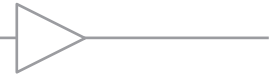


# Comlinear® CLC2023

## Low Distortion, Low Offset, RRIO Amplifier



### FEATURES

- 6mV max input offset voltage
- 0.00005% THD at 1kHz
- 5.3nV/√Hz input voltage noise >10kHz
- -90dB/-85dB HD2/HD3 at 100kHz,  $R_L=100\Omega$
- <-100dB HD2 and HD3 at 10kHz,  $R_L=1k\Omega$
- Rail-to-Rail input and output
- 55MHz unity gain bandwidth
- 12V/μs slew rate
- -40°C to +125°C operating temperature range
- Fully specified at 3V and ±5V supplies
- CLC2023: Pb-free SOIC-8

### APPLICATIONS

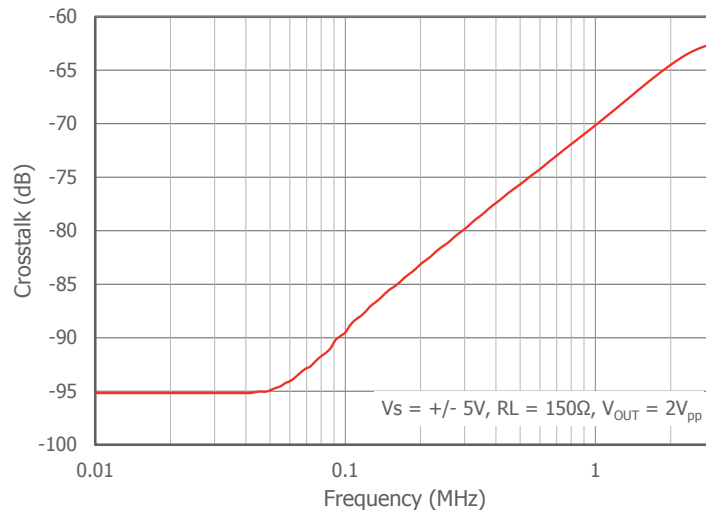
- Active filters
- Sensor interface
- High-speed transducer amp
- Medical instrumentation
- Probe equipment
- Test equipment
- Smoke detectors
- Hand-held analytic instruments

### General Description

The COMLINEAR CLC2023 is a dual channel, high-performance, voltage feedback amplifier with near precision performance, low input voltage noise, and ultra low distortion. The CLC2023 offers 6mV maximum input offset voltage, 3.5nV/√Hz broadband input voltage noise, and 0.00005% THD at 1kHz. It also provides 55MHz gain bandwidth product and 12V/μs slew rate making it well suited for applications requiring precision DC performance and high AC performance. This COMLINEAR high-performance amplifiers also offer a rail-to-rail input and output, simplifying single supply designs and offering larger dynamic range possibilities. The inputs extend beyond the rails by 300mV.

The COMLINEAR CLC2023 is designed to operate from 2.5V to 12V supplies and operate over the extended temperature range of -40°C to +125°.

### Crosstalk vs. Frequency



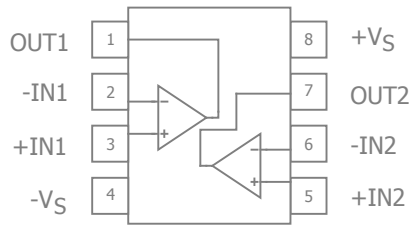
### Ordering Information

Part Number	Package	Pb-Free	RoHS Compliant	Operating Temperature Range	Packaging Method
CLC2023ISO8X	SOIC-8	Yes	Yes	-40°C to +85°C	Reel
CLC2023ASO8X	SOIC-8	Yes	Yes	-40°C to +125°C	Reel
CLC2023IMP8X	MSOP-8	Yes	Yes	-40°C to +85°C	Reel
CLC2023AMP8X	MSOP-8	Yes	Yes	-40°C to +125°C	Reel

Moisture sensitivity level for all parts is MSL-3.



### CLC2023 Pin Configuration



### CLC2023 Pin Configuration

Pin No.	Pin Name	Description
1	OUT1	Output, channel 1
2	-IN1	Negative input, channel 1
3	+IN1	Positive input, channel 1
4	-VS	Negative supply
5	+IN2	Positive input, channel 2
6	-IN2	Negative input, channel 2
7	OUT2	Output, channel 2
8	+VS	Positive supply



## Absolute Maximum Ratings

The safety of the device is not guaranteed when it is operated above the "Absolute Maximum Ratings". The device should not be operated at these "absolute" limits. Adhere to the "Recommended Operating Conditions" for proper device function. The information contained in the Electrical Characteristics tables and Typical Performance plots reflect the operating conditions noted on the tables and plots.

Parameter	Min	Max	Unit
Supply Voltage	0	14	V
Input Voltage Range	$-V_S - 0.5V$	$+V_S + 0.5V$	V

## Reliability Information

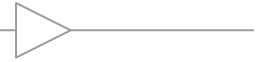
Parameter	Min	Typ	Max	Unit
Junction Temperature			150	°C
Storage Temperature Range	-65		150	°C
Lead Temperature (Soldering, 10s)			260	°C
Package Thermal Resistance				
8-Lead SOIC		100		°C/W
8-Lead MSOP		139		°C/W

Notes:

Package thermal resistance ( $\theta_{JA}$ ), JEDEC standard, multi-layer test boards, still air.

## Recommended Operating Conditions

Parameter	Min	Typ	Max	Unit
Operating Temperature Range (CLC2023I)	-40		+85	°C
Operating Temperature Range (CLC2023A)	-40		+125	°C
Supply Voltage Range	2.5		12	V



## Electrical Characteristics at +3V

$T_A = 25^\circ\text{C}$ ,  $V_S = +3\text{V}$ ,  $R_f = 1\text{k}\Omega$ ,  $R_L = 1\text{k}\Omega$  to  $V_S/2$ ,  $G = 2$ ; unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Frequency Domain Response						
GBWP	-3dB Gain Bandwidth Product	$G = 10$ , $V_{OUT} = 0.05V_{pp}$		31		MHz
UGBW	Unity Gain Bandwidth	$V_{OUT} = 0.05V_{pp}$ , $R_f = 0$		50		MHz
BW <sub>SS</sub>	-3dB Bandwidth	$V_{OUT} = 0.05V_{pp}$		24		MHz
BW <sub>LS</sub>	Large Signal Bandwidth	$V_{OUT} = 2V_{pp}$		3.3		MHz
Time Domain Response						
$t_R$ , $t_F$	Rise and Fall Time	$V_{OUT} = 2\text{V}$ step; (10% to 90%)		150		ns
$t_S$	Settling Time to 0.1%	$V_{OUT} = 2\text{V}$ step		78		ns
OS	Overshoot	$V_{OUT} = 2\text{V}$ step		0.3		%
SR	Slew Rate	2V step		11		V/ $\mu\text{s}$
Distortion/Noise Response						
HD2	2nd Harmonic Distortion	$2V_{pp}$ , 10kHz, $R_L = 1\text{k}\Omega$		-98		dBc
		$2V_{pp}$ , 100kHz, $R_L = 100\Omega$		-85		dBc
HD3	3rd Harmonic Distortion	$2V_{pp}$ , 10kHz, $R_L = 1\text{k}\Omega$		-95		dBc
		$2V_{pp}$ , 100kHz, $R_L = 100\Omega$		-81		dBc
THD	Total Harmonic Distortion	$1V_{pp}$ , 1kHz, $G=1$ , $R_L = 2\text{k}\Omega$		0.0005		%
$e_n$	Input Voltage Noise	> 10kHz		5.5		nV/ $\sqrt{\text{Hz}}$
		> 100kHz		3.9		nV/ $\sqrt{\text{Hz}}$
$X_{TALK}$	Cross Talk	1MHz		70		dB
DC Performance						
$V_{IO}$	Input Offset Voltage			0.088		mV
$dV_{IO}$	Average Drift			1.3		$\mu\text{V}/^\circ\text{C}$
$I_b$	Input Bias Current			-0.340		$\mu\text{A}$
$dI_b$	Average Drift			0.8		nA/ $^\circ\text{C}$
$I_{os}$	Input Offset Current			0.2		nA
PSRR	Power Supply Rejection Ratio	DC		100		dB
$A_{OL}$	Open-Loop Gain	$V_{OUT} = V_S / 2$		104		dB
$I_S$	Supply Current	per channel		1.85		mA
Input Characteristics						
$R_{IN}$	Input Resistance	Non-inverting, $G = 1$		30		M $\Omega$
$C_{IN}$	Input Capacitance			1.1		pF
CMIR	Common Mode Input Range			-0.3 to 3.3		V
CMRR	Common Mode Rejection Ratio	DC, $V_{cm} = 0.5\text{V}$ to $2.5\text{V}$		75		dB
Output Characteristics						
$V_{OUT}$	Output Voltage Swing	$R_L = 150\Omega$		0.085 to 2.80		V
		$R_L = 1\text{k}\Omega$		0.04 to 2.91		V
$I_{OUT}$	Output Current			+57, -47		mA
$I_{SC}$	Short-Circuit Output Current	$V_{OUT} = V_S / 2$		+65, -52		mA

