

### FEATURES

**Low noise:** 1 nV/ $\sqrt{\text{Hz}}$  at 1 kHz  
**Low distortion:**  $-105$  dB THD @ 20 kHz  
**<80 nV p-p input noise, 0.1 Hz to 10 Hz**  
**Slew rate:** 16 V/ $\mu\text{s}$   
**Wide bandwidth:** 10 MHz  
**Supply current:** 4.7 mA/amp typical  
**Low offset voltage:** 10  $\mu\text{V}$  typical  
**CMRR:** 120 dB  
**Unity-gain stable**  
 **$\pm 15$  V operation**

### APPLICATIONS

**Professional audio preamplifiers**  
**ATE/precision testers**  
**Imaging systems**  
**Medical/physiological measurements**  
**Precision detectors/instruments**  
**Precision data conversion**

### GENERAL DESCRIPTION

The AD8599 is a dual, very low noise, low distortion operational amplifier ideal for use as a preamplifier. The low noise of 1 nV/ $\sqrt{\text{Hz}}$  and low harmonic distortion of  $-105$  dB (or better) at audio bandwidths give the AD8599 the wide dynamic range necessary for preamps in audio, medical, and instrumentation applications. The AD8599's excellent slew rate of 16 V/ $\mu\text{s}$  and

### PIN CONFIGURATION

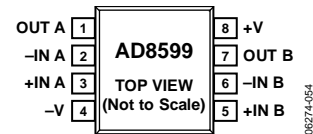


Figure 1. 8-Lead SOIC (R-8)

10 MHz gain bandwidth make it highly suitable for medical applications. The low distortion and settling time of the AD8599 make it ideal for buffering of high resolution data converters.

The AD8599 is available in an 8-Lead SOIC package and is specified over a  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  temperature range.

#### Rev. A

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**TABLE OF CONTENTS**

Features .....	1	Thermal Resistance .....	4
Applications.....	1	Power Sequencing .....	4
Pin Configuration.....	1	ESD Caution.....	4
General Description .....	1	Typical Performance Characteristics .....	5
Revision History .....	2	Outline Dimensions .....	14
Specifications.....	3	Ordering Guide .....	14
Absolute Maximum Ratings.....	4		

**REVISION HISTORY**

**4/07—Rev. 0 to Rev. A**

Updated Layout.....	5
Changes to Figure 45 Caption.....	12
Added Figure 48.....	12
Changes to Figure 51 Caption.....	13

**2/07—Revision 0: Initial Version**

## SPECIFICATIONS

$V_S = \pm 15\text{ V}$ ,  $V_{CM} = 0\text{ V}$ ,  $V_O = 0\text{ V}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise specified.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		10	120	$\mu\text{V}$
					180	$\mu\text{V}$
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.8	2.2	$\mu\text{V}/^\circ\text{C}$
Input Bias Current	$I_B$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		25	180	nA
Input Offset Current	$I_{OS}$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		25	180	nA
					220	nA
Input Voltage Range	IVR	$V_{DD} = \pm 15\text{ V}$	-12.5		+12.5	V
Common-Mode Rejection Ratio	CMRR	$-12.5\text{ V} \leq V_{CM} \leq +12.5\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	120	140		dB
			115			dB
Large Signal Voltage Gain	$A_{VO}$	$R_L \geq 600\ \Omega$ , $V_O = -11\text{ V to } +11\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	110	116		dB
			106			dB
Input Capacitance	$C_{DIFF}$			4.8		pf
	$C_{CM}$			4.5		pf
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$R_L = 600\ \Omega$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	13.1	13.4		V
			12.8			V
			13.5	13.7		V
			13.2			V
Output Voltage Low	$V_{OL}$	$R_L = 600\ \Omega$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		-13.2	-12.9	V
					-12.8	V
				-13.5	-13.4	V
					-13.3	V
Output Source Circuit	$I_{SC}$			$\pm 52$		mA
Closed-Loop Output Impedance	$Z_{OUT}$	At 1 MHz, $A_V = 1$		5		$\Omega$
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_{DD} = \pm 18\text{ V to } \pm 4.5\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	120	140		dB
			118			dB
Supply Current per Amplifier	$I_{SY}$	$-40^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		4.7	5.7	mA
					6.75	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$A_V = -1$ , $R_L = 2\text{ k}\Omega$ $A_V = 1$ , $R_L = 2\text{ k}\Omega$		16.8		V/ $\mu\text{s}$
				15		V/ $\mu\text{s}$
Settling Time	$t_s$	To 0.01%, step = 10 V		2		$\mu\text{s}$
Gain Bandwidth Product	GBP			10		MHz
Phase Margin	$\phi_M$			68		Degrees
<b>NOISE PERFORMANCE</b>						
Peak-to-Peak Noise	$e_n\text{ p-p}$	0.1 Hz to 10 Hz		76		nV
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$ $f = 10\text{ kHz}$		1.07	1.15	nV/ $\sqrt{\text{Hz}}$
					1.5	nV/ $\sqrt{\text{Hz}}$
Current Noise		$f = 1\text{ kHz}$		1.5		pA/ $\sqrt{\text{Hz}}$
Total Harmonic Distortion + Noise	THD + N	$G = 1$ , $R_L \geq 1\text{ k}\Omega$ , $f = 1\text{ kHz}$ , $V_{RMS} = 3\text{ V}$ $G = 1$ , $R_L \geq 1\text{ k}\Omega$ , $f = 20\text{ kHz}$ , $V_{RMS} = 3\text{ V}$		-108		dB
				-105		dB
Channel Separation	CS	$f = 10\text{ kHz}$		-120		dB

## ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage	±18 V
Input Voltage	GND to $V_{DD}$
Differential Input Voltage	±1 V
Output Short-Circuit to GND	Indefinite
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−40°C to +125°C
Lead Temperature Range (Soldering 60 sec)	300°C
Junction Temperature	150°C

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.

## THERMAL RESISTANCE

$\theta_{JA}$  is specified for the worst-case conditions, that is, a device soldered in a circuit board for surface-mount packages.

Table 3. Thermal Resistance

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
8-Lead SOIC (R-8)	120	36	°C/W

## POWER SEQUENCING

The op amp supplies must be established simultaneously with, or before, any input signals are applied.

If this is not possible, the input current must be limited to 10 mA.

## ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

# TYPICAL PERFORMANCE CHARACTERISTICS

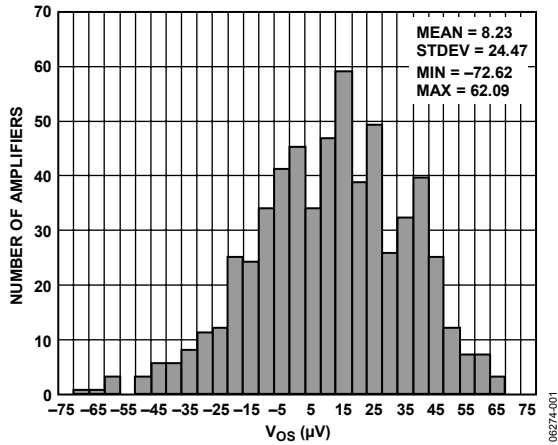


Figure 2. Input Offset Voltage Distribution,  $V_S = \pm 5 V$

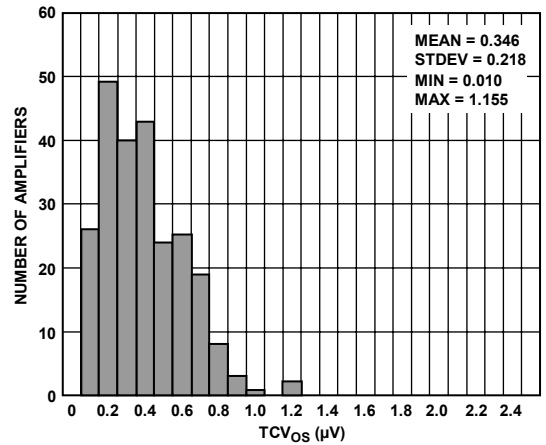


Figure 5.  $TCV_{OS}$  Distribution,  $V_S = \pm 5 V$ ,  $-40^{\circ}C \leq T_A \leq +125^{\circ}C$

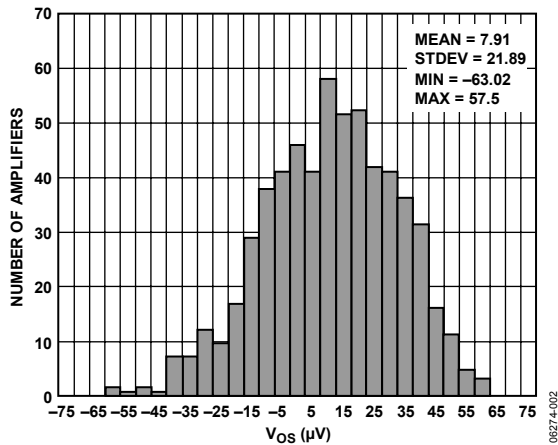


Figure 3. Input Offset Voltage Distribution,  $V_S = \pm 15 V$

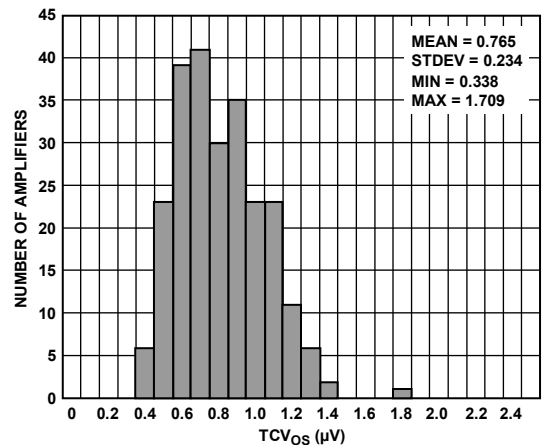


Figure 6.  $TCV_{OS}$  Distribution,  $V_S = \pm 15 V$ ,  $-40^{\circ}C \leq T_A \leq +125^{\circ}C$

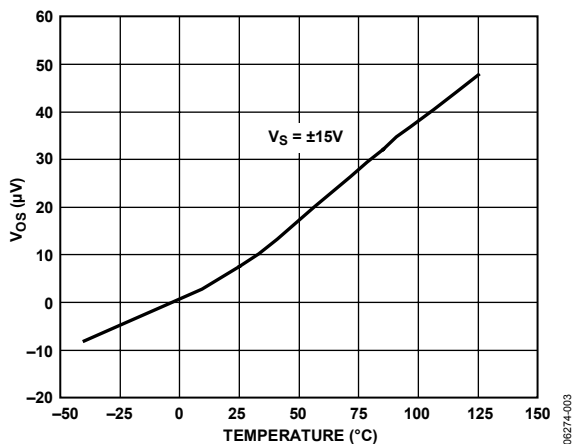


Figure 4. Input Offset Voltage vs. Temperature

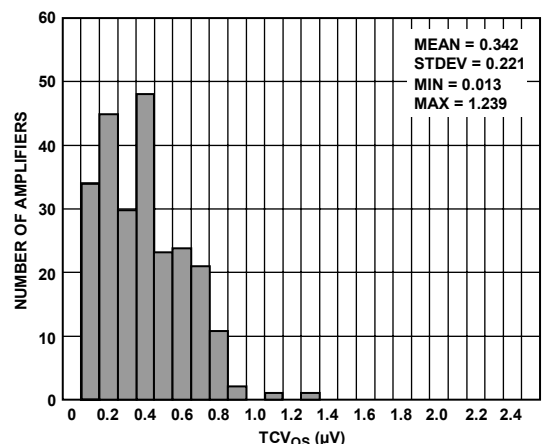


Figure 7.  $TCV_{OS}$  Distribution,  $V_S = \pm 15 V$ ,  $-40^{\circ}C \leq T_A \leq +85^{\circ}C$

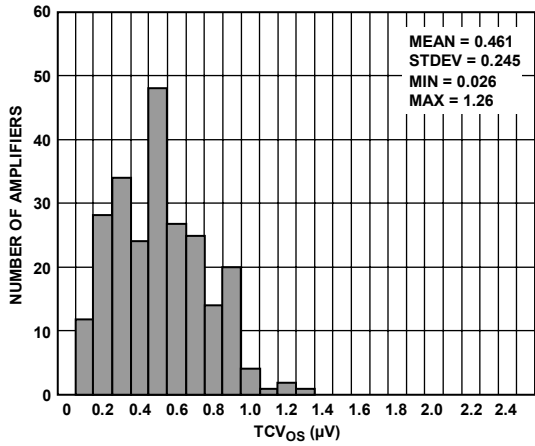


Figure 8.  $TCV_{OS}$  Distribution,  $V_S = \pm 5\text{ V}$ ,  $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$

