



**THE DATASHEET OF  
AD822TRZ-EP-R7**



### FEATURES

#### True single-supply operation

- Input voltage range extends below ground
- Output swings rail-to-rail
- Single-supply capability from 5 V to 30 V
- Dual-supply capability from  $\pm 2.5$  V to  $\pm 15$  V

#### High load drive

- Capacitive load drive of 350 pF,  $G = +1$
- Minimum output current of 15 mA

#### Excellent ac performance for low power

- 800  $\mu$ A maximum quiescent current per amplifier
- Unity-gain bandwidth: 1.8 MHz
- Slew rate of 3 V/ $\mu$ s

#### Good dc performance

- 800  $\mu$ V maximum input offset voltage
- 2  $\mu$ V/ $^{\circ}$ C typical offset voltage drift
- 25 pA maximum input bias current

#### Low noise

- 13 nV/ $\sqrt{\text{Hz}}$  @ 10 kHz
- No phase inversion

### 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

One assembly/test site

One fabrication site

Enhanced product change notification

Qualification data available on request

### APPLICATIONS

Photodiode preamps

Active filters

12-bit to 14-bit data acquisition systems

Low power references and regulators

### CONNECTION DIAGRAM

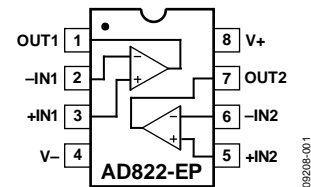


Figure 1. 8-Lead SOIC\_N (R Suffix)

### GENERAL DESCRIPTION

The AD822-EP is a dual precision, low power FET input op amp that can operate from a single supply of 5 V to 30 V or dual supplies of  $\pm 2.5$  V to  $\pm 15$  V. It has true single-supply capability with an input voltage range extending below the negative rail, allowing the AD822 to accommodate input signals below ground in the single-supply mode. Output voltage swing extends to within 10 mV of each rail, providing the maximum output dynamic range.

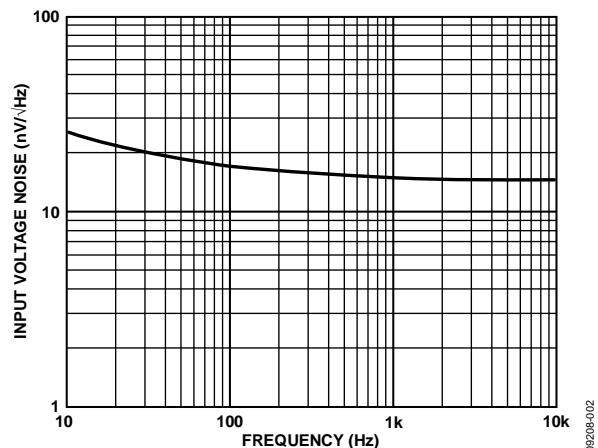


Figure 2. Input Voltage Noise vs. Frequency

Offset voltage of 800  $\mu$ V maximum, offset voltage drift of 2  $\mu$ V/ $^{\circ}$ C, input bias currents below 25 pA, and low input voltage noise provide dc precision with source impedances up to a gigaohm. The 1.8 MHz unity-gain bandwidth,  $-93$  dB THD at 10 kHz, and 3 V/ $\mu$ s slew rate are provided with a low supply current of 800  $\mu$ A per amplifier.

#### 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 .....            | 10 |
| Enhanced Product Features ..... | 1 | Thermal Resistance .....                  | 10 |
| Applications.....               | 1 | ESD Caution.....                          | 10 |
| Connection Diagram .....        | 1 | Typical Performance Characteristics ..... | 11 |
| General Description .....       | 1 | Outline Dimensions .....                  | 18 |
| Revision History .....          | 2 | Ordering Guide .....                      | 18 |
| Specifications.....             | 4 |                                           |    |

## REVISION HISTORY

6/10—Revision 0: Initial Version

The AD822-EP drives up to 350 pF of direct capacitive load as a follower and provides a minimum output current of 15 mA. This allows the amplifier to handle a wide range of load conditions. Its combination of ac and dc performance, plus the outstanding load drive capability, results in an exceptionally versatile amplifier for the single-supply user.

The AD822-EP operates over the military temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

The AD822-EP is offered in an 8-lead SOIC\_N package.

Full details about this enhanced product are available in the [AD822](#) data sheet, which should be consulted in conjunction with this data sheet.

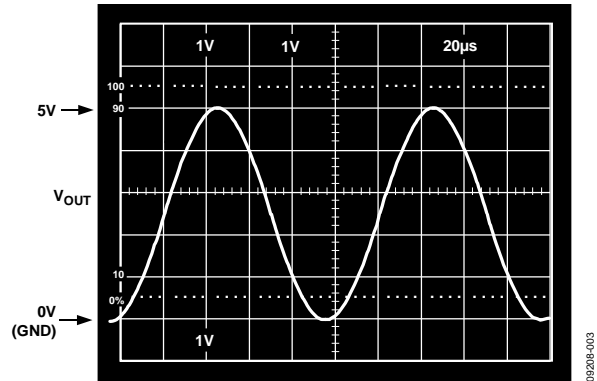


Figure 3. Gain-of-2 Amplifier;  $V_S = 5\text{ V}$ ,  $0\text{ V}$ ,  $V_{IN} = 2.5\text{ V}$  Sine Centered at  $1.25\text{ V}$ ,  $R_L = 100\ \Omega$

# AD822-EP

## SPECIFICATIONS

$V_S = 0\text{ V}$ ,  $5\text{ V}$  @  $T_A = 25^\circ\text{C}$ ,  $V_{CM} = 0\text{ V}$ ,  $V_{OUT} = 0.2\text{ V}$ , unless otherwise noted.

Table 1.

| Parameter                         | Test Conditions/Comments                                                                  | T Grade                   |      |      | Unit                         |
|-----------------------------------|-------------------------------------------------------------------------------------------|---------------------------|------|------|------------------------------|
|                                   |                                                                                           | Min                       | Typ  | Max  |                              |
| <b>DC PERFORMANCE</b>             |                                                                                           |                           |      |      |                              |
| Initial Offset                    |                                                                                           |                           | 0.1  | 0.8  | mV                           |
| Maximum Offset Over Temperature   |                                                                                           |                           | 0.5  | 1.2  | mV                           |
| Offset Drift                      |                                                                                           |                           | 2    |      | $\mu\text{V}/^\circ\text{C}$ |
| Input Bias Current                | $V_{CM} = 0\text{ V to }4\text{ V}$                                                       |                           | 2    | 25   | pA                           |
| At $T_{MAX}$                      |                                                                                           |                           | 0.5  | 6    | nA                           |
| Input Offset Current              |                                                                                           |                           | 2    | 20   | pA                           |
| At $T_{MAX}$                      |                                                                                           |                           | 0.5  |      | nA                           |
| Open-Loop Gain                    | $V_{OUT} = 0.2\text{ V to }4\text{ V}$<br>$R_L = 100\text{ k}\Omega$                      |                           | 500  | 1000 | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$            |                                                                                           |                           | 400  |      | V/mV                         |
|                                   |                                                                                           | $R_L = 10\text{ k}\Omega$ | 80   | 150  | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$            |                                                                                           |                           | 80   |      | V/mV                         |
|                                   |                                                                                           | $R_L = 1\text{ k}\Omega$  | 15   | 30   | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$            |                                                                                           | 10                        |      | V/mV |                              |
| <b>NOISE/HARMONIC PERFORMANCE</b> |                                                                                           |                           |      |      |                              |
| Input Voltage Noise               |                                                                                           |                           | 2    |      | $\mu\text{V p-p}$            |
| f = 0.1 Hz to 10 Hz               |                                                                                           |                           | 25   |      | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 10 Hz                         |                                                                                           |                           | 21   |      | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 100 Hz                        |                                                                                           |                           | 16   |      | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 1 kHz                         |                                                                                           |                           | 13   |      | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 10 kHz                        |                                                                                           |                           |      |      | $\text{nV}/\sqrt{\text{Hz}}$ |
| Input Current Noise               |                                                                                           |                           | 18   |      | fA p-p                       |
| f = 0.1 Hz to 10 Hz               |                                                                                           |                           | 0.8  |      | $\text{fA}/\sqrt{\text{Hz}}$ |
| f = 1 kHz                         |                                                                                           |                           |      |      |                              |
| Harmonic Distortion               | $R_L = 10\text{ k}\Omega$ to $2.5\text{ V}$<br>$V_{OUT} = 0.25\text{ V to }4.75\text{ V}$ |                           |      |      |                              |
| f = 10 kHz                        |                                                                                           |                           |      | -93  |                              |
| <b>DYNAMIC PERFORMANCE</b>        |                                                                                           |                           |      |      |                              |
| Unity-Gain Frequency              |                                                                                           |                           | 1.8  |      | MHz                          |
| Full Power Response               | $V_{OUT}$ p-p = $4.5\text{ V}$                                                            |                           | 210  |      | kHz                          |
| Slew Rate                         |                                                                                           |                           | 3    |      | V/ $\mu\text{s}$             |
| Settling Time                     |                                                                                           |                           |      |      |                              |
| To 0.1%                           | $V_{OUT} = 0.2\text{ V to }4.5\text{ V}$                                                  |                           | 1.4  |      | $\mu\text{s}$                |
| To 0.01%                          | $V_{OUT} = 0.2\text{ V to }4.5\text{ V}$                                                  |                           | 1.8  |      | $\mu\text{s}$                |
| <b>MATCHING CHARACTERISTICS</b>   |                                                                                           |                           |      |      |                              |
| Initial Offset                    |                                                                                           |                           |      | 1.0  | mV                           |
| Maximum Offset Over Temperature   |                                                                                           |                           |      | 1.6  | mV                           |
| Offset Drift                      |                                                                                           |                           | 3    |      | $\mu\text{V}/^\circ\text{C}$ |
| Input Bias Current                |                                                                                           |                           |      | 20   | pA                           |
| Crosstalk @ f = 1 kHz             | $R_L = 5\text{ k}\Omega$                                                                  |                           | -130 |      | dB                           |
| Crosstalk @ f = 100 kHz           | $R_L = 5\text{ k}\Omega$                                                                  |                           | -93  |      | dB                           |