### Notes:

- 100% tested at  $25^\circ\text{C}$



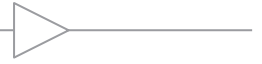
## Electrical Characteristics at $\pm 5V$

$T_A = 25^\circ C$ ,  $V_S = \pm 5V$ ,  $R_f = 1k\Omega$ ,  $R_L = 1k\Omega$  to GND,  $G = 2$ ; unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Frequency Domain Response						
GBWP	-3dB Gain Bandwidth Product	$G = 10$ , $V_{OUT} = 0.05V_{pp}$		35		MHz
UGBW	Unity Gain Bandwidth	$V_{OUT} = 0.05V_{pp}$ , $R_f = 0$		55		MHz
BW <sub>SS</sub>	-3dB Bandwidth	$V_{OUT} = 0.05V_{pp}$		25		MHz
BW <sub>LS</sub>	Large Signal Bandwidth	$V_{OUT} = 2V_{pp}$		3.6		MHz
Time Domain Response						
$t_R$ , $t_F$	Rise and Fall Time	$V_{OUT} = 2V$ step; (10% to 90%)		125		ns
$t_S$	Settling Time to 0.1%	$V_{OUT} = 2V$ step		80		ns
OS	Overshoot	$V_{OUT} = 2V$ step		0.3		%
SR	Slew Rate	4V step		12		V/ $\mu s$
Distortion/Noise Response						
HD2	2nd Harmonic Distortion	$2V_{pp}$ , 10kHz, $R_L = 1k\Omega$		-125		dBc
		$2V_{pp}$ , 100kHz, $R_L = 100\Omega$		-90		dBc
HD3	3rd Harmonic Distortion	$2V_{pp}$ , 10kHz, $R_L = 1k\Omega$		-127		dBc
		$2V_{pp}$ , 100kHz, $R_L = 100\Omega$		-85		dBc
THD	Total Harmonic Distortion	$1V_{pp}$ , 1kHz, $G=1$ , $R_L = 2k\Omega$		0.00005		%
$e_n$	Input Voltage Noise	> 10kHz		5.3		nV/ $\sqrt{Hz}$
		> 100kHz		3.5		nV/ $\sqrt{Hz}$
$X_{TALK}$	Cross Talk	1MHz		70		dB
DC Performance						
$V_{IO}$	Input Offset Voltage <sup>(1)</sup>		-6	0.050	6	mV
$dV_{IO}$	Average Drift			1.3		$\mu V/^\circ C$
$I_b$	Input Bias Current <sup>(1)</sup>		-2.6	-0.30	2.6	$\mu A$
$dI_b$	Average Drift			0.85		nA/ $^\circ C$
$I_{os}$	Input Offset Current <sup>(1)</sup>			0.2	0.7	$\mu A$
PSRR	Power Supply Rejection Ratio <sup>(1)</sup>	DC	82	100		dB
$A_{OL}$	Open-Loop Gain <sup>(1)</sup>	$V_{OUT} = V_S / 2$	95	115		dB
$I_S$	Supply Current <sup>(1)</sup>	per channel		2.2	2.75	mA
Input Characteristics						
$R_{IN}$	Input Resistance	Non-inverting, $G = 1$		30		M $\Omega$
$C_{IN}$	Input Capacitance			1		pF
CMIR	Common Mode Input Range			$\pm 5.3$		V
CMRR	Common Mode Rejection Ratio <sup>(1)</sup>	DC, $V_{cm} = -3V$ to $3V$	70	85		dB
Output Characteristics						
$V_{OUT}$	Output Voltage Swing	$R_L = 150\Omega$		-4.826 to 4.534		V
		$R_L = 1k\Omega$ <sup>(1)</sup>	-4.7	-4.93 to 4.85	4.7	V
$I_{OUT}$	Output Current			+60, -48		mA
$I_{SC}$	Short-Circuit Output Current	$V_{OUT} = V_S / 2$		+65, -52		mA

### Notes:

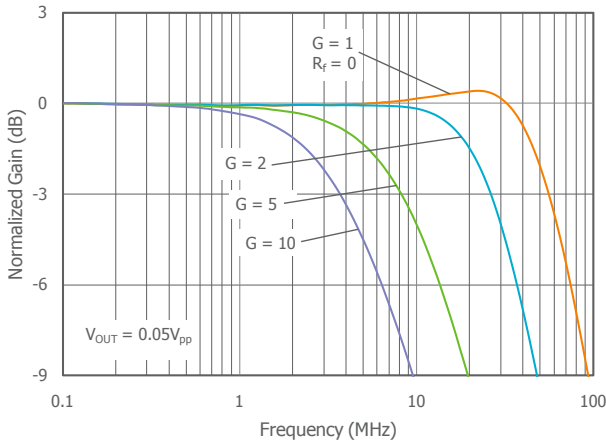
- 100% tested at  $25^\circ C$



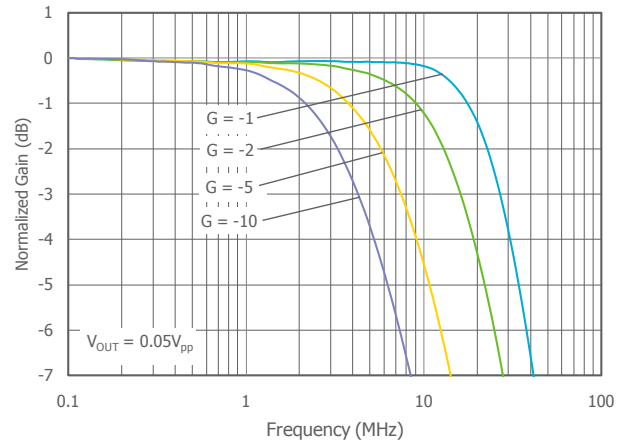
## Typical Performance Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = 1\text{k}\Omega$ ,  $R_L = 1\text{k}\Omega$  to GND,  $G = 2$ ; unless otherwise noted.

