Single-Supply, Rail-to-Rail Low Power FET-Input Op Amp

AD822-EP

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 ±2.5 V to ±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 µA maximum quiescent current per amplifier**
- **Unity-gain bandwidth: 1.8 MHz**
- **Slew rate of 3 V/µs**

Good dc performance
- **800 µV maximum input offset voltage**
- **2 µV/°C typical offset voltage drift**
- **25 pA maximum input bias current**

Low noise
- **13 nV/√Hz @ 10 kHz**
- **No phase inversion**

ENHANCED PRODUCT FEATURES

Supports defense and aerospace applications (AQEC standard)
Military temperature range (−55°C to +125°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

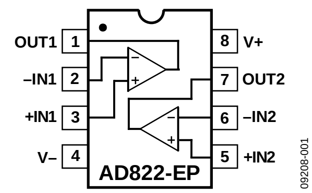

Figure 1. 8-Lead SOIC_N (R Suffix)

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 ±2.5 V to ±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.

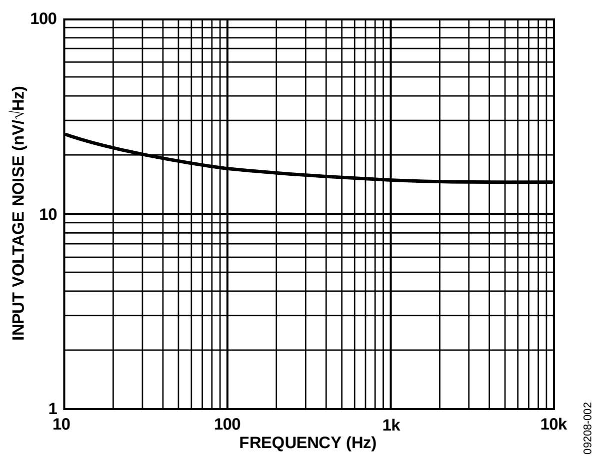

Figure 2. Input Voltage Noise vs. Frequency

Offset voltage of 800 µV maximum, offset voltage drift of 2 µV/°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/µs slew rate are provided with a low supply current of 800 µA per amplifier.

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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°C to +125°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.

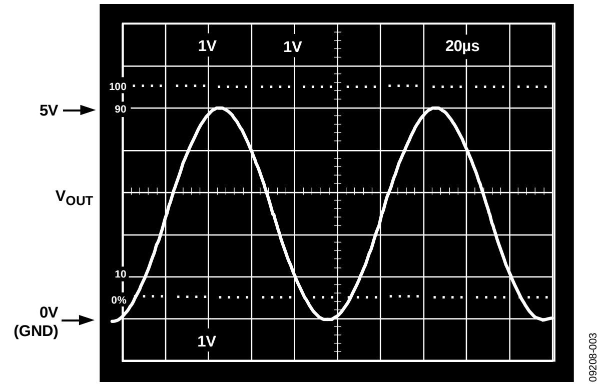

Figure 3. Gain-of-2 Amplifier; V_S = 5 V, 0 V, V_{IN} = 2.5 V Sine Centered at 1.25 V, R_L = 100 Ω

SPECIFICATIONS

V_S = 0 V, 5 V @ T_A = 25°C, V_{CM} = 0 V, V_{OUT} = 0.2 V, unless otherwise noted.

Table 1.

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

Parameter	Test Conditions/Comments	T Grade Min	Typ	Max	Unit
INPUT CHARACTERISTICS					
Input Voltage Range[1], T_{MIN} to T_{MAX}		−0.2		+4	V
Common-Mode Rejection Ratio (CMRR)	V_{CM} = 0 V to 2 V	66	80		dB
T_{MIN} to T_{MAX}	V_{CM} = 0 V to 2 V	66			dB
Input Impedance					
Differential			10^{13}‖0.5		Ω‖pF
Common Mode			10^{13}‖2.8		Ω‖pF
OUTPUT CHARACTERISTICS					
Output Saturation Voltage[2]					
$V_{OL} - V_{EE}$	I_{SINK} = 20 μA		5	7	mV
T_{MIN} to T_{MAX}				10	mV
$V_{CC} - V_{OH}$	I_{SOURCE} = 20 μA		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		15			mA
T_{MIN} to T_{MAX}		12			mA
Capacitive Load Drive			350		pF
POWER SUPPLY					
Quiescent Current, T_{MIN} to T_{MAX}			1.24	1.6	mA
Power Supply Rejection	V+ = 5 V to 15 V	66	80		dB
T_{MIN} to T_{MAX}		66			dB

[1] 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.

[2] $V_{OL} - V_{EE}$ 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}).

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

Table 2.

Parameter	Test Conditions/Comments	T Grade Min	T Grade Typ	T Grade Max	Unit
DC PERFORMANCE					
Initial Offset			0.1	0.8	mV
Maximum Offset Over Temperature			0.5	1.5	mV
Offset Drift			2		µV/°C
Input Bias Current	V_{CM} = −5 V to +4 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 V to +4 V				
	R_L = 100 kΩ	400	1000		V/mV
T_{MIN} to T_{MAX}		400			V/mV
	R_L = 10 kΩ	80	150		V/mV
T_{MIN} to T_{MAX}		80			V/mV
	R_L = 1 kΩ	20	30		V/mV
T_{MIN} to T_{MAX}		10			V/mV
NOISE/HARMONIC PERFORMANCE					
Input Voltage Noise					
f = 0.1 Hz to 10 Hz			2		µV p-p
f = 10 Hz			25		nV/√Hz
f = 100 Hz			21		nV/√Hz
f = 1 kHz			16		nV/√Hz
f = 10 kHz			13		nV/√Hz
Input Current Noise					
f = 0.1 Hz to 10 Hz			18		fA p-p
f = 1 kHz			0.8		fA/√Hz
Harmonic Distortion	R_L = 10 kΩ				
f = 10 kHz	V_{OUT} = ±4.5 V		−93		dB
DYNAMIC PERFORMANCE					
Unity-Gain Frequency			1.9		MHz
Full Power Response	V_{OUT} p-p = 9 V		105		kHz
Slew Rate			3		V/µs
Settling Time					
to 0.1%	V_{OUT} = 0 V to ±4.5 V		1.4		µs
to 0.01%	V_{OUT} = 0 V to ±4.5 V		1.8		µs
MATCHING CHARACTERISTICS					
Initial Offset				1.0	mV
Maximum Offset Over Temperature				3	mV
Offset Drift			3		µV/°C
Input Bias Current				25	pA
Crosstalk @ f = 1 kHz	R_L = 5 kΩ		−130		dB
Crosstalk @ f = 100 kHz	R_L = 5 kΩ		−93		dB
INPUT CHARACTERISTICS					
Input Voltage Range[1], T_{MIN} to T_{MAX}		−5.2		+4	V
Common-Mode Rejection Ratio (CMRR)	V_{CM} = −5 V to +2 V	66	80		dB
T_{MIN} to T_{MAX}	V_{CM} = −5 V to +2 V	66			dB
Input Impedance					
Differential			10^{13}‖0.5		Ω‖pF
Common Mode			10^{13}‖2.8		Ω‖pF

