

## FEATURES

**Single-supply operation**  
**Wide bandwidth: 4.25 MHz**  
**Low offset voltage: 100  $\mu$ V**  
**Unity-gain stable**  
**High slew rate: 4.0 V/ $\mu$ s**  
**Low noise: 3.9 nV/ $\sqrt$ Hz**

## ENHANCED PRODUCT FEATURES

**Supports defense and aerospace applications (AQEC standard)**  
**Military temperature range ( $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ )**  
**Controlled manufacturing baseline**  
**1 assembly/test site**  
**1 fabrication site**  
**Enhanced product change notification**  
**Qualification data available on request**

## APPLICATIONS

**Battery-powered instrumentation**  
**Power supply control and protection**  
**Telecommunications**  
**DAC output amplifier**  
**ADC input buffer**

## GENERAL DESCRIPTION

The **OP284-EP** is a dual, single-supply, 4.25 MHz bandwidth amplifier featuring rail-to-rail inputs and outputs (RRIO).

The **OP284-EP** is guaranteed to operate from 5 V to 36 V (or  $\pm 2.5$  V to  $\pm 18$  V).

This amplifier is superb for single-supply applications requiring both ac and precision dc performance. The combination of wide bandwidth, low noise, and precision makes the **OP284-EP** useful in a wide variety of applications, including filters and instrumentation.

Other applications for this amplifier include portable telecommunications equipment, power supply control and protection,

and use as an amplifier or buffer for transducers with wide output ranges. Sensors requiring a rail-to-rail input amplifier include Hall effect, piezoelectric, and resistive transducers.

The ability to swing rail to rail at both the input and output enables designers to build multistage filters in single-supply systems and to maintain high signal-to-noise ratios.

The **OP284-EP** is specified over the extended industrial temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . The **OP284-EP** is available in a SOIC surface-mount package.

## PIN CONNECTION DIAGRAM

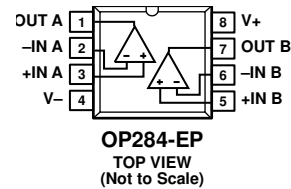


Figure 1.

125682-001

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**REVISION HISTORY**

5/15—Revision 0: Initial Version

**SPECIFICATIONS****ELECTRICAL CHARACTERISTICS**

$V_S = 5.0\text{ V}$ ,  $V_{CM} = 2.5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			125	$\mu\text{V}$
Input Bias Current	$I_B$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		60	250	$\mu\text{V}$
Input Offset Current	$I_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			450	nA
Input Voltage Range		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			600	nA
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 1.0\text{ V to }4.0\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	0		5	V
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $1\text{ V} \leq V_{OUT} \leq 4\text{ V}$	86	240		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$R_L = 2\text{ k}\Omega$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	50			V/mV
Bias Current Drift	$\Delta I_B/\Delta T$		25	0.2	2.00	V/mV
				150		$\mu\text{V}/^\circ\text{C}$
						$\text{pA}/^\circ\text{C}$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$I_L = 1.0\text{ mA}$	4.80			V
Output Voltage Low	$V_{OL}$	$I_L = 1.0\text{ mA}$			125	mV
Output Current	$I_{OUT}$		$\pm 6.5$			mA
<b>POWER SUPPLY</b>						
Supply Current/Amplifier	$I_{SY}$	$V_{OUT} = 2.5\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			1.45	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 2\text{ k}\Omega$	1.65	2.4		V/ $\mu\text{s}$
Settling Time	$t_s$	To 0.01%, 1.0 V step		2.5		$\mu\text{s}$
Gain Bandwidth Product	GBP			3.25		MHz
Phase Margin	$\Phi_M$			45		Degrees
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n$ p-p	0.1 Hz to 10 Hz		0.3		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		3.9		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$			0.4		$\text{pA}/\sqrt{\text{Hz}}$

$V_S = \pm 15.0\text{ V}$ ,  $V_{CM} = 0\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 2.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			100	$\mu\text{V}$
Input Bias Current	$I_B$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		80	200	$\mu\text{V}$
Input Offset Current	$I_{OS}$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			450	nA
Input Voltage Range		$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			600	nA
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -14.0\text{ V to }+14.0\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	-15	90	+15	V
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $-10\text{ V} \leq V_{OUT} \leq 10\text{ V}$	150	1000		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$R_L = 2\text{ k}\Omega$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.2	2.00	$\mu\text{V}/^\circ\text{C}$
Bias Current Drift	$\Delta I_B/\Delta T$			150		$\text{pA}/^\circ\text{C}$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$I_L = 1.0\text{ mA}$	14.8			V
Output Voltage Low	$V_{OL}$	$I_L = 1.0\text{ mA}$			-14.875	V
Output Current	$I_{OUT}$		$\pm 10$			mA
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = \pm 2.0\text{ V to } \pm 18\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	90			dB
Supply Current/Amplifier	$I_{SY}$	$V_{OUT} = 0\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			2.0	mA
		$V_S = \pm 18\text{ V}$ , $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$			2.25	mA
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 2\text{ k}\Omega$	2.4	4.0		$\text{V}/\mu\text{s}$
Full Power Bandwidth	$BW_p$	1% distortion, $R_L = 2\text{ k}\Omega$ , $V_{OUT} = 29\text{ V p-p}$		35		kHz
Settling Time	$t_s$	To 0.01%, 10 V step		4		$\mu\text{s}$
Gain Bandwidth Product	GBP			4.25		MHz
Phase Margin	$\Phi_M$			50		Degrees
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n$ p-p	0.1 Hz to 10 Hz		0.3		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		3.9		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$			0.4		$\text{pA}/\sqrt{\text{Hz}}$

## ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	±18 V
Input Voltage	±18 V
Differential Input Voltage <sup>1</sup>	±0.6 V
Output Short-Circuit Duration to GND	Indefinite
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 (Soldering 60 sec)	300°C

<sup>1</sup> For input voltages greater than 0.6 V, the input current must be limited to less than 5 mA to prevent degradation or destruction of the input devices.

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

## THERMAL RESISTANCE

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

Table 4. Thermal Resistance

Package Type	$\theta_{JA}$	$\theta_{JC}$	Unit
8-Lead SOIC	158	43	°C/W

## 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.

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

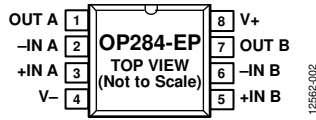


Figure 2. Pin Configuration

Table 5. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	OUT A	Output Channel A.
2	-IN A	Inverting Input Channel A.
3	+IN A	Noninverting Input Channel A.
4	V-	Negative Supply Voltage.
5	+IN B	Noninverting Input Channel B.
6	-IN B	Inverting Input Channel B.
7	OUT B	Output Channel B.
8	V+	Positive Supply Voltage.

TYPICAL PERFORMANCE CHARACTERISTICS

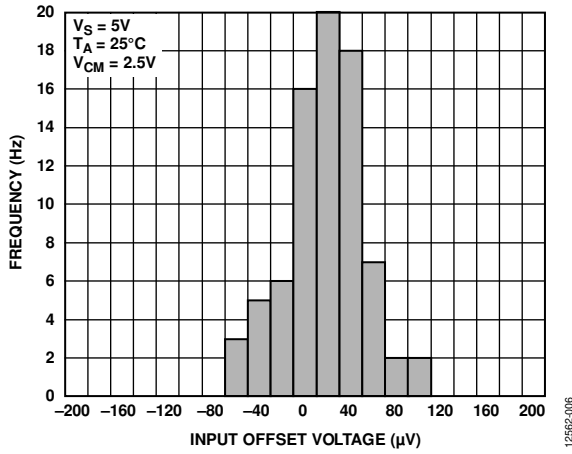


Figure 3. Input Offset Voltage Distribution,  $V_S = 5V$

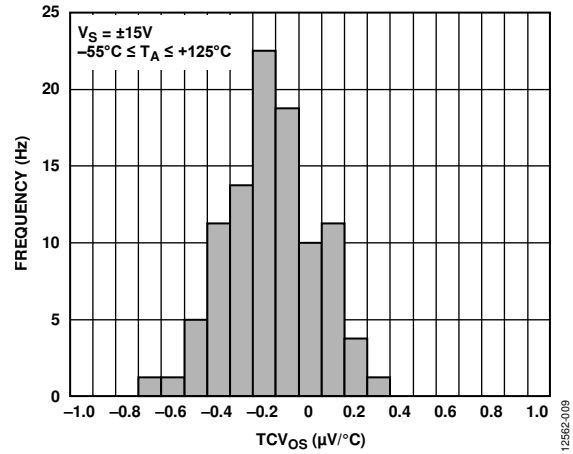


Figure 6. Input Offset Voltage Drift Distribution,  $V_S = \pm 15V$

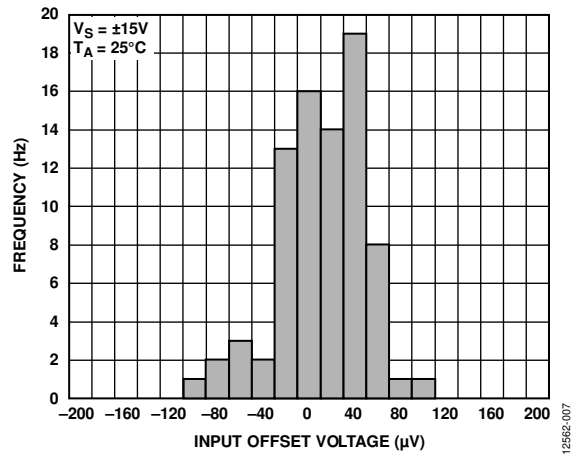


Figure 4. Input Offset Voltage Distribution,  $V_S = \pm 15V$

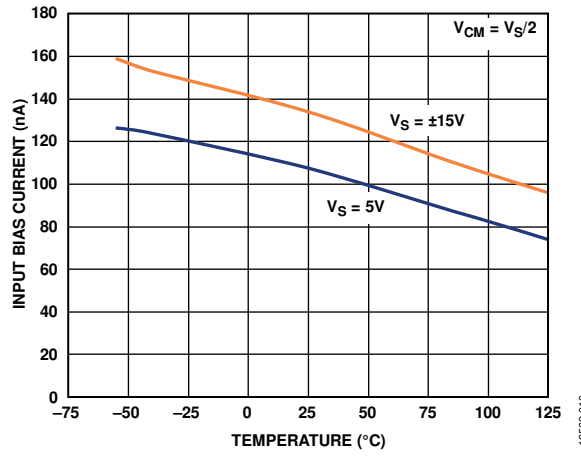


Figure 7. Bias Current vs. Temperature

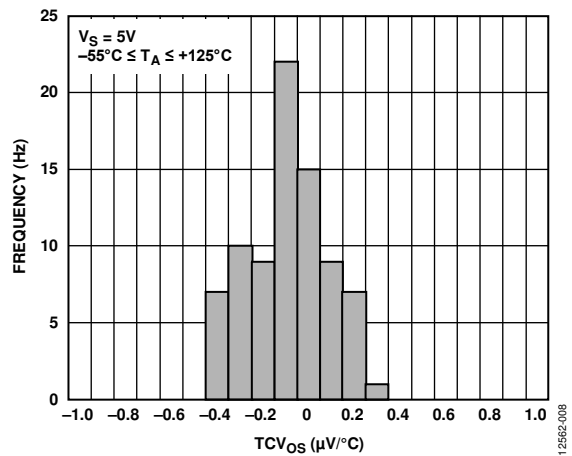


Figure 5. Input Offset Voltage Drift Distribution,  $V_S = 5V$

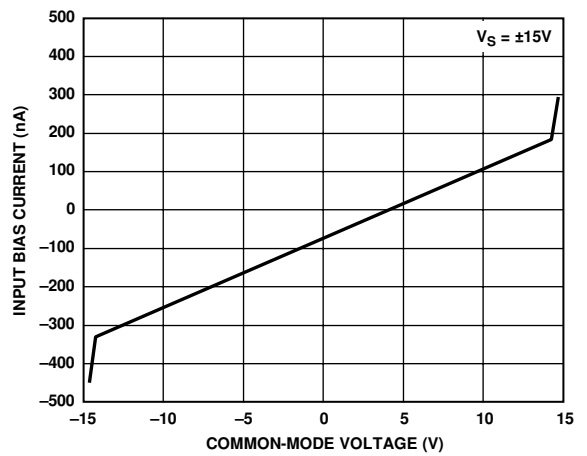


Figure 8. Input Bias Current vs. Common-Mode Voltage

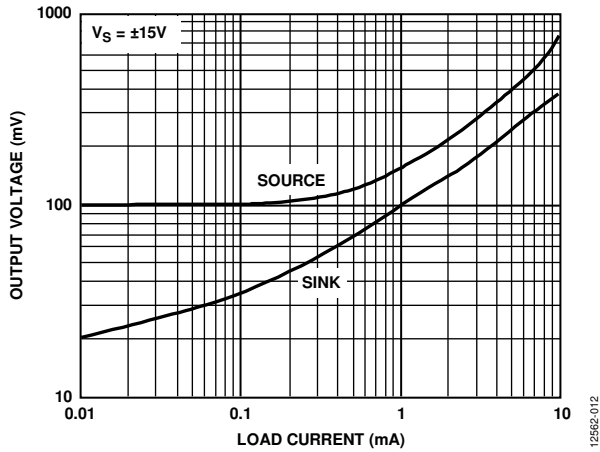