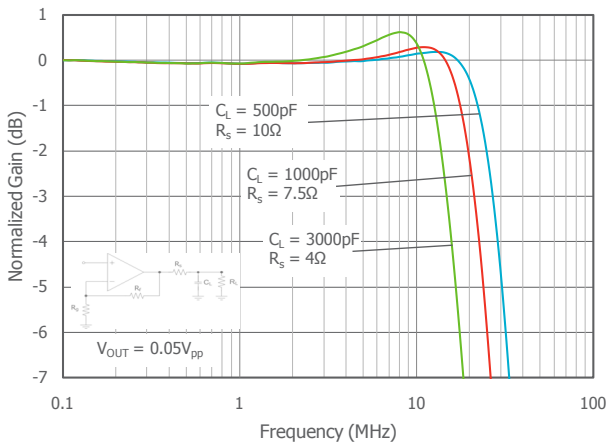
Non-Inverting Frequency Response



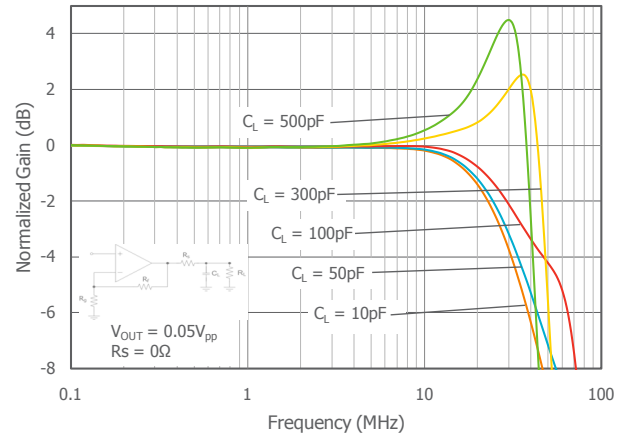
Inverting Frequency Response



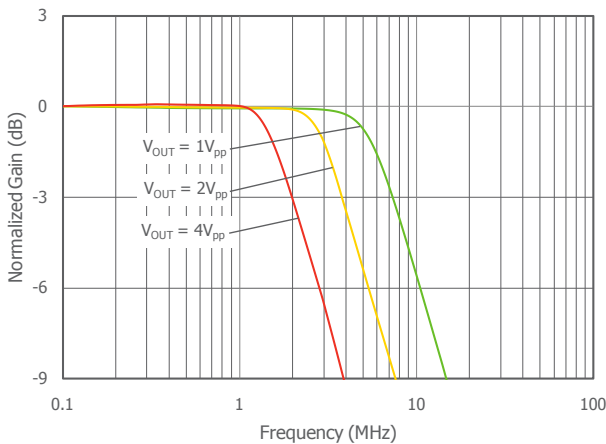
Frequency Response vs.  $C_L$



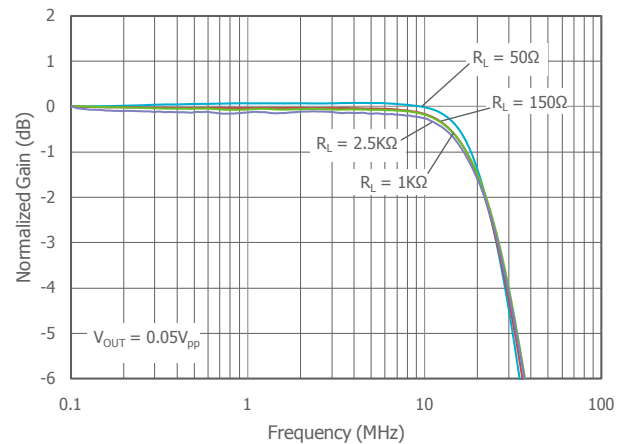
Frequency Response vs.  $C_L$  without  $R_S$



Frequency Response vs.  $V_{OUT}$



Frequency Response vs.  $R_L$

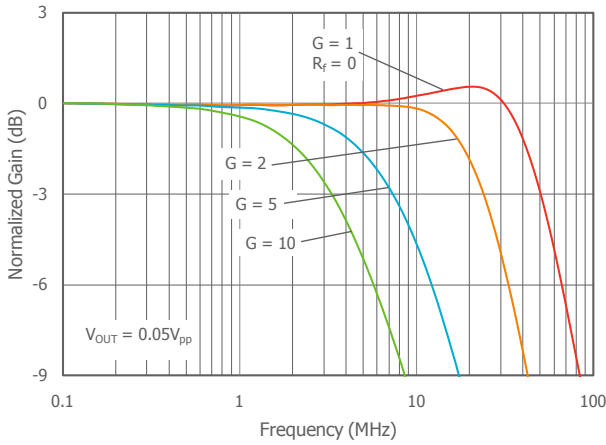




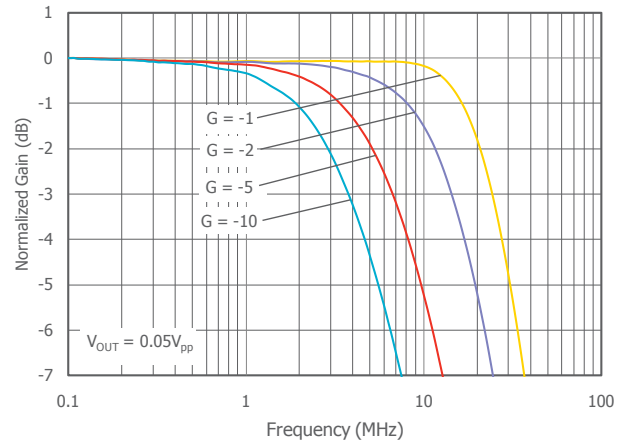
## Typical Performance Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = 1\text{k}\Omega$ ,  $R_L = 1\text{k}\Omega$  to GND,  $G = 2$ ; unless otherwise noted.

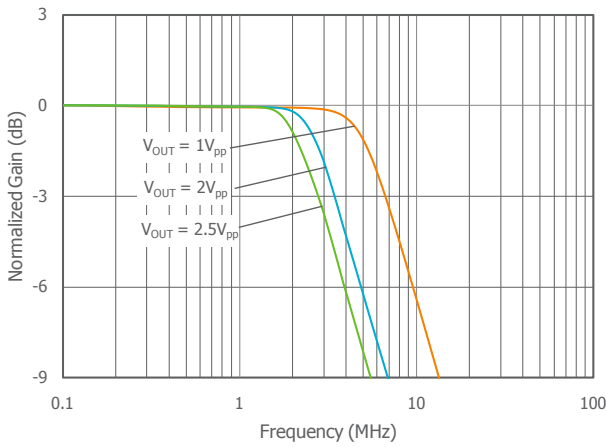
Non-Inverting Frequency Response at  $V_S = 3\text{V}$



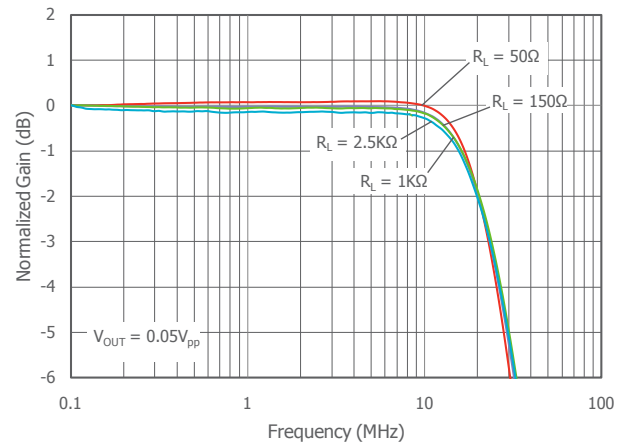
Inverting Frequency Response at  $V_S = 3\text{V}$



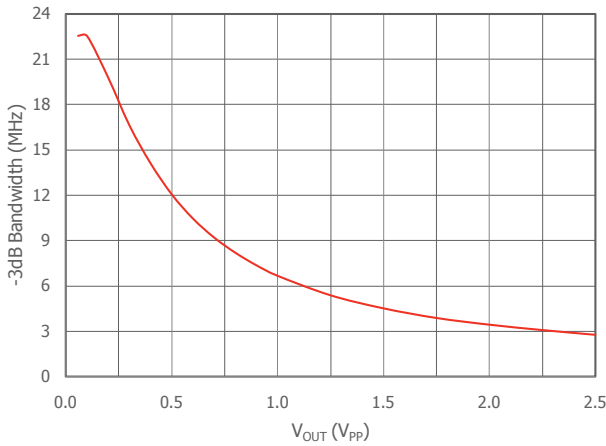
Frequency Response vs.  $V_{OUT}$  at  $V_S = 3\text{V}$



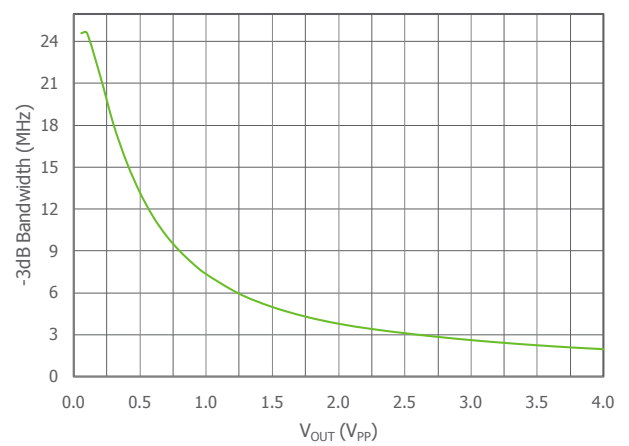
Frequency Response vs.  $R_L$  at  $V_S = 3\text{V}$



