Low Cost, High Performance, CMOS Rail-to-Rail Output Operational Amplifier

AD8692

FEATURES

Offset voltage: 400 μV typ
Low offset voltage drift: 6 μV/°C maximum
Very low input bias currents: 1 pA maximum
Low noise: 8 nV/√Hz
Low distortion: 0.0006%
Wide bandwidth: 10 MHz
Unity gain stable
Single-supply operation: 2.7 V to 6 V

APPLICATIONS

Photodiode amplification
Battery-powered instrumentation
Medical instruments
Multipole filters
Sensors
Portable audio devices

PIN CONFIGURATIONS

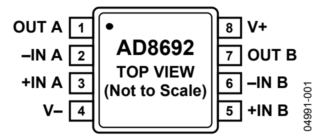

Figure 1. 8-Lead MSOP Pin Configuration

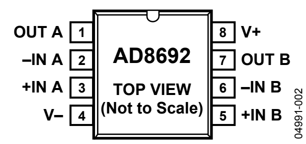

Figure 2. 8-Lead SOIC Pin Configuration

GENERAL DESCRIPTION

The AD8692 is a low cost, dual rail-to-rail output, single-supply amplifier featuring low offset voltage, low input voltage and current noise, and wide signal bandwidth. The combination of low offset, low noise, very low input bias currents, and high speed makes this amplifier useful in a wide variety of applications. Filters, integrators, photodiode amplifiers, and high impedance sensors all benefit from the combination of performance features. Audio and other ac applications benefit from the wide bandwidth and low distortion.

Applications for this amplifier include PA controls, laser diode control loops, portable and loop-powered instrumentation, audio amplification for portable devices, and ASIC input and output amplifiers.

The AD8692 is specified over the extended industrial temperature range of −40°C to +125°C. The AD8692 is available in the micro-SOIC and 8-lead narrow SOIC surface-mount packages.

Rev. 0

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REVISION HISTORY

10/04—Revision 0: Initial Version

ELECTRICAL CHARACTERISTICS

V_S = 2.7 V, V_{CM} = $V_S/2$, T_A = 25°C, unless otherwise noted.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = −0.3 V to +1.6 V		0.4	2.0	mV
		V_{CM} = −0.1 V to +1.6 V; −40°C < T_A < +125°C			3.0	mV
Input Bias Current	I_B			0.2	1	pA
		−40°C < T_A < +85°C			50	pA
		−40°C < T_A < +125°C			260	pA
Input Offset Current	I_{OS}			0.1	0.5	pA
		−40°C < T_A < +85°C			20	pA
		−40°C < T_A < +125°C			75	pA
Input Voltage Range			−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	65	85		dB
Large Signal Voltage Gain	A_{VO}	R_L = 2 kΩ, V_O = 0.5 V to 2.2 V	90	250		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			1.3	6.0	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1 mA	2.64	2.66		V
		−40°C < T_A < +125°C	2.6			V
Output Voltage Low	V_{OL}	I_L = 1 mA		25	40	mV
		−40°C < T_A < +125°C			50	mV
Short-Circuit Current	I_{SC}			±20		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1 MHz, A_V = 1		12		Ω
POWER SUPPLY						
Power-Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	80	95		dB
		−40°C < T_A < +125°C	75	95		dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V		0.85	0.95	mA
		−40°C < T_A < +125°C			1.2	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ		5		V/µs
Settling Time	t_S	To 0.01%		1		µs
Gain Bandwidth Product	GBP			10		MHz
Phase Margin	Øo			60		Degrees
Total Harmonic Distortion + Noise	THD+N	G = 1, R_L = 600 Ω, f = 1 kHz, V_O = 250 mV p-p		0.003		%
NOISE PERFORMANCE						
Voltage Noise	$e_{n\ p\text{-}p}$	f = 0.1 Hz to 10 Hz		1.6	3.0	µV p-p
Voltage Noise Density	e_n	f = 1 kHz		8	12	nV/√Hz
	e_n	f = 10 kHz		6.5		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.05		pA/√Hz