| Parameter                                                                             | Test Conditions/Comments                                                   | T Grade |                |      | Unit                |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------|---------|----------------|------|---------------------|
|                                                                                       |                                                                            | Min     | Typ            | Max  |                     |
| <b>INPUT CHARACTERISTICS</b>                                                          |                                                                            |         |                |      |                     |
| Input Voltage Range <sup>1</sup> , $T_{MIN}$ to $T_{MAX}$                             |                                                                            | -0.2    |                | +4   | V                   |
| Common-Mode Rejection Ratio (CMRR)<br>$T_{MIN}$ to $T_{MAX}$                          | $V_{CM} = 0\text{ V to }2\text{ V}$<br>$V_{CM} = 0\text{ V to }2\text{ V}$ | 66      | 80             |      | dB                  |
| Input Impedance<br>Differential                                                       |                                                                            |         | $10^{13}  0.5$ |      | $\Omega  \text{pF}$ |
| Common Mode                                                                           |                                                                            |         | $10^{13}  2.8$ |      | $\Omega  \text{pF}$ |
| <b>OUTPUT CHARACTERISTICS</b>                                                         |                                                                            |         |                |      |                     |
| Output Saturation Voltage <sup>2</sup><br>$V_{OL} - V_{EE}$<br>$T_{MIN}$ to $T_{MAX}$ | $I_{SINK} = 20\ \mu\text{A}$                                               |         | 5              | 7    | mV                  |
| $V_{CC} - V_{OH}$<br>$T_{MIN}$ to $T_{MAX}$                                           | $I_{SOURCE} = 20\ \mu\text{A}$                                             |         | 10             | 14   | mV                  |
| $V_{OL} - V_{EE}$<br>$T_{MIN}$ to $T_{MAX}$                                           | $I_{SINK} = 2\ \text{mA}$                                                  |         | 40             | 55   | mV                  |
| $V_{CC} - V_{OH}$<br>$T_{MIN}$ to $T_{MAX}$                                           | $I_{SOURCE} = 2\ \text{mA}$                                                |         | 80             | 110  | mV                  |
| $V_{OL} - V_{EE}$<br>$T_{MIN}$ to $T_{MAX}$                                           | $I_{SINK} = 15\ \text{mA}$                                                 |         | 300            | 500  | mV                  |
| $V_{CC} - V_{OH}$<br>$T_{MIN}$ to $T_{MAX}$                                           | $I_{SOURCE} = 15\ \text{mA}$                                               |         | 800            | 1500 | mV                  |
| Operating Output Current<br>$T_{MIN}$ to $T_{MAX}$                                    |                                                                            | 15      |                |      | mA                  |
| Capacitive Load Drive                                                                 |                                                                            |         | 350            |      | pF                  |
| <b>POWER SUPPLY</b>                                                                   |                                                                            |         |                |      |                     |
| Quiescent Current, $T_{MIN}$ to $T_{MAX}$                                             |                                                                            |         | 1.24           | 1.6  | mA                  |
| Power Supply Rejection<br>$T_{MIN}$ to $T_{MAX}$                                      | $V_{+} = 5\text{ V to }15\text{ V}$                                        | 66      | 80             |      | dB                  |
|                                                                                       |                                                                            | 66      |                |      | dB                  |

<sup>1</sup> This is a functional specification. Amplifier bandwidth decreases when the input common-mode voltage is driven in the range  $(V_{+} - 1\text{ V})$  to  $V_{+}$ . Common-mode error voltage is typically less than 5 mV with the common-mode voltage set at 1 V below the positive supply.

<sup>2</sup>  $V_{OL} - V_{EE}$  is defined as the difference between the lowest possible output voltage ( $V_{OL}$ ) and the negative voltage supply rail ( $V_{EE}$ ).  $V_{CC} - V_{OH}$  is defined as the difference between the highest possible output voltage ( $V_{OH}$ ) and the positive supply voltage ( $V_{CC}$ ).

# AD822-EP

$V_S = \pm 5\text{ V}$  @  $T_A = 25^\circ\text{C}$ ,  $V_{CM} = 0\text{ V}$ ,  $V_{OUT} = 0\text{ V}$ , unless otherwise noted.

**Table 2.**

| Parameter                                                 | Test Conditions/Comments                    | T Grade |                |     | Unit                         |
|-----------------------------------------------------------|---------------------------------------------|---------|----------------|-----|------------------------------|
|                                                           |                                             | Min     | Typ            | Max |                              |
| <b>DC PERFORMANCE</b>                                     |                                             |         |                |     |                              |
| Initial Offset                                            |                                             |         | 0.1            | 0.8 | mV                           |
| Maximum Offset Over Temperature                           |                                             |         | 0.5            | 1.5 | mV                           |
| Offset Drift                                              |                                             |         | 2              |     | $\mu\text{V}/^\circ\text{C}$ |
| Input Bias Current                                        | $V_{CM} = -5\text{ V to }+4\text{ V}$       |         | 2              | 25  | pA                           |
| At $T_{MAX}$                                              |                                             |         | 0.5            | 6   | nA                           |
| Input Offset Current                                      |                                             |         | 2              | 20  | pA                           |
| At $T_{MAX}$                                              |                                             |         | 0.5            |     | nA                           |
| Open-Loop Gain                                            | $V_{OUT} = -4\text{ V to }+4\text{ V}$      |         |                |     |                              |
|                                                           | $R_L = 100\text{ k}\Omega$                  | 400     | 1000           |     | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$                                    |                                             | 400     |                |     | V/mV                         |
|                                                           | $R_L = 10\text{ k}\Omega$                   | 80      | 150            |     | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$                                    |                                             | 80      |                |     | V/mV                         |
|                                                           | $R_L = 1\text{ k}\Omega$                    | 20      | 30             |     | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$                                    |                                             | 10      |                |     | V/mV                         |
| <b>NOISE/HARMONIC PERFORMANCE</b>                         |                                             |         |                |     |                              |
| Input Voltage Noise                                       |                                             |         |                |     |                              |
| f = 0.1 Hz to 10 Hz                                       |                                             |         | 2              |     | $\mu\text{V p-p}$            |
| f = 10 Hz                                                 |                                             |         | 25             |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 100 Hz                                                |                                             |         | 21             |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 1 kHz                                                 |                                             |         | 16             |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 10 kHz                                                |                                             |         | 13             |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| Input Current Noise                                       |                                             |         |                |     |                              |
| f = 0.1 Hz to 10 Hz                                       |                                             |         | 18             |     | fA p-p                       |
| f = 1 kHz                                                 |                                             |         | 0.8            |     | $\text{fA}/\sqrt{\text{Hz}}$ |
| Harmonic Distortion                                       | $R_L = 10\text{ k}\Omega$                   |         |                |     |                              |
| f = 10 kHz                                                | $V_{OUT} = \pm 4.5\text{ V}$                |         | -93            |     | dB                           |
| <b>DYNAMIC PERFORMANCE</b>                                |                                             |         |                |     |                              |
| Unity-Gain Frequency                                      |                                             |         | 1.9            |     | MHz                          |
| Full Power Response                                       | $V_{OUT\text{ p-p}} = 9\text{ V}$           |         | 105            |     | kHz                          |
| Slew Rate                                                 |                                             |         | 3              |     | V/ $\mu\text{s}$             |
| Settling Time                                             |                                             |         |                |     |                              |
| to 0.1%                                                   | $V_{OUT} = 0\text{ V to } \pm 4.5\text{ V}$ |         | 1.4            |     | $\mu\text{s}$                |
| to 0.01%                                                  | $V_{OUT} = 0\text{ V to } \pm 4.5\text{ V}$ |         | 1.8            |     | $\mu\text{s}$                |
| <b>MATCHING CHARACTERISTICS</b>                           |                                             |         |                |     |                              |
| Initial Offset                                            |                                             |         |                | 1.0 | mV                           |
| Maximum Offset Over Temperature                           |                                             |         |                | 3   | mV                           |
| Offset Drift                                              |                                             |         | 3              |     | $\mu\text{V}/^\circ\text{C}$ |
| Input Bias Current                                        |                                             |         |                | 25  | pA                           |
| Crosstalk @ f = 1 kHz                                     | $R_L = 5\text{ k}\Omega$                    |         | -130           |     | dB                           |
| Crosstalk @ f = 100 kHz                                   | $R_L = 5\text{ k}\Omega$                    |         | -93            |     | dB                           |
| <b>INPUT CHARACTERISTICS</b>                              |                                             |         |                |     |                              |
| Input Voltage Range <sup>1</sup> , $T_{MIN}$ to $T_{MAX}$ |                                             | -5.2    |                | +4  | V                            |
| Common-Mode Rejection Ratio (CMRR)                        | $V_{CM} = -5\text{ V to }+2\text{ V}$       | 66      | 80             |     | dB                           |
| $T_{MIN}$ to $T_{MAX}$                                    | $V_{CM} = -5\text{ V to }+2\text{ V}$       | 66      |                |     | dB                           |
| Input Impedance                                           |                                             |         |                |     |                              |
| Differential                                              |                                             |         | $10^{13}  0.5$ |     | $\Omega  \text{pF}$          |
| Common Mode                                               |                                             |         | $10^{13}  2.8$ |     | $\Omega  \text{pF}$          |

