

### FEATURES

- Supports defense and aerospace applications (AQEC standard)
- Military temperature range ( $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ )
- Controlled manufacturing baseline
- One assembly/test site
- One fabrication site
- Enhanced product change notification
- Qualification data available on request
- Wide bandwidth: 15 MHz
- Low offset voltage: 325  $\mu\text{V}$  maximum
- Low noise: 9.5 nV/ $\sqrt{\text{Hz}}$  @ 1 kHz
- Single-supply operation: 2.7 V to 12 V
- Low supply current: 850  $\mu\text{A}$  maximum
- Rail-to-rail output swing
- Low  $\text{TCV}_{\text{os}}$ : 1  $\mu\text{V}/^{\circ}\text{C}$  typical
- High slew rate: 13 V/ $\mu\text{s}$
- No phase inversion
- Unity-gain stable

### APPLICATIONS

- Portable instrumentation
- Sampling ADC amplifiers
- Precision filters

### PIN CONFIGURATION

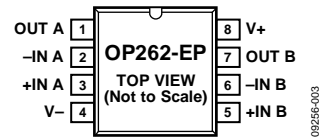


Figure 1. 8-Lead Narrow-Body SOIC (R Suffix)

### GENERAL DESCRIPTION

The OP262-EP is a low power, precision op amp that features a rail-to-rail output and a 15 MHz bandwidth. With its low offset voltage of 45  $\mu\text{V}$  (typical) and low noise, it is well suited for precision filter and control applications.

This product operates from a single supply as low as 2.7 V or from dual supplies up to  $\pm 6$  V. The OP262-EP is specified over the military temperature range ( $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ) and is available in an 8-lead SOIC\_N package.

Additional applications information is available in the [OP162/OP262/OP462](#) data sheet.

#### Rev. 0

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

## TABLE OF CONTENTS

Features .....	1	Absolute Maximum Ratings .....	6
Applications.....	1	ESD Caution.....	6
Pin Configuration.....	1	Typical Performance Characteristics .....	7
General Description .....	1	Outline Dimensions .....	11
Revision History .....	2	Ordering Guide .....	11
Specifications.....	3		
Electrical Characteristics .....	3		

## REVISION HISTORY

7/10—Revision 0: Initial Version

# SPECIFICATIONS

## ELECTRICAL CHARACTERISTICS

$V_S = 5.0\text{ V}$ ,  $V_{CM} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		45	325	$\mu\text{V}$
Input Bias Current	$I_B$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		360	600	nA
Input Offset Current	$I_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		$\pm 2.5$	$\pm 25$	nA
Input Voltage Range	$V_{CM}$	$0\text{ V} \leq V_{CM} \leq 4.0\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	0		4	V
Common-Mode Rejection	CMRR	$0\text{ V} \leq V_{CM} \leq 4.0\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	70	110		dB
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $0.5 \leq V_{OUT} \leq 4.5\text{ V}$		30		V/mV
		$R_L = 10\text{ k}\Omega$ , $0.5 \leq V_{OUT} \leq 4.5\text{ V}$	65	88		V/mV
		$R_L = 10\text{ k}\Omega$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	40			V/mV
Offset Voltage Drift <sup>1</sup>	$\Delta V_{OS}/\Delta T$			1		$\mu\text{V}/^\circ\text{C}$
Bias Current Drift	$\Delta I_B/\Delta T$			250		$\text{pA}/^\circ\text{C}$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage Swing High	$V_{OH}$	$I_L = 250\text{ }\mu\text{A}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	4.95	4.99		V
Output Voltage Swing Low	$V_{OL}$	$I_L = 250\text{ }\mu\text{A}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	4.85	4.94		V
Short-Circuit Current	$I_{SC}$	$I_L = 250\text{ }\mu\text{A}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		14	50	mV
Maximum Output Current	$I_{OUT}$	$I_L = 5\text{ mA}$		65	150	mV
		Short to ground		$\pm 80$		mA
				$\pm 30$		mA
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = 2.7\text{ V to }7\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	90	120		dB
Supply Current/Amplifier	$I_{SY}$	$V_{OUT} = 2.5\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		500	700	$\mu\text{A}$
					850	$\mu\text{A}$
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$1\text{ V} < V_{OUT} < 4\text{ V}$ , $R_L = 10\text{ k}\Omega$		10		V/ $\mu\text{s}$
Settling Time	$t_s$	To 0.1%, $A_V = -1$ , $V_O = 2\text{ V step}$		540		ns
Gain Bandwidth Product	GBP			15		MHz
Phase Margin	$\phi_m$			61		Degrees
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n$ p-p	0.1 Hz to 10 Hz		0.5		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		9.5		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$	$f = 1\text{ kHz}$		0.4		$\text{pA}/\sqrt{\text{Hz}}$