Parameter	Test Conditions/Comments	T Grade Min	Typ	Max	Unit
OUTPUT CHARACTERISTICS					
Output Saturation Voltage[2]					
$V_{OL} - V_{EE}$	I_{SINK} = 20 µA		5	7	mV
T_{MIN} to T_{MAX}				10	mV
$V_{CC} - V_{OH}$	I_{SOURCE} = 20 µA		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		15			mA
T_{MIN} to T_{MAX}		12			mA
Capacitive Load Drive			350		pF
POWER SUPPLY					
Quiescent Current, T_{MIN} to T_{MAX}			1.3	1.6	mA
Power Supply Rejection	V_{SY} = ±5 V to ±15 V	66	80		dB
T_{MIN} to T_{MAX}		66			dB

[1] 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.
[2] $V_{OL} - V_{EE}$ 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}).

V_S = ±15 V @ T_A = 25°C, V_{CM} = 0 V, V_{OUT} = 0 V, unless otherwise noted.

Table 3.

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

Parameter	Test Conditions/Comments	T Grade Min	Typ	Max	Unit
OUTPUT CHARACTERISTICS					
Output Saturation Voltage[2]					
$V_{OL} - V_{EE}$	I_{SINK} = 20 µA		5	7	mV
T_{MIN} to T_{MAX}				10	mV
$V_{CC} - V_{OH}$	I_{SOURCE} = 20 µA		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
POWER SUPPLY					
Quiescent Current, T_{MIN} to T_{MAX}			1.4	1.8	mA
Power Supply Rejection	V_{SY} = ±5 V to ±15 V	70	80		dB
T_{MIN} to T_{MAX}		70			dB

[1] 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.

[2] $V_{OL} - V_{EE}$ 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	
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 (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

θ_{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	θ_{JA}	θ_{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

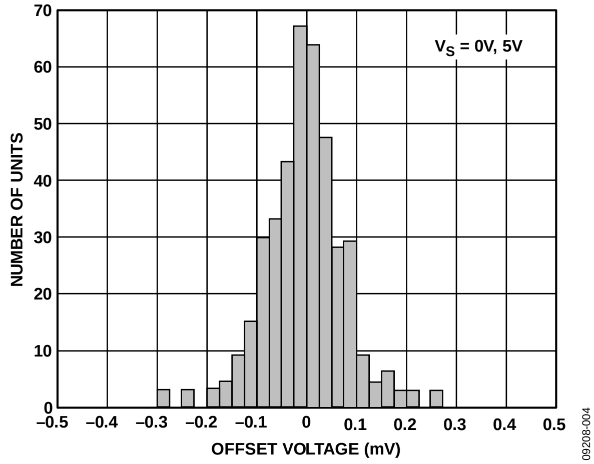

Figure 4. Typical Distribution of Offset Voltage (390 Units)

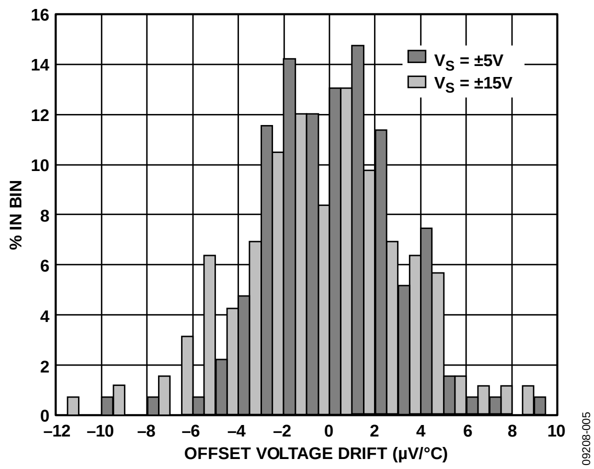

Figure 5. Typical Distribution of Offset Voltage Drift (100 Units)

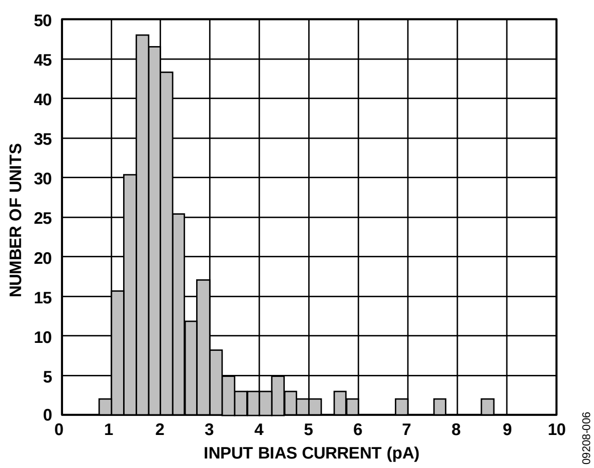

Figure 6. Typical Distribution of Input Bias Current (213 Units)