| Parameter                                          | Test Conditions/Comments         | T Grade |     |      | Unit |
|----------------------------------------------------|----------------------------------|---------|-----|------|------|
|                                                    |                                  | Min     | Typ | Max  |      |
| <b>OUTPUT CHARACTERISTICS</b>                      |                                  |         |     |      |      |
| Output Saturation Voltage <sup>2</sup>             |                                  |         |     |      |      |
| $V_{OL} - V_{EE}$<br>$T_{MIN}$ to $T_{MAX}$        | $I_{SINK} = 20 \mu A$            |         | 5   | 7    | mV   |
| $V_{CC} - V_{OH}$<br>$T_{MIN}$ to $T_{MAX}$        | $I_{SOURCE} = 20 \mu A$          |         | 10  | 14   | mV   |
| $V_{OL} - V_{EE}$<br>$T_{MIN}$ to $T_{MAX}$        | $I_{SINK} = 2 mA$                |         | 40  | 55   | mV   |
| $V_{CC} - V_{OH}$<br>$T_{MIN}$ to $T_{MAX}$        | $I_{SOURCE} = 2 mA$              |         | 80  | 110  | mV   |
| $V_{OL} - V_{EE}$<br>$T_{MIN}$ to $T_{MAX}$        | $I_{SINK} = 15 mA$               |         | 300 | 500  | mV   |
| $V_{CC} - V_{OH}$<br>$T_{MIN}$ to $T_{MAX}$        | $I_{SOURCE} = 15 mA$             |         | 800 | 1500 | mV   |
| Operating Output Current<br>$T_{MIN}$ to $T_{MAX}$ |                                  | 15      |     |      | mA   |
| Capacitive Load Drive                              |                                  |         | 350 |      | pF   |
| <b>POWER SUPPLY</b>                                |                                  |         |     |      |      |
| Quiescent Current, $T_{MIN}$ to $T_{MAX}$          |                                  |         | 1.3 | 1.6  | mA   |
| Power Supply Rejection<br>$T_{MIN}$ to $T_{MAX}$   | $V_{SY} = \pm 5 V$ to $\pm 15 V$ | 66      | 80  |      | dB   |
|                                                    |                                  | 66      |     |      | dB   |

<sup>1</sup> This is a functional specification. Amplifier bandwidth decreases when the input common-mode voltage is driven in the range  $(V_+ - 1 V)$  to  $V_+$ . Common-mode error voltage is typically less than 5 mV with the common-mode voltage set at 1 V below the positive supply.

<sup>2</sup>  $V_{OL} - V_{EE}$  is defined as the difference between the lowest possible output voltage ( $V_{OL}$ ) and the negative voltage supply rail ( $V_{EE}$ ).  $V_{CC} - V_{OH}$  is defined as the difference between the highest possible output voltage ( $V_{OH}$ ) and the positive supply voltage ( $V_{CC}$ ).

# AD822-EP

$V_S = \pm 15\text{ V}$  @  $T_A = 25^\circ\text{C}$ ,  $V_{CM} = 0\text{ V}$ ,  $V_{OUT} = 0\text{ V}$ , unless otherwise noted.

**Table 3.**

| Parameter                                                 | Test Conditions/Comments                   | T Grade |                |     | Unit                         |
|-----------------------------------------------------------|--------------------------------------------|---------|----------------|-----|------------------------------|
|                                                           |                                            | Min     | Typ            | Max |                              |
| <b>DC PERFORMANCE</b>                                     |                                            |         |                |     |                              |
| Initial Offset                                            |                                            |         | 0.4            | 2   | mV                           |
| Maximum Offset Over Temperature                           |                                            |         | 0.5            | 3   | mV                           |
| Offset Drift                                              |                                            |         | 2              |     | $\mu\text{V}/^\circ\text{C}$ |
| Input Bias Current                                        | $V_{CM} = 0\text{ V}$                      |         | 2              | 25  | pA                           |
|                                                           | $V_{CM} = -10\text{ V}$                    |         | 40             |     | pA                           |
| At $T_{MAX}$                                              | $V_{CM} = 0\text{ V}$                      |         | 0.5            | 6   | nA                           |
| Input Offset Current                                      |                                            |         | 2              | 20  | pA                           |
| At $T_{MAX}$                                              |                                            |         | 0.5            |     | nA                           |
| Open-Loop Gain                                            | $V_{OUT} = -10\text{ V to }+10\text{ V}$   |         |                |     |                              |
|                                                           | $R_L = 100\text{ k}\Omega$                 | 500     | 2000           |     | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$                                    |                                            | 500     |                |     | V/mV                         |
|                                                           | $R_L = 10\text{ k}\Omega$                  | 100     | 500            |     | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$                                    |                                            | 100     |                |     | V/mV                         |
|                                                           | $R_L = 1\text{ k}\Omega$                   | 30      | 45             |     | V/mV                         |
| $T_{MIN}$ to $T_{MAX}$                                    |                                            | 20      |                |     | V/mV                         |
| <b>NOISE/HARMONIC PERFORMANCE</b>                         |                                            |         |                |     |                              |
| Input Voltage Noise                                       |                                            |         |                |     |                              |
| f = 0.1 Hz to 10 Hz                                       |                                            |         | 2              |     | $\mu\text{V p-p}$            |
| f = 10 Hz                                                 |                                            |         | 25             |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 100 Hz                                                |                                            |         | 21             |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 1 kHz                                                 |                                            |         | 16             |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| f = 10 kHz                                                |                                            |         | 13             |     | $\text{nV}/\sqrt{\text{Hz}}$ |
| Input Current Noise                                       |                                            |         |                |     |                              |
| f = 0.1 Hz to 10 Hz                                       |                                            |         | 18             |     | fA p-p                       |
| f = 1 kHz                                                 |                                            |         | 0.8            |     | $\text{fA}/\sqrt{\text{Hz}}$ |
| Harmonic Distortion                                       | $R_L = 10\text{ k}\Omega$                  |         |                |     |                              |
| f = 10 kHz                                                | $V_{OUT} = \pm 10\text{ V}$                |         | -85            |     | dB                           |
| <b>DYNAMIC PERFORMANCE</b>                                |                                            |         |                |     |                              |
| Unity-Gain Frequency                                      |                                            |         | 1.9            |     | MHz                          |
| Full Power Response                                       | $V_{OUT\text{ p-p}} = 20\text{ V}$         |         | 45             |     | kHz                          |
| Slew Rate                                                 |                                            |         | 3              |     | V/ $\mu\text{s}$             |
| Settling Time                                             |                                            |         |                |     |                              |
| to 0.1%                                                   | $V_{OUT} = 0\text{ V to } \pm 10\text{ V}$ |         | 4.1            |     | $\mu\text{s}$                |
| to 0.01%                                                  | $V_{OUT} = 0\text{ V to } \pm 10\text{ V}$ |         | 4.5            |     | $\mu\text{s}$                |
| <b>MATCHING CHARACTERISTICS</b>                           |                                            |         |                |     |                              |
| Initial Offset                                            |                                            |         |                | 3   | mV                           |
| Maximum Offset Over Temperature                           |                                            |         |                | 4   | mV                           |
| Offset Drift                                              |                                            |         | 3              |     | $\mu\text{V}/^\circ\text{C}$ |
| Input Bias Current                                        |                                            |         |                | 25  | pA                           |
| Crosstalk @ f = 1 kHz                                     | $R_L = 5\text{ k}\Omega$                   |         | -130           |     | dB                           |
| Crosstalk @ f = 100 kHz                                   | $R_L = 5\text{ k}\Omega$                   |         | -93            |     | dB                           |
| <b>INPUT CHARACTERISTICS</b>                              |                                            |         |                |     |                              |
| Input Voltage Range <sup>1</sup> , $T_{MIN}$ to $T_{MAX}$ |                                            | -15.2   |                | +14 | V                            |
| Common-Mode Rejection Ratio (CMRR)                        | $V_{CM} = -15\text{ V to }+12\text{ V}$    | 70      | 80             |     | dB                           |
| $T_{MIN}$ to $T_{MAX}$                                    | $V_{CM} = -15\text{ V to }+12\text{ V}$    | 70      |                |     | dB                           |
| Input Impedance                                           |                                            |         |                |     |                              |
| Differential                                              |                                            |         | $10^{13}  0.5$ |     | $\Omega  \text{pF}$          |
| Common Mode                                               |                                            |         | $10^{13}  2.8$ |     | $\Omega  \text{pF}$          |