V_S = 5.0 V, V_{CM} = V_S/2, T_A = 5°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	A Grade Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	V_{CM} = −0.3 V to +3.9 V		0.4	2.0	mV
		V_{CM} = −0.1 V to +3.9 V; −40°C < T_A < +125°C			3.0	mV
Input Bias Current	I_B			0.2	1	pA
		−40°C < T_A < +85°C			50	pA
		−40°C < T_A < +125°C			260	pA
Input Offset Current	I_{OS}			0.1	0.5	pA
		−40°C < T_A < +85°C			20	pA
		−40°C < T_A < +125°C			75	pA
Input Voltage Range			−0.3		+3.9	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = −0.3 V to +3.9 V	75	95		dB
		V_{CM} = −0.1 V to +3.9 V; −40°C < T_A < +125°C	70	95		dB
Large Signal Voltage Gain	A_{VO}	V_O = 0.5 V to 4.5 V, R_L = 2 kΩ, V_{CM} = 0 V	250	2,000		V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			1.3	6	µV/°C
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	I_L = 1 mA	4.96	4.98		V
		I_L = 10 mA	4.7	4.78		V
		−40°C to +125°C	4.6			V
Voltage Low	V_{OL}	I_L = 1 mA		16.5	40	mV
		I_L = 10 mA		165	210	mV
		−40°C to +125°C			290	mV
Short-Circuit Current	I_{SC}			±80		mA
Closed-Loop Output Impedance	Z_{OUT}	f = 1 MHz, A_V = 1		10		Ω
POWER SUPPLY						
Power-Supply Rejection Ratio	PSRR	V_S = 2.7 V to 5.5 V	80	95		dB
		−40°C < T_A < +125°C	75	95		dB
Supply Current/Amplifier	I_{SY}	V_O = 0 V		0.95	1.05	mA
		−40°C < T_A < +125°C			1.3	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	R_L = 2 kΩ		5		V/µs
Settling Time	t_S	To 0.01%		1		µs
Full Power Bandwidth	BW_P	<1% distortion		360		kHz
Gain Bandwidth Product	GBP			10		MHz
Phase Margin	Øo			65		Degrees
Total Harmonic Distortion + Noise	THD+N	G = 1, R_L = 600 Ω, f = 1 kHz, V_O = 1 V p-p		0.0006		%
NOISE PERFORMANCE						
Voltage Noise	$e_{n\,p\text{-}p}$	f = 0.1 Hz to 10 Hz		1.6	3.0	µV p-p
Voltage Noise Density	e_n	f = 1 kHz		8	12	nV/√Hz
	e_n	f = 10 kHz		6.5		nV/√Hz
Current Noise Density	i_n	f = 1 kHz		0.05		pA/√Hz

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 3.

Parameters	Ratings
Supply Voltage	6 V
Input Voltage	V_{SS} – 0.3 V to V_{DD} + 0.3 V
Differential Input Voltage	±6 V
Output Short-Circuit Duration to Gnd[1]	Observe derating curves
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 Range (Soldering, 60 s)	300°C

[1] θ_{JA} is specified for the worst-case conditions, that is, the device soldered in the circuit board for surface-mount packages.

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and 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 CHARACTERISTICS

Table 4.

Package Type	θ_{JA}	θ_{JC}	Unit
8-Lead MSOP (RM)	210	45	°C/W
8-Lead SOIC (R)	158	43	°C/W

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

TYPICAL PERFORMANCE CHARACTERISTICS

V_S = +5 V or ±2.5 V.