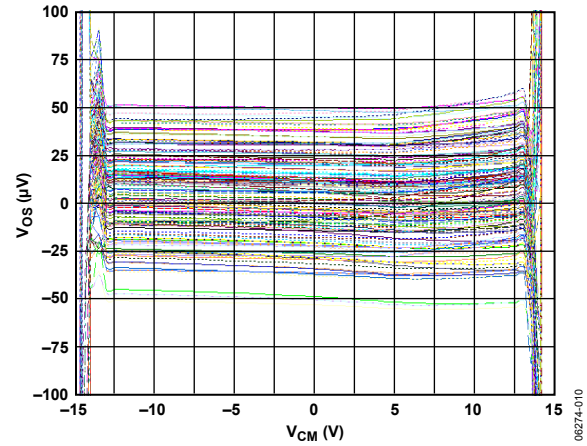


Figure 11. Offset Voltage vs.  $V_{CM}$ ,  $V_S = \pm 15\text{ V}$

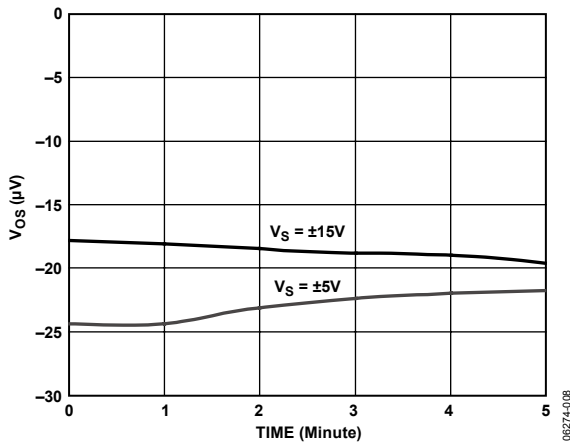


Figure 9. Offset Voltage vs. Time

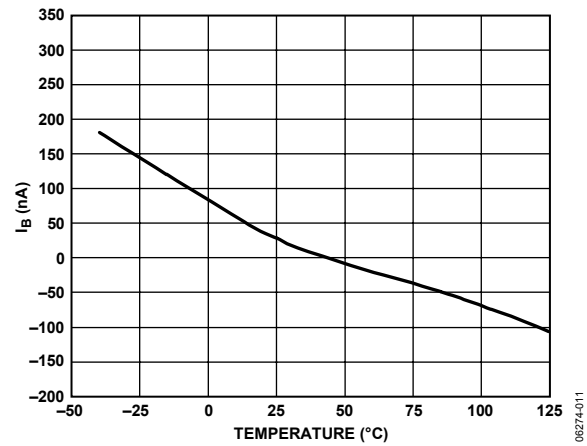


Figure 12. Input Bias Current vs. Temperature,  $V_S = \pm 5\text{ V}$ ,  $V_{CM} = 0\text{ V}$

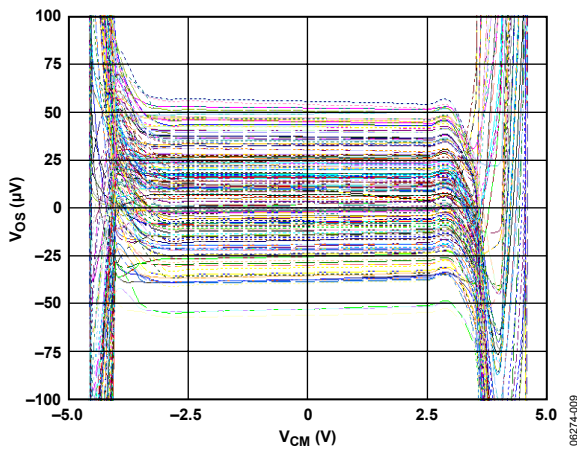


Figure 10. Offset Voltage vs. Common-Mode Voltage,  $V_S = \pm 5\text{ V}$

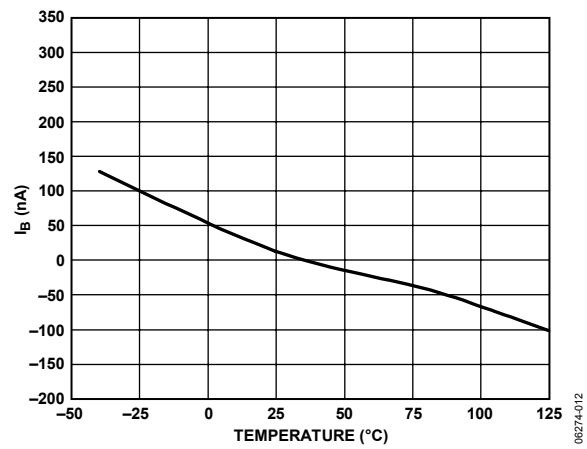


Figure 13. Input Bias Current vs. Temperature,  $V_S = \pm 15\text{ V}$ ,  $V_{CM} = 0\text{ V}$