| Parameter                                 | Test Conditions/Comments         | T Grade |     |      | Unit |
|-------------------------------------------|----------------------------------|---------|-----|------|------|
|                                           |                                  | Min     | Typ | Max  |      |
| <b>OUTPUT CHARACTERISTICS</b>             |                                  |         |     |      |      |
| Output Saturation Voltage <sup>2</sup>    |                                  |         |     |      |      |
| $V_{OL} - V_{EE}$                         | $I_{SINK} = 20 \mu A$            |         | 5   | 7    | mV   |
| $T_{MIN}$ to $T_{MAX}$                    |                                  |         |     | 10   | mV   |
| $V_{CC} - V_{OH}$                         | $I_{SOURCE} = 20 \mu A$          |         | 10  | 14   | mV   |
| $T_{MIN}$ to $T_{MAX}$                    |                                  |         |     | 20   | mV   |
| $V_{OL} - V_{EE}$                         | $I_{SINK} = 2 mA$                |         | 40  | 55   | mV   |
| $T_{MIN}$ to $T_{MAX}$                    |                                  |         |     | 80   | mV   |
| $V_{CC} - V_{OH}$                         | $I_{SOURCE} = 2 mA$              |         | 80  | 110  | mV   |
| $T_{MIN}$ to $T_{MAX}$                    |                                  |         |     | 160  | mV   |
| $V_{OL} - V_{EE}$                         | $I_{SINK} = 15 mA$               |         | 300 | 500  | mV   |
| $T_{MIN}$ to $T_{MAX}$                    |                                  |         |     | 1000 | mV   |
| $V_{CC} - V_{OH}$                         | $I_{SOURCE} = 15 mA$             |         | 800 | 1500 | mV   |
| $T_{MIN}$ to $T_{MAX}$                    |                                  |         |     | 1900 | mV   |
| Operating Output Current                  |                                  | 20      |     |      | mA   |
| $T_{MIN}$ to $T_{MAX}$                    |                                  | 15      |     |      | mA   |
| Capacitive Load Drive                     |                                  |         | 350 |      | pF   |
| <b>POWER SUPPLY</b>                       |                                  |         |     |      |      |
| Quiescent Current, $T_{MIN}$ to $T_{MAX}$ |                                  |         | 1.4 | 1.8  | mA   |
| Power Supply Rejection                    | $V_{SY} = \pm 5 V$ to $\pm 15 V$ | 70      | 80  |      | dB   |
| $T_{MIN}$ to $T_{MAX}$                    |                                  | 70      |     |      | dB   |

<sup>1</sup> This is a functional specification. Amplifier bandwidth decreases when the input common-mode voltage is driven in the range  $(V+ - 1 V)$  to  $V+$ . Common-mode error voltage is typically less than 5 mV with the common-mode voltage set at 1 V below the positive supply.

<sup>2</sup>  $V_{OL} - V_{EE}$  is defined as the difference between the lowest possible output voltage ( $V_{OL}$ ) and the negative voltage supply rail ( $V_{EE}$ ).  $V_{CC} - V_{OH}$  is defined as the difference between the highest possible output voltage ( $V_{OH}$ ) and the positive supply voltage ( $V_{CC}$ ).

## ABSOLUTE MAXIMUM RATINGS

Table 4.

| Parameter                                       | Rating                               |
|-------------------------------------------------|--------------------------------------|
| Supply Voltage                                  | ±18 V                                |
| Internal Power Dissipation<br>8-Lead SOIC_N (R) | Observe Maximum Junction Temperature |
| Input Voltage                                   | ((V+) + 0.2 V) to ((V-) - 20 V)      |
| Output Short-Circuit Duration                   | Indefinite                           |
| Differential Input Voltage                      | ±30 V                                |
| Storage Temperature Range (R)                   | -65°C to +150°C                      |
| Operating Temperature Range                     | -55°C to +125°C                      |
| Maximum Junction Temperature                    | 150°C                                |
| Lead Temperature<br>(Soldering, 60 sec)         | 260°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 5. Thermal Resistance

| Package Type      | $\theta_{JA}$ | $\theta_{JC}$ | Unit |
|-------------------|---------------|---------------|------|
| 8-lead SOIC_N (R) | 160           | 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.

# TYPICAL PERFORMANCE CHARACTERISTICS

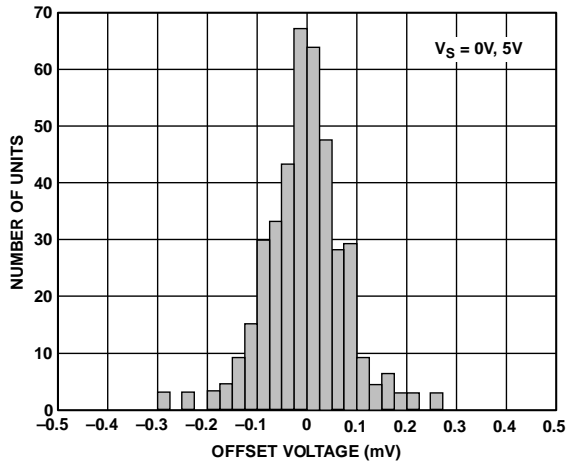


Figure 4. Typical Distribution of Offset Voltage (390 Units)

09208-004

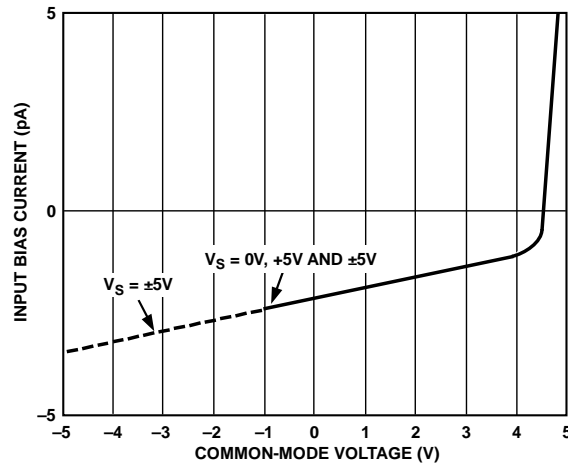


Figure 7. Input Bias Current vs. Common-Mode Voltage;  $V_S = 5\text{ V}, 0\text{ V},$  and  $V_S = \pm 5\text{ V}$