<sup>1</sup> Offset voltage drift is the average of the  $-55^\circ\text{C}$  to  $+25^\circ\text{C}$  delta and the  $+25^\circ\text{C}$  to  $+125^\circ\text{C}$  delta.

# OP262-EP

$V_S = 3.0\text{ V}$ ,  $V_{CM} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

**Table 2.**

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		50	325	$\mu\text{V}$ mV
Input Bias Current	$I_B$			360	600	nA
Input Offset Current	$I_{OS}$			$\pm 2.5$	$\pm 25$	nA
Input Voltage Range	$V_{CM}$		0		2	V
Common-Mode Rejection	CMRR	$0\text{ V} \leq V_{CM} \leq 2.0\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	70	110		dB
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $0.5\text{ V} \leq V_{OUT} \leq 2.5\text{ V}$		20		V/mV
		$R_L = 10\text{ k}\Omega$ , $0.5\text{ V} \leq V_{OUT} \leq 2.5\text{ V}$	20	30		V/mV
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage Swing High	$V_{OH}$	$I_L = 250\ \mu\text{A}$ $I_L = 5\text{ mA}$	2.95 2.85	2.99 2.93		V V
Output Voltage Swing Low	$V_{OL}$	$I_L = 250\ \mu\text{A}$		14	50	mV
		$I_L = 5\text{ mA}$		66	150	mV
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = 2.7\text{ V to } 7\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	60	110		dB dB
Supply Current/Amplifier	$I_{SY}$	$V_{OUT} = 1.5\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		500	650 850	$\mu\text{A}$ $\mu\text{A}$
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 10\text{ k}\Omega$		10		V/ $\mu\text{s}$
Settling Time	$t_s$	To 0.1%, $A_v = -1$ , $V_o = 2\text{ V step}$		575		ns
Gain Bandwidth Product	GBP			15		MHz
Phase Margin	$\phi_m$			59		Degrees
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n\text{ p-p}$	0.1 Hz to 10 Hz		0.5		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		9.5		nV/ $\sqrt{\text{Hz}}$
Current Noise Density	$i_n$	$f = 1\text{ kHz}$		0.4		pA/ $\sqrt{\text{Hz}}$

$V_S = \pm 5.0\text{ V}$ ,  $V_{CM} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 3.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		25	325	$\mu\text{V}$
Input Bias Current	$I_B$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		260	500	nA
Input Offset Current	$I_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		$\pm 2.5$	$\pm 25$	nA
Input Voltage Range	$V_{CM}$		-5		+4	V
Common-Mode Rejection	CMRR	$-4.9\text{ V} \leq V_{CM} \leq +4.0\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	70	110		dB
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $-4.5\text{ V} \leq V_{OUT} \leq +4.5\text{ V}$		35		V/mV
		$R_L = 10\text{ k}\Omega$ , $-4.5\text{ V} \leq V_{OUT} \leq +4.5\text{ V}$	75	120		V/mV
Long-Term Offset Voltage <sup>1</sup>	$V_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			600	$\mu\text{V}$
Offset Voltage Drift <sup>2</sup>	$\Delta V_{OS}/\Delta T$			1		$\mu\text{V}/^\circ\text{C}$
Bias Current Drift	$\Delta I_B/\Delta T$			250		$\text{pA}/^\circ\text{C}$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage Swing High	$V_{OH}$	$I_L = 250\ \mu\text{A}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	4.95	4.99		V
Output Voltage Swing Low	$V_{OL}$	$I_L = 250\ \mu\text{A}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	4.85	4.94		V
Short-Circuit Current	$I_{SC}$	Short to ground		$\pm 80$		mA
Maximum Output Current	$I_{OUT}$			$\pm 30$		mA
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = \pm 1.35\text{ V to } \pm 6\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	60	110		dB
Supply Current/Amplifier	$I_{SY}$	$V_{OUT} = 0\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		650	800	$\mu\text{A}$
		$V_{OUT} = 0\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		550	775	$\mu\text{A}$
		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			1	mA
Supply Voltage Range	$V_S$		3.0 ( $\pm 1.5$ )		12 ( $\pm 6$ )	V
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$-4\text{ V} < V_{OUT} < +4\text{ V}$ , $R_L = 10\text{ k}\Omega$		13		V/ $\mu\text{s}$
Settling Time	$t_S$	To 0.1%, $A_V = -1$ , $V_O = 2\text{ V}$ step		475		ns
Gain Bandwidth Product	GBP			15		MHz
Phase Margin	$\phi_m$			64		Degrees
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n$ p-p	0.1 Hz to 10 Hz		0.5		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		9.5		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$	$f = 1\text{ kHz}$		0.4		$\text{pA}/\sqrt{\text{Hz}}$