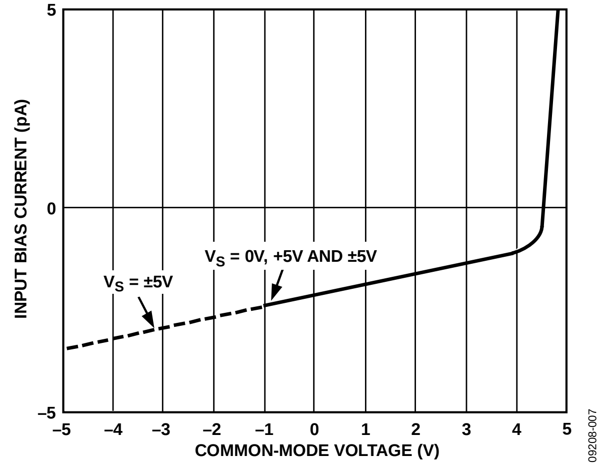

Figure 7. Input Bias Current vs. Common-Mode Voltage; V_S = 5 V, 0 V, and V_S = ±5 V

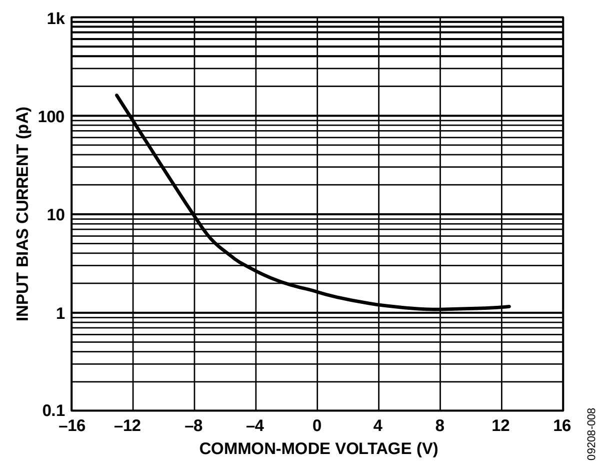

Figure 8. Input Bias Current vs. Common-Mode Voltage; V_S = ±15 V

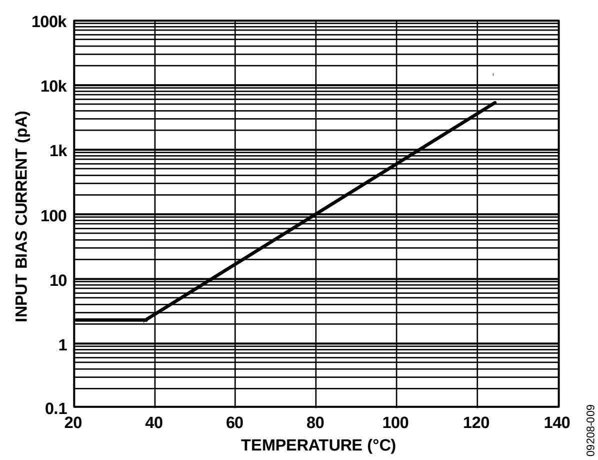

Figure 9. Input Bias Current vs. Temperature; V_S = 5 V, V_{CM} = 0 V

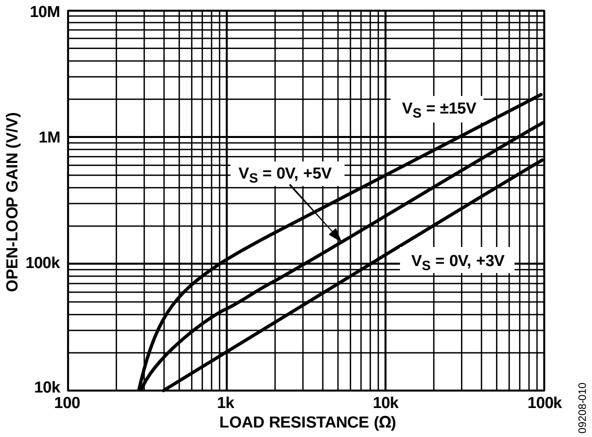

Figure 10. Open-Loop Gain vs. Load Resistance

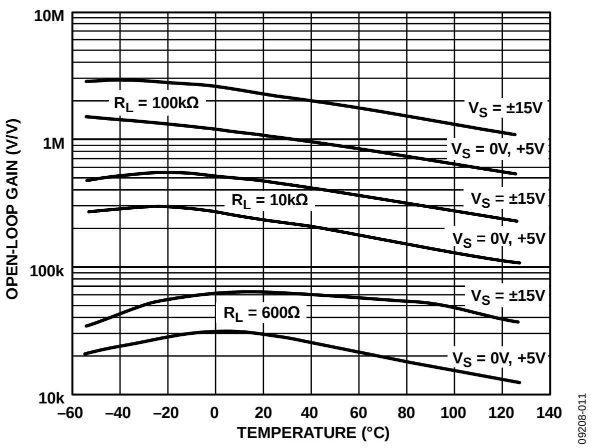

Figure 11. Open-Loop Gain vs. Temperature

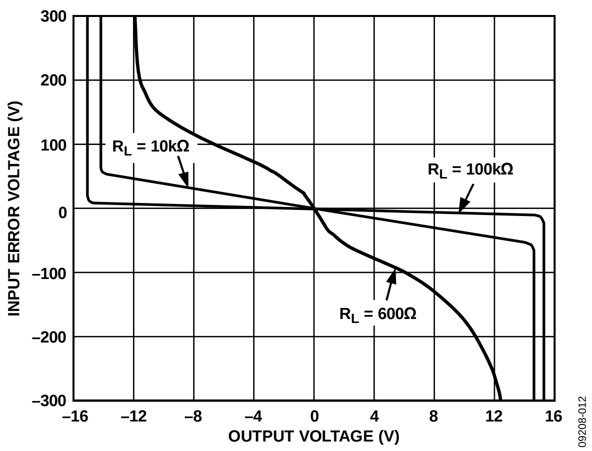

Figure 12. Input Error Voltage vs. Output Voltage for Resistive Loads

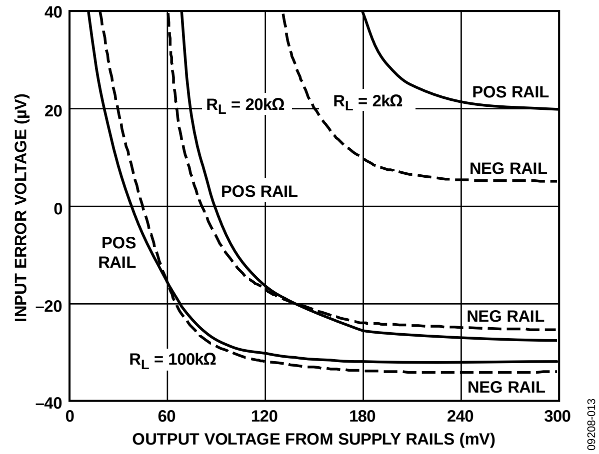

Figure 13. Input Error Voltage with Output Voltage Within 300 mV of Either Supply Rail for Various Resistive Loads; V_S = ±5 V