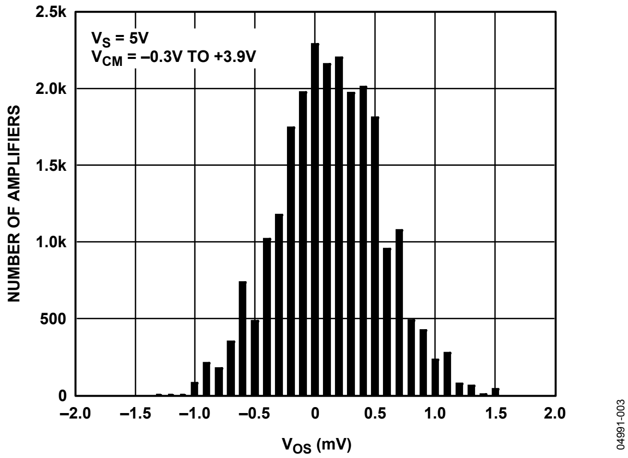

Figure 3. Input Offset Voltage Distribution

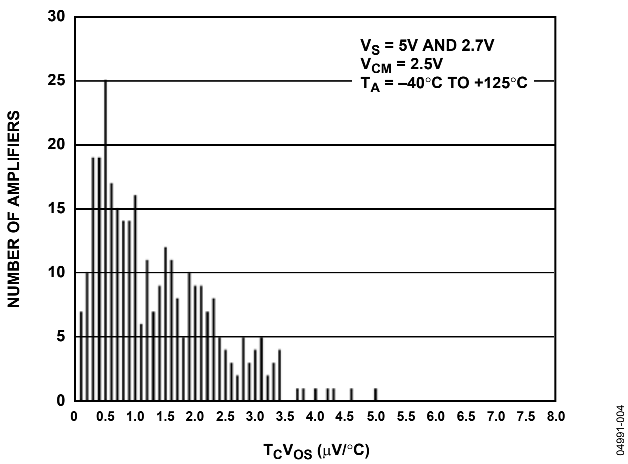

Figure 4. Input Offset Voltage Drift Distribution

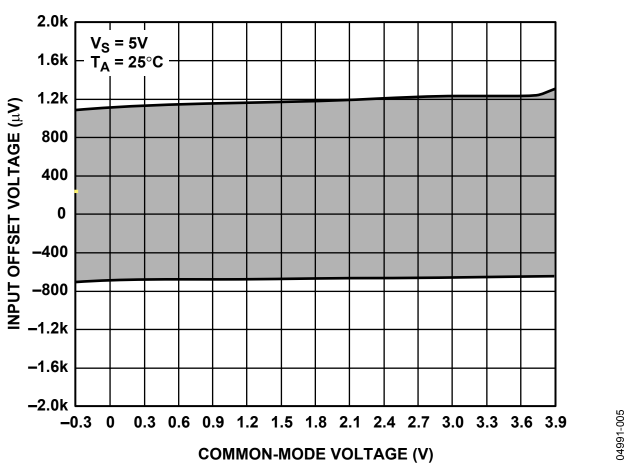

Figure 5. Input Offset Voltage vs. Common-Mode Voltage

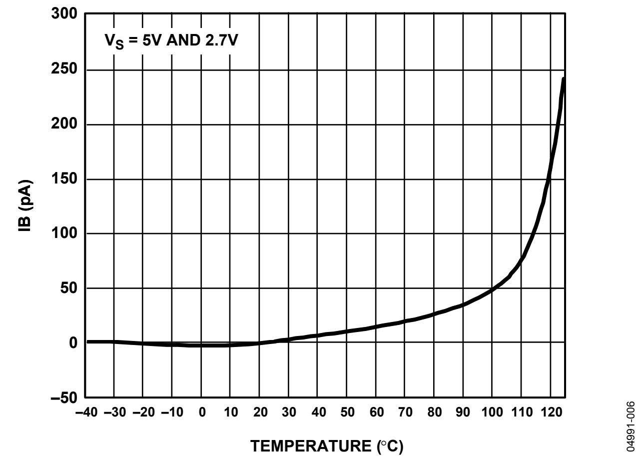

Figure 6. Input Bias Current vs. Temperature

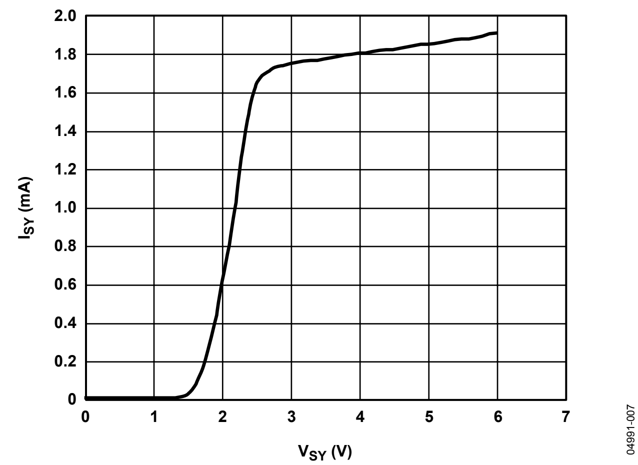