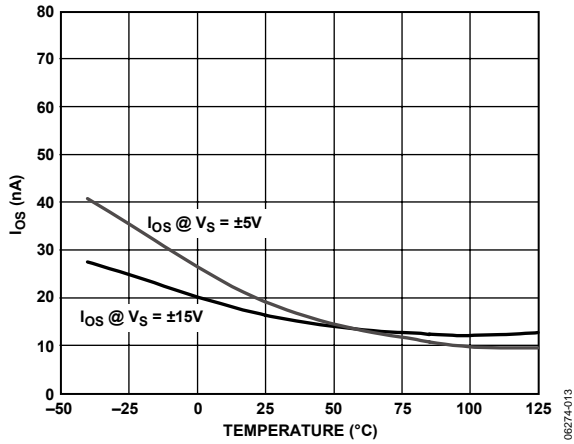


Figure 14. Input Offset Current vs. Temperature

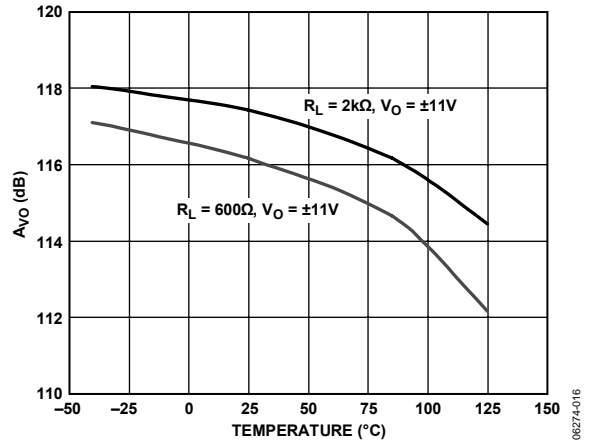


Figure 17. Large Signal Voltage Gain vs. Temperature,  $V_S = \pm 15V$

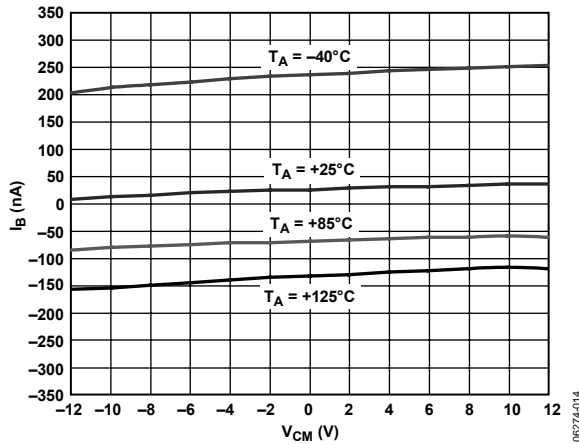


Figure 15. Input Bias Current vs. Voltage Common Mode;  $V_S = \pm 15V$

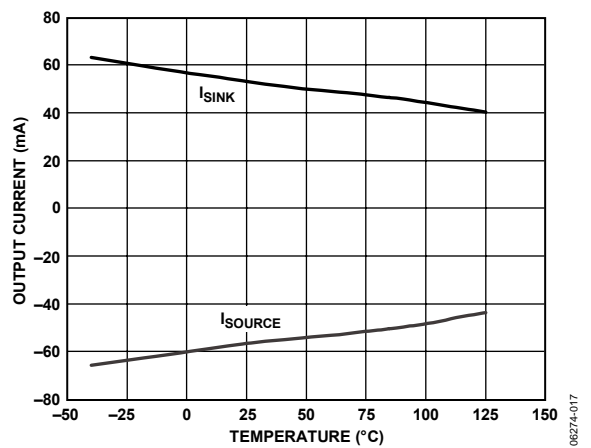


Figure 18. Output Current vs. Temperature,  $V_S = \pm 5V$

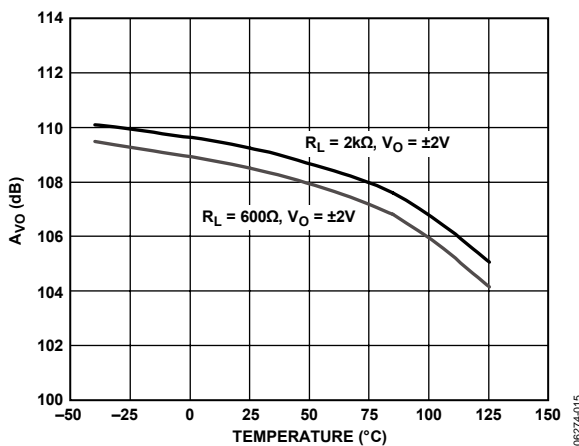


Figure 16. Large Signal Voltage Gain vs. Temperature,  $V_S = \pm 5V$

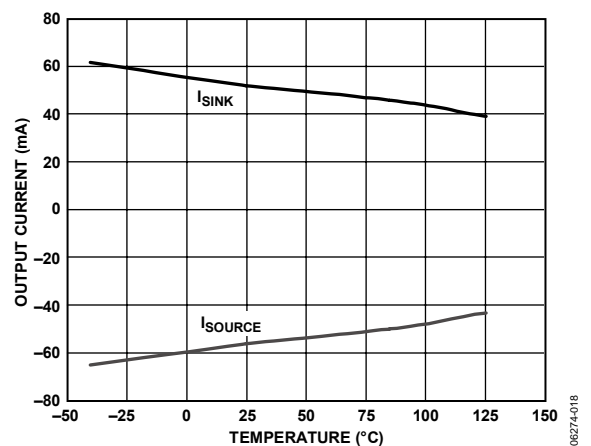


Figure 19. Output Current vs. Temperature,  $V_S = \pm 15V$

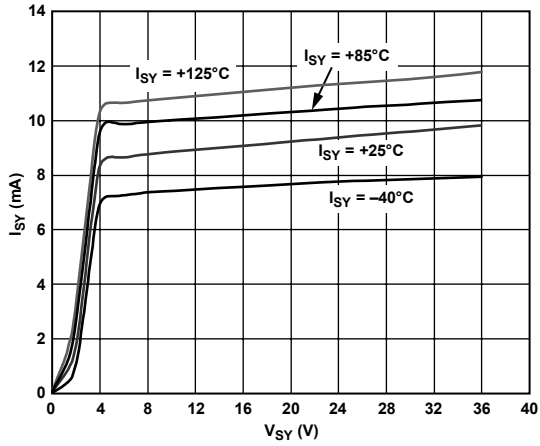


Figure 20. Supply Current vs. Supply Voltage

06274-019

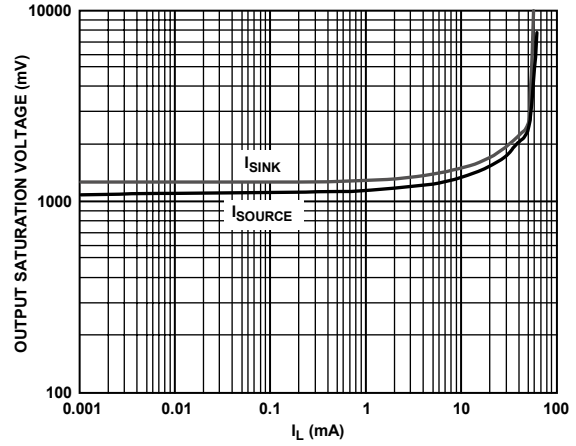


Figure 23. Output Saturation Voltage vs. Current Load,  $V_S = \pm 15 V$

06274-022

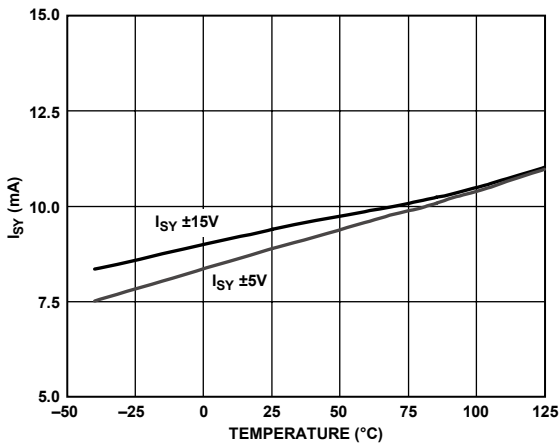


Figure 21. Supply Current vs. Temperature