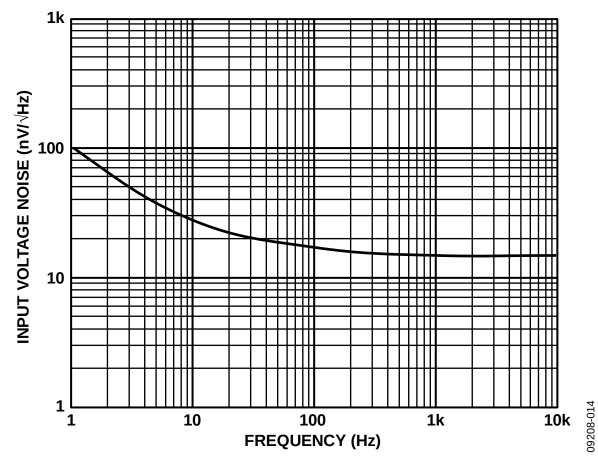

Figure 14. Input Voltage Noise vs. Frequency

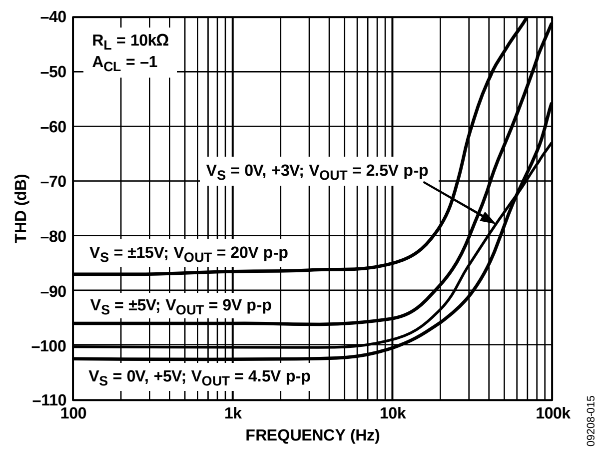

Figure 15. Total Harmonic Distortion (THD) vs. Frequency

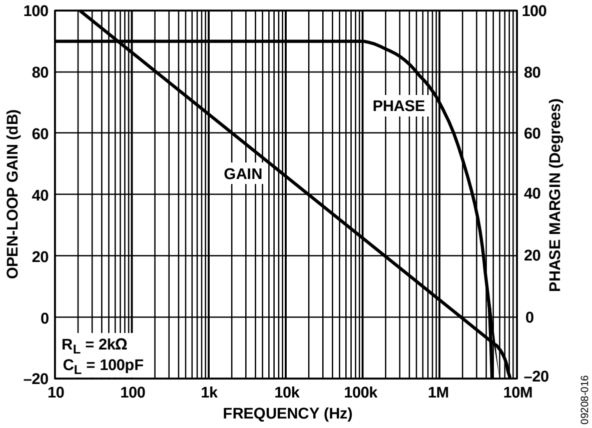

Figure 16. Open-Loop Gain and Phase Margin vs. Frequency

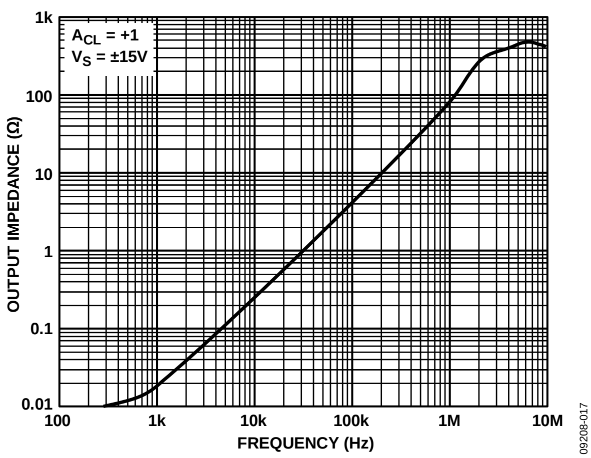

Figure 17. Output Impedance vs. Frequency

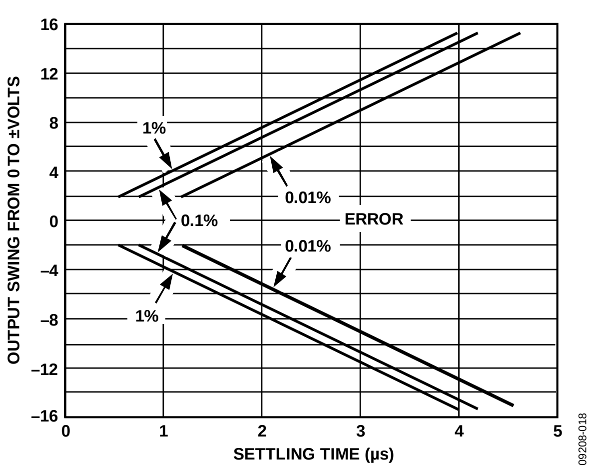

Figure 18. Output Swing and Error vs. Settling Time

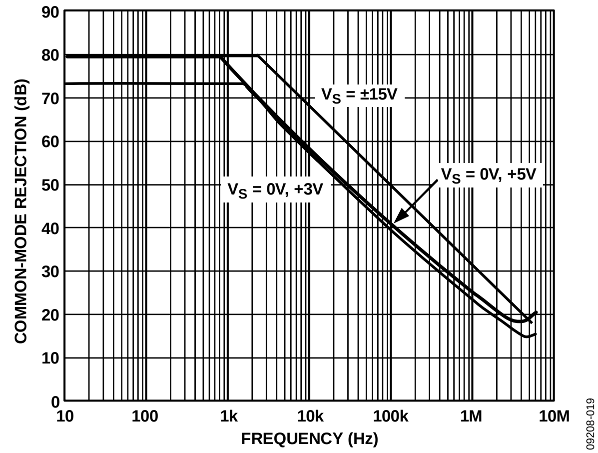

Figure 19. Common-Mode Rejection vs. Frequency

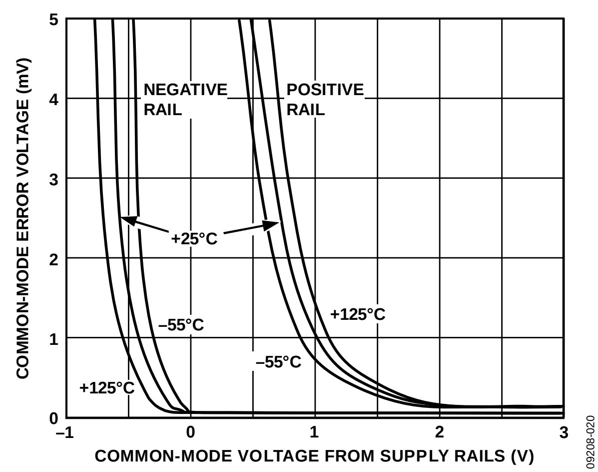

Figure 20. Absolute Common-Mode Error vs. Common-Mode Voltage from Supply Rails ($V_S – V_{CM}$)