09208-007

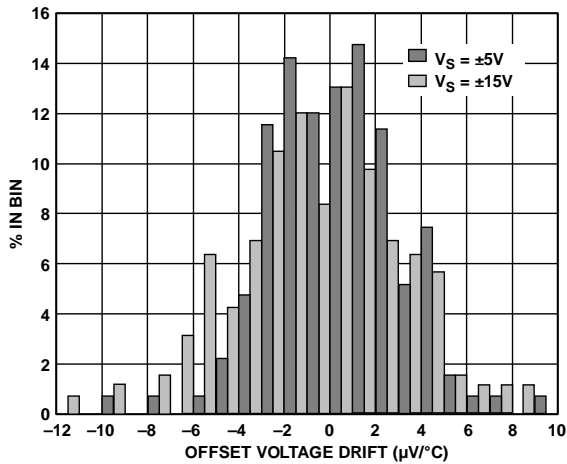


Figure 5. Typical Distribution of Offset Voltage Drift (100 Units)

09208-005

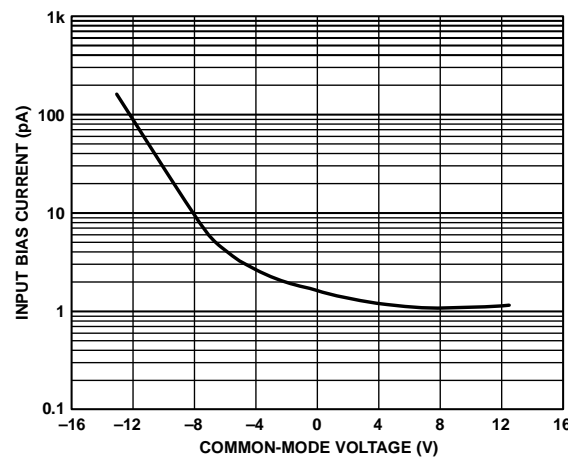


Figure 8. Input Bias Current vs. Common-Mode Voltage;  $V_S = \pm 15\text{ V}$

09208-008

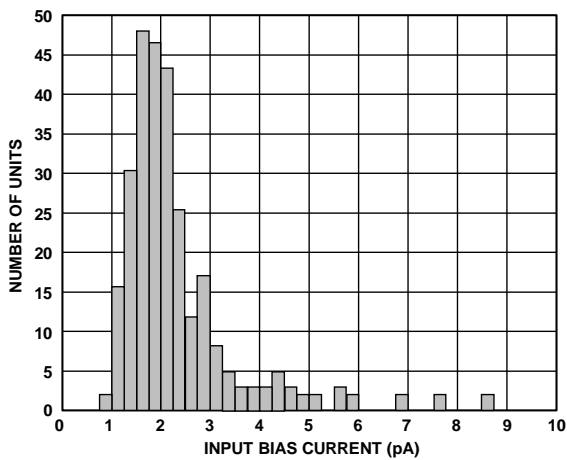


Figure 6. Typical Distribution of Input Bias Current (213 Units)

09208-006

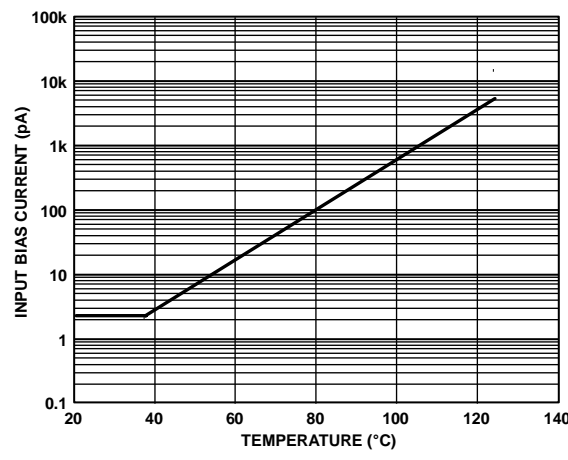


Figure 9. Input Bias Current vs. Temperature;  $V_S = 5\text{ V}, V_{CM} = 0\text{ V}$

09208-009

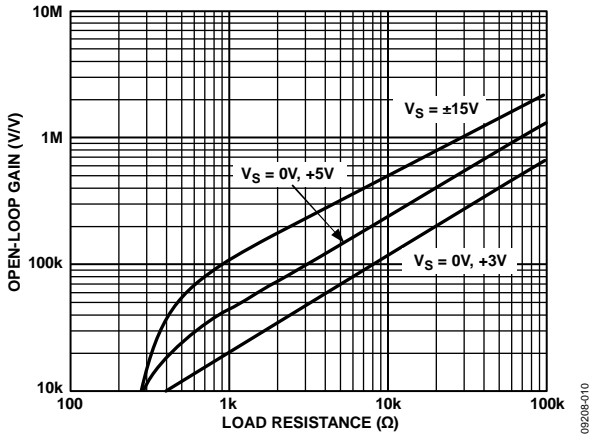


Figure 10. Open-Loop Gain vs. Load Resistance

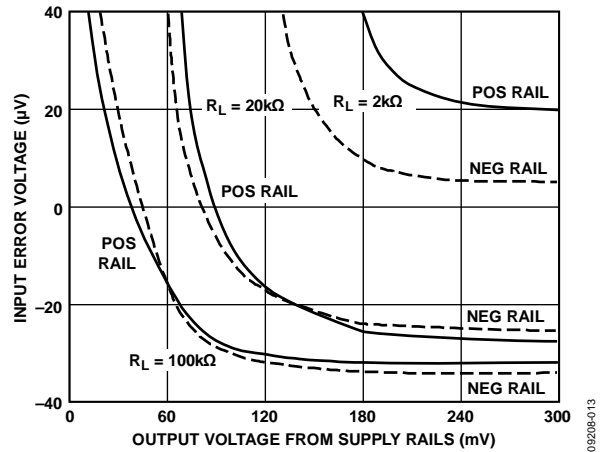


Figure 13. Input Error Voltage with Output Voltage Within 300 mV of Either Supply Rail for Various Resistive Loads;  $V_S = \pm 5 V$

