Dual, Low Power, Wideband, Low Noise, Rail-to-Rail Output Operational Amplifier

ADA4692-2

FEATURES

Low power: 200 μA typical, 250 μA maximum
Low distortion: 0.003% THD + N
Low noise: 16 nV/√Hz typical
3.9 MHz bandwidth
Slew rate: 1.4 V/μs typical
Offset voltage: 500 μV typical
Low offset voltage drift: 4 μV/°C maximum
Very low input bias currents: 0.5 pA typical
2.7 V to 5 V single supply or ±1.35 V to ±2.5 V dual supply

APPLICATIONS

Portable audio: MP3, PDA, smart phone, notebook
Portable instrumentation
Portable medical devices
Photodiode amplifier
Sensor amplifier
Low-side current sense
ADC driver
Active filter
Sample-and-hold
Automotive sensors

PIN CONFIGURATION

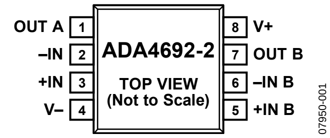

Figure 1. 8-Lead SOIC_N (R-8)

GENERAL DESCRIPTION

The ADA4692-2 is a dual, rail-to-rail output, single-supply amplifier featuring low power, wide bandwidth, and low noise ideal for a wide variety of applications. Audio preamps, filters, IR/photodiode amplifiers, charge amps, and high impedance sensors all benefit from this combination of performance features.

Applications for these amplifiers include consumer audio personal players with low noise and low distortion that provide enough gain and slew rate response over the audio band at low power. Industrial applications with high impedance sensors, such as pyroelectric sensors and other IR sensors, benefit from the high impedance input, low offset drift, and enough bandwidth and response for low gain applications.

The ADA4692-2 is specified over the extended industrial temperature range (−40°C to +125°C). The ADA4692-2 is a dual op amp available in an 8-lead SOIC package.

Rev. 0

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REVISION HISTORY

3/09—Revision 0: Initial Version

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS—2.7 V OPERATION

V_{SY} = 2.7 V, V_{CM} = V_{SY}/2, T_A = 25°C, unless otherwise specified.

Table 1.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = −0.3 V to +1.6 V		0.5	2.5	mV
		V_{CM} = −0.1 V to +1.6 V; −40°C < T_A < +125°C			3.5	mV
Input Bias Current	I_B			0.5	5	pA
		−40°C < T_A < +125°C			325	pA
Input Offset Current	I_{OS}			1	5	pA
		−40°C < T_A < +125°C			225	pA
Input Voltage Range		−40°C < T_A < +125°C	−0.3		+1.6	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −0.3 V to +1.6 V	70	90		dB
		V_{CM} = −0.1 V to +1.6 V; −40°C < T_A < +125°C	70			dB
Large Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, V_{OUT} = 0.5 V to 2.2 V	90	100		dB
		−40°C < T_A < +85°C	85			dB
		−40°C < T_A < +125°C	73			dB
		R_L = 600 Ω, V_{OUT} = 0.5 V to 2.2 V	85	95		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		0.6	3	µV/°C
Input Capacitance	C_{IN}					
Differential Mode	C_{INDM}			2.5		pF
Common Mode	C_{INCM}			7		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	R_L = 2 kΩ to GND	2.65	2.67		V
		−40°C < T_A < +125°C	2.6			V
		R_L = 600 Ω to GND	2.55	2.59		V
		−40°C < T_A < +125°C	2.5			V
Output Voltage Low	V_{OL}	R_L = 2 kΩ to V_{SY}		24	30	mV
		−40°C < T_A < +125°C			40	mV
		R_L = 600 Ω to V_{SY}		78	95	mV
		−40°C < T_A < +125°C			125	mV
Short-Circuit Current	I_{SC}	V_{OUT} = V_{SY} or GND		±15		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1 MHz, A_V = −100		372		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	80	90		dB
		−40°C < T_A < +125°C	75			dB
Supply Current Per Amplifier	I_{SY}	V_{OUT} = V_{SY}/2		165	200	µA
		−40°C < T_A < +125°C			225	µA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 600 Ω, C_L = 20 pF, A_V = +1		1.1		V/µs
Slew Rate	SR	R_L = 2 kΩ, C_L = 20 pF, A_V = +1		1.4		V/µs
Settling Time to 0.1%	t_S	Step = 0.5 V, R_L = 2 kΩ, 600 Ω		1		µs
Gain Bandwidth Product	GBP	R_L = 1 MΩ, C_L = 35 pF, A_V = +1		3.9		MHz
Phase Margin	Φ_M	R_L = 1 MΩ, C_L = 35 pF, A_V = +1		49		Degrees

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
NOISE PERFORMANCE						
Distortion	THD + N	$A_V = -1$, $R_L = 2$ kΩ, f = 1 kHz, V_{IN} rms = 0.15 V rms		0.008		%
		$A_V = -1$, $R_L = 600$ Ω, f = 1 kHz, V_{IN} rms = 0.15 V rms		0.01		%
		$A_V = +1$, $R_L = 2$ kΩ, f = 1 kHz, V_{IN} rms = 0.15 V rms		0.004		%
		$A_V = +1$, $R_L = 600$ Ω, f = 1 kHz, V_{IN} rms = 0.15 V rms		0.005		%
Voltage Noise	e_n p-p	f = 0.1 Hz to 10 Hz		3.1		μV p-p
Voltage Noise Density	e_n	f = 1 kHz		16		nV/√Hz
		f = 10 kHz		13		nV/√Hz

ELECTRICAL CHARACTERISTICS—5 V OPERATION

$V_{SY} = 5$ V, $V_{CM} = V_{SY}/2$, $T_A = 25°C$, unless otherwise specified.

Table 2.

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	$V_{CM} = -0.3$ V to +3.9 V		0.5	2.5	mV
		$V_{CM} = -0.1$ V to +3.9 V; −40°C < T_A < +125°C			3.5	mV
Input Bias Current	I_B			0.5	5	pA
		−40°C < T_A < +125°C			360	pA
Input Offset Current	I_{OS}			1	5	pA
		−40°C < T_A < +125°C			260	pA
Input Voltage Range		−40°C < T_A < +125°C	−0.3		+3.9	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -0.3$ V to +3.9 V	75	98		dB
		$V_{CM} = -0.1$ V to +3.9 V; −40°C < T_A < +125°C	75			dB
Large Signal Voltage Gain	A_{VO}	$R_L = 2$ kΩ, $V_O = 0.5$ V to 4.5 V, $V_{CM} = 0$ V	95	110		dB
		−40°C < T_A < +85°C	90			dB
		−40°C < T_A < +125°C	80			dB
		$R_L = 600$ Ω, $V_O = 0.5$ V to 4.5 V, $V_{CM} = 0$ V	90	100		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	−40°C < T_A < +125°C		1	4	μV/°C
Input Capacitance						
Differential Mode	C_{INDM}			2.5		pF
Common Mode	C_{INCM}			7		pF
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	$R_L = 2$ kΩ	4.95	4.97		V
		−40°C ≤ T_A ≤ +125°C	4.9			V
		$R_L = 600$ Ω to GND	4.85	4.88		V
		−40°C ≤ T_A ≤ +125°C	4.8			V
Output Voltage Low	V_{OL}	$R_L = 2$ kΩ		28	35	mV
		−40°C ≤ T_A ≤ +125°C			45	mV
		$R_L = 600$ Ω		90	110	mV
		−40°C ≤ T_A ≤ +125°C			140	mV
Short-Circuit Limit	I_{SC}	$V_{OUT} = V_{SY}$ or GND		±55		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1 MHz, $A_V = -100$		344		Ω
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_{SY} = 2.7$ V to 5.5 V	80	90		dB
		−40°C ≤ T_A ≤ +125°C	75			dB
Supply Current per Amplifier	I_{SY}	$V_{OUT} = V_{SY}/2$		175	225	μA
		−40°C ≤ T_A ≤ +125°C			250	μA