<sup>1</sup> Long-term offset voltage is guaranteed by a 1000 hour life test performed on three independent lots at 125°C, with an LTPD of 1.3.

<sup>2</sup> Offset voltage drift is the average of the  $-55^\circ\text{C}$  to  $+25^\circ\text{C}$  delta and the  $+25^\circ\text{C}$  to  $+125^\circ\text{C}$  delta.

## ABSOLUTE MAXIMUM RATINGS

**Table 4.**

Parameter	Min
Supply Voltage	±6 V
Input Voltage <sup>1</sup>	±6 V
Differential Input Voltage <sup>2</sup>	±0.6 V
Internal Power Dissipation SOIC (S)	Observe Derating Curves
Output Short-Circuit Duration	Observe Derating Curves
Storage Temperature Range	–65°C to +150°C
Operating Temperature Range	–55°C to +125°C
Junction Temperature Range	–65°C to +150°C
Lead Temperature Range, (Soldering, 10 sec)	300°C

<sup>1</sup> For supply voltages greater than 6 V, the input voltage is limited to less than or equal to the supply voltage.

<sup>2</sup> For differential input voltages greater than 0.6 V, the input current should be limited to less than 5 mA to prevent degradation or destruction of the input devices.

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.

**Table 5.**

Package Type	$\theta_{JA}$ <sup>1</sup>	$\theta_{JC}$	Unit
8-Lead SOIC (R)	157	56	°C/W

<sup>1</sup>  $\theta_{JA}$  is specified for the worst-case conditions, that is,  $\theta_{JA}$  is specified for a device soldered in circuit board for SOIC package.