Figure 9. Output Voltage to Supply Rail vs. Load Current

12562-012

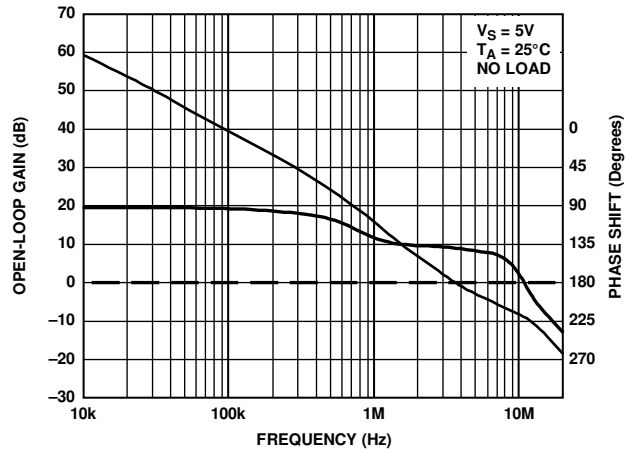


Figure 12. Open-Loop Gain and Phase vs. Frequency (No Load),  $V_S = 5V$

12562-016

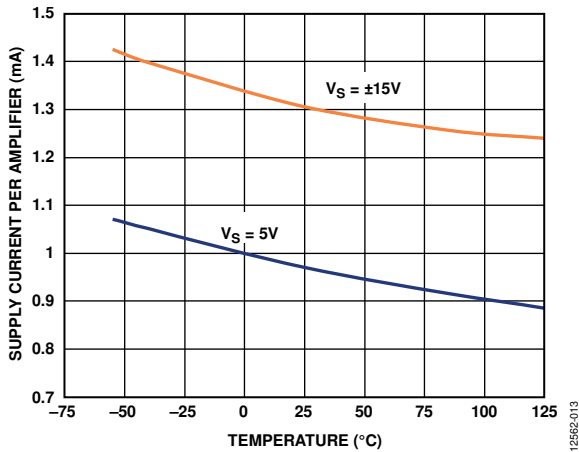


Figure 10. Supply Current vs. Temperature

12562-013

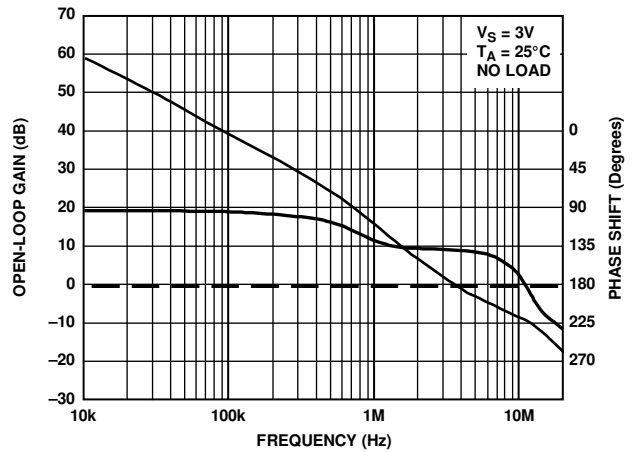


Figure 13. Open-Loop Gain and Phase vs. Frequency (No Load),  $V_S = 3V$

12562-017

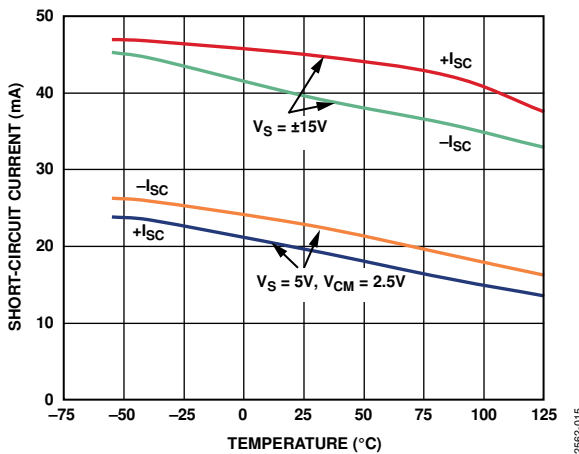


Figure 11. Short-Circuit Current vs. Temperature

12562-015

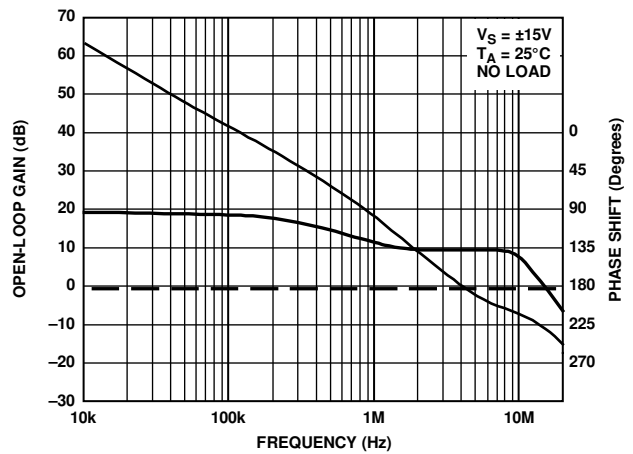


Figure 14. Open-Loop Gain and Phase vs. Frequency (No Load),  $V_S = \pm 15V$

12562-018



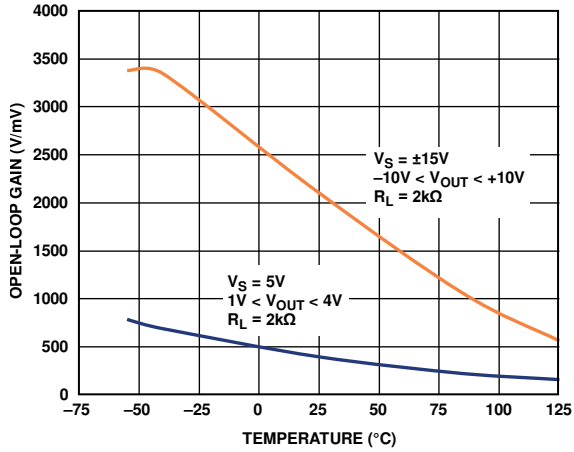


Figure 15. Open-Loop Gain vs. Temperature

12562-019

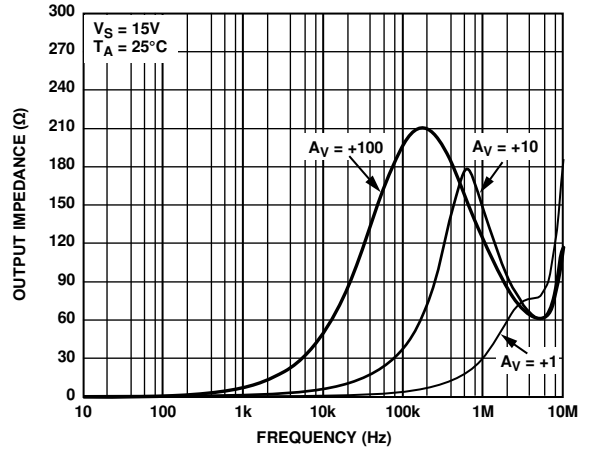


Figure 18. Output Impedance vs. Frequency

12562-024

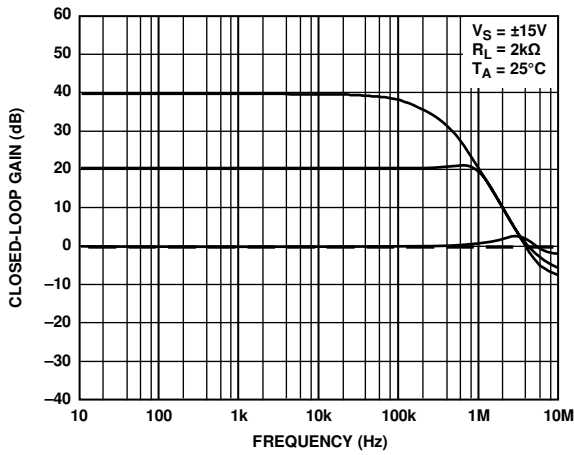


Figure 16. Closed-Loop Gain vs. Frequency (2 kΩ Load)