Parameter	Symbol	Test Conditions/Comments	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ, 600 Ω, C_L = 20 pF, A_V = +1		1.3		V/µs
Settling Time to 0.1%	t_S	V_{IN} = 2 V step, R_L = 2 kΩ, 600 Ω		1.5		µs
Gain Bandwidth Product	GBP	R_L = 1 MΩ, C_L = 35 pF, A_V = +1		3.6		MHz
Phase Margin	Φ_M	R_L = 1 MΩ, C_L = 35 pF, A_V = +1		52		Degrees
NOISE PERFORMANCE						
Distortion	THD + N	A_V = −1, R_L = 2 kΩ, f = 1 kHz, V_{IN} rms = 0.8 V rms		0.008		%
		A_V = −1, R_L = 600 Ω, f = 1 kHz, V_{IN} rms = 0.8 V rms		0.006		%
		A_V = +1, R_L = 2 kΩ, f = 1 kHz, V_{IN} rms = 0.8 V rms		0.003		%
		A_V = +1, R_L = 600 Ω, f = 1 kHz, V_{IN} rms = 0.8 V rms		0.001		%
Voltage Noise	e_n p-p	f = 0.1 Hz to 10 Hz		3.2		µV p-p
Voltage Noise Density	e_n	f = 1 kHz		16		nV/√Hz
	e_n	f = 10 kHz		13		nV/√Hz

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	6 V
Input Voltage	V_{SS} – 0.3 V to V_{DD} +0.3 V
Input Current[1]	±10 mA
Differential Input Voltage[2]	$\pm V_{SY}$
Output Short-Circuit Duration to GND	Indefinite
Temperature	
Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	−40°C to +125°C
Junction Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 60 sec)	300°C

[1] Input pins have clamp diodes to the supply pins. Limit the input current to 10 mA or less whenever the input signal exceeds the power supply rail by 0.3 V.
[2] Differential input voltage is limited to 5 V or the supply voltage, whichever is less.

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 and measured using a standard 2-layer board, unless otherwise specified.

Table 4. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
8-Lead SOIC_N (R-8)	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.

TYPICAL PERFORMANCE CHARACTERISTICS

T_A = 25°C, unless otherwise noted.