### 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

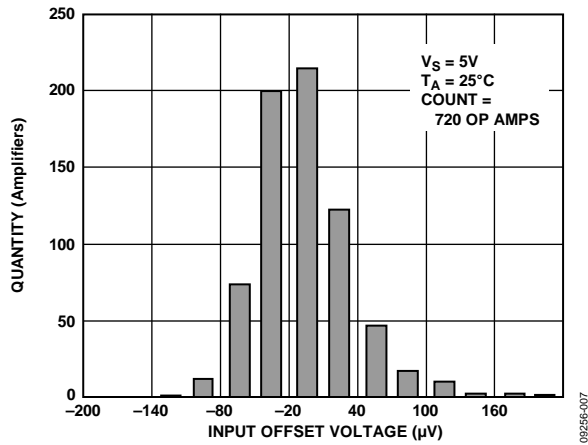


Figure 2. Input Offset Voltage Distribution

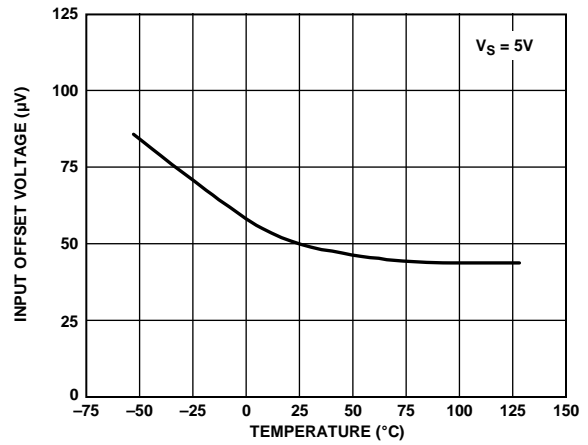


Figure 5. Input Offset Voltage vs. Temperature

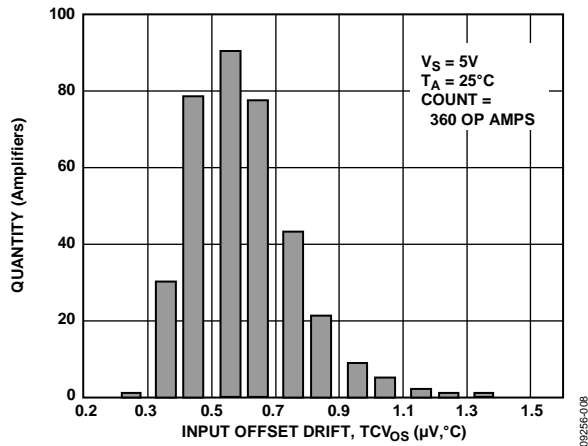


Figure 3. Input Offset Voltage Drift (TCV<sub>0S</sub>)