12562-021

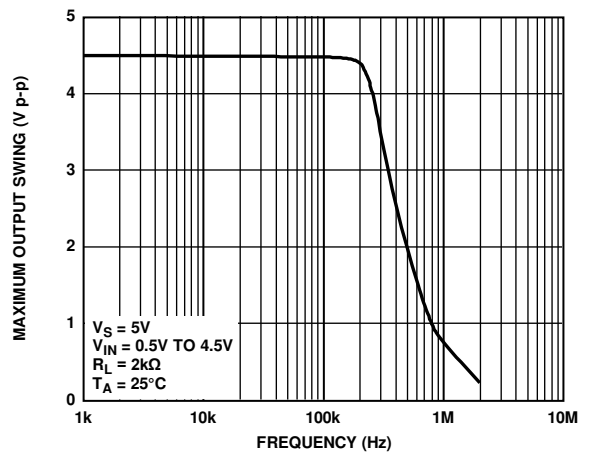


Figure 19. Maximum Output Swing vs. Frequency

12562-026

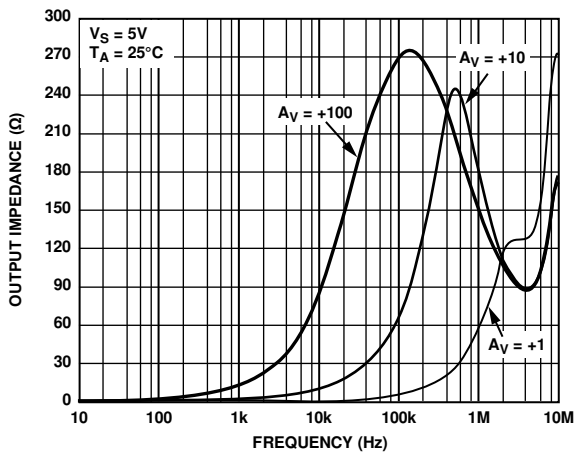


Figure 17. Output Impedance vs. Frequency

12562-023

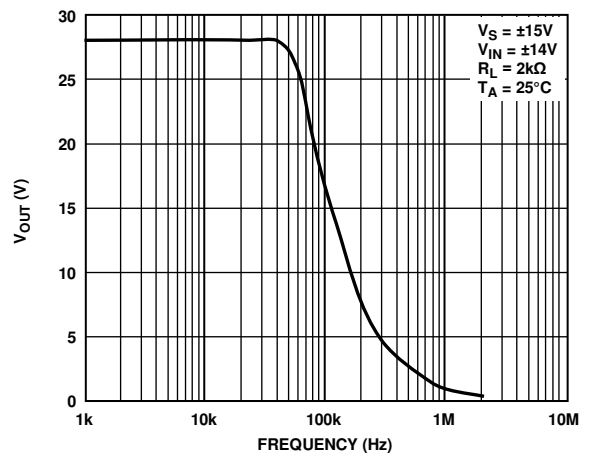


Figure 20. Maximum Output Swing vs. Frequency

12562-027

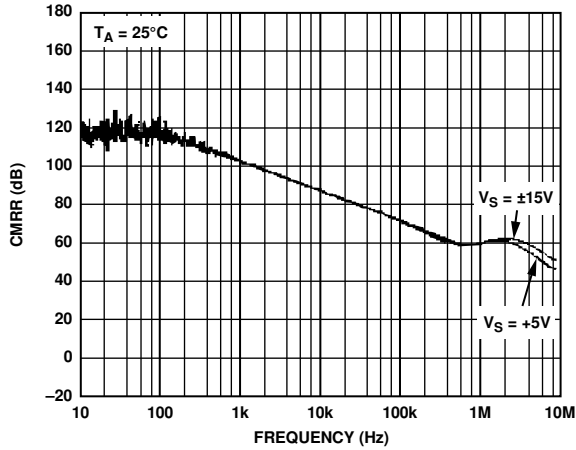


Figure 21. CMRR vs. Frequency

12562-028

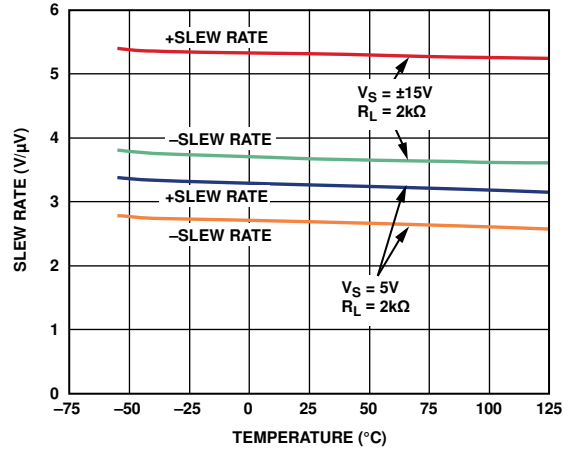


Figure 24. Slew Rate vs. Temperature

12562-031