06274-020

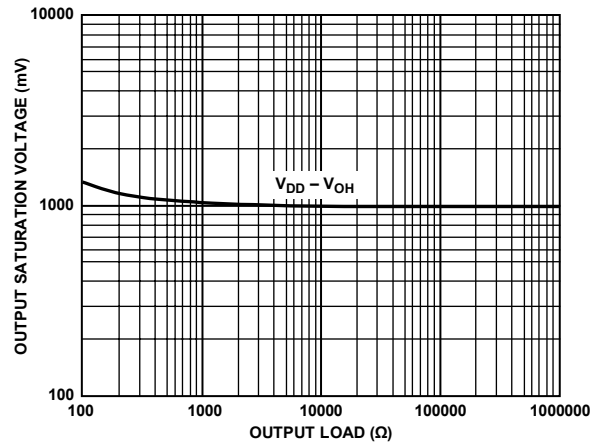


Figure 24. Output Saturation Voltage vs.  $R_L$ ,  $V_S = \pm 5 V$

06274-023

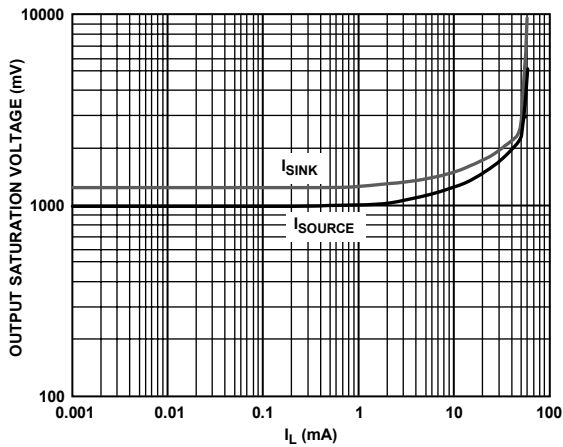


Figure 22. Output Saturation Voltage vs. Current Load,  $V_S = \pm 5 V$

06274-021

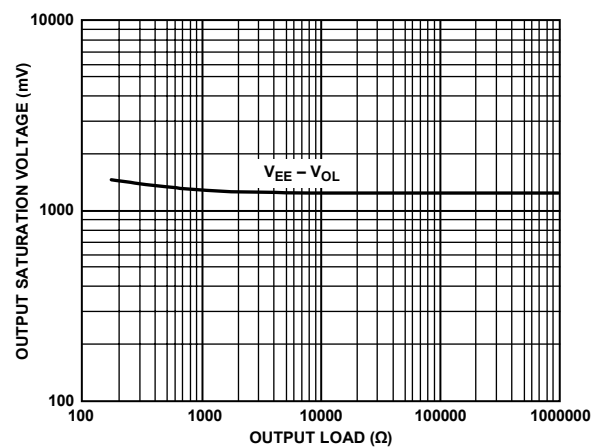


Figure 25. Output Saturation Voltage vs.  $R_L$ ,  $V_S = \pm 5 V$

06274-024



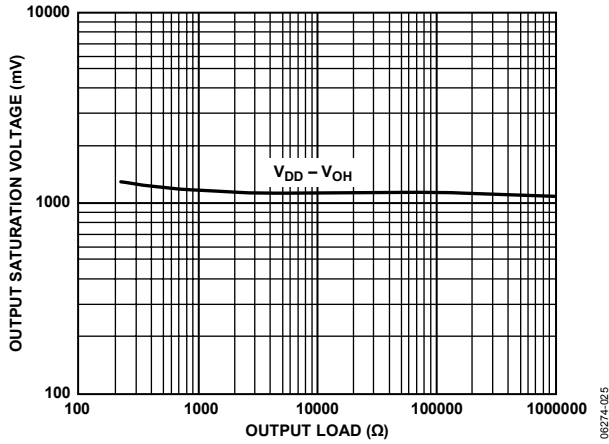


Figure 26. Output Saturation Voltage vs.  $R_L$ ,  $V_S = \pm 15\text{ V}$

06274-025

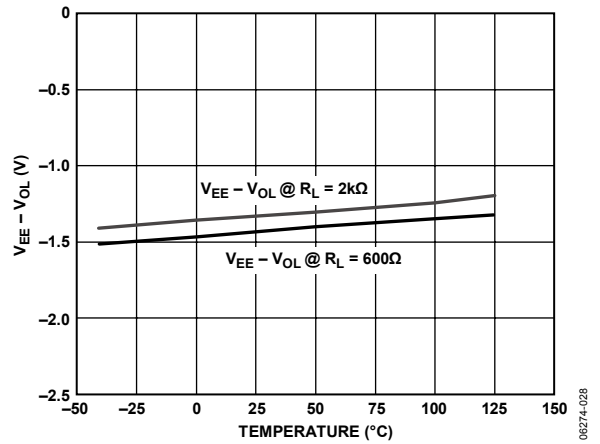


Figure 29. Output Saturation Voltage vs. Temperature,  $V_S = \pm 5\text{ V}$

06274-028

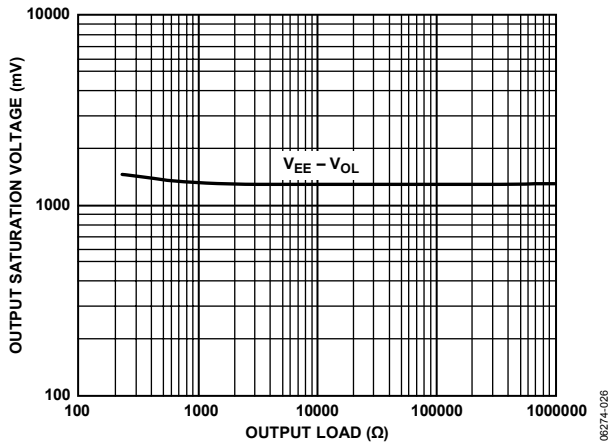


Figure 27. Output Saturation Voltage vs.  $R_L$ ,  $V_S = \pm 15\text{ V}$

06274-026

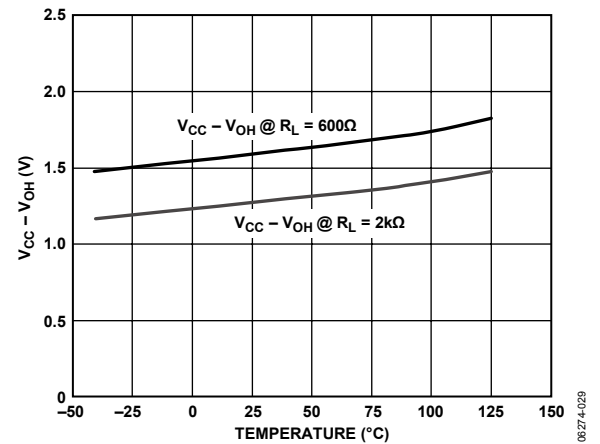


Figure 30. Output Saturation Voltage vs. Temperature,  $V_S = \pm 15\text{ V}$

06274-029