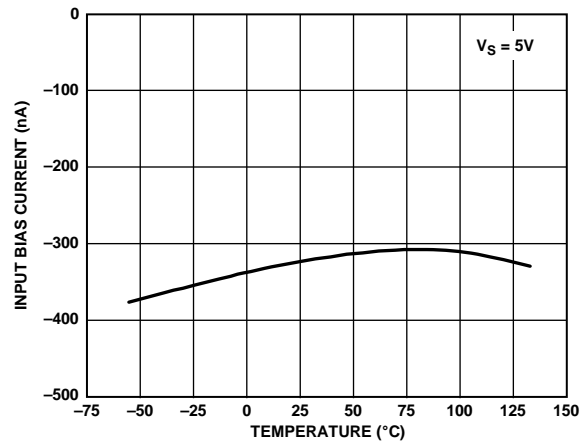


Figure 6. Input Bias Current vs. Temperature

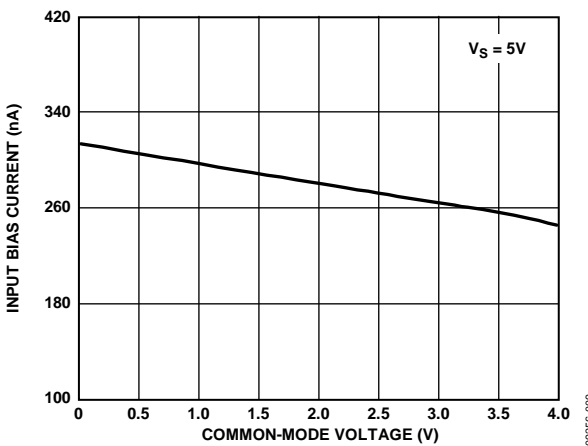


Figure 4. Input Bias Current vs. Common-Mode Voltage

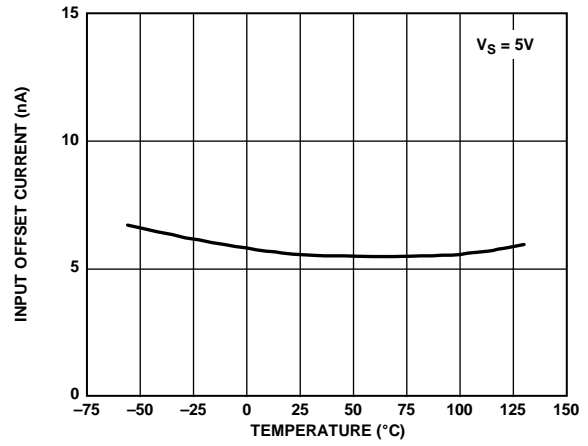


Figure 7. Input Offset Current vs. Temperature

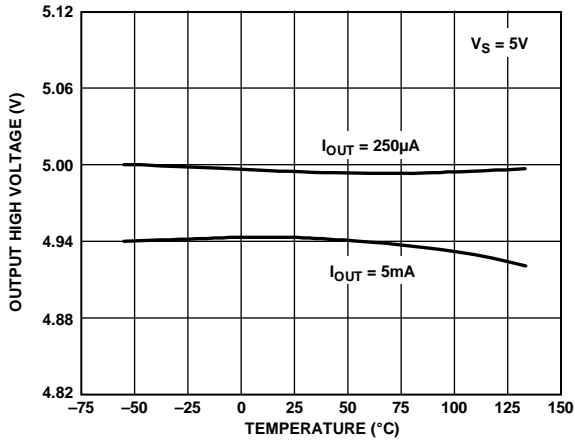


Figure 8. Output High Voltage vs. Temperature

09256-013

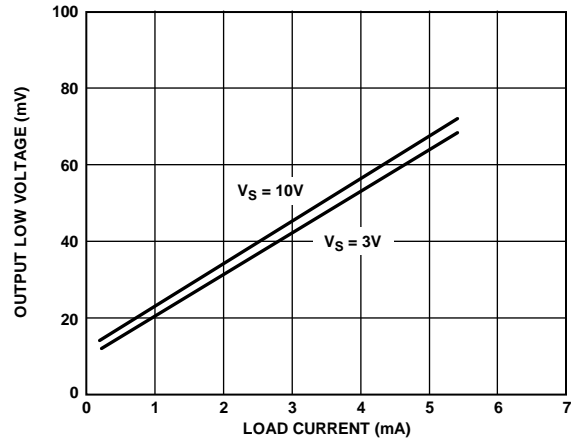


Figure 11. Output Low Voltage to Supply Rail vs. Load Current

09256-016