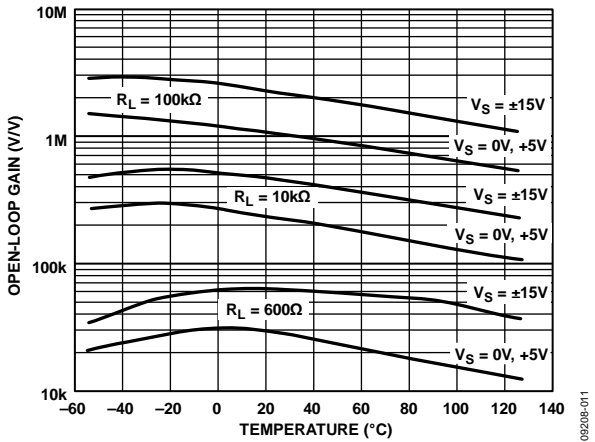


Figure 11. Open-Loop Gain vs. Temperature

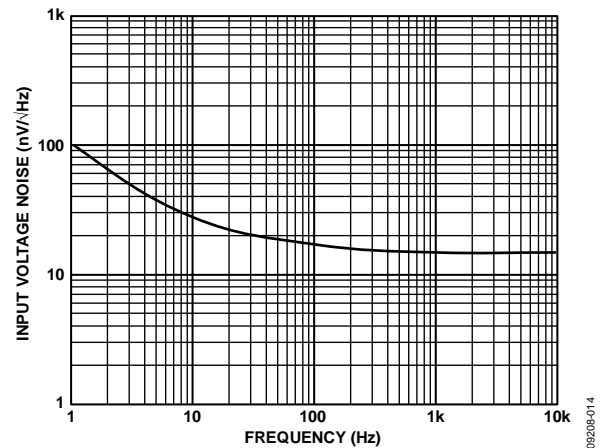


Figure 14. Input Voltage Noise vs. Frequency

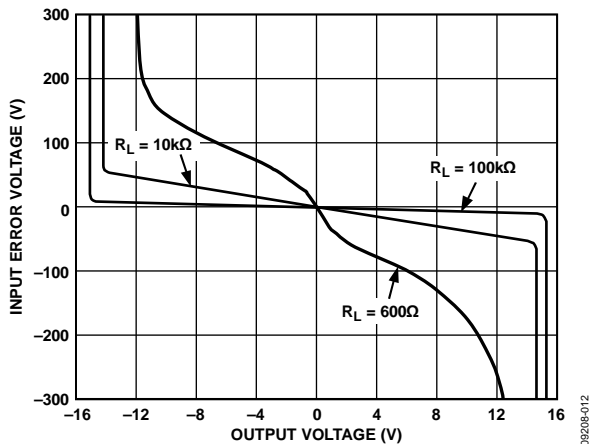


Figure 12. Input Error Voltage vs. Output Voltage for Resistive Loads

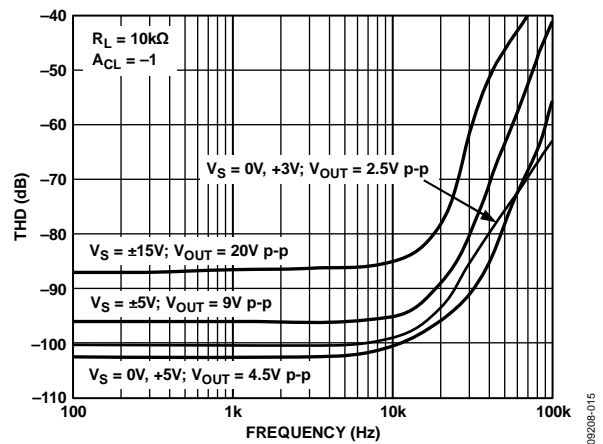


Figure 15. Total Harmonic Distortion (THD) vs. Frequency

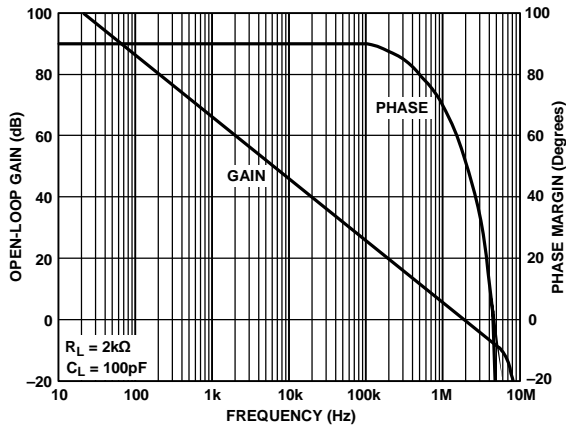


Figure 16. Open-Loop Gain and Phase Margin vs. Frequency

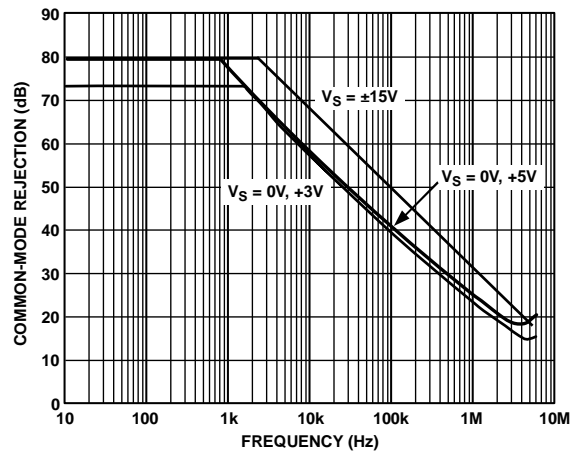


Figure 19. Common-Mode Rejection vs. Frequency

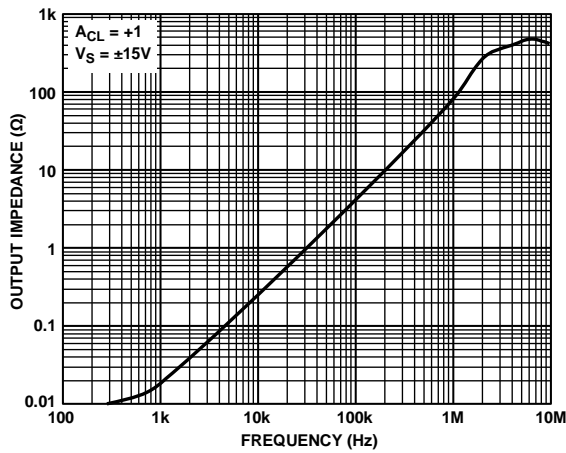


Figure 17. Output Impedance vs. Frequency

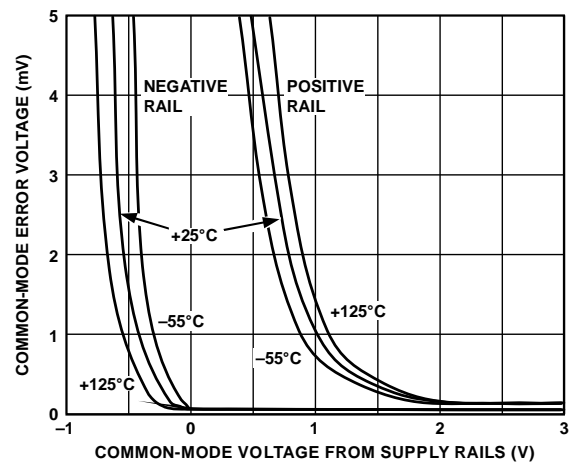


Figure 20. Absolute Common-Mode Error vs. Common-Mode Voltage from Supply Rails ( $V_S - V_{CM}$ )