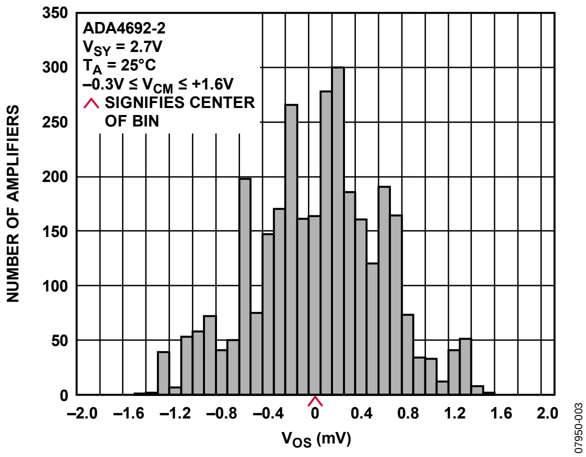

Figure 2. Input Offset Voltage Distribution

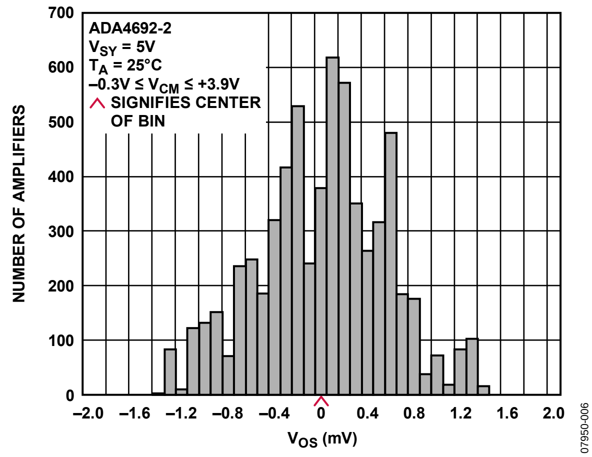

Figure 5. Input Offset Voltage Distribution

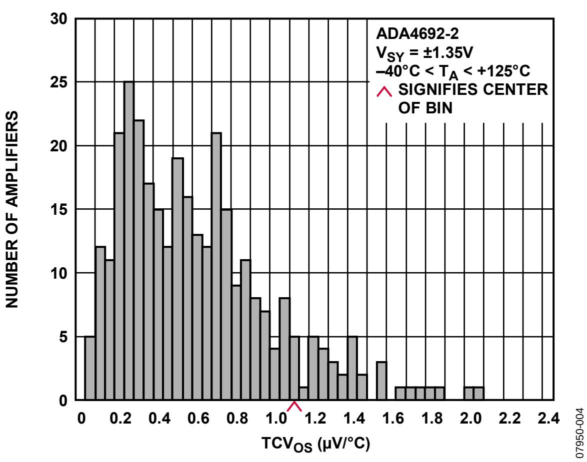

Figure 3. Input Offset Voltage Drift Distribution

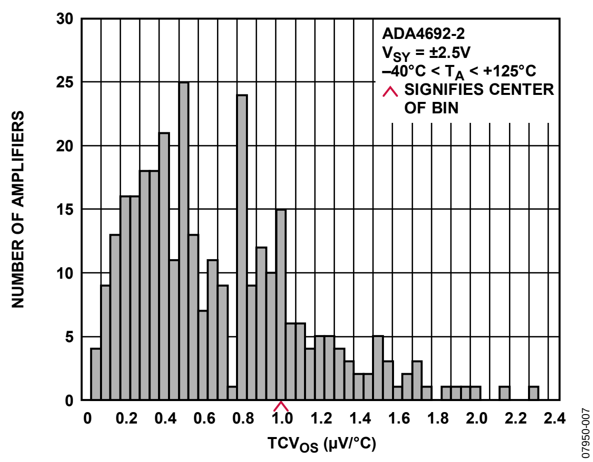

Figure 6. Input Offset Voltage Drift Distribution

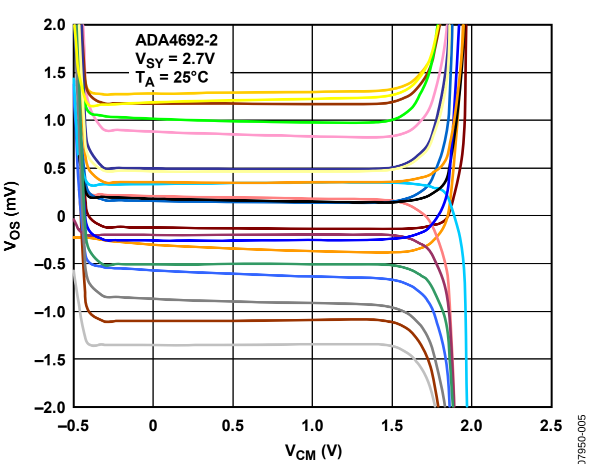

Figure 4. Input Offset Voltage vs. Common-Mode Voltage

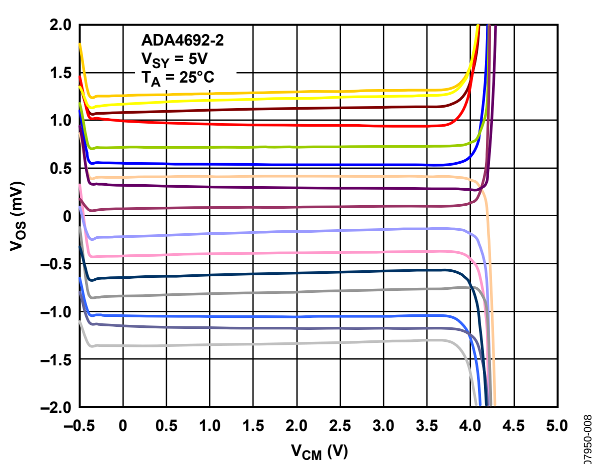

Figure 7. Input Offset Voltage vs. Common-Mode Voltage

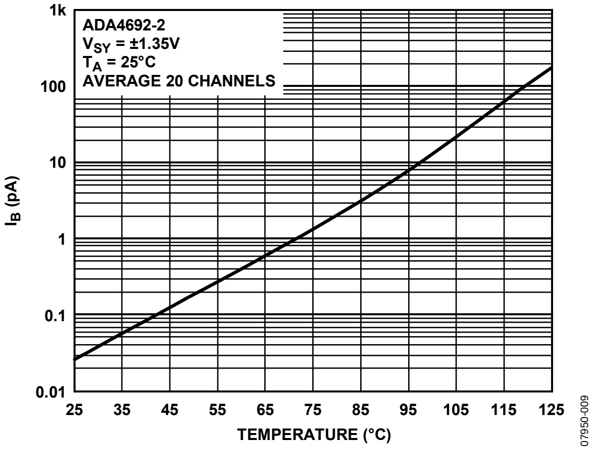

Figure 8. Input Bias Current vs. Temperature

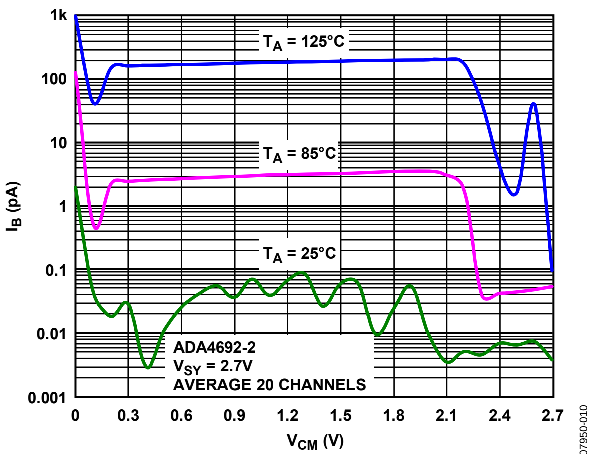

Figure 9. Input Bias Current vs. Common-Mode Voltage