Figure 7. Supply Current vs. Supply Voltage

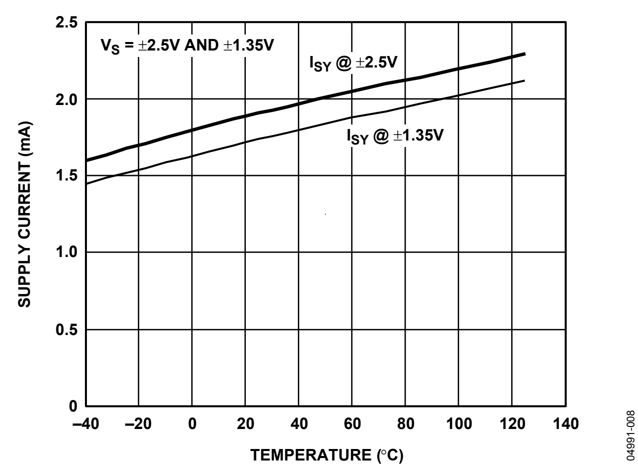

Figure 8. Supply Current vs. Temperature

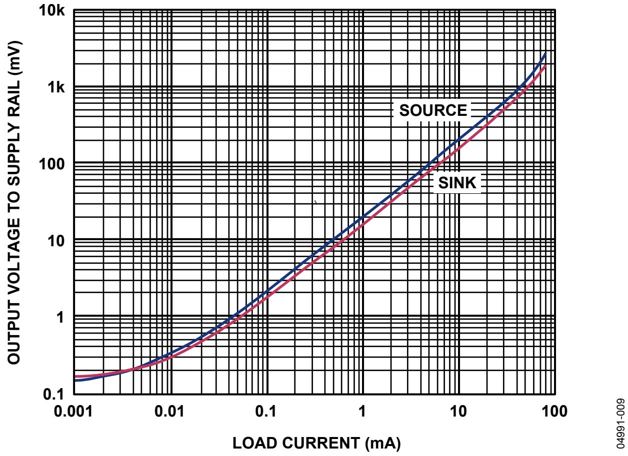

Figure 9. Output Voltage to Supply Rail vs. Load Current

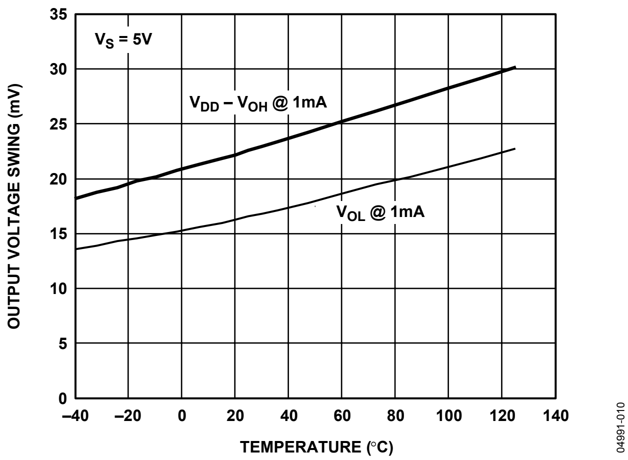

Figure 10. Output Voltage Swing vs. Temperature (IL = 1 mA)

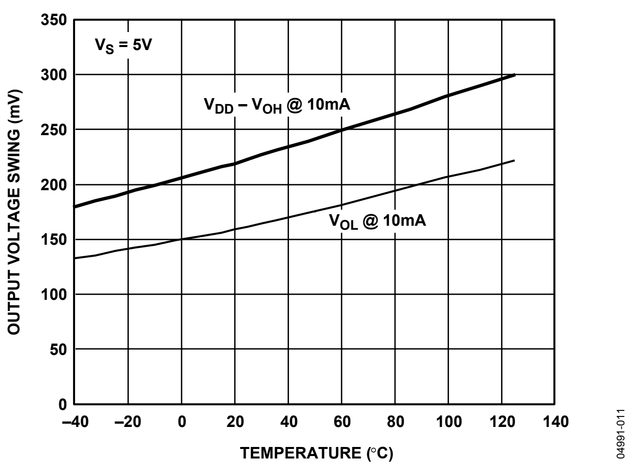

Figure 11. Output Voltage Swing vs. Temperature (IL = 10 mA)