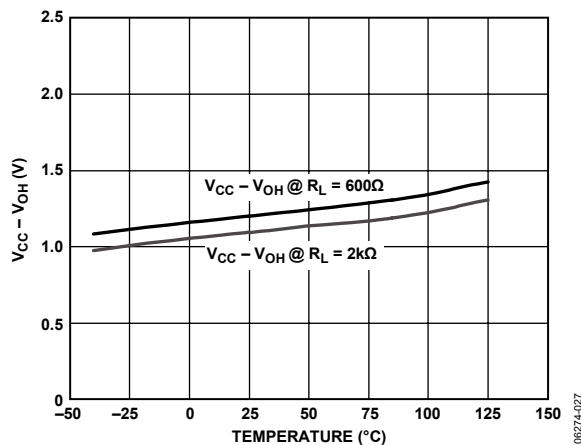


Figure 28. Output Saturation Voltage vs. Temperature,  $V_S = \pm 5\text{ V}$

06274-027

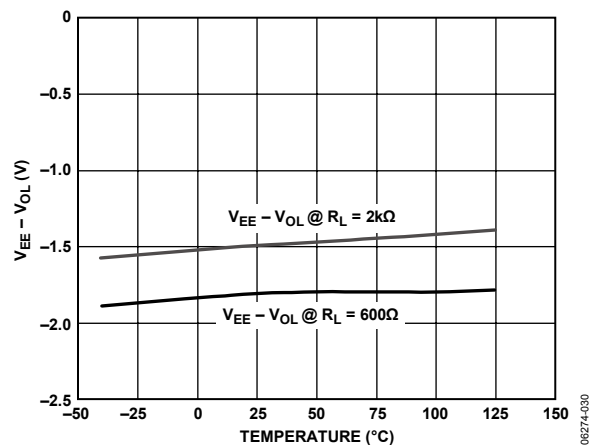


Figure 31. Output Saturation Voltage vs. Temperature,  $V_S = \pm 15\text{ V}$

06274-030

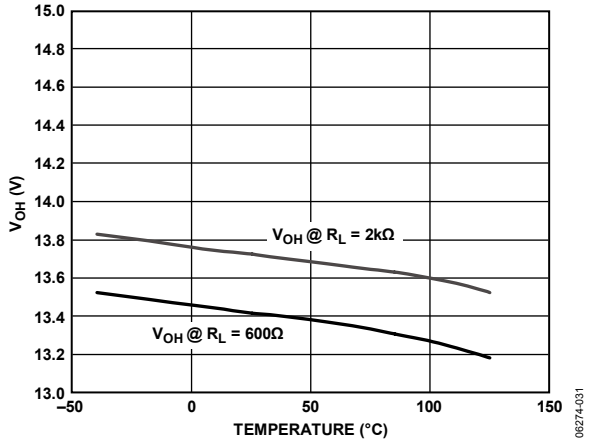


Figure 32. Output Voltage High vs. Temperature,  $V_S = \pm 15 V$

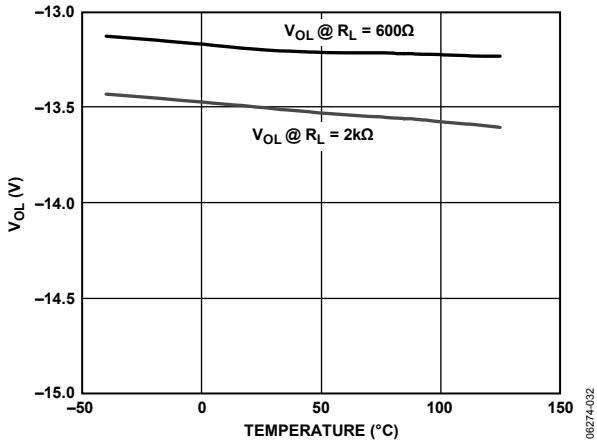


Figure 33. Output Voltage Low vs. Temperature,  $V_S = \pm 15 V$

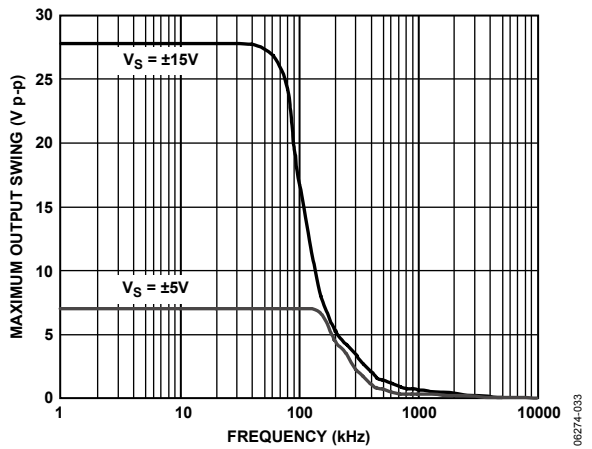


Figure 34. Maximum Output Swing vs. Frequency

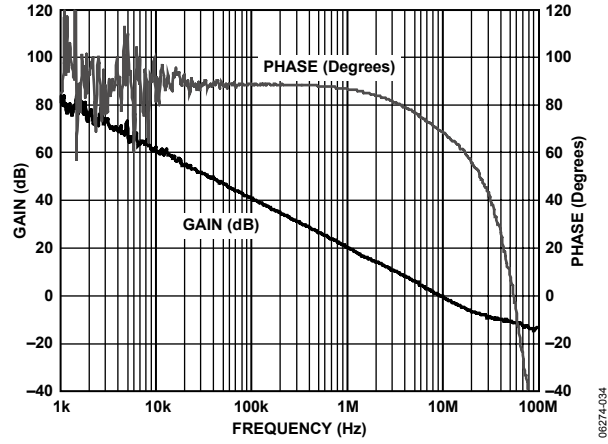


Figure 35. Gain and Phase vs. Frequency,  $\pm 5 V \leq V_S \leq \pm 15 V$

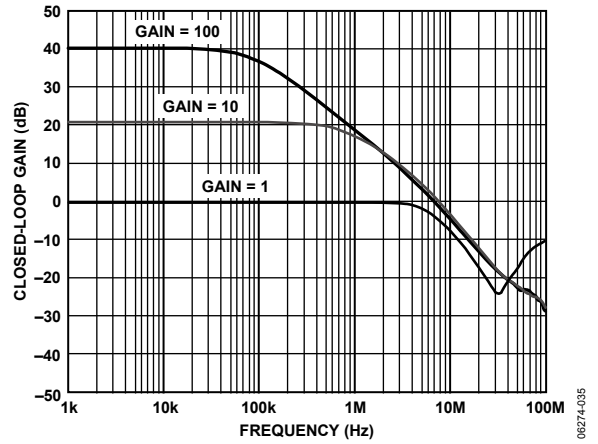


Figure 36. Closed-Loop Gain vs. Frequency,  $\pm 5 V \leq V_S \leq \pm 15 V$

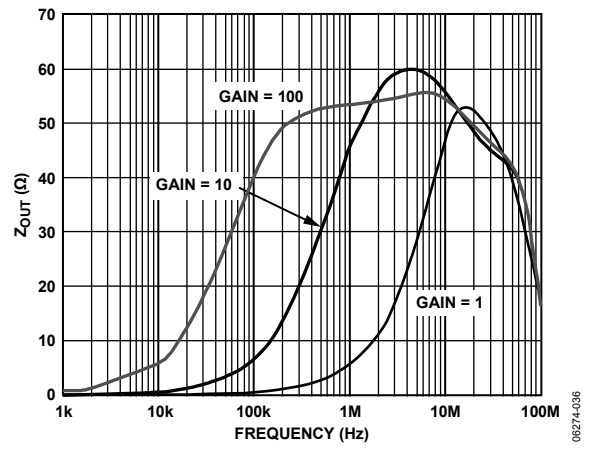


Figure 37. Closed-Loop Output Impedance vs. Frequency,  $\pm 5 V \leq V_S \leq \pm 15 V$