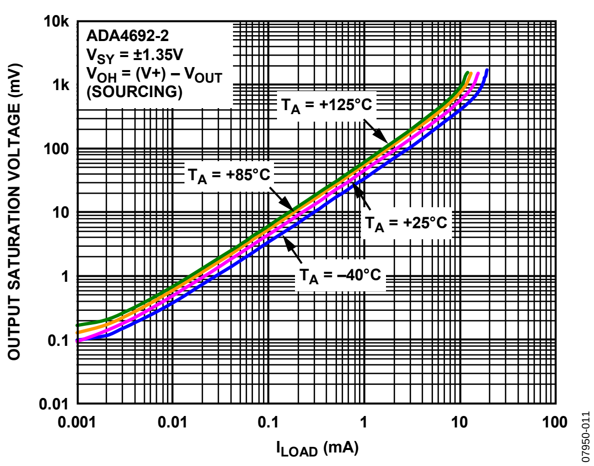

Figure 10. Output Voltage (V_{OH}) to Supply Rail vs. Load Current

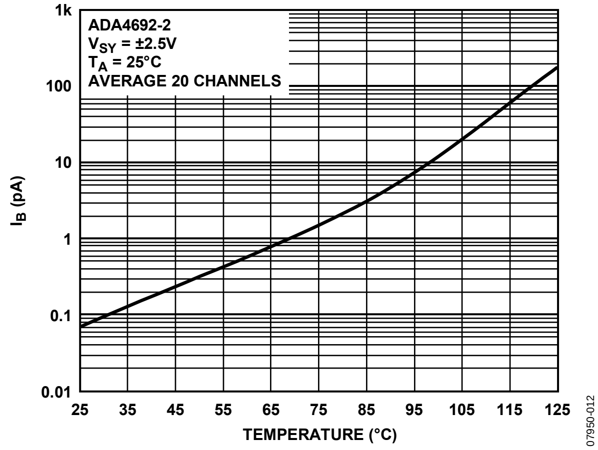

Figure 11. Input Bias Current vs. Temperature

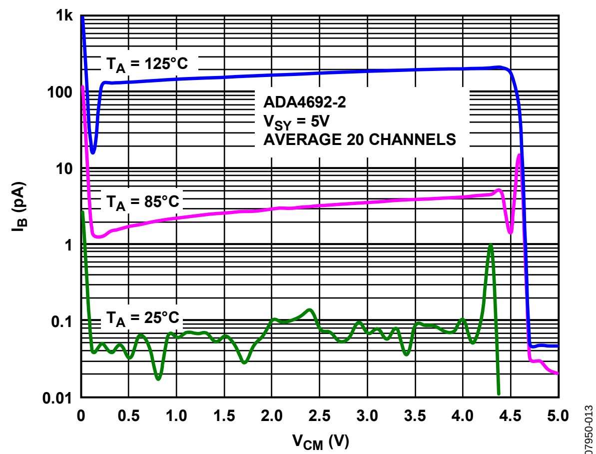

Figure 12. Input Bias Current vs. Common-Mode Voltage

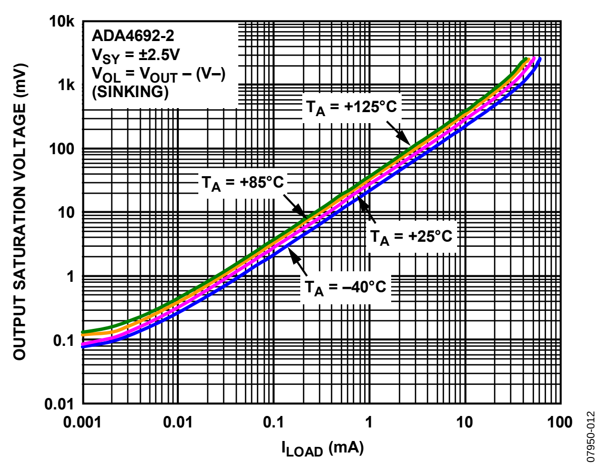

Figure 13. Output Voltage (V_{OH}) to Supply Rail vs. Load Current

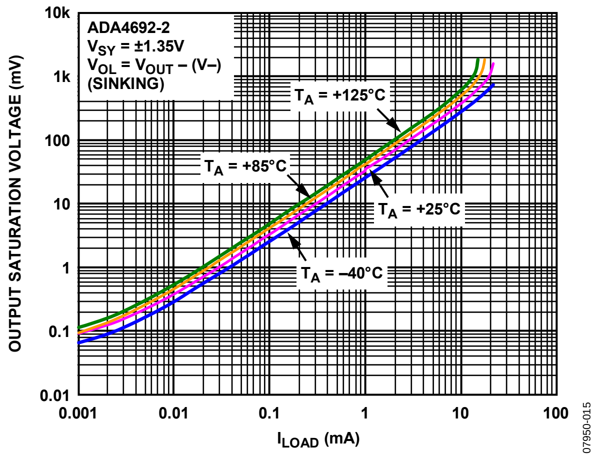

Figure 14. Output Voltage (V_{OL}) to Supply Rail vs. Load Current

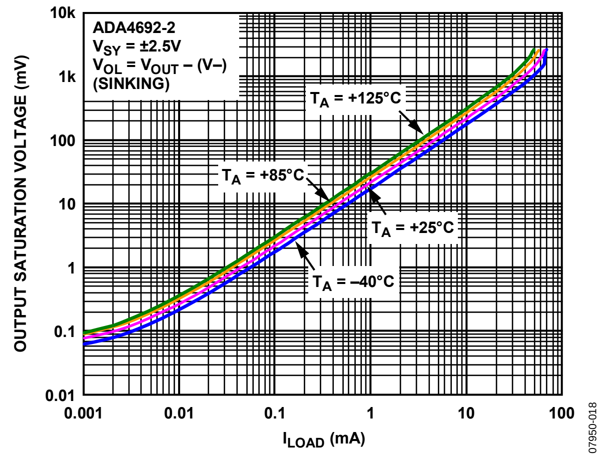

Figure 17. Output Voltage (V_{OL}) to Supply Rail vs. Load Current

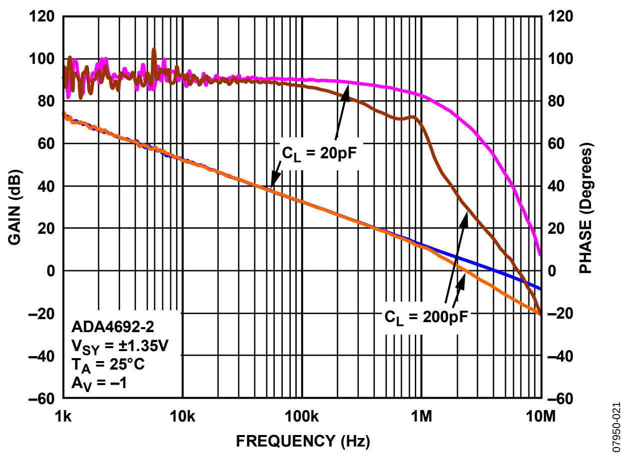

Figure 15. Open-Loop Gain and Phase vs. Frequency

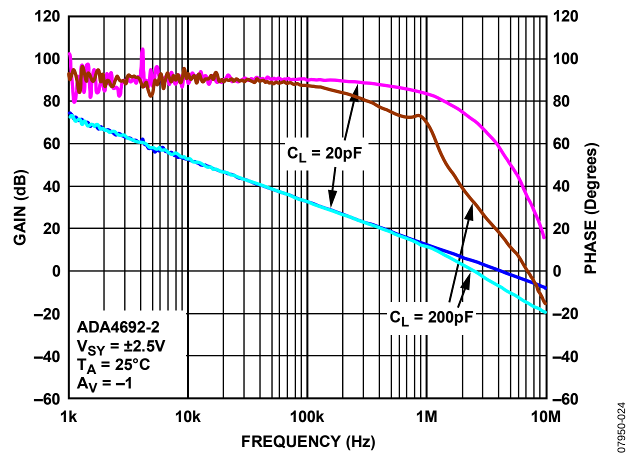