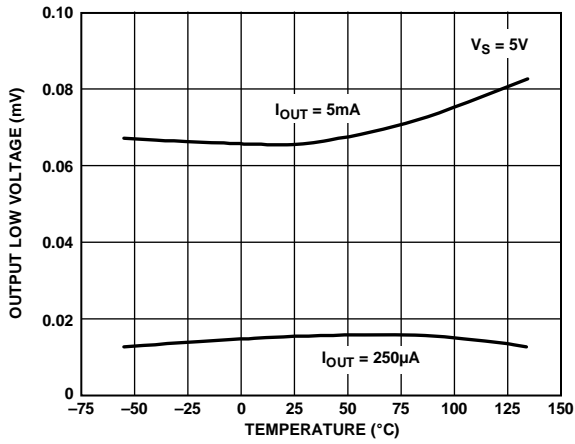


Figure 9. Output Low Voltage vs. Temperature

09256-014

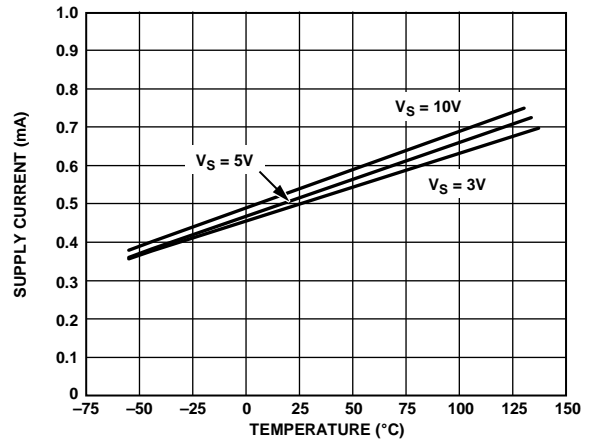


Figure 12. Supply Current/Amplifier vs. Temperature

09256-017

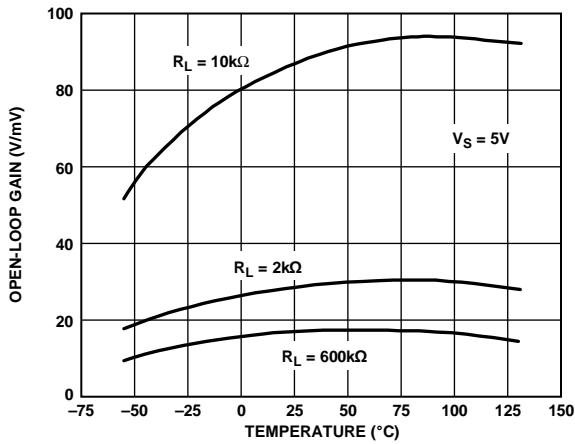


Figure 10. Open-Loop Gain vs. Temperature

09256-015

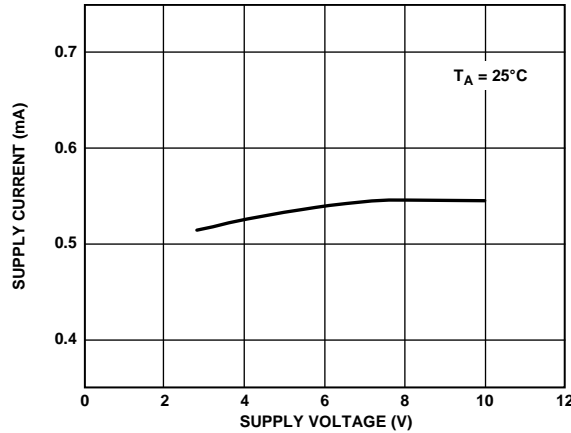


Figure 13. Supply Current/Amplifier vs. Supply Voltage

09256-018



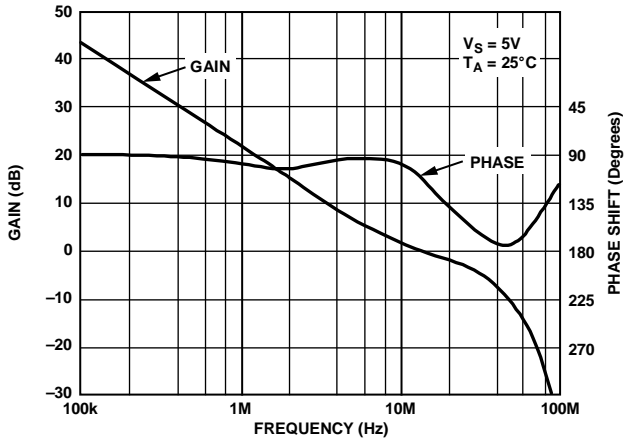


Figure 14. Open-Loop Gain and Phase vs. Frequency (No Load)