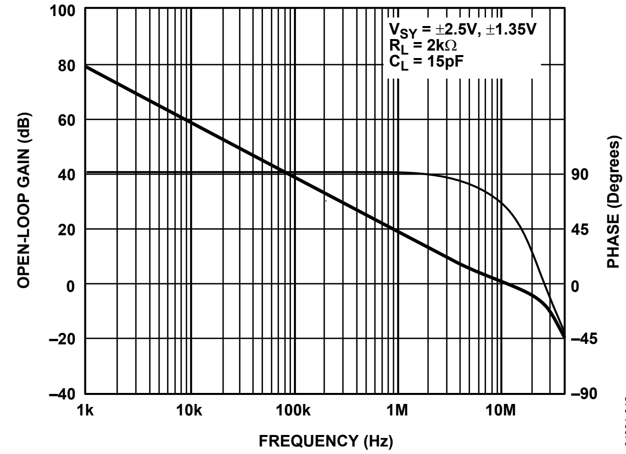

Figure 12. Open-Loop Gain and Phase vs. Frequency

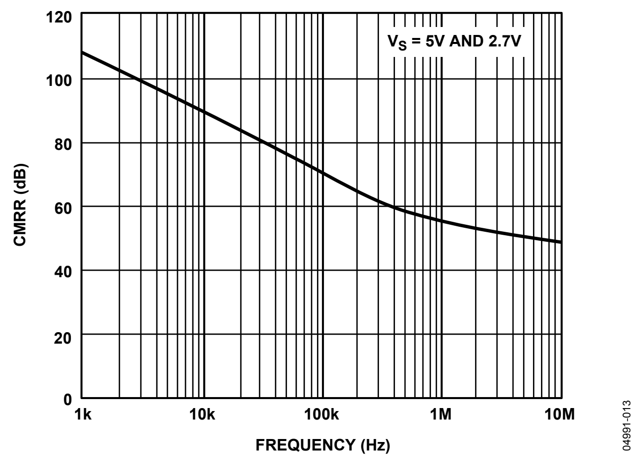

Figure 13. CMRR vs. Frequency

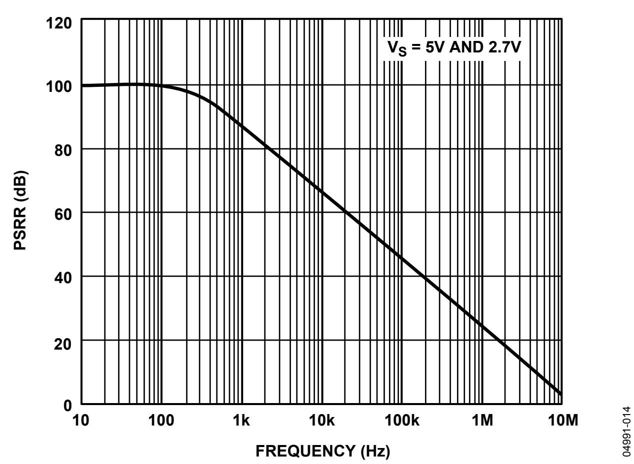

Figure 14. PSRR vs. Frequency

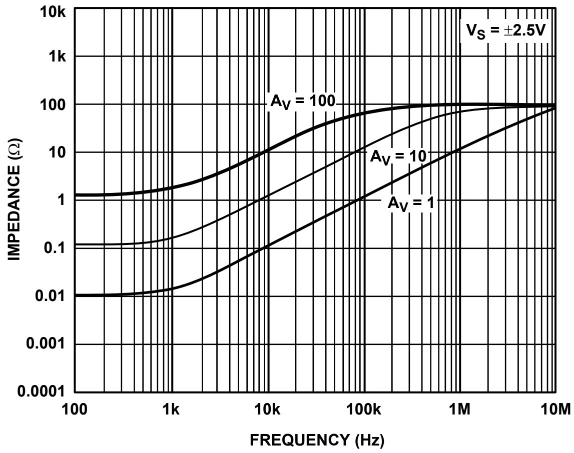

Figure 15. Closed-Loop Output Impedance vs. Frequency