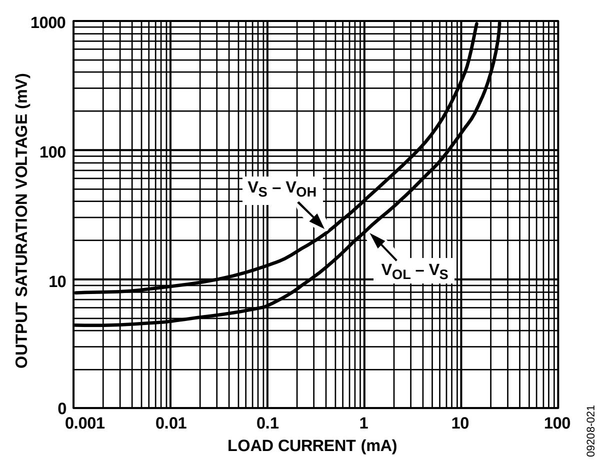

Figure 21. Output Saturation Voltage vs. Load Current

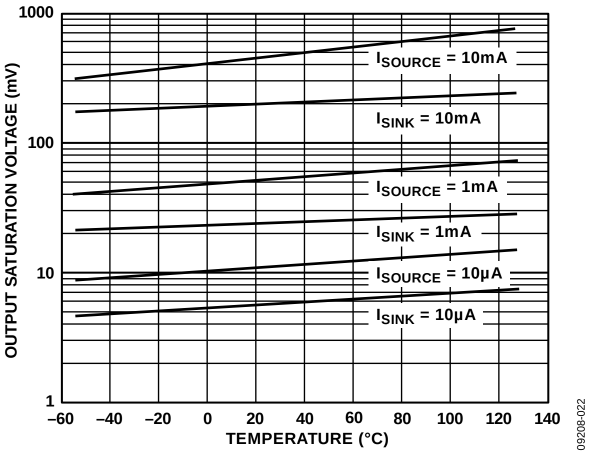

Figure 22. Output Saturation Voltage vs. Temperature

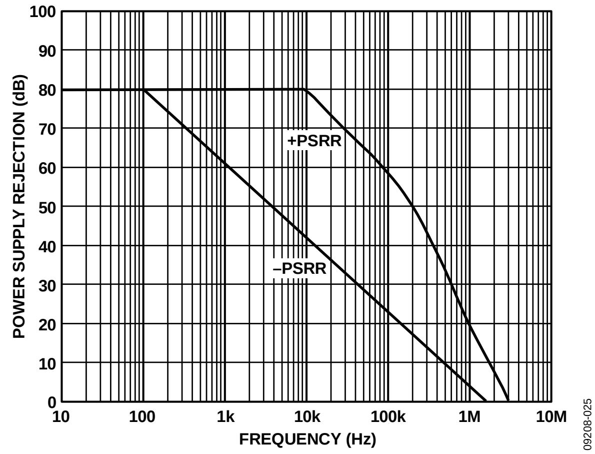

Figure 25. Power Supply Rejection vs. Frequency

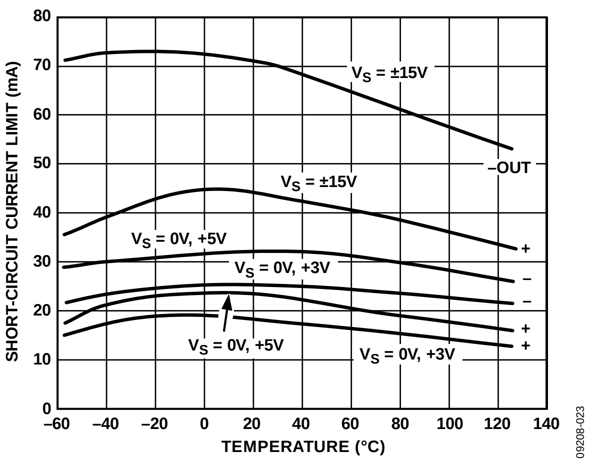

Figure 23. Short-Circuit Current Limit vs. Temperature

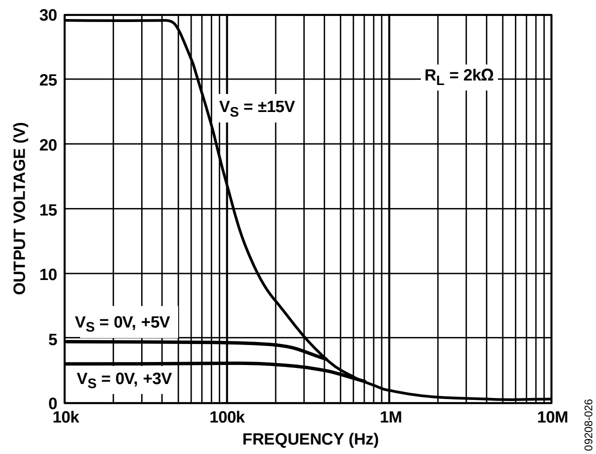

Figure 26. Large Signal Frequency Response

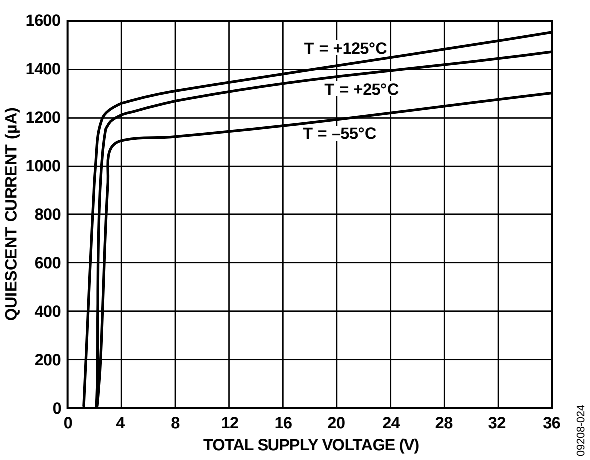