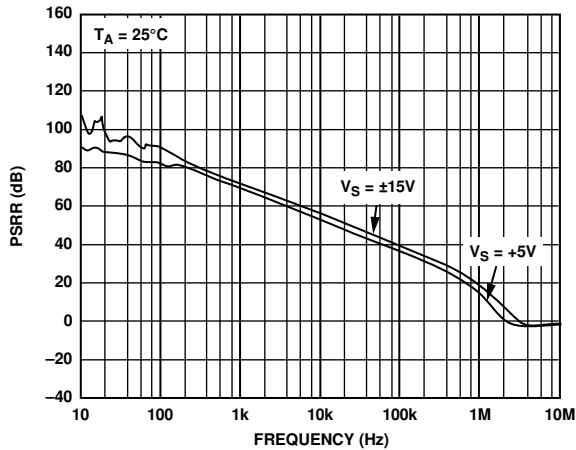


Figure 22. PSRR vs. Frequency

12562-029

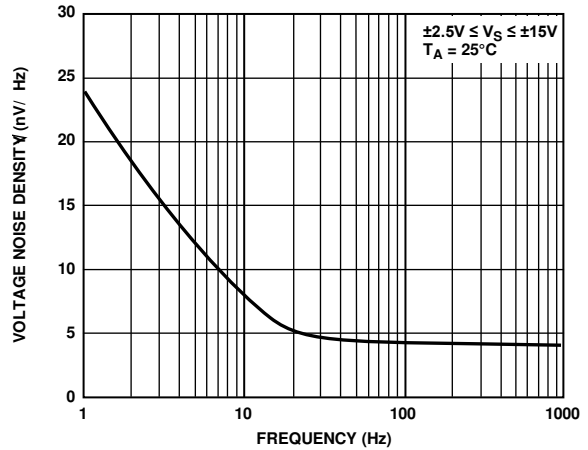


Figure 25. Voltage Noise Density vs. Frequency

12562-032

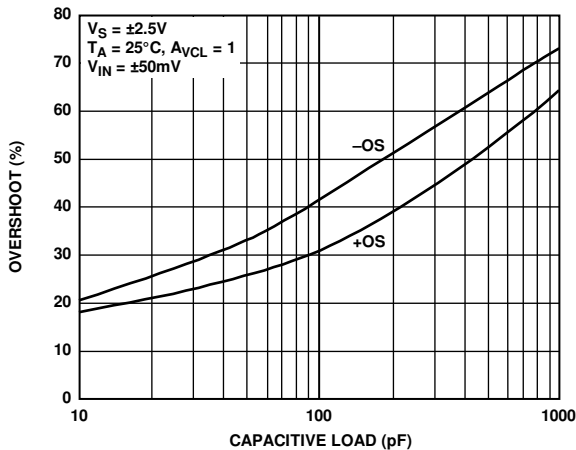


Figure 23. Small Signal Overshoot vs. Capacitive Load

12562-030

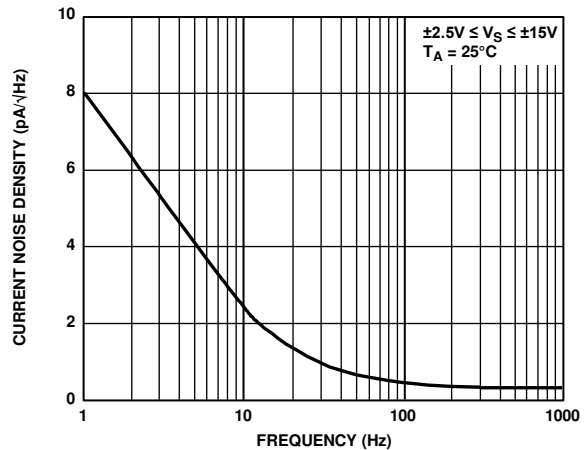


Figure 26. Current Noise Density vs. Frequency

12562-033

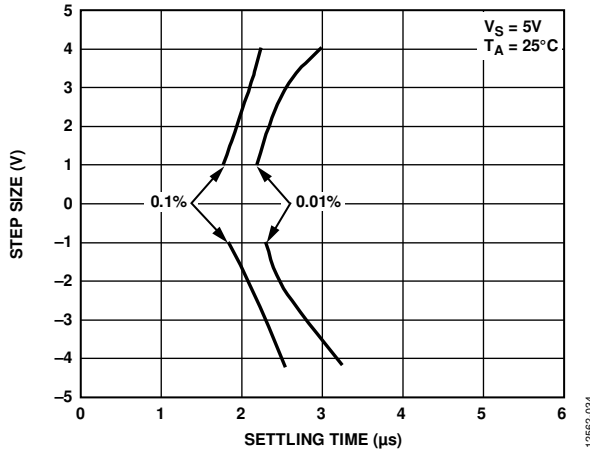


Figure 27. Step Size vs. Settling Time,  $V_S = 5V$

125662-034