Figure 18. Open-Loop Gain and Phase vs. Frequency

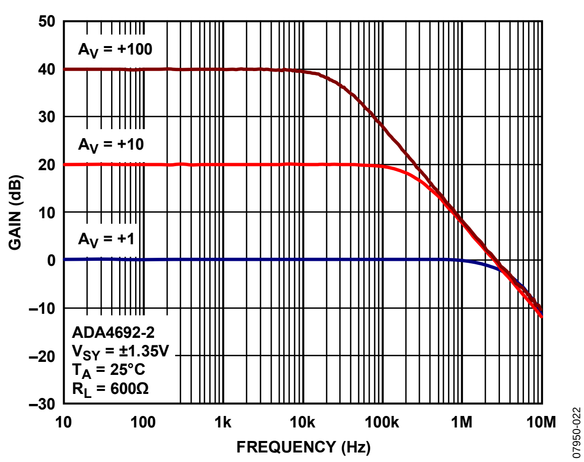

Figure 16. Closed-Loop Gain vs. Frequency

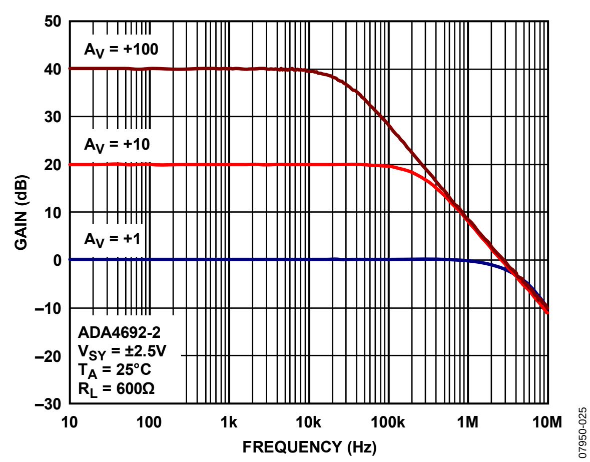

Figure 19. Closed-Loop Gain vs. Frequency

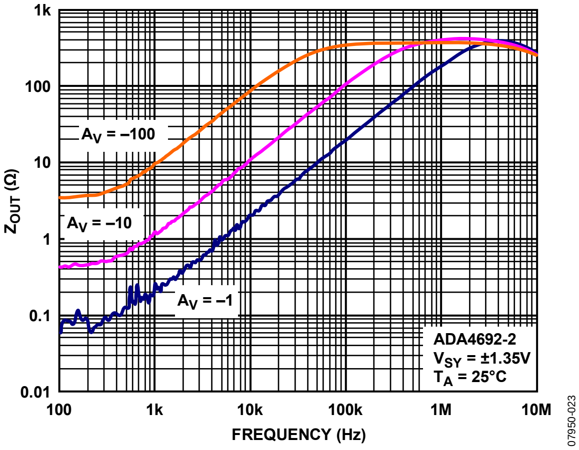

Figure 20. Output Impedance vs. Frequency

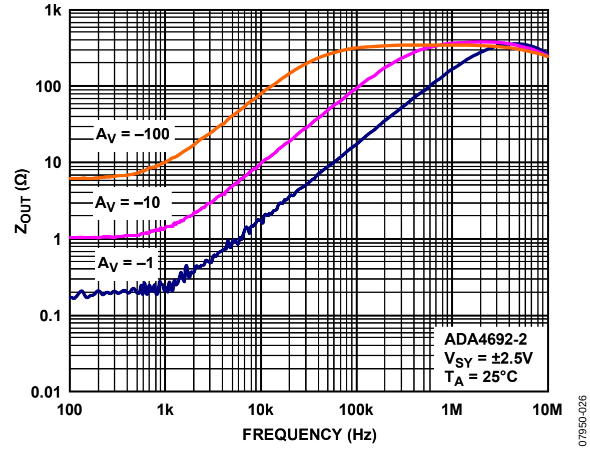

Figure 23. Output Impedance vs. Frequency

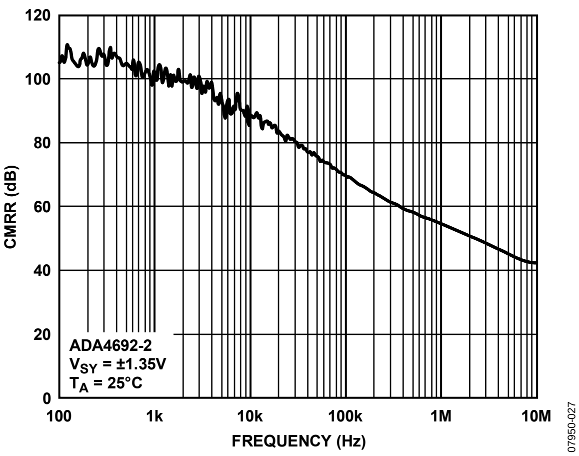

Figure 21. CMRR vs. Frequency

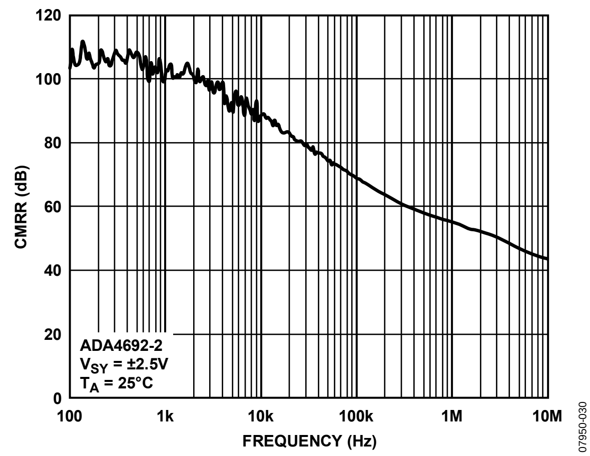

Figure 24. CMRR vs. Frequency

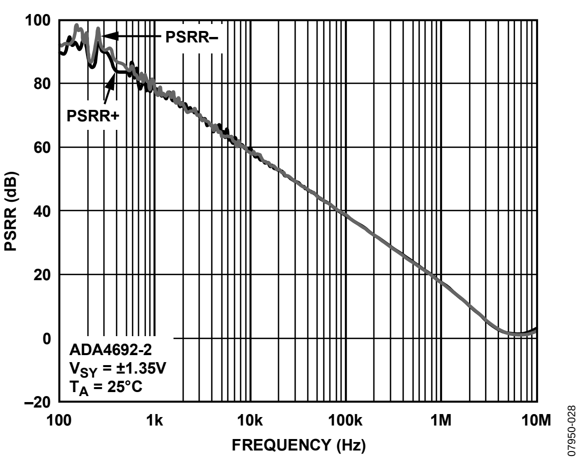

Figure 22. PSRR vs. Frequency

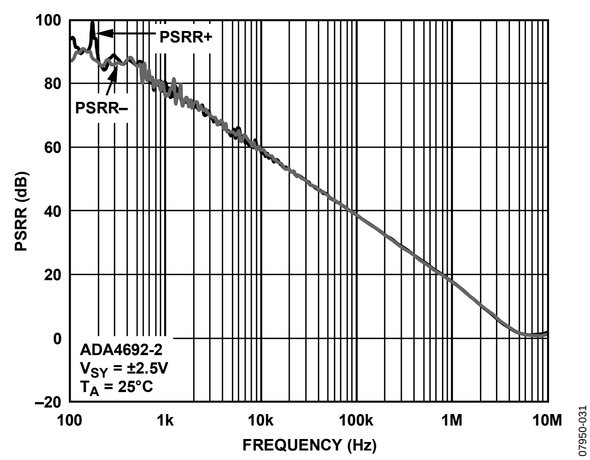

Figure 25. PSRR vs. Frequency

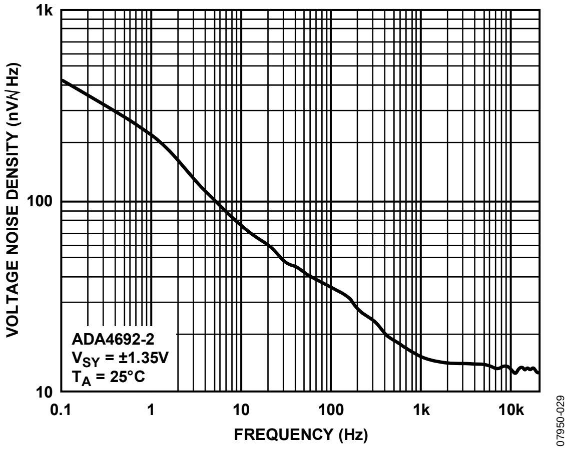