Figure 24. Quiescent Current vs. Supply Voltage vs. Temperature

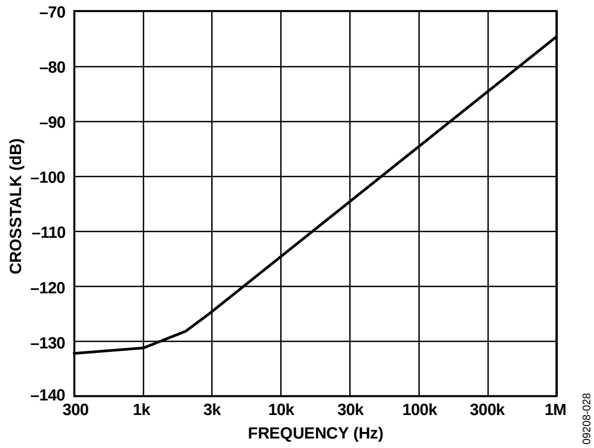

Figure 27. Crosstalk vs. Frequency

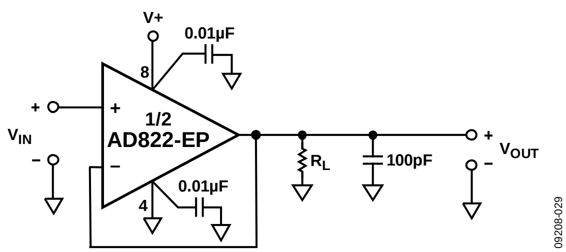

Figure 28. Unity-Gain Follower

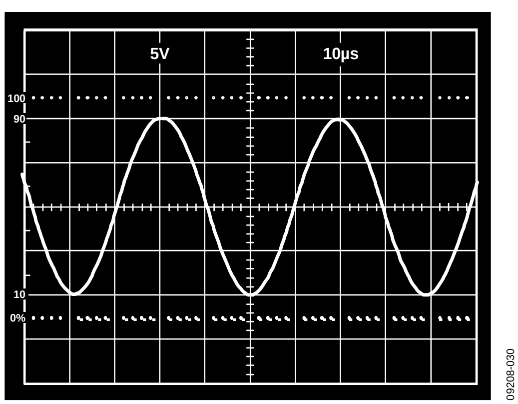

Figure 29. 20 V p-p, 25 kHz Sine Wave Input; Unity-Gain Follower; $V_S = \pm15$ V, $R_L = 600\ \Omega$

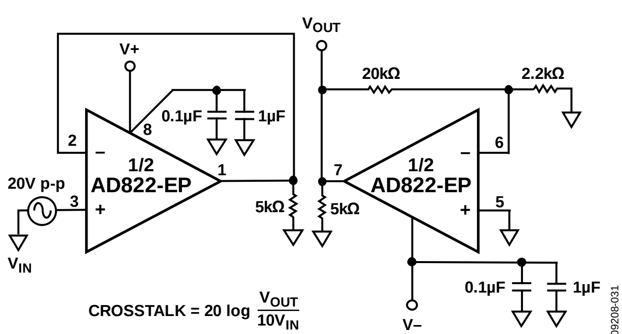

Figure 30. Crosstalk Test Circuit

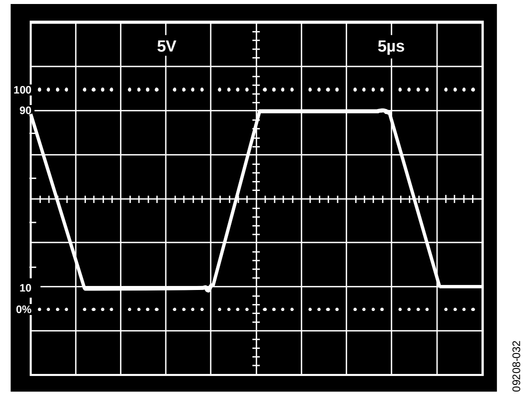

Figure 31. Large Signal Response Unity-Gain Follower; $V_S = \pm15$ V, $R_L = 10\ k\Omega$