09256-019

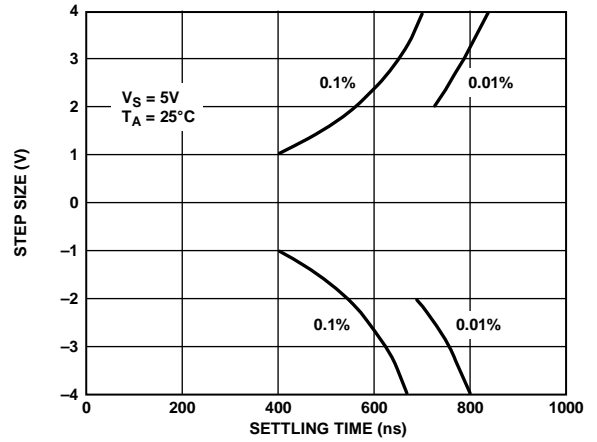


Figure 17. Step Size vs. Settling Time

09256-022

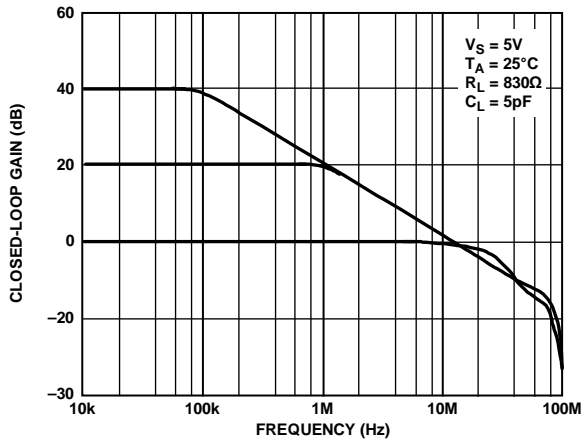


Figure 15. Closed-Loop Gain vs. Frequency

09256-020

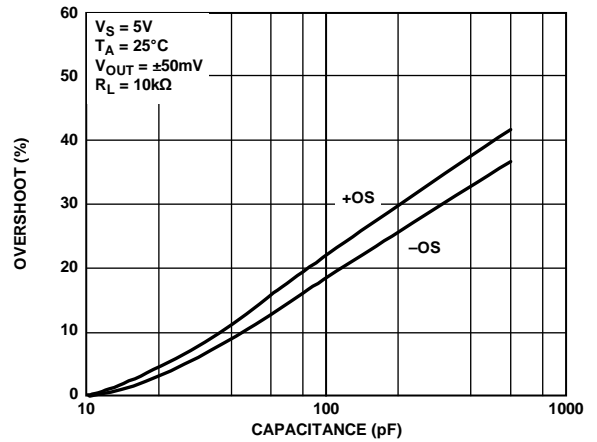


Figure 18. Small-Signal Overshoot vs. Capacitance

09256-023

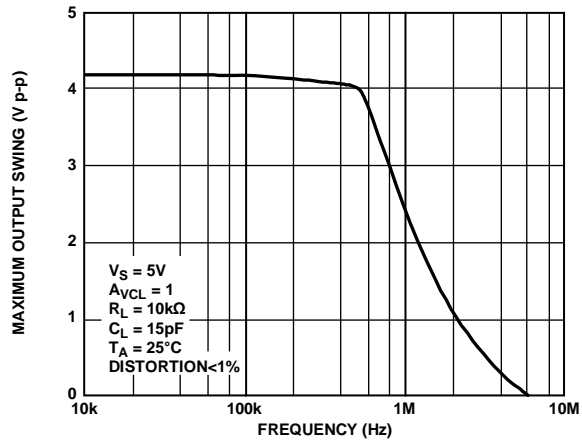


Figure 16. Maximum Output Swing vs. Frequency

09256-021

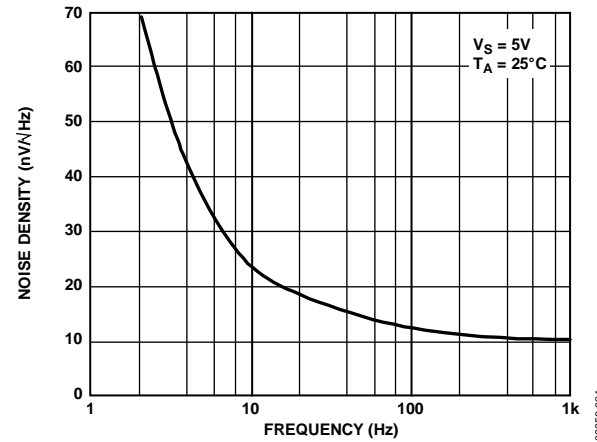


Figure 19. Voltage Noise Density vs. Frequency

09256-024

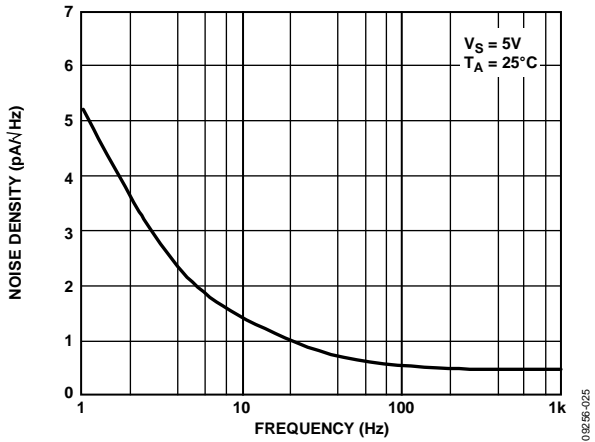


Figure 20. Current Noise Density vs. Frequency

09256-025

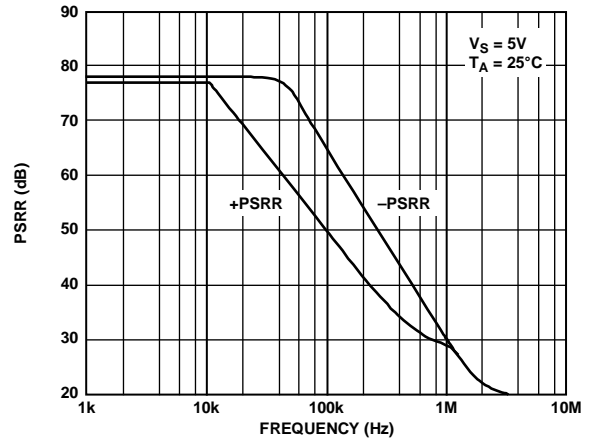


Figure 23. PSRR vs. Frequency

09256-028

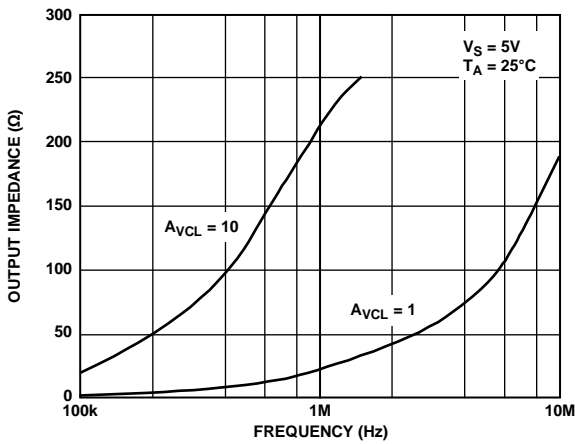


Figure 21. Output Impedance vs. Frequency

09256-026

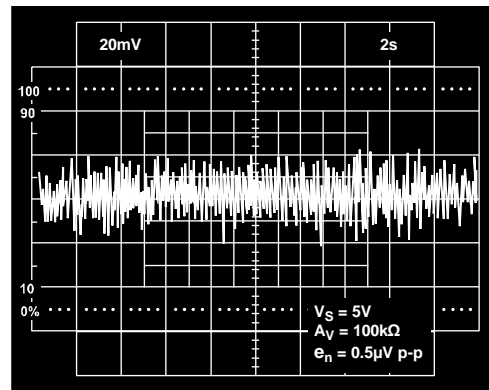