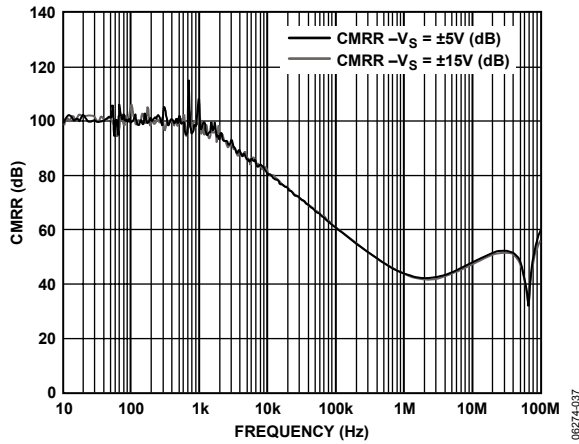


Figure 38. Common-Mode Rejection Ratio vs. Frequency

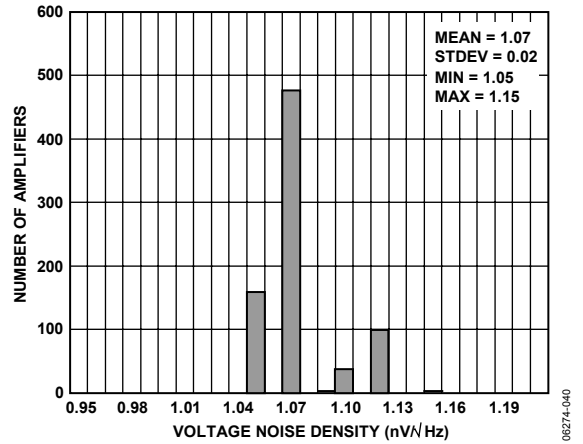


Figure 41. Voltage Noise Density @ 1 kHz,  $\pm 5 V \leq V_S \leq \pm 15 V$

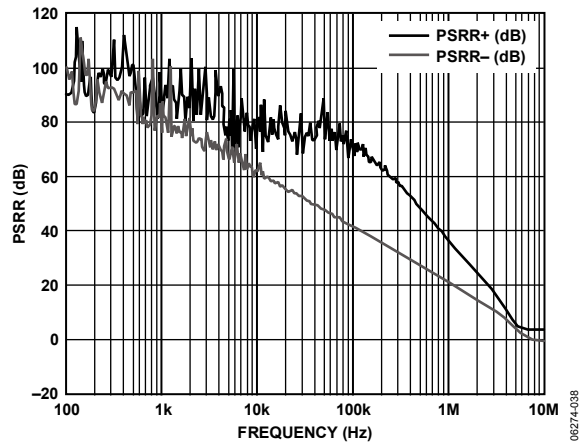


Figure 39. Power Supply Rejection Ratio vs. Frequency,  $\pm 5 V \leq V_S \leq \pm 15 V$

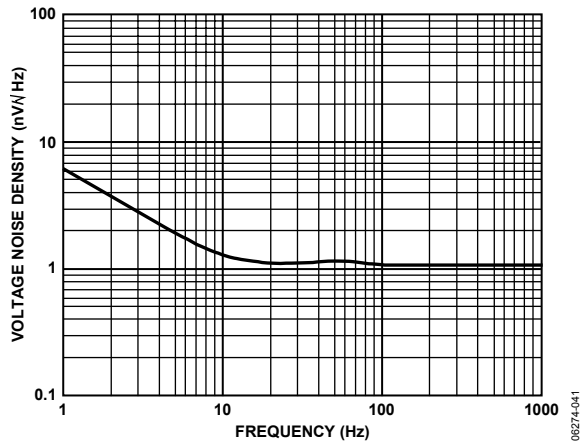


Figure 42. Voltage Noise Density vs. Frequency,  $\pm 5 V \leq V_S \leq \pm 15 V$

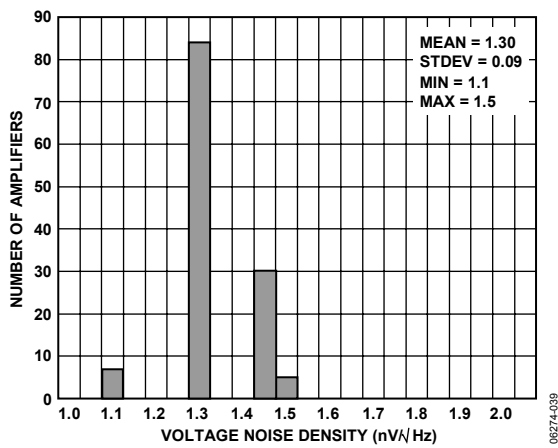


Figure 40. Voltage Noise Density @ 10 kHz,  $\pm 5 V \leq V_S \leq \pm 15 V$

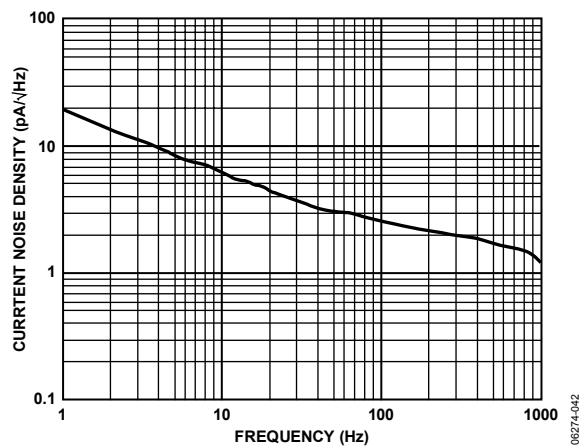


Figure 43. Current Noise Density vs. Frequency,  $\pm 5 V \leq V_S \leq \pm 15 V$

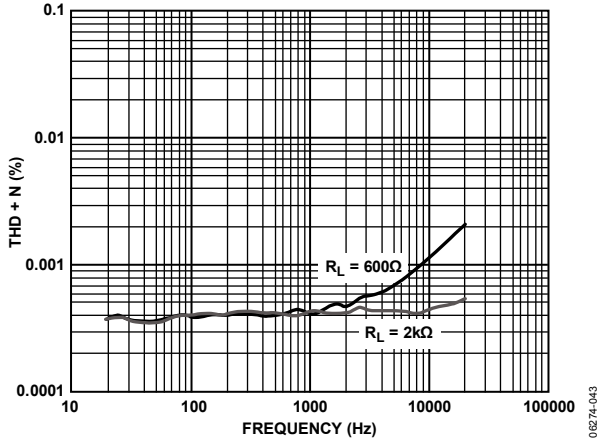


Figure 44. Total Harmonic Distortion + Noise vs. Frequency,  $V_S = \pm 15\text{ V}$ ,  $V_{IN} = 3\text{ V rms}$

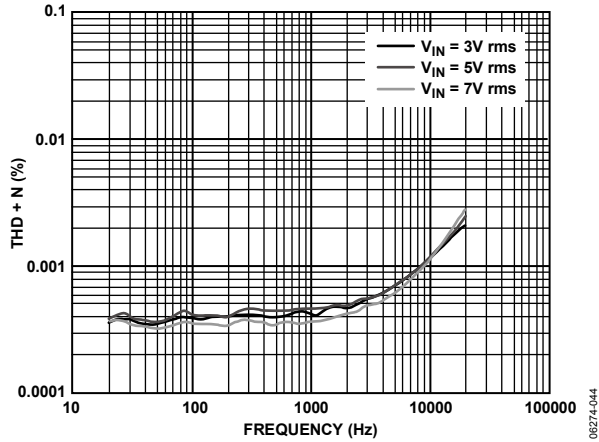


Figure 45. Total Harmonic Distortion + Noise vs. Frequency,  $V_S = \pm 15\text{ V}$