Figure 26. Voltage Noise Density vs. Frequency

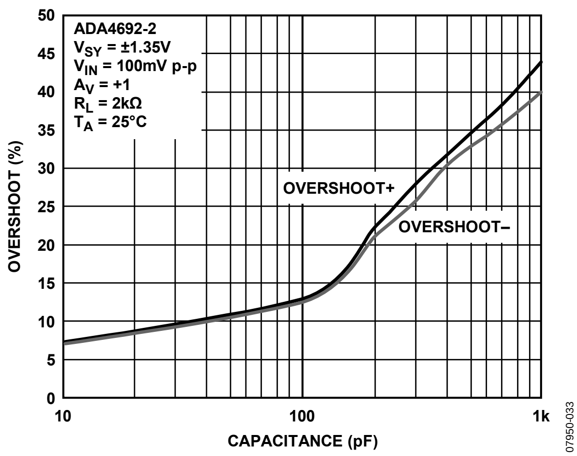

Figure 27. Small Signal Overshoot vs. Load Capacitance

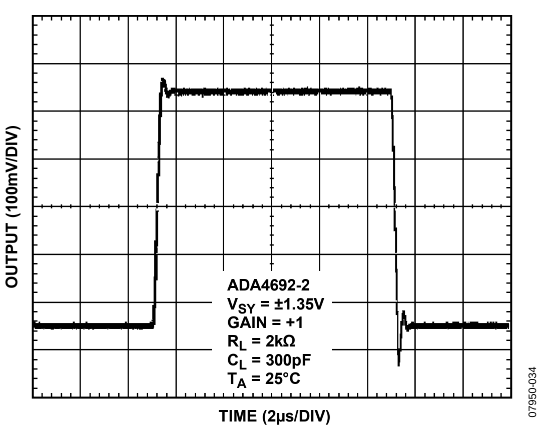

Figure 28. Large Signal Transient Response

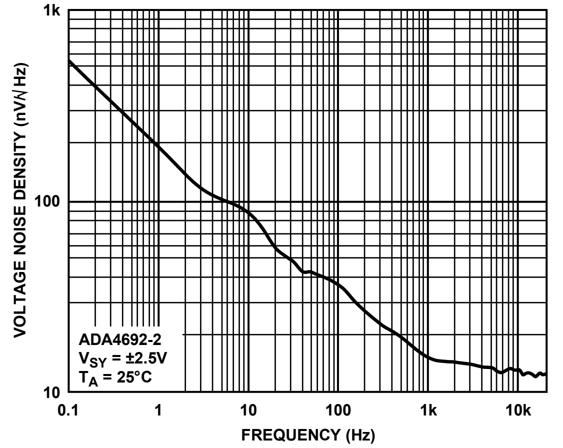

Figure 29. Voltage Noise Density vs. Frequency

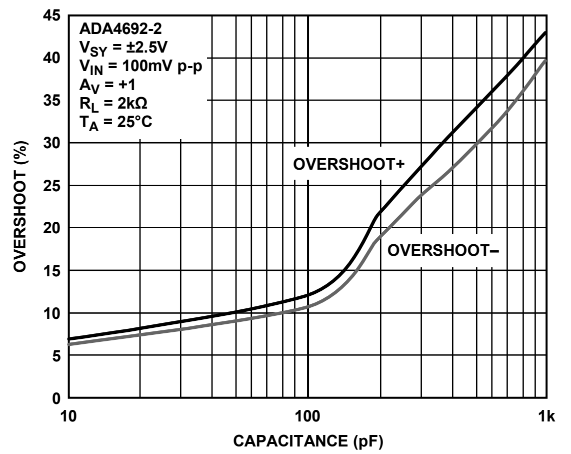

Figure 30. Small Signal Overshoot vs. Load Capacitance

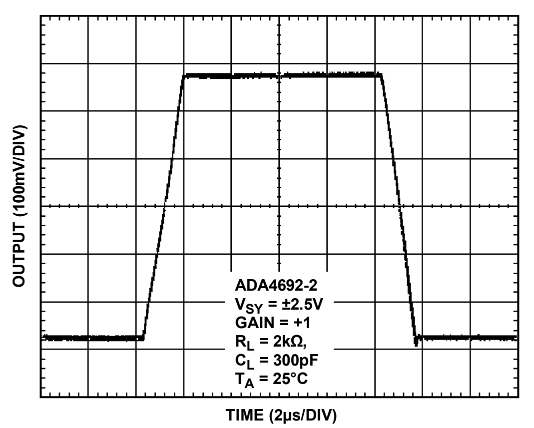

Figure 31. Large Signal Transient Response

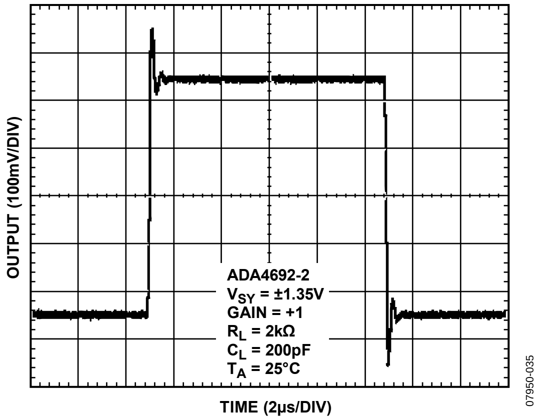

Figure 32. Small Signal Transient Response

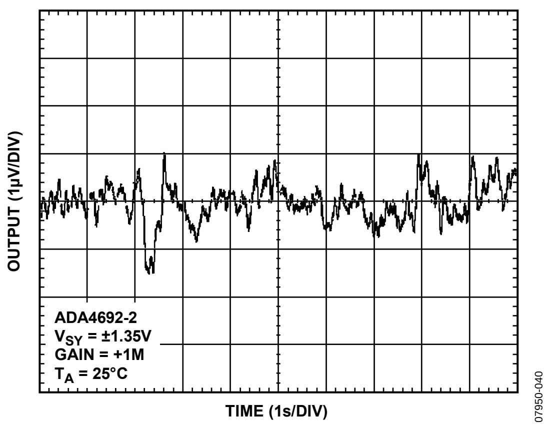

Figure 33. 0.1 Hz to 10 Hz Noise

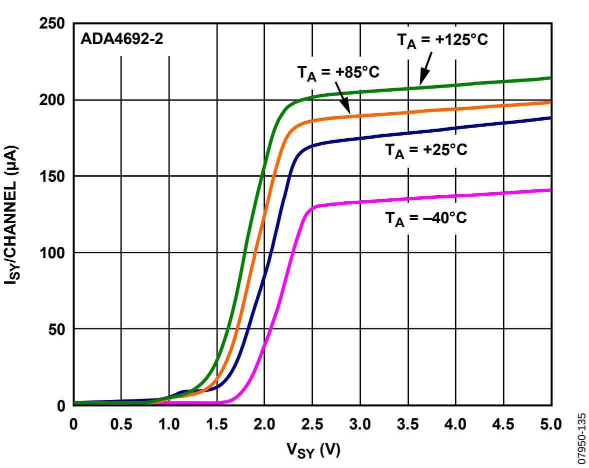

Figure 34. Supply Current per Amplifier vs. Supply Voltage

