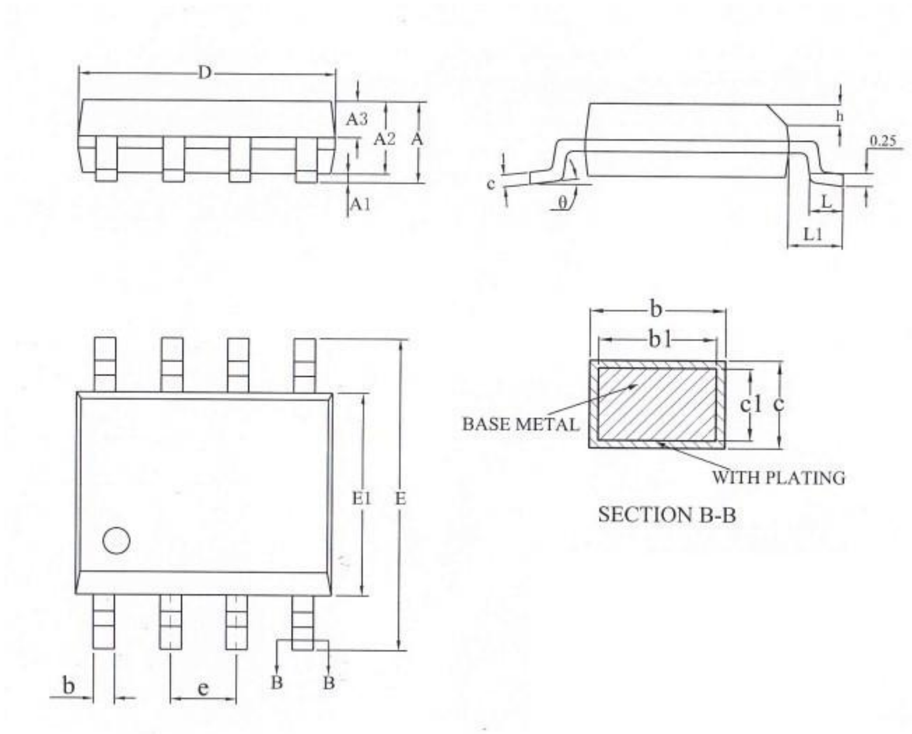


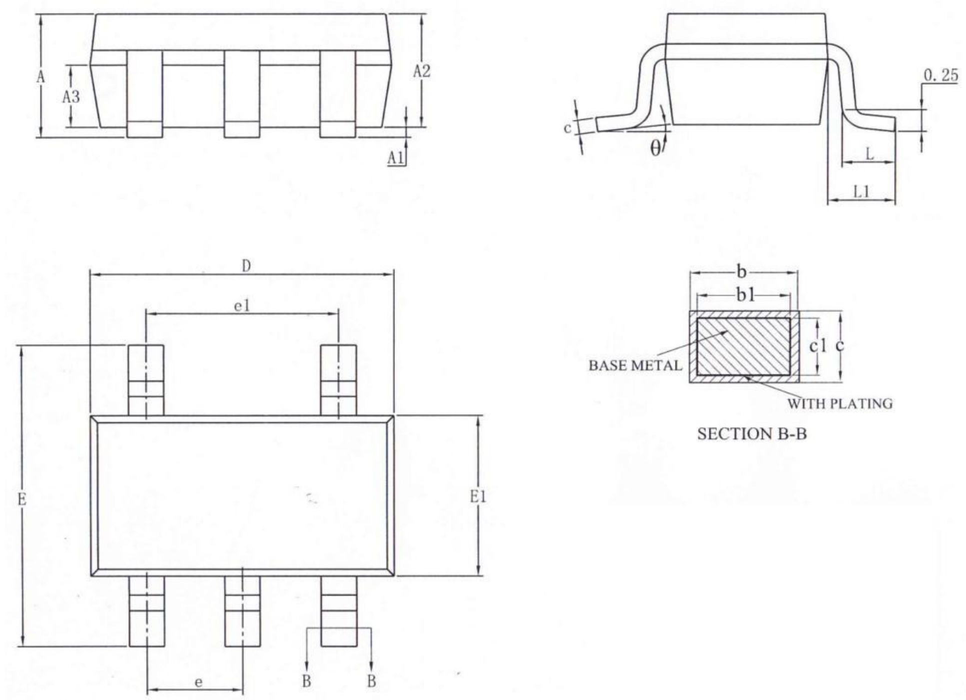
Figure 5. Capacitive Load Drive Circuit

OUTLINE DIMENSIONS



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.75
A1	0.10	—	0.225
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.47
b1	0.38	0.41	0.44
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	—	0.80
L1	1.05REF		
θ	0	—	8°

Figure 6. SOIC-8 Package



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.25
A1	0.04	—	0.10
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.33	—	0.41
b1	0.32	0.35	0.38
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95BSC		
e1	1.90BSC		
L	0.30	—	0.60
L1	0.60REF		
θ	0	—	8°

Figure 7. SOT23-5 Package

ORDERING GUIDE

Material No.	Temperature range	Package
GX8009GAOUMX	-40 ~ 85°C	SOIC-8
GX8009GALUMY	-40 ~ 85°C	SOT23-5

Custom packages are available upon request

Contact Us:
NAME：JESSE
EMAIL:service jesseli@gxschip.com
WECHAT: f40044269
FACEBOOK:GXSC
VK:@id836505054