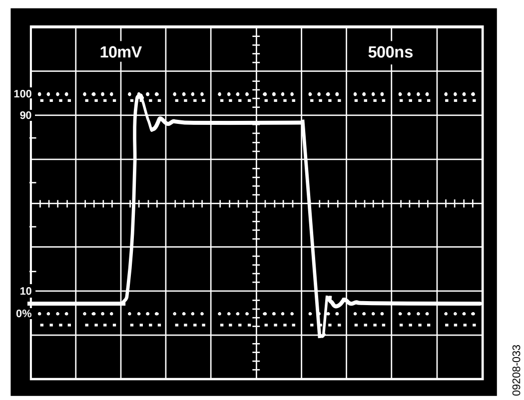

Figure 32. Small Signal Response Unity-Gain Follower; $V_S = \pm15$ V, $R_L = 10\ k\Omega$

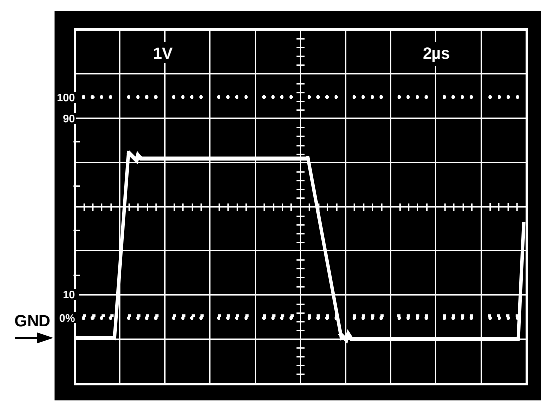

Figure 33. $V_S = 5$ V, 0 V; Unity-Gain Follower Response to 0 V to 4 V Step

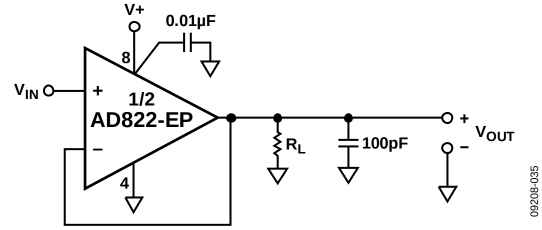

Figure 34. Unity-Gain Follower

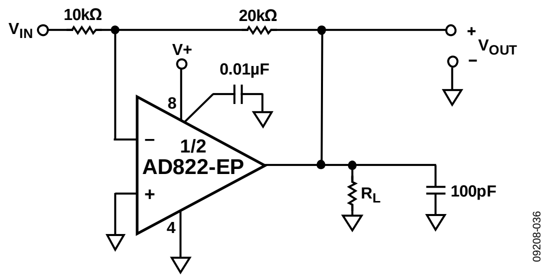

Figure 35. Gain-of-Two Inverter

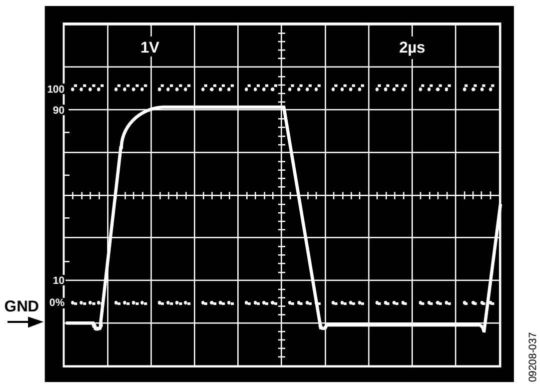

Figure 36. V_S = 5 V, 0 V; Unity-Gain Follower Response to 0 V to 5 V Step

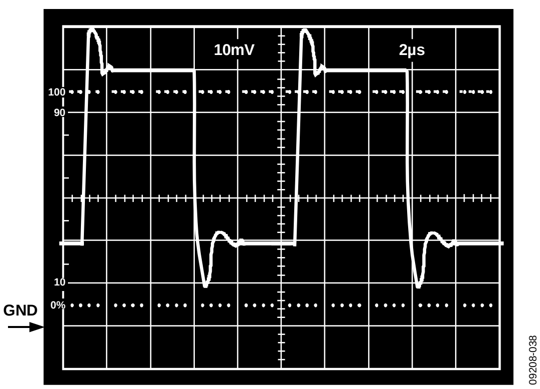

Figure 37. V_S = 5 V, 0 V; Unity-Gain Follower Response to 40 mV Step, Centered 40 mV above Ground, R_L = 10 kΩ

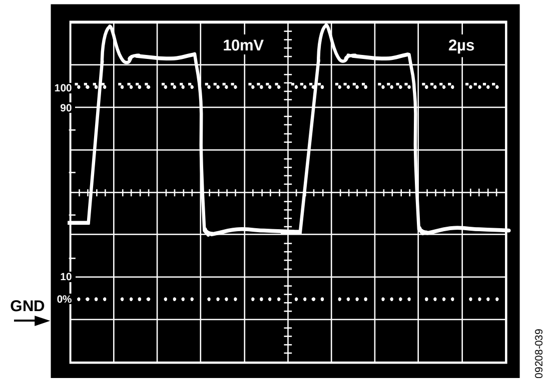

Figure 38. V_S = 5 V, 0 V; Gain-of-2 Inverter Response to 20 mV Step, Centered 20 mV Below Ground, R_L = 10 kΩ

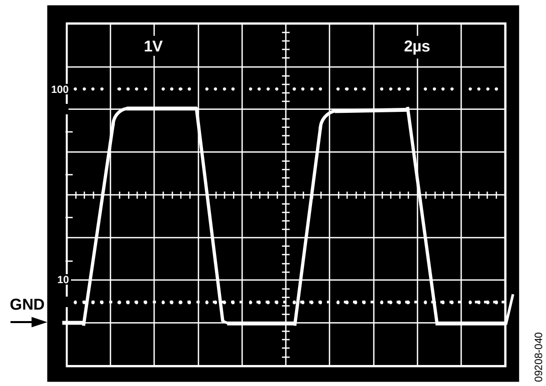

Figure 39. V_S = 5 V, 0 V; Gain-of-2 Inverter Response to 2.5 V Step, Centered –1.25 V Below Ground, R_L = 10 kΩ