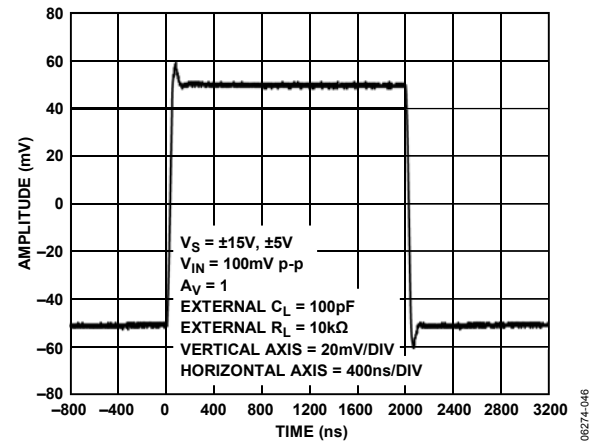


Figure 46. Small Signal Response

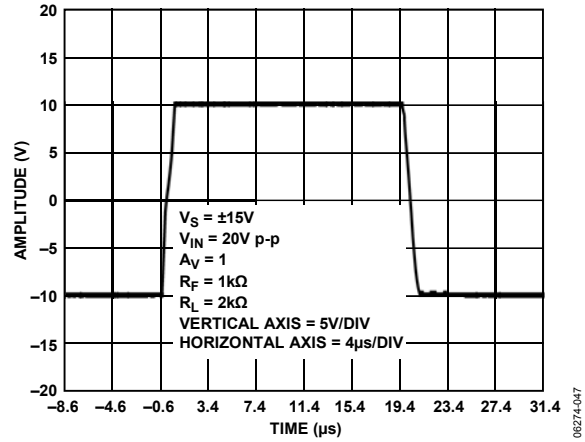


Figure 47. Large Signal Response,  $A_V = 1$

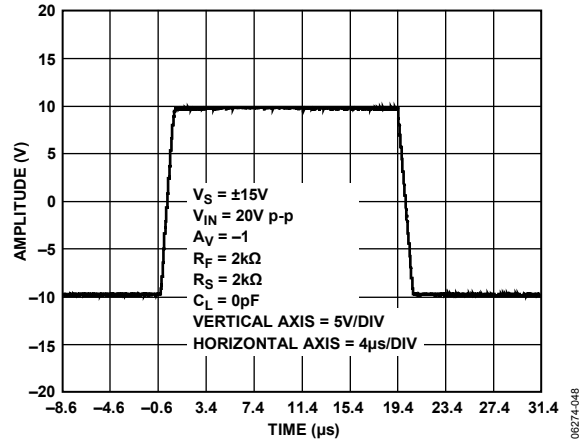


Figure 48. Large Signal Response,  $A_V = -1$

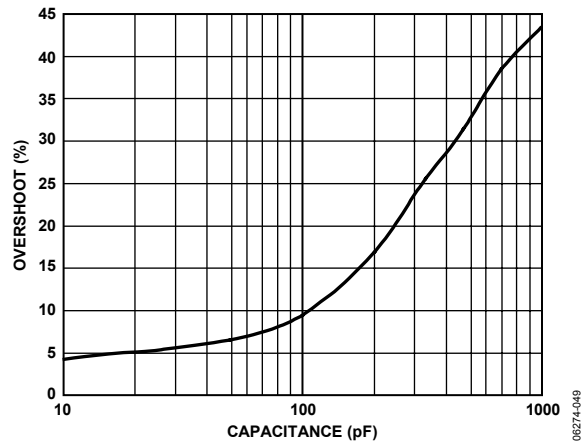


Figure 49. Overshoot vs. Capacitance,  $\pm 5\text{ V} \leq V_S \leq \pm 15\text{ V}$ ,  $A_V = 1$ ,  $R_L = 10\text{ k}\Omega$

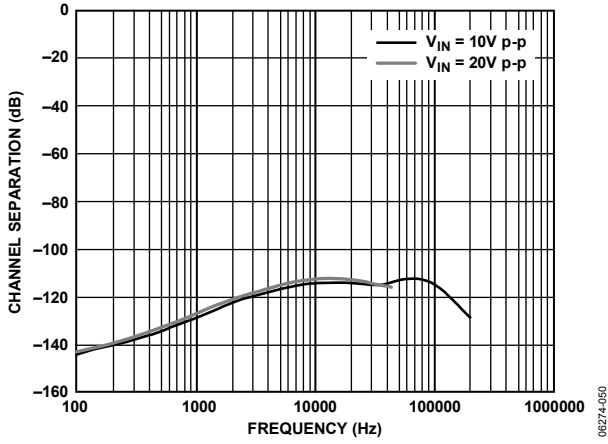


Figure 50. Channel Separation vs. Frequency,  $V_S = \pm 15V$ ,  $A_V = 100$ ,  $R_L = 1k\Omega$

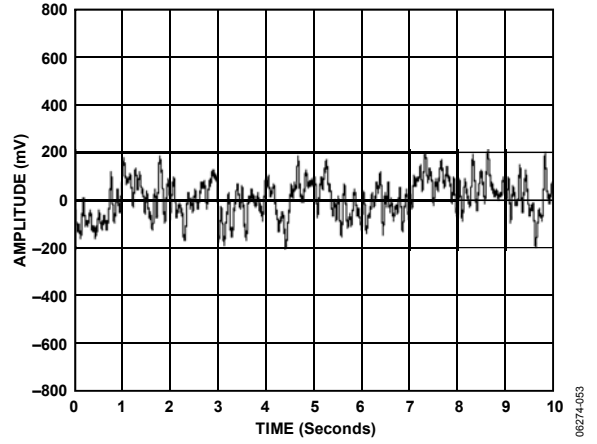
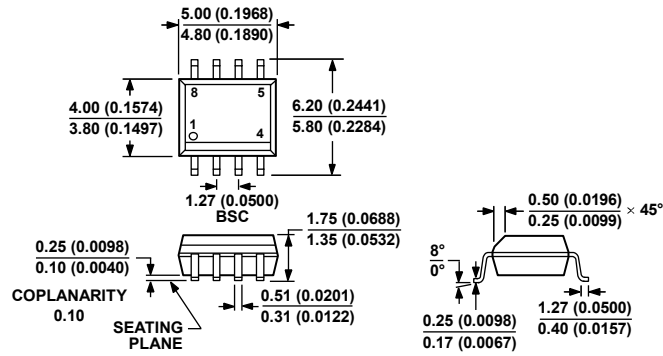


Figure 51. Peak-to-Peak Noise,  $\pm 5V \leq V_S \leq \pm 15V$ ,  $A_V = 1M$

## OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-012-AA  
 CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS  
 (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR  
 REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

012407-A

Figure 52. 8-Lead Standard Small Outline Package [SOIC\_N]  
 Narrow Body (R-8)  
 Dimensions shown in millimeters and (inches)

## ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD8599ARZ <sup>1</sup>	-40°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8
AD8599ARZ-REEL <sup>1</sup>	-40°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8
AD8599ARZ-REEL7 <sup>1</sup>	-40°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8

<sup>1</sup> Z = RoHS Compliant Part.

**NOTES**

**AD8599**

**NOTES**