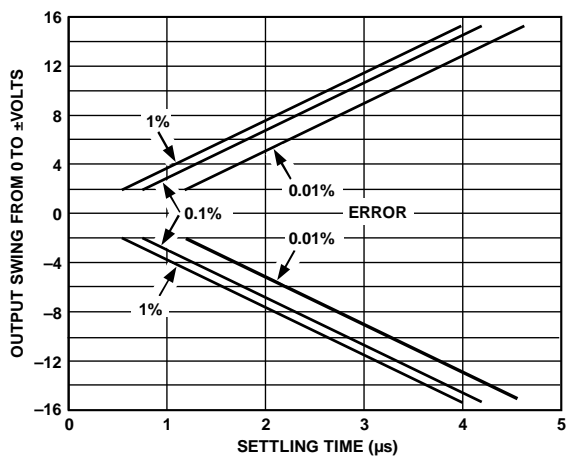


Figure 18. Output Swing and Error vs. Settling Time

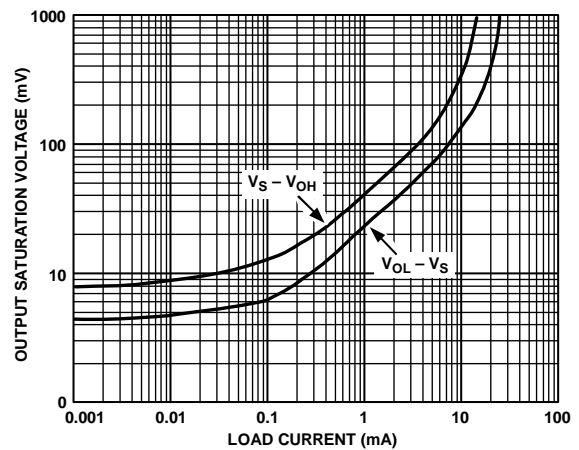


Figure 21. Output Saturation Voltage vs. Load Current

# AD822-EP

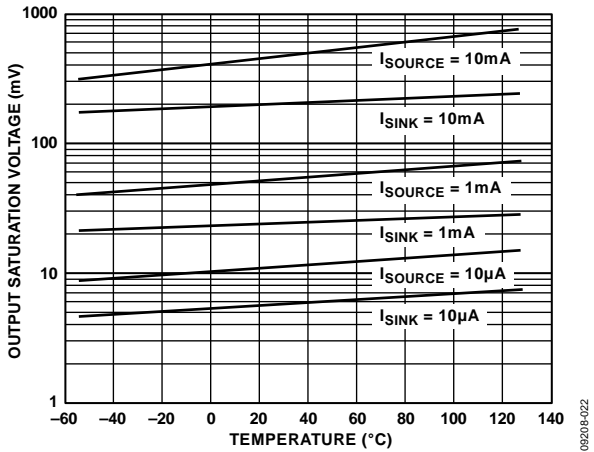


Figure 22. Output Saturation Voltage vs. Temperature

09208-022

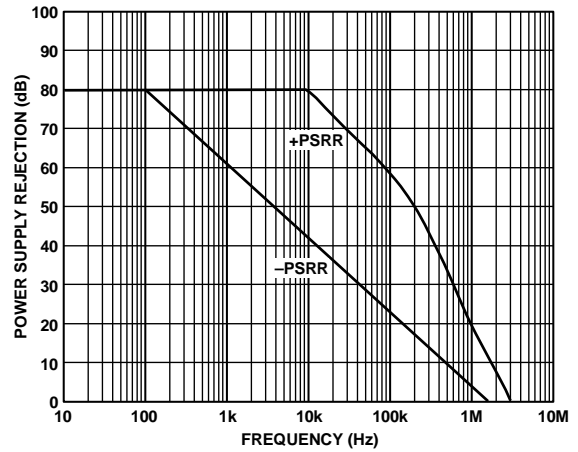


Figure 25. Power Supply Rejection vs. Frequency

09208-025

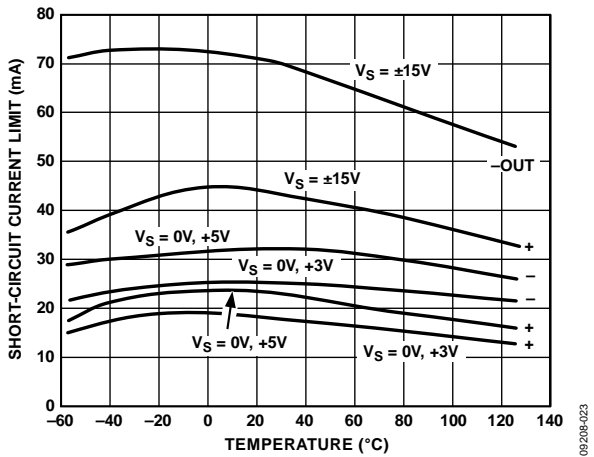


Figure 23. Short-Circuit Current Limit vs. Temperature

09208-023

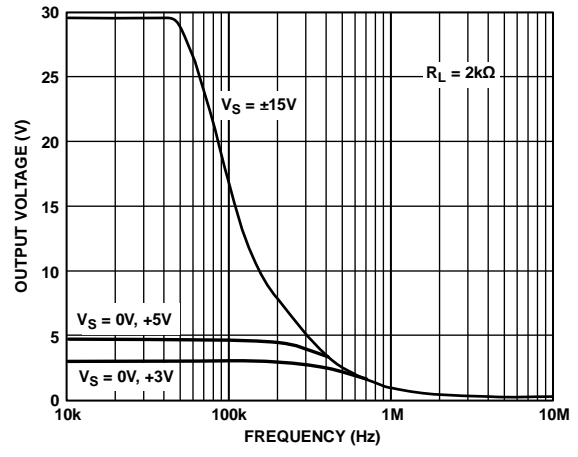


Figure 26. Large Signal Frequency Response

09208-026

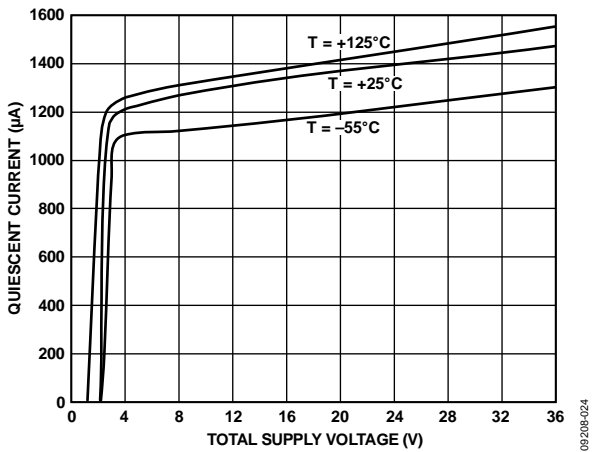


Figure 24. Quiescent Current vs. Supply Voltage vs. Temperature

09208-024

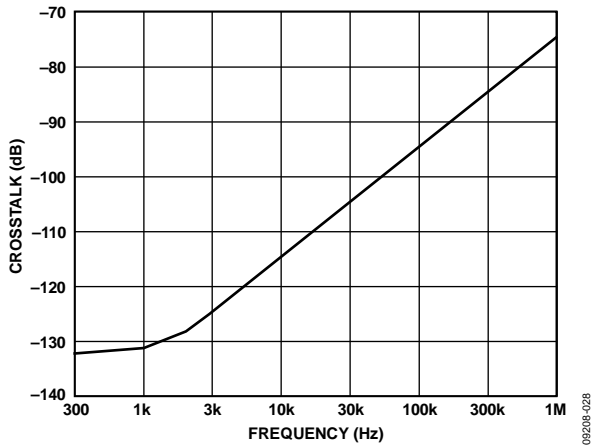


Figure 27. Crosstalk vs. Frequency

09208-028

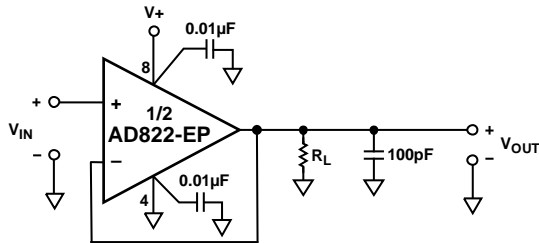


Figure 28. Unity-Gain Follower

09208-029

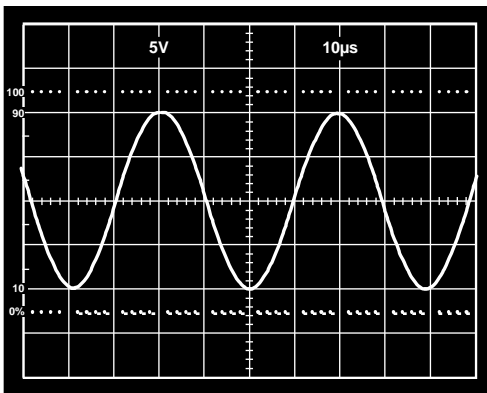


Figure 29. 20 V p-p, 25 kHz Sine Wave Input; Unity-Gain Follower;  $V_S = \pm 15\text{ V}$ ,  $R_L = 600\ \Omega$

09208-030

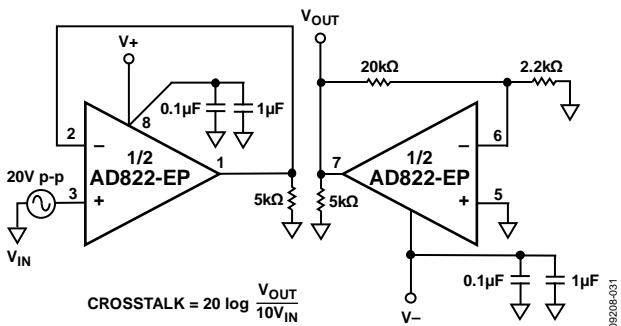


Figure 30. Crosstalk Test Circuit

09208-031

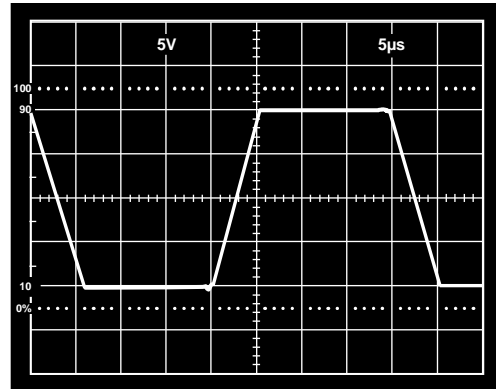


Figure 31. Large Signal Response Unity-Gain Follower;  $V_S = \pm 15\text{ V}$ ,  $R_L = 10\text{ k}\Omega$

09208-032

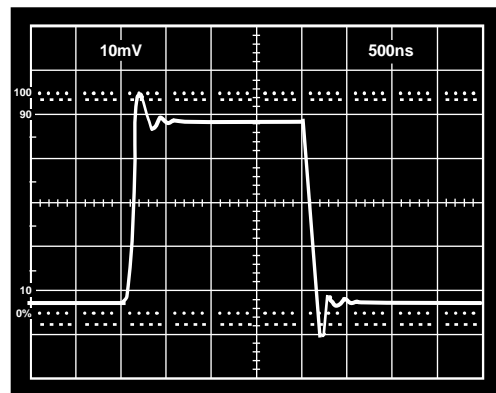


Figure 32. Small Signal Response Unity-Gain Follower;  $V_S = \pm 15\text{ V}$ ,  $R_L = 10\text{ k}\Omega$