-3dB Bandwidth vs. Output Voltage at  $V_S = 3\text{V}$



-3dB Bandwidth vs. Output Voltage

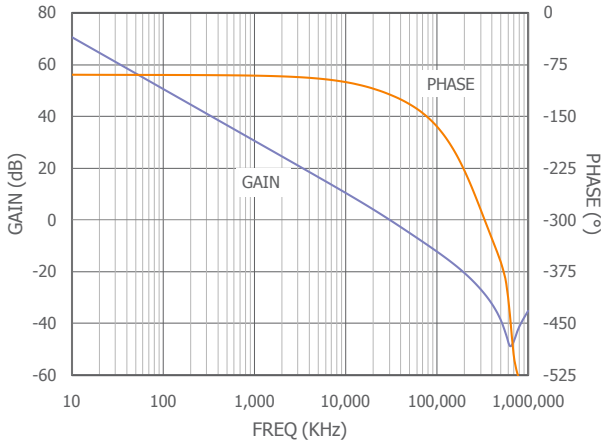




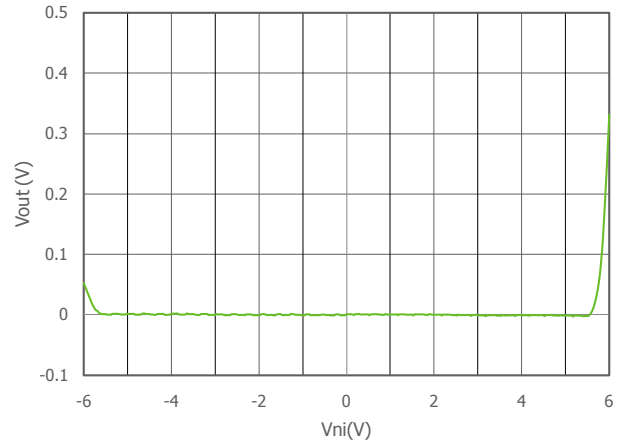
## Typical Performance Characteristics - Continued

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = 1\text{k}\Omega$ ,  $R_L = 1\text{k}\Omega$  to GND,  $G = 2$ ; unless otherwise noted.

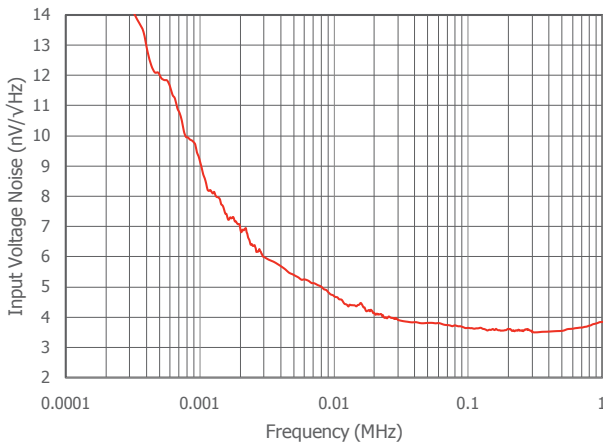
Open Loop Gain and Phase vs. Frequency



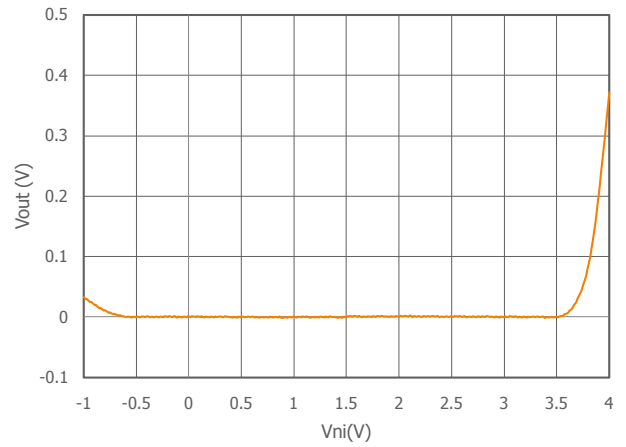
CMIR



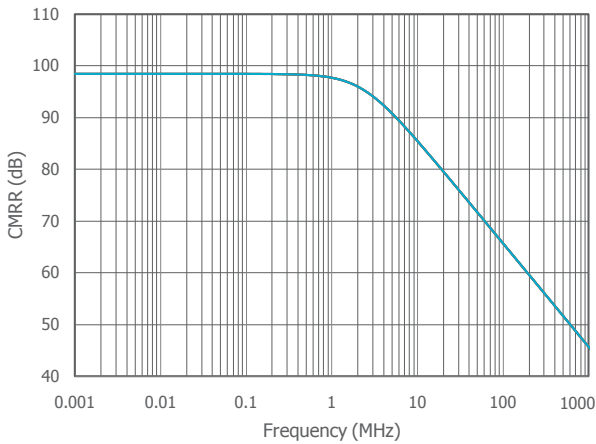
Input Voltage Noise



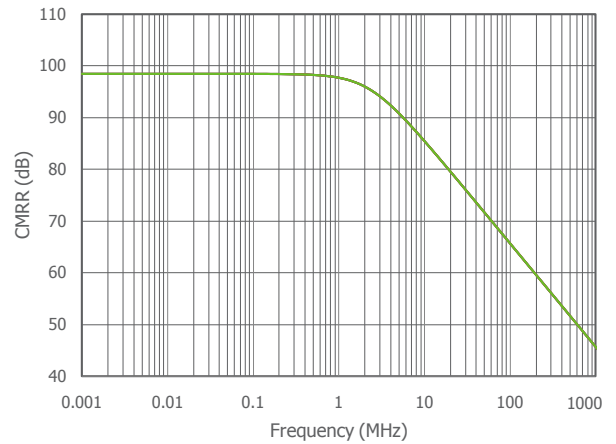
CMIR at  $V_S = 3\text{V}$



CMRR vs. Frequency



PSRR vs. Frequency

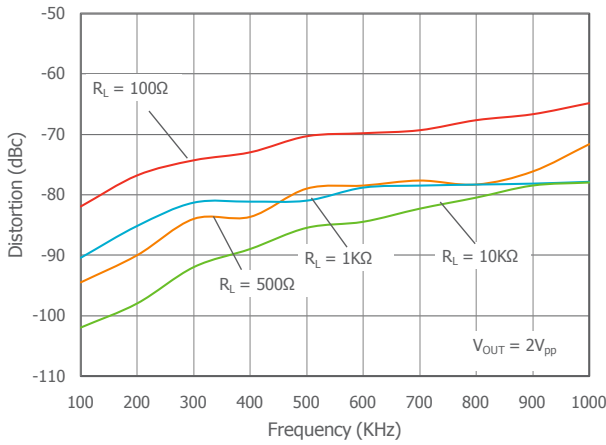




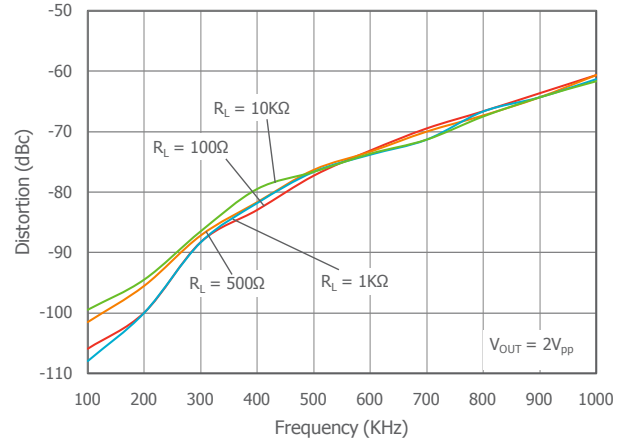
## Typical Performance Characteristics - Continued

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = 1\text{k}\Omega$ ,  $R_L = 1\text{k}\Omega$  to GND,  $G = 2$ ; unless otherwise noted.