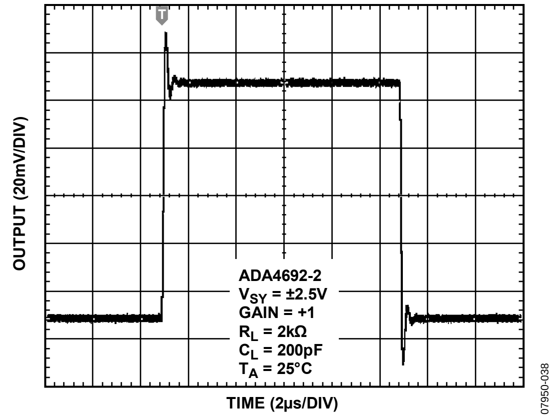

Figure 35. Small Signal Transient Response

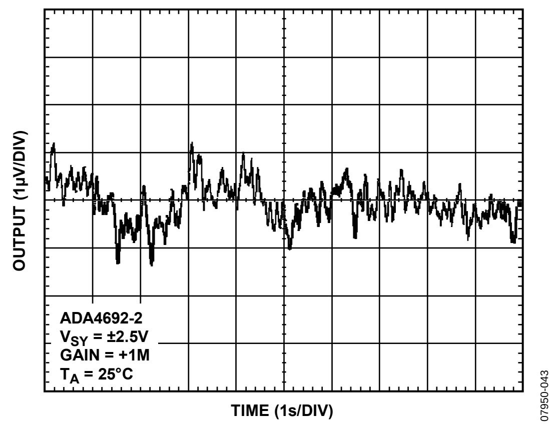

Figure 36. 0.1 Hz to 10 Hz Noise

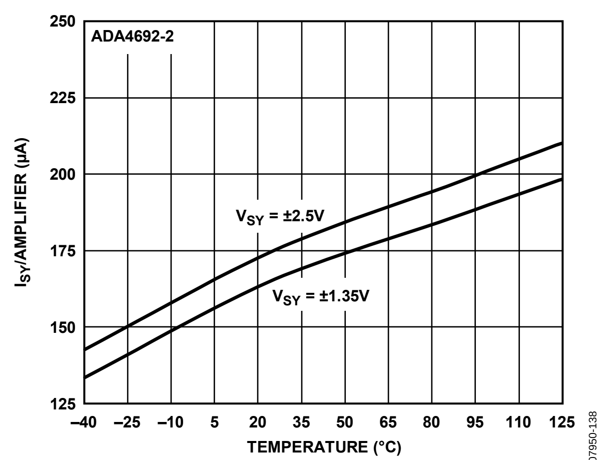

Figure 37. Supply Current per Channel vs. Temperature

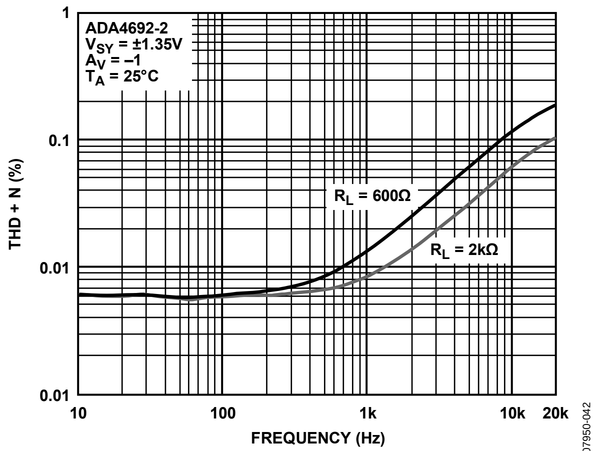

Figure 38. THD + Noise vs. Frequency

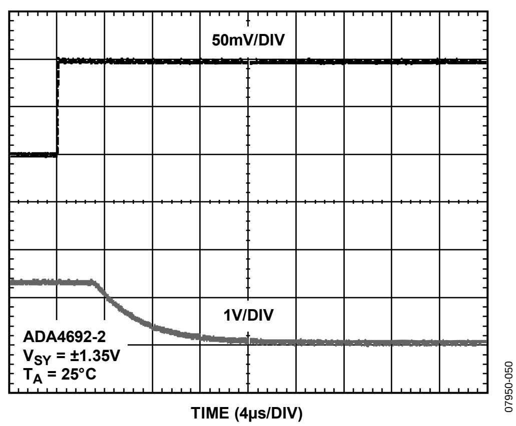

Figure 39. Negative Overload Recovery

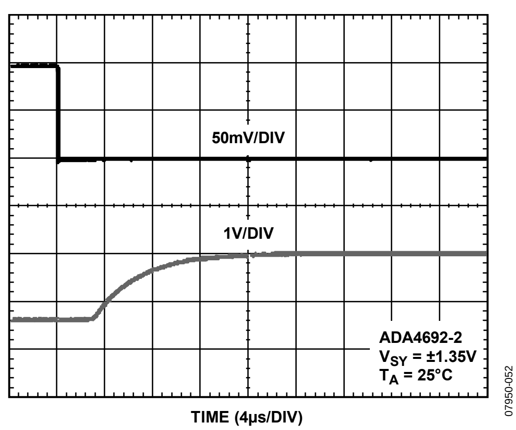

Figure 40. Positive Overload Recovery

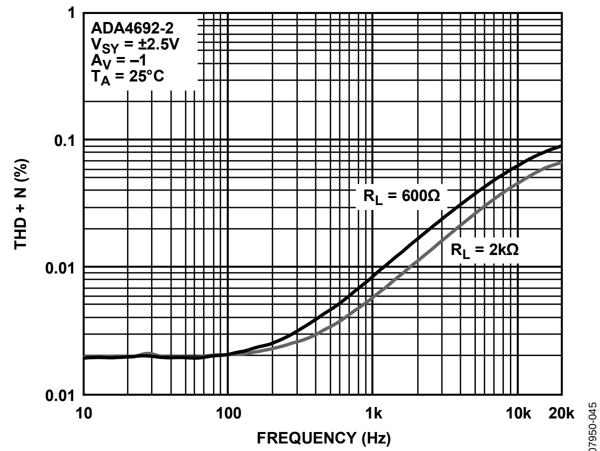

Figure 41. THD + Noise vs. Frequency

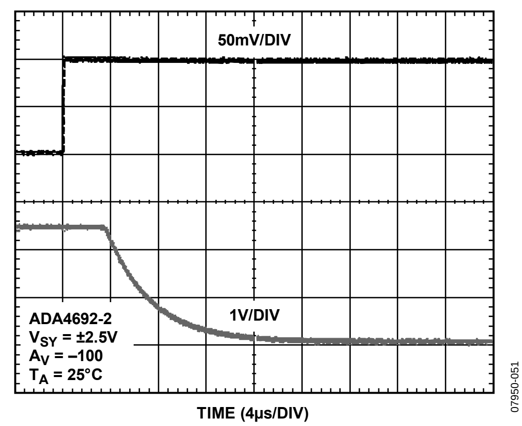

Figure 42. Negative Overload Recovery

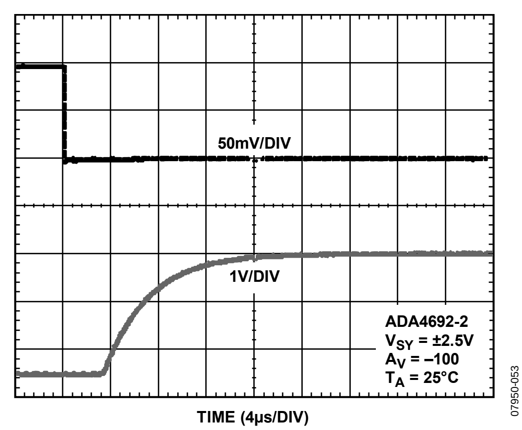

Figure 43. Positive Overload Recovery