09208-033

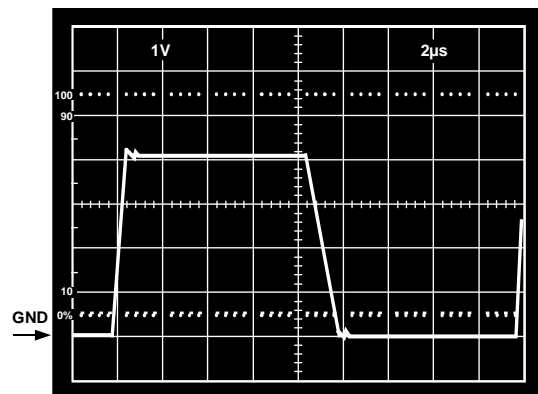


Figure 33.  $V_S = 5\text{ V}$ ,  $0\text{ V}$ ; Unity-Gain Follower Response to 0 V to 4 V Step

09208-034

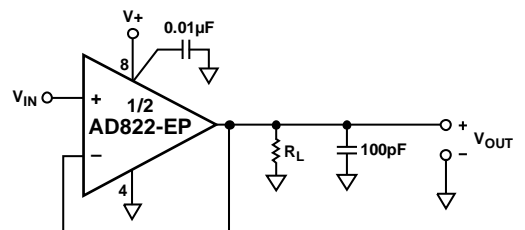


Figure 34. Unity-Gain Follower

09208-035

# AD822-EP

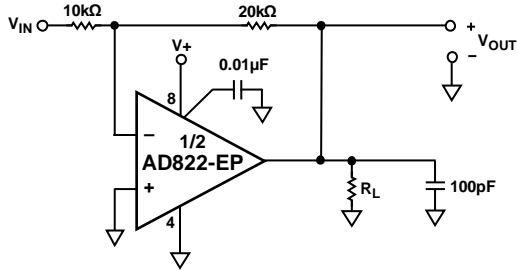


Figure 35. Gain-of-Two Inverter

09208-036

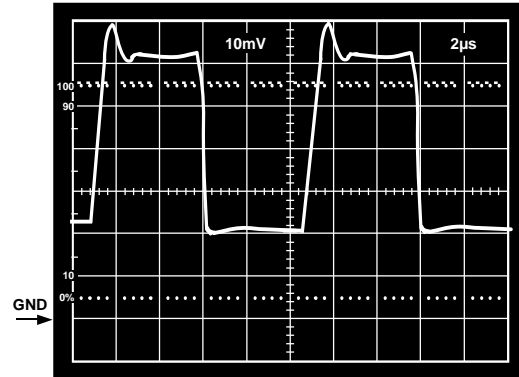


Figure 38.  $V_S = 5\text{ V}$ ,  $0\text{ V}$ ; Gain-of-2 Inverter Response to 20 mV Step, Centered 20 mV Below Ground,  $R_L = 10\text{ k}\Omega$

09208-038

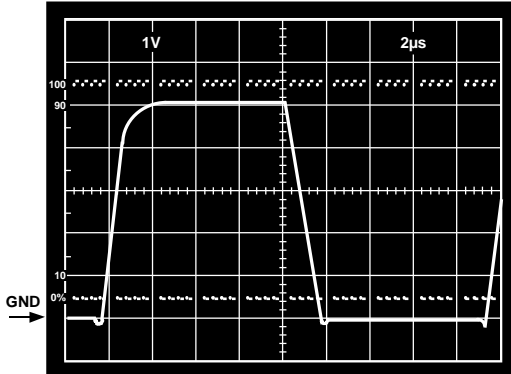


Figure 36.  $V_S = 5\text{ V}$ ,  $0\text{ V}$ ; Unity-Gain Follower Response to 0 V to 5 V Step

09208-037

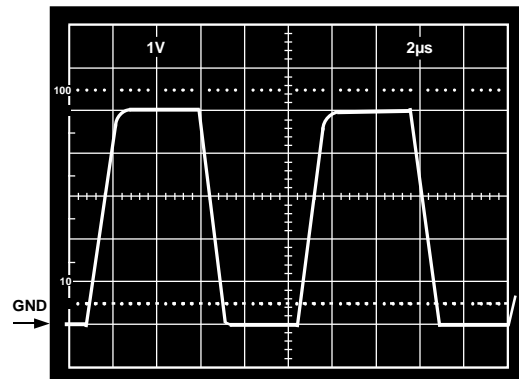


Figure 39.  $V_S = 5\text{ V}$ ,  $0\text{ V}$ ; Gain-of-2 Inverter Response to 2.5 V Step, Centered  $-1.25\text{ V}$  Below Ground,  $R_L = 10\text{ k}\Omega$

09208-040

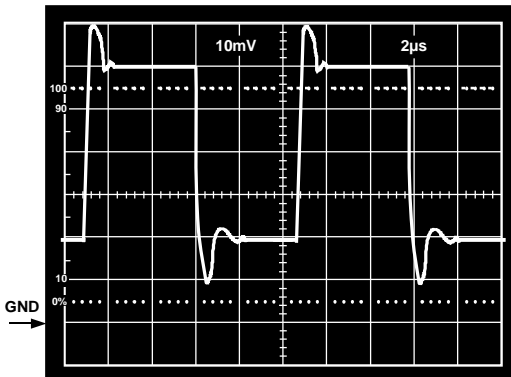


Figure 37.  $V_S = 5\text{ V}$ ,  $0\text{ V}$ ; Unity-Gain Follower Response to 40 mV Step, Centered 40 mV above Ground,  $R_L = 10\text{ k}\Omega$

09208-038

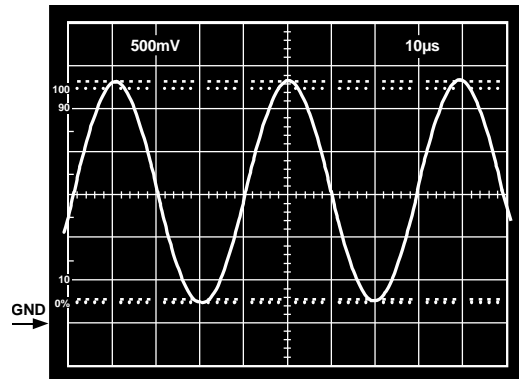
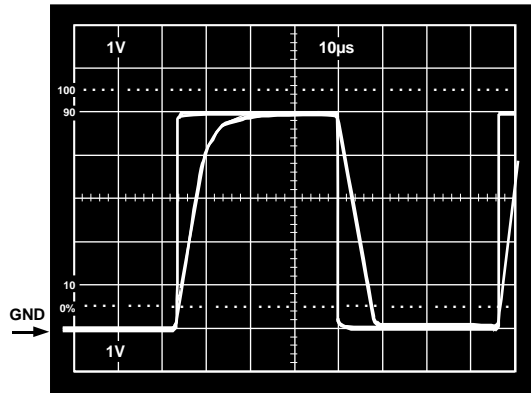
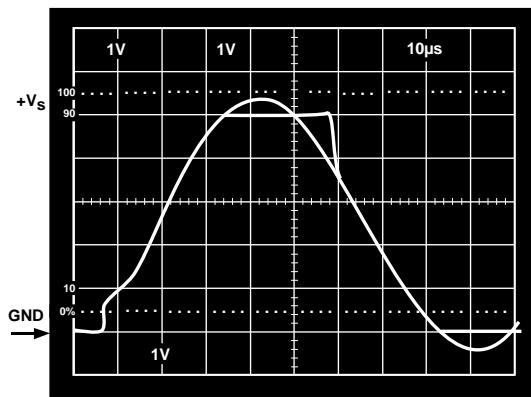


Figure 40.  $V_S = 3\text{ V}$ ,  $0\text{ V}$ ; Gain-of-2 Inverter,  $V_{IN} = 1.25\text{ V}$ , 25 kHz, Sine Wave Centered at  $-0.75\text{ V}$ ,  $R_L = 600\Omega$

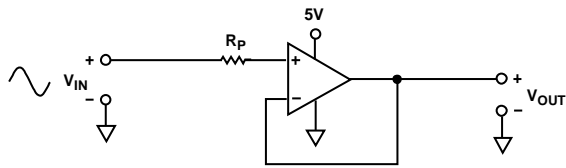
09208-041



(a)



(b)



09208-042

Figure 41. (a) Response with  $R_P = 0$ ;  $V_{IN}$  from 0 V to  $+V_S$   
 (b)  $V_{IN} = 0$  V to  $+V_S + 200$  mV  
 $V_{OUT} = 0$  V to  $+V_S$   
 $R_P = 49.9$  k $\Omega$



**NOTES**

**AD822-EP**

**NOTES**

## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

 [View AD822TRZ-EP-R7 on WIN SOURCE](#)

 [Analog Devices Inc. Information](#)

## Optimize Your Supply Chain with WIN SOURCE Solutions

-  Global Sourcing Solution
-  Obsolete Management
-  Cost Control Management
-  Shortage Management
-  Alternative Solution
-  Excess Inventory Management