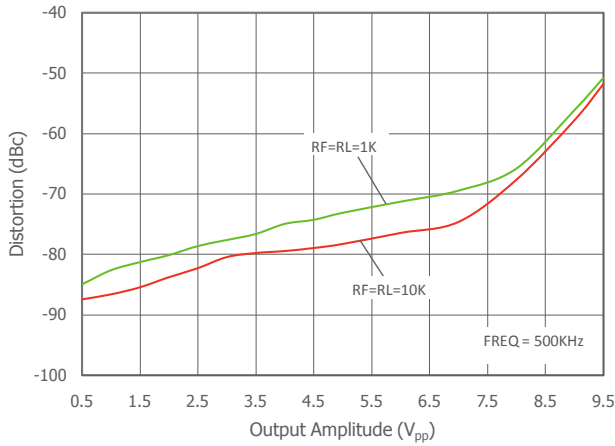
2nd Harmonic Distortion vs.  $R_L$



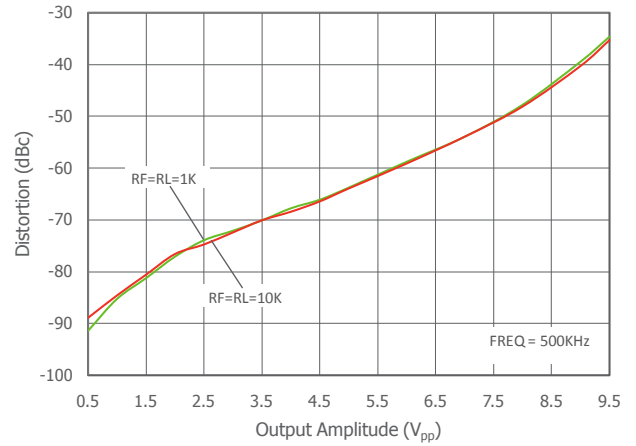
3rd Harmonic Distortion vs.  $R_L$



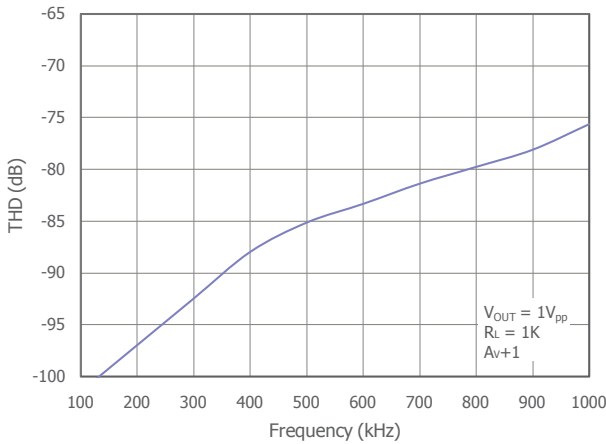
2nd Harmonic Distortion vs.  $V_{OUT}$



3rd Harmonic Distortion vs.  $V_{OUT}$



THD vs. Frequency

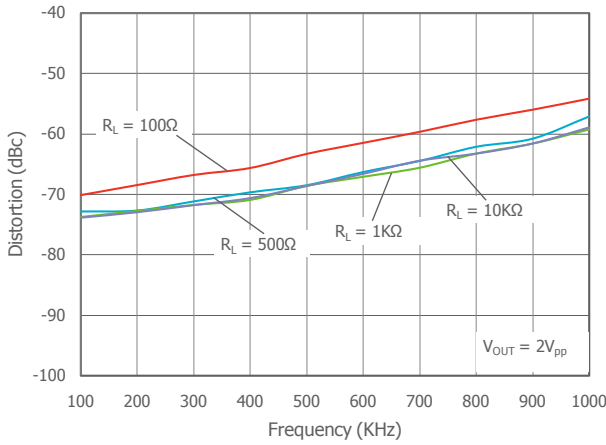




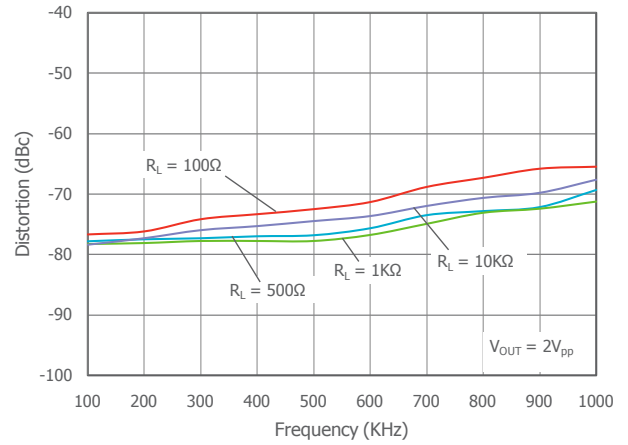
## Typical Performance Characteristics - Continued

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = 1\text{k}\Omega$ ,  $R_L = 1\text{k}\Omega$  to GND,  $G = 2$ ; unless otherwise noted.

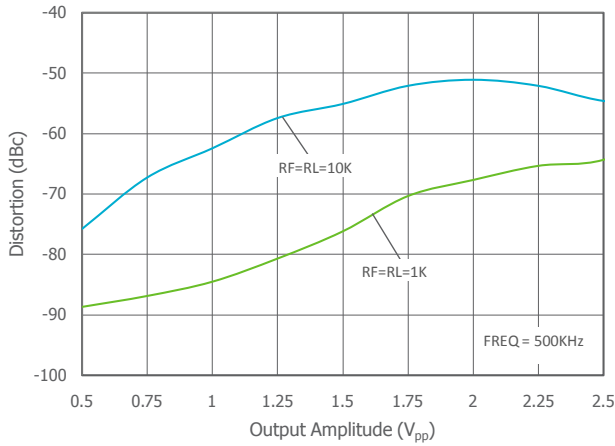
2nd Harmonic Distortion vs.  $R_L$  at  $V_S = 3\text{V}$



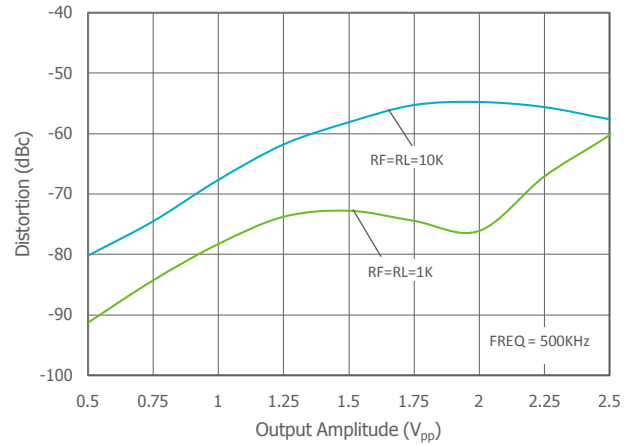
3rd Harmonic Distortion vs.  $R_L$  at  $V_S = 3\text{V}$



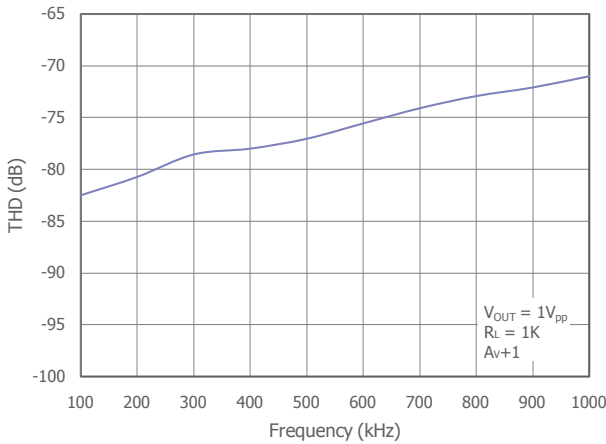
2nd Harmonic Distortion vs.  $V_{OUT}$  at  $V_S = 3\text{V}$



3rd Harmonic Distortion vs.  $V_{OUT}$  at  $V_S = 3\text{V}$



THD vs. Frequency at  $V_S = 3\text{V}$

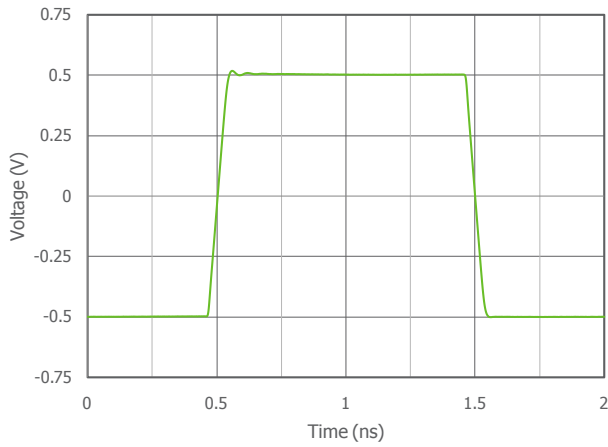




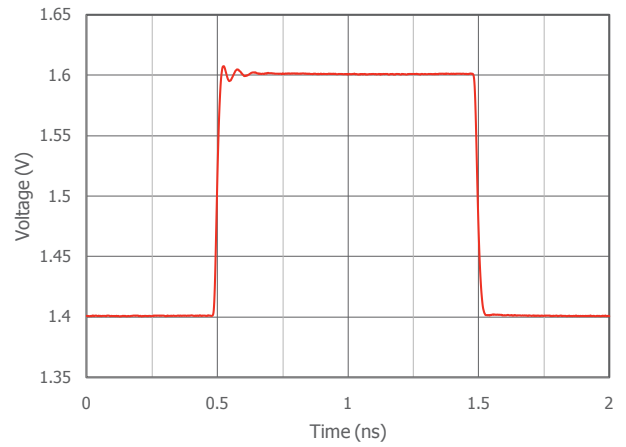
## Typical Performance Characteristics - Continued

$T_A = 25^\circ\text{C}$ ,  $V_S = \pm 5\text{V}$ ,  $R_f = 1\text{k}\Omega$ ,  $R_L = 1\text{k}\Omega$  to GND,  $G = 2$ ; unless otherwise noted.