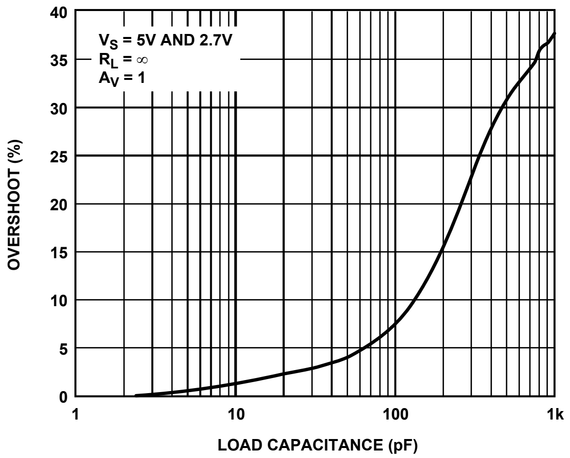

Figure 16. Small Signal Overshoot vs. Load Capacitance

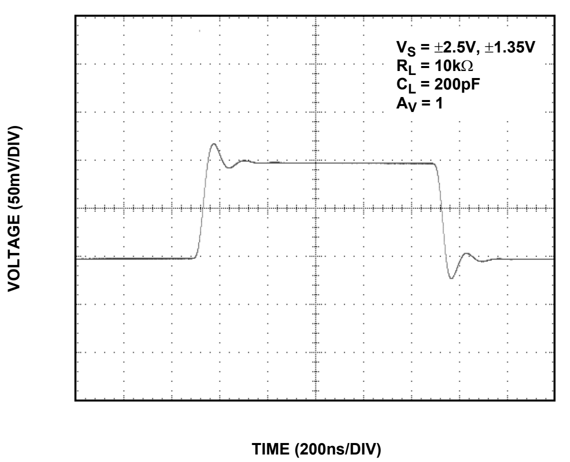

Figure 17. Small Signal Transient Response

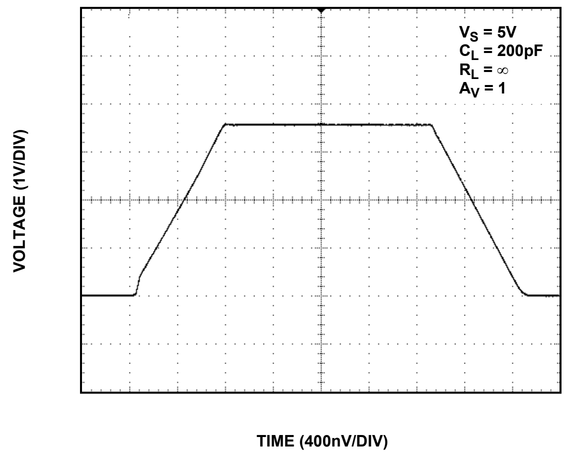

Figure 18. Large Signal Transient Response

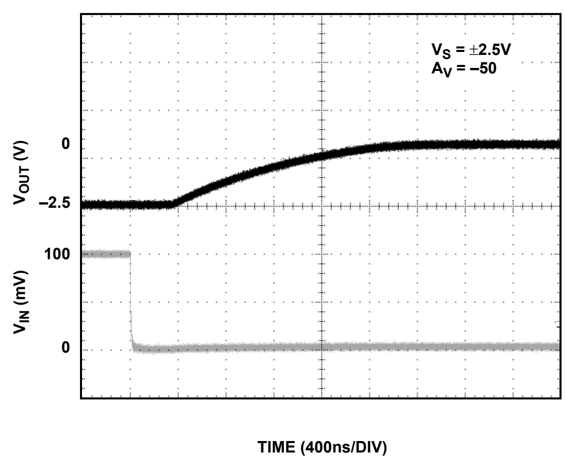

Figure 19. Positive Overload Recovery