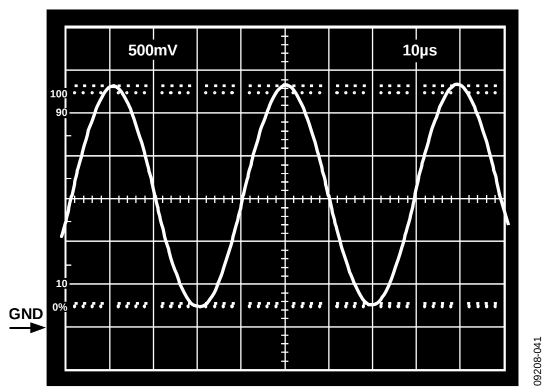

Figure 40. V_S = 3 V, 0 V; Gain-of-2 Inverter, V_{IN} = 1.25 V, 25 kHz, Sine Wave Centered at –0.75 V, R_L = 600 Ω

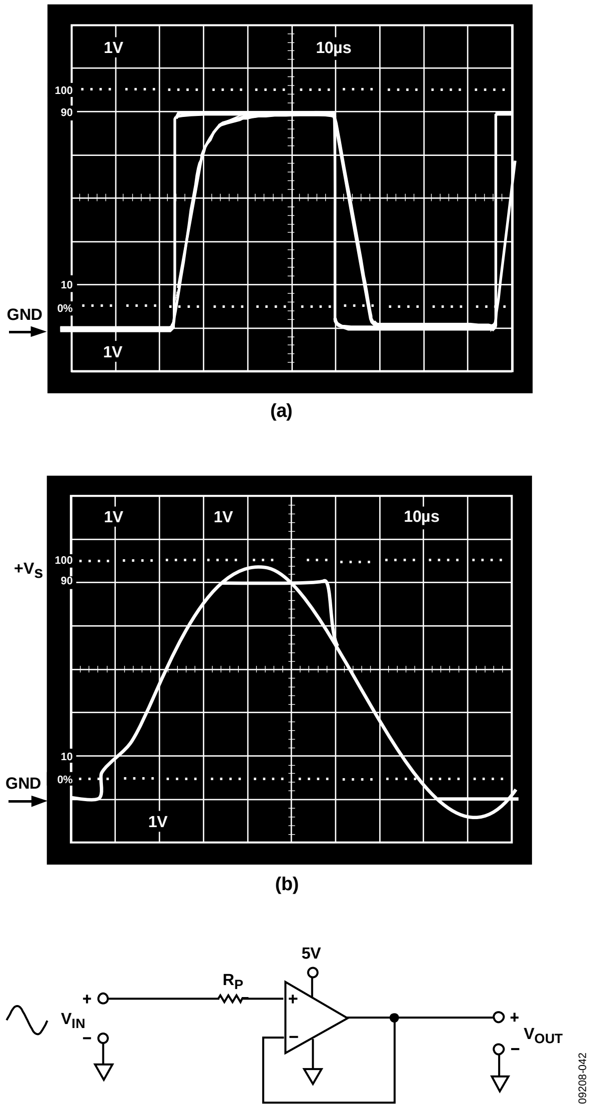

Figure 41. (a) Response with $R_P = 0$; V_{IN} from 0 V to $+V_S$
(b) $V_{IN} = 0$ V to $+V_S + 200$ mV
$V_{OUT} = 0$ V to $+V_S$
$R_P = 49.9$ kΩ

OUTLINE DIMENSIONS

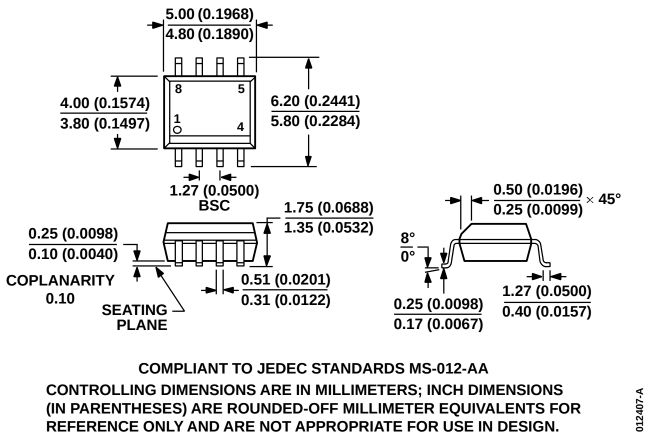

Figure 42. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option
AD822TRZ-EP	−55°C to +125°C	8-Lead SOIC_N	R-8
AD822TRZ-EP-R7	−55°C to +125°C	8-Lead SOIC_N	R-8

[1] Z = RoHS Compliant Part.

SPICE model is available at www.analog.com.

NOTES

NOTES

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- *Конкурентоспособные цены и скидки постоянным клиентам.*
- *Специальные условия для постоянных клиентов.*
- *Подбор аналогов.*
- *Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.*

- *Приемлемые сроки поставки, возможна ускоренная поставка.*
- *Доставку товара в любую точку России и стран СНГ.*
- *Комплексную поставку.*
- *Работу по проектам и поставку образцов.*
- *Формирование склада под заказчика.*

- *Сертификаты соответствия на поставляемую продукцию (по желанию клиента).*
- *Тестирование поставляемой продукции.*
- *Поставку компонентов, требующих военную и космическую приемку.*
- *Входной контроль качества.*
- *Наличие сертификата ISO.*

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- *Регистрацию проекта у производителя компонентов.*
- *Техническую поддержку проекта.*
- *Защиту от снятия компонента с производства.*
- *Оценку стоимости проекта по компонентам.*
- *Изготовление тестовой платы монтаж и пусконаладочные работы.*

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