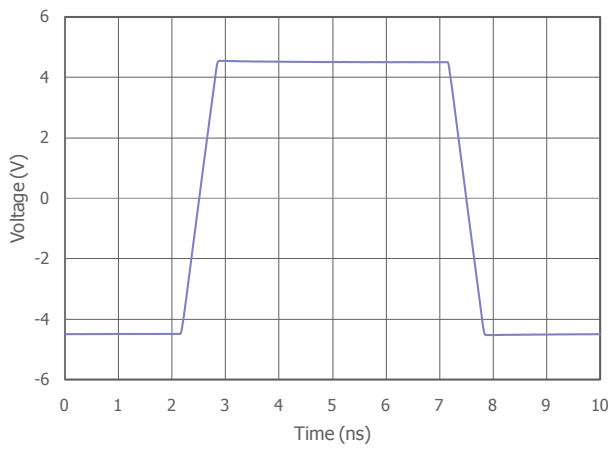
Small Signal Pulse Response



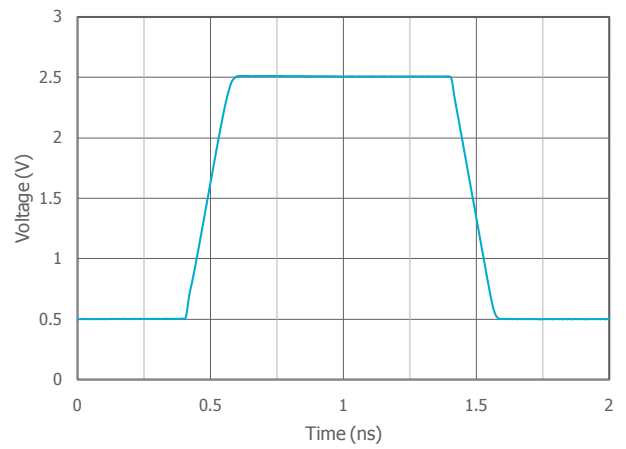
Small Signal Pulse Response at  $V_S = 3\text{V}$



Large Signal Pulse Response



Large Signal Pulse Response at  $V_S = 3\text{V}$





## Application Information

### Basic Operation

Figures 1 and 2 illustrate typical circuit configurations for non-inverting, inverting, and unity gain topologies for dual supply applications. They show the recommended bypass capacitor values and overall closed loop gain equations.

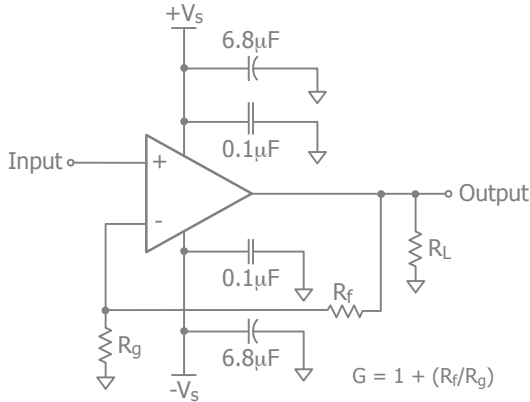


Figure 1. Typical Non-Inverting Gain Circuit

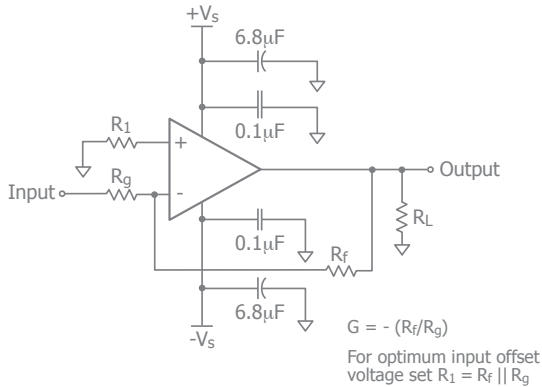


Figure 2. Typical Inverting Gain Circuit

### Power Dissipation

Power dissipation should not be a factor when operating under the stated 300 ohm load condition. However, applications with low impedance, DC coupled loads should be analyzed to ensure that maximum allowed junction temperature is not exceeded. Guidelines listed below can be used to verify that the particular application will not cause the device to operate beyond its intended operating range.

Maximum power levels are set by the absolute maximum junction rating of 150°C. To calculate the junction tem-

perature, the package thermal resistance value  $\Theta_{JA}$  ( $\Theta_{JA}$ ) is used along with the total die power dissipation.

$$T_{Junction} = T_{Ambient} + (\Theta_{JA} \times P_D)$$

Where  $T_{Ambient}$  is the temperature of the working environment.

In order to determine  $P_D$ , the power dissipated in the load needs to be subtracted from the total power delivered by the supplies.

$$P_D = P_{supply} - P_{load}$$

Supply power is calculated by the standard power equation.

$$P_{supply} = V_{supply} \times I_{RMS\ supply}$$

$$V_{supply} = V_{S+} - V_{S-}$$

Power delivered to a purely resistive load is:

$$P_{load} = ((V_{LOAD})_{RMS}^2) / R_{load\ eff}$$

The effective load resistor ( $R_{load\ eff}$ ) will need to include the effect of the feedback network. For instance,

$R_{load\ eff}$  in figure 3 would be calculated as:

$$R_L \parallel (R_f + R_g)$$

These measurements are basic and are relatively easy to perform with standard lab equipment. For design purposes however, prior knowledge of actual signal levels and load impedance is needed to determine the dissipated power. Here,  $P_D$  can be found from

$$P_D = P_{Quiescent} + P_{Dynamic} - P_{Load}$$

Quiescent power can be derived from the specified  $I_S$  values along with known supply voltage,  $V_{Supply}$ . Load power can be calculated as above with the desired signal amplitudes using:

$$(V_{LOAD})_{RMS} = V_{PEAK} / \sqrt{2}$$

$$(I_{LOAD})_{RMS} = (V_{LOAD})_{RMS} / R_{load\ eff}$$

The dynamic power is focused primarily within the output stage driving the load. This value can be calculated as:

$$P_{DYNAMIC} = (V_{S+} - V_{LOAD})_{RMS} \times (I_{LOAD})_{RMS}$$

Assuming the load is referenced in the middle of the power rails or  $V_{supply}/2$ .

Figure 3 shows the maximum safe power dissipation in the package vs. the ambient temperature for the packages available.

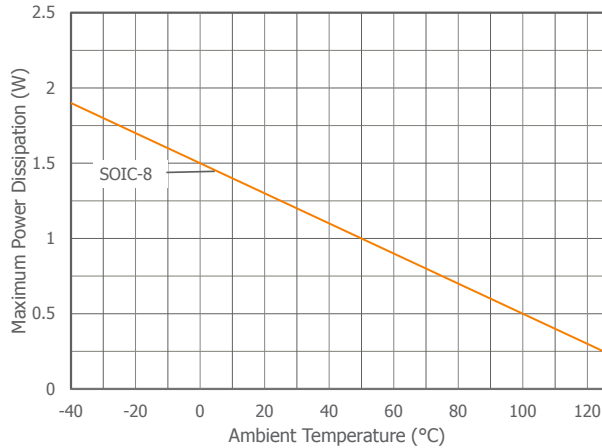


Figure 3. Maximum Power Derating

**Driving Capacitive Loads**

Increased phase delay at the output due to capacitive loading can cause ringing, peaking in the frequency response, and possible unstable behavior. Use a series resistance,  $R_S$ , between the amplifier and the load to help improve stability and settling performance. Refer to Figure 4.