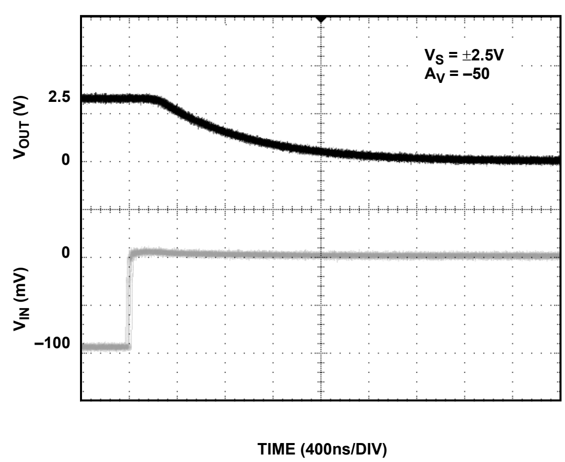

Figure 20. Negative Overload Recovery

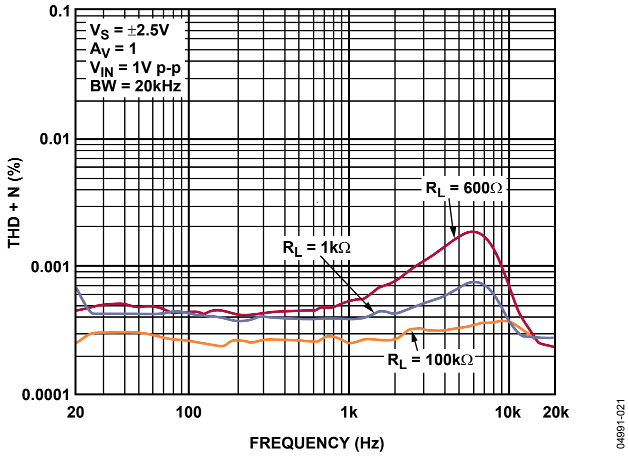

Figure 21. THD + N vs. Frequency

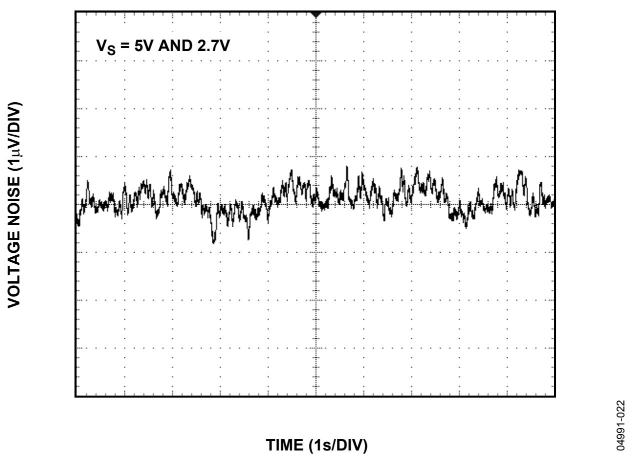

Figure 22. 0.1 Hz to 10 Hz Input Voltage Noise

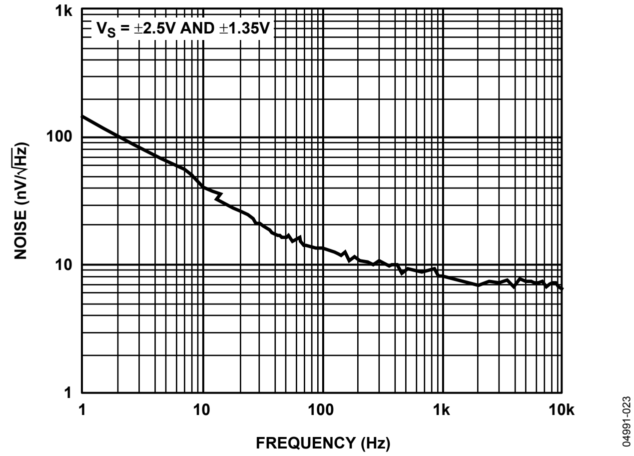

Figure 23. Voltage Noise Density

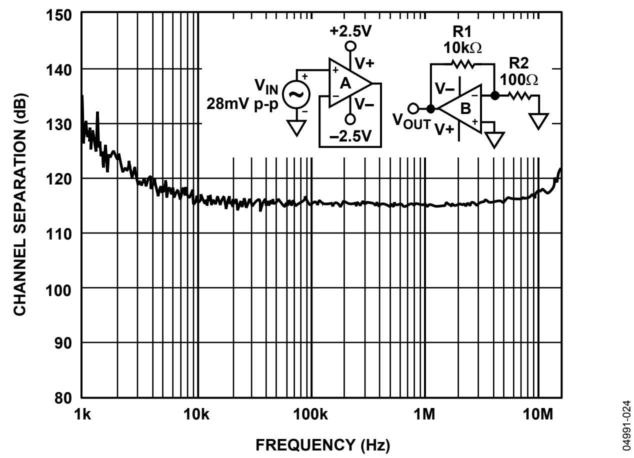