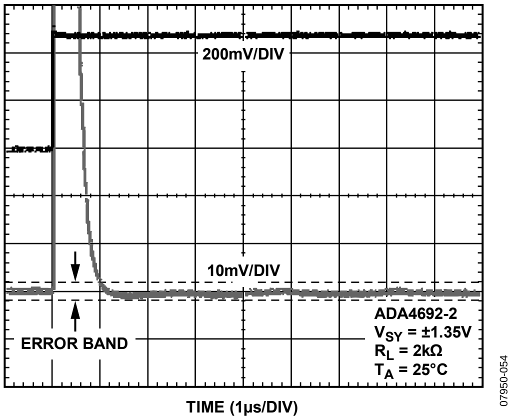

Figure 44. Positive Settling Time to 0.1%

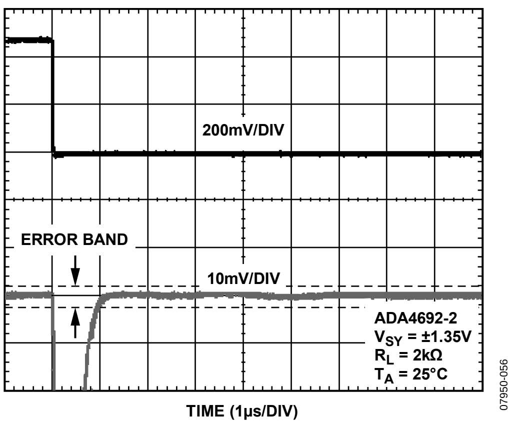

Figure 45. Negative Settling Time to 0.1%

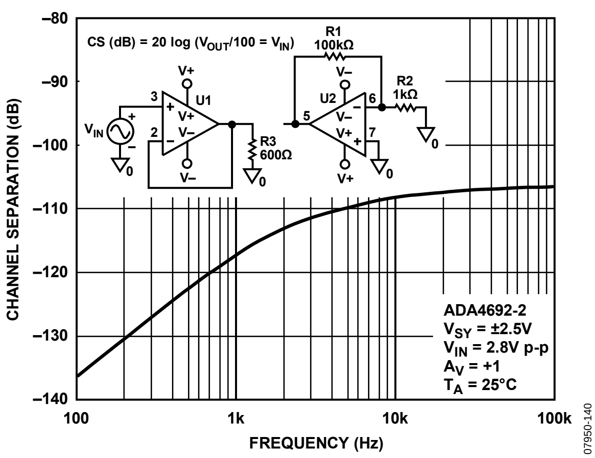

Figure 46. Channel Separation vs. Frequency

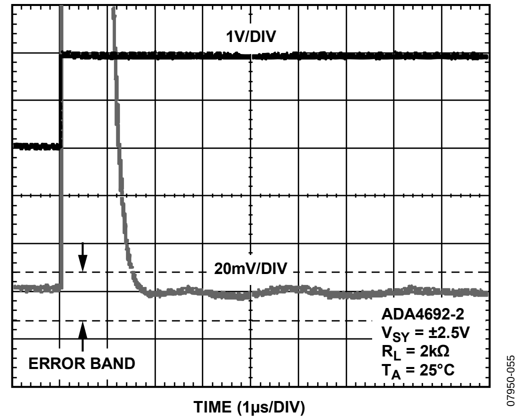

Figure 47. Positive Settling Time to 0.1%

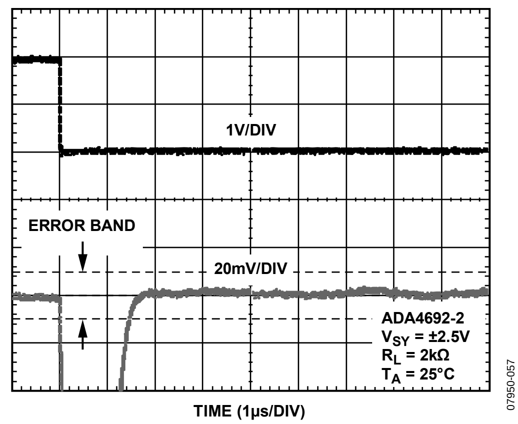

Figure 48. Negative Settling Time to 0.1%

OUTLINE DIMENSIONS

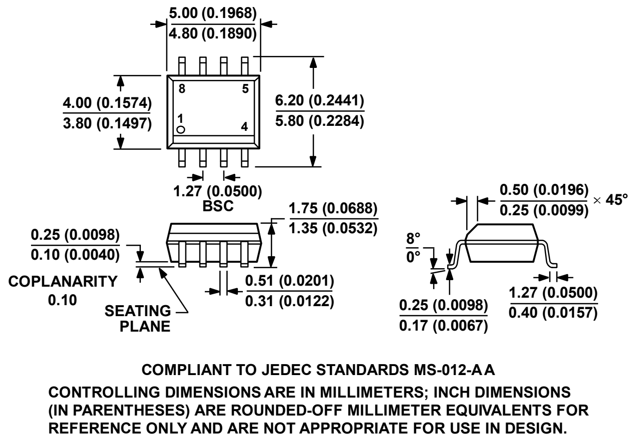

Figure 49. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADA4692-2ARZ[1]	–40°C to +125°C	8-Lead SOIC_N	R-8
ADA4692-2ARZ-R7[1]	–40°C to +125°C	8-Lead SOIC_N	R-8
ADA4692-2ARZ-RL[1]	–40°C to +125°C	8-Lead SOIC_N	R-8

[1] Z = RoHS Compliant Part.

NOTES