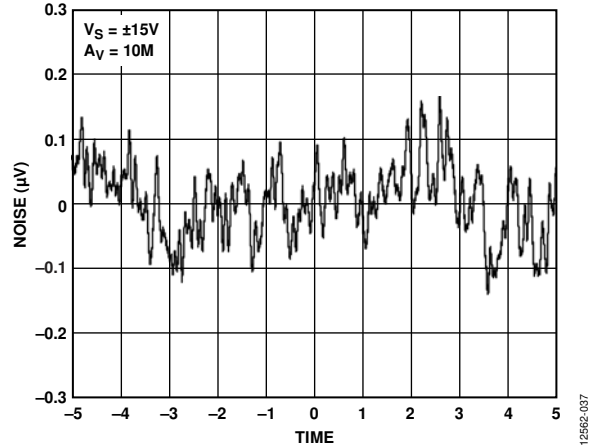


Figure 30. 0.1 Hz to 10 Hz Noise,  $V_S = \pm 15V$

125662-037

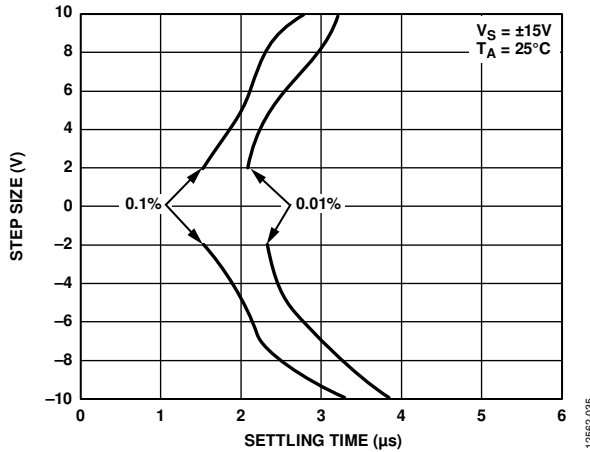


Figure 28. Step Size vs. Settling Time,  $V_S = \pm 15V$

125662-035

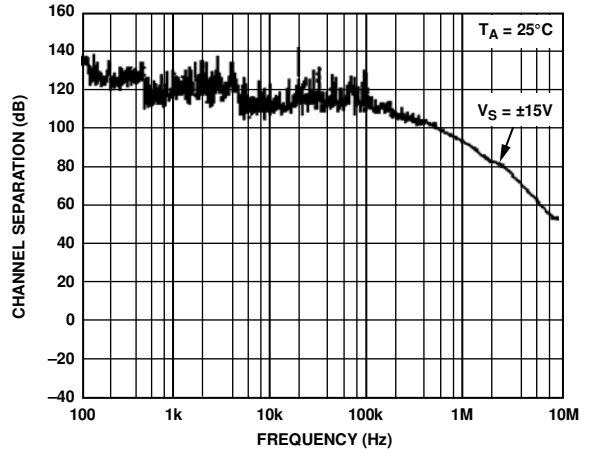


Figure 31. Channel Separation vs. Frequency

125662-038

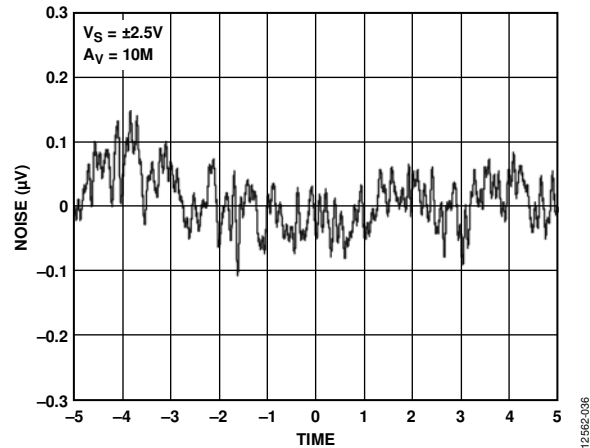


Figure 29. 0.1 Hz to 10 Hz Noise,  $V_S = \pm 2.5V$

125662-036

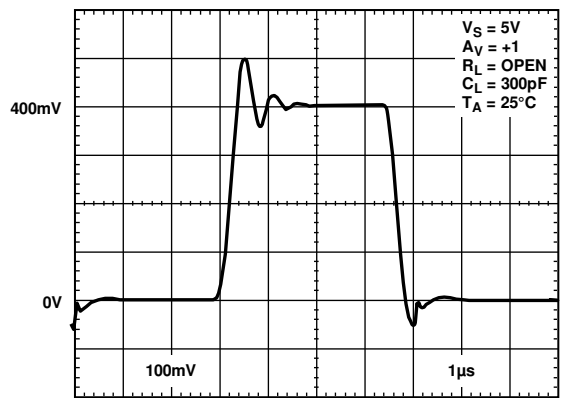


Figure 32. Small Signal Transient Response

125662-039