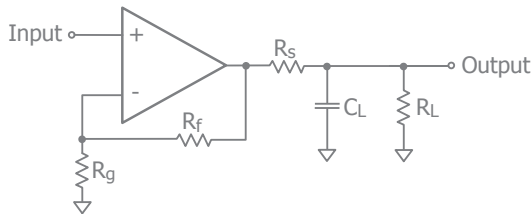


Figure 4. Addition of  $R_S$  for Driving Capacitive Loads

The CLC2023 family of amplifiers is capable of driving up to 300pF directly, with no series resistance. Directly driving 500pF causes over 4dB of frequency peaking, as shown in the plot on page 6. Table 1 provides the recommended  $R_S$  for various capacitive loads. The recommended  $R_S$  values result in  $\leq 1$ dB peaking in the frequency response. The Frequency Response vs.  $C_L$  plots, on page 6, illustrates the response of the CLC2023.

$C_L$ (pF)	$R_S$ ( $\Omega$ )	-3dB BW (MHz)
500	10	27
1000	7.5	20
3000	4	15

Table 1: Recommended  $R_S$  vs.  $C_L$

For a given load capacitance, adjust  $R_S$  to optimize the tradeoff between settling time and bandwidth. In general, reducing  $R_S$  will increase bandwidth at the expense of additional overshoot and ringing.

**Overdrive Recovery**

An overdrive condition is defined as the point when either one of the inputs or the output exceed their specified voltage range. Overdrive recovery is the time needed for the amplifier to return to its normal or linear operating point. The recovery time varies, based on whether the input or output is overdriven and by how much the range is exceeded. The CLC2023 will typically recover in less than 20ns from an overdrive condition. Figure 5 shows the CLC2023 in an overdriven condition.

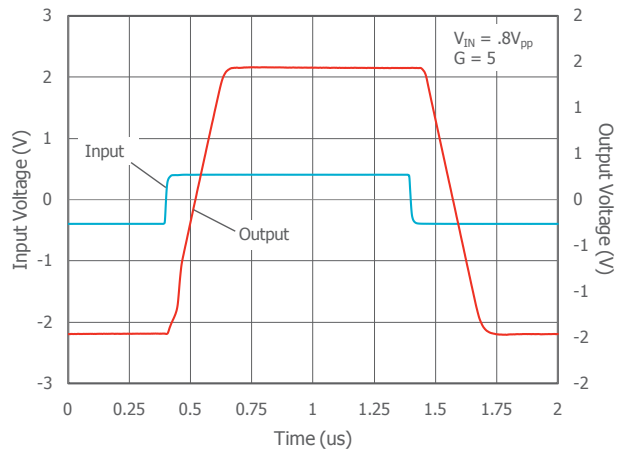


Figure 5. Overdrive Recovery

**Considerations for Offset and Noise Performance**

**Offset Analysis**

There are three sources of offset contribution to consider; input bias current, input bias current mismatch, and input offset voltage. The input bias currents are assumed to be equal with an additional offset current in one of the inputs to account for mismatch. The bias currents will not affect the offset as long as the parallel combination of  $R_f$  and  $R_g$  matches  $R_t$ . Refer to Figure 6.

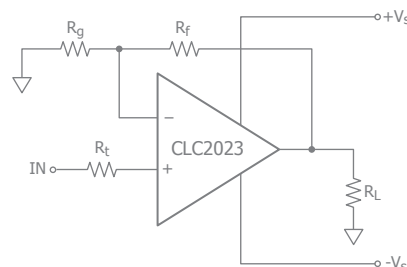


Figure 6: Circuit for Evaluating Offset



The first place to start is to determine the source resistance. If it is very small an additional resistance may need to be added to keep the values of  $R_f$  and  $R_g$  to practical levels. For this analysis we assume that  $R_t$  is the total resistance present on the non-inverting input. This gives us one equation that we must solve:

$$R_t = R_g || R_f$$

This equation can be rearranged to solve for  $R_g$ :

$$R_g = (R_t * R_f) / (R_f - R_t)$$

The other consideration is desired gain ( $G$ ) which is:

$$G = (1 + R_f/R_g)$$

By plugging in the value for  $R_g$  we get

$$R_f = G * R_t$$

And  $R_g$  can be written in terms of  $R_t$  and  $G$  as follows:

$$R_g = (G * R_t) / (G - 1)$$

The complete input offset equation is now only dependent on the voltage offset and input offset terms given by:

$$VI_{OS} = \sqrt{(V_{IO})^2 + (I_{OS} * RT)^2}$$

And the output offset is:

$$VO_{OS} = G * \sqrt{(V_{IO})^2 + (I_{OS} * RT)^2}$$

### Noise analysis

The complete equivalent noise circuit is shown in Figure 7.

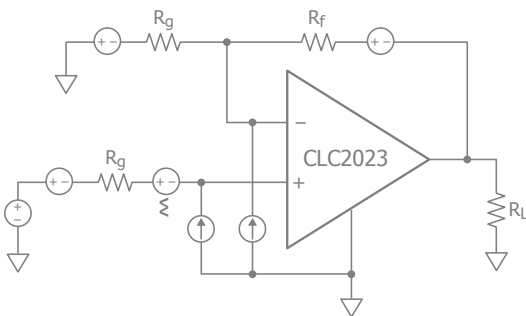


Figure 7: Complete Equivalent Noise Circuit

The complete noise equation is given by:

$$v_o^2 = v_{orext}^2 + \left( e_n \left( 1 + \frac{R_f}{R_g} \right) \right)^2 + \left( i_{bp} * RT \left( 1 + \frac{R_f}{R_g} \right) \right)^2 + \left( i_{bn} * R_f \right)^2$$

Where  $V_{orext}$  is the noise due to the external resistors and is given by:

$$v_o^2 = \left( e_n \left( 1 + \frac{R_f}{R_g} \right) \right)^2 + \left( e_G * \frac{R_f}{R_g} \right)^2 + e_F^2$$

The complete equation can be simplified to:

$$v_o^2 = 3 * (4kT * G * RT) + (e_n G)^2 + 2 * (i_n * RT)^2$$

It's easy to see that the effect of amplifier voltage noise is proportionate to gain and will tend to dominate at large gains. The other terms will have their greatest impact at large  $R_t$  values at lower gains.

### Layout Considerations

General layout and supply bypassing play major roles in high frequency performance. Exar has evaluation boards to use as a guide for high frequency layout and as aid in device testing and characterization. Follow the steps below as a basis for high frequency layout:

- Include 6.8μF and 0.1μF ceramic capacitors for power supply decoupling
- Place the 6.8μF capacitor within 0.75 inches of the power pin
- Place the 0.1μF capacitor within 0.1 inches of the power pin
- Remove the ground plane under and around the part, especially near the input and output pins to reduce parasitic capacitance
- Minimize all trace lengths to reduce series inductances

Refer to the evaluation board layouts below for more information.

### Evaluation Board Information

The following evaluation boards are available to aid in the testing and layout of these devices:

Evaluation Board	Products
CEB006	CLC2023 in SOIC-8
CEB010	CLC2023 in MSOP-8



### Evaluation Board Schematics

Evaluation board schematics and layouts are shown in Figures 8-12. These evaluation boards are built for dual-supply operation. Follow these steps to use the board in a single-supply application:

1. Short  $-V_s$  to ground.
2. Use C3 and C4, if the  $-V_s$  pin of the amplifier is not directly connected to the ground plane.