Figure 24. 0.1 Hz to 10 Hz Noise

09256-029

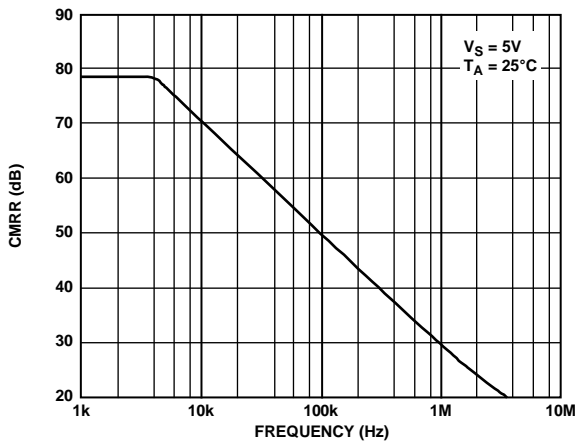


Figure 22. CMRR vs. Frequency

09256-027

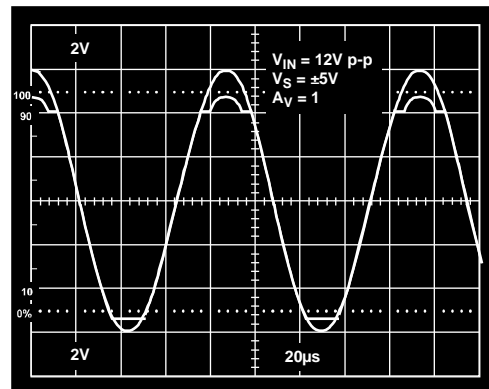
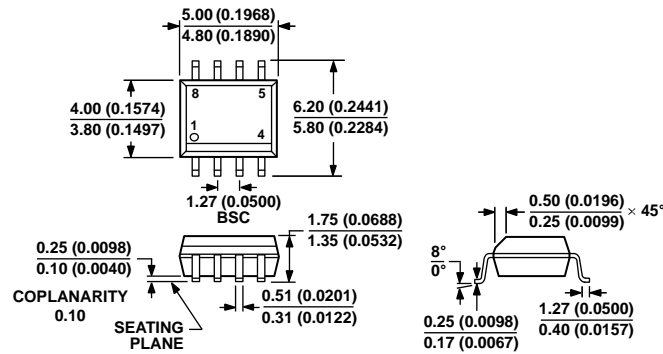


Figure 25. No Phase Reversal ( $V_{IN} = 12V$  p-p,  $V_S = \pm 5V$ ,  $A_V = 1$ )

09256-030

# 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.

012607-A

Figure 26. 8-Lead Standard Small Outline Package [SOIC\_N]  
 Narrow Body  
 (R-8)  
 Dimensions shown in millimeters and (inches)

## ORDERING GUIDE

Model <sup>1</sup>	Temperature Range	Package Description	Package Option
OP262TRZ-EP	-55°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8
OP262TRZ-EP-R7	-55°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8

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

**OP262-EP**

**NOTES**