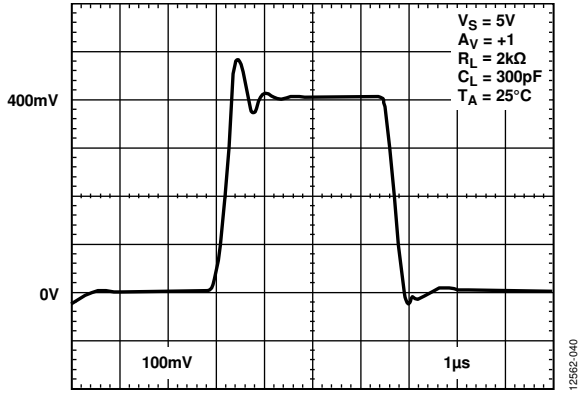


Figure 33. Small Signal Transient Response

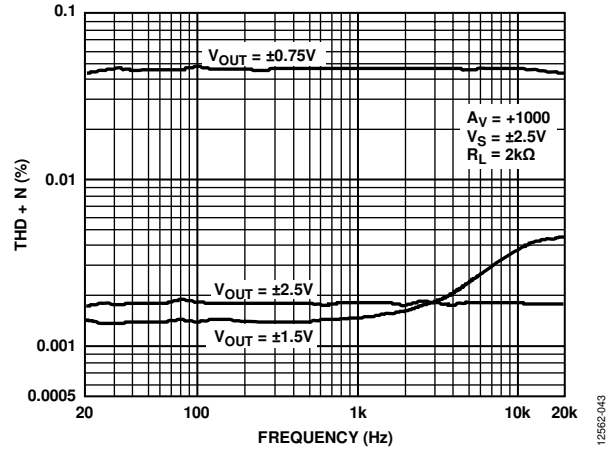
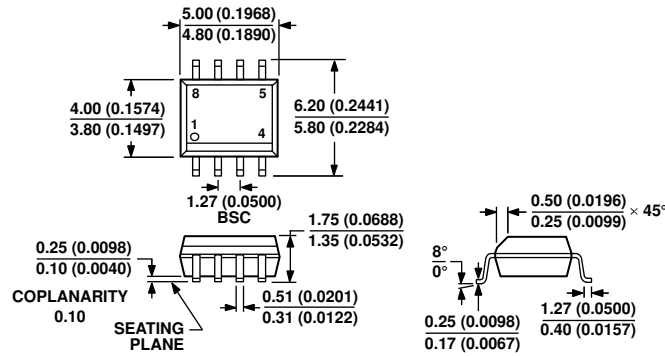


Figure 34. Total Harmonic Distortion + Noise vs. Frequency

### 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.

012807-A

Figure 35. 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
OP284TRZ-EP-R7	-55°C to +125°C	8-Lead Standard Small Outline Package [SOIC_N]	R-8

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