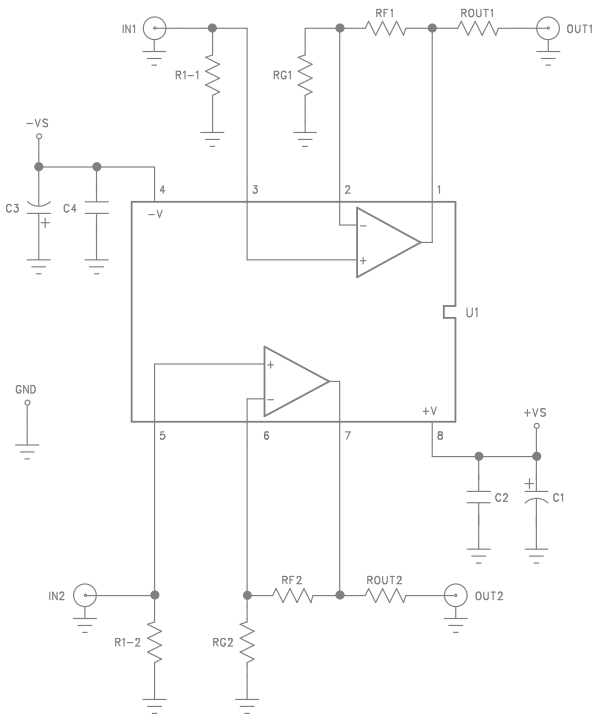


Figure 8. CEB006 Schematic

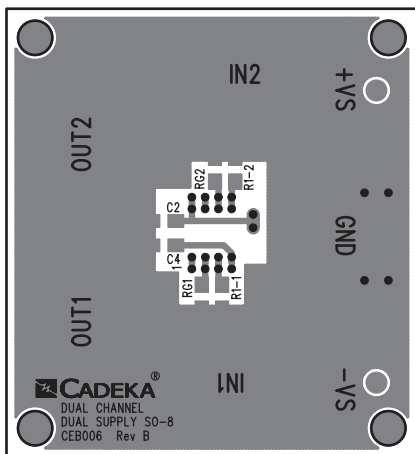


Figure 9. CEB006 Top View

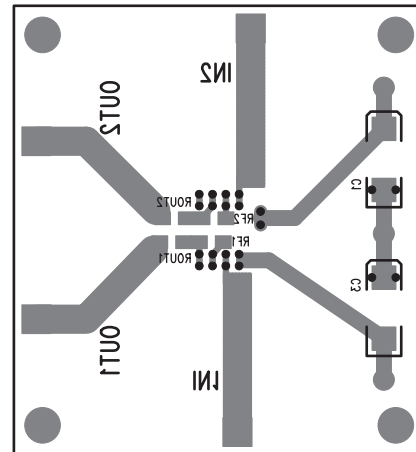


Figure 10. CEB006 Bottom View

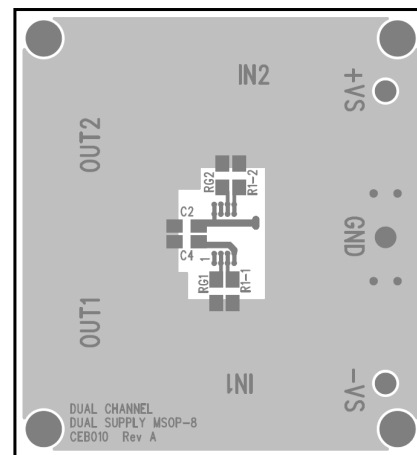


Figure 11. CEB010 Top View

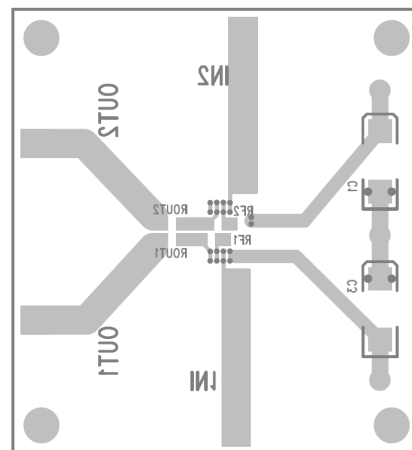
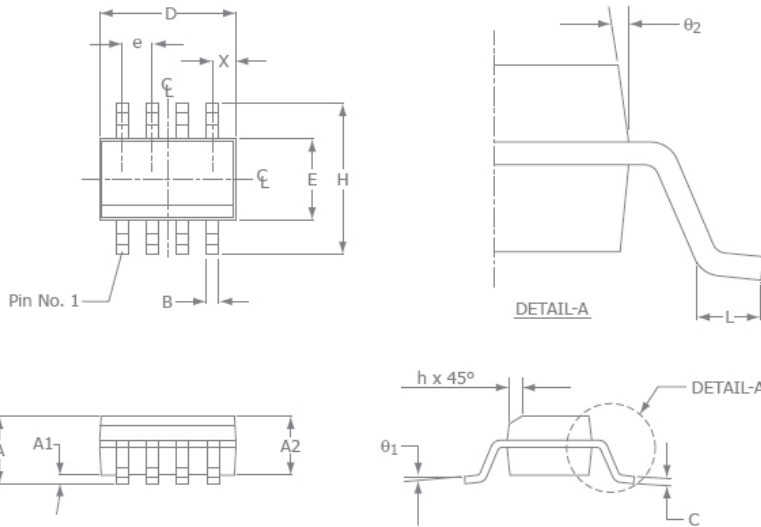


Figure 12. CEB010 Bottom View



## Mechanical Dimensions

### SOIC-8 Package

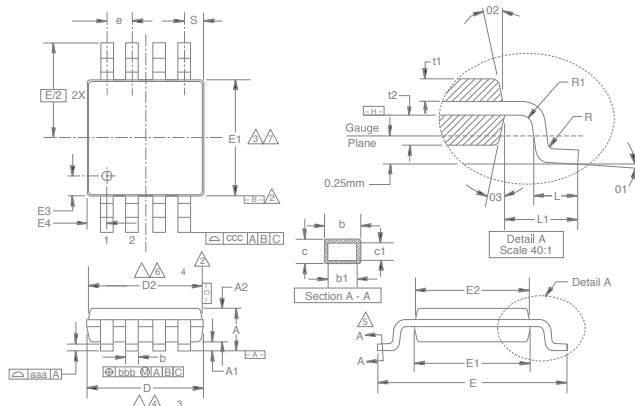


SOIC-8		
SYMBOL	MIN	MAX
A1	0.10	0.25
B	0.36	0.48
C	0.19	0.25
D	4.80	4.98
E	3.81	3.99
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.5
L	0.41	1.27
A	1.37	1.73
$\theta_1$	0°	8°
X	0.55 ref	
$\theta_2$	7° BSC	

**NOTE:**

1. All dimensions are in millimeters.
2. Lead coplanarity should be 0 to 0.1mm (0.004") max.
3. Package surface finishing: VDI 24~27
4. All dimension excluding mold flashes.
5. The lead width, B to be determined at 0.1905mm from the lead tip.

### MSOP-8



Symbol	Min	Max
A	1.10	-
A1	0.10	±0.05
A2	0.86	±0.08
D	3.00	±0.10
D2	2.95	±0.10
E	4.90	±0.15
E1	3.00	±0.10
E2	2.95	±0.10
E3	0.51	±0.13
E4	0.51	±0.13
R	0.15	+0.15/-0.06
R1	0.15	+0.15/-0.06
t1	0.31	±0.08
t2	0.41	±0.08
b	0.33	+0.07/-0.08
b1	0.30	±0.05
c	0.18	±0.05
c1	0.15	+0.03/-0.02
$\theta_1$	3.0°	±3.0°
$\theta_2$	12.0°	±3.0°
$\theta_3$	12.0°	±3.0°
L	0.55	±0.15
L1	0.95 BSC	-
aaa	0.10	-
bbb	0.08	-
ccc	0.25	-
e	0.65 BSC	-
S	0.525 BSC	-

**NOTE:**

- 1 All dimensions are in millimeters (angle in degrees), unless otherwise specified.
- △ Datums [B] and [C] to be determined at datum plane [H].
- △ Dimensions "D" and "E1" are to be determined at datum [H].
- △ Dimensions "D2" and "E2" are for top package and dimensions "D" and "E1" are for bottom package.
- △ Cross sections A - A to be determined at 0.13 to 0.25mm from the leadtip.
- △ Dimension "D" and "D2" does not include mold flash, protrusion or gate burrs.
- △ Dimension "E1" and "E2" does not include interlead flash or protrusion.

**For Further Assistance:**

**Exar Corporation Headquarters and Sales Offices**  
 48720 Kato Road Tel.: +1 (510) 668-7000  
 Fremont, CA 94538 - USA Fax: +1 (510) 668-7001  
 www.exar.com



A New Direction in Mixed-Signal

**NOTICE**  
 EXAR Corporation reserves the right to make changes to the products contained in this publication in order to improve design, performance or reliability. EXAR Corporation assumes no responsibility for the use of any circuits described herein, conveys no license under any patent or other right, and makes no representation that the circuits are free of patent infringement. Charts and schedules contained here in are only for illustration purposes and may vary depending upon a user's specific application. While the information in this publication has been carefully checked; no responsibility, however, is assumed for inaccuracies.

EXAR Corporation does not recommend the use of any of its products in life support applications where the failure or malfunction of the product can reasonably be expected to cause failure of the life support system or to significantly affect its safety or effectiveness. Products are not authorized for use in such applications unless EXAR Corporation receives, in writing, assurances to its satisfaction that: (a) the risk of injury or damage has been minimized; (b) the user assumes all such risks; (c) potential liability of EXAR Corporation is adequately protected under the circumstances.

Reproduction, in part or whole, without the prior written consent of EXAR Corporation is prohibited.