Figure 24. Channel Separation

V_S = +2.7 V or ±1.35 V.

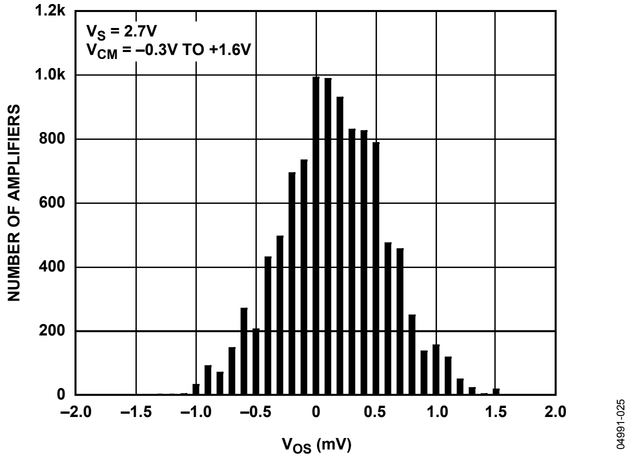

Figure 25. Input Offset Voltage Distribution

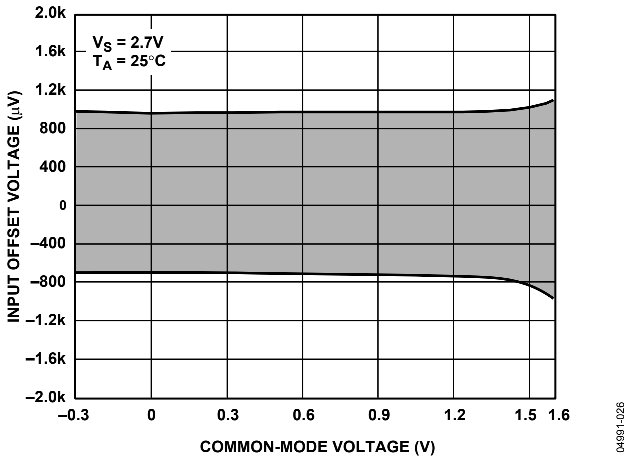

Figure 26. Input Offset Voltage vs. Common-Mode Voltage

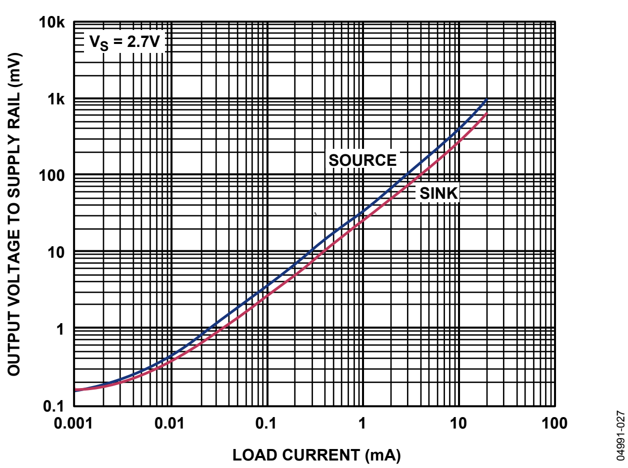

Figure 27. Output Voltage to Supply Rail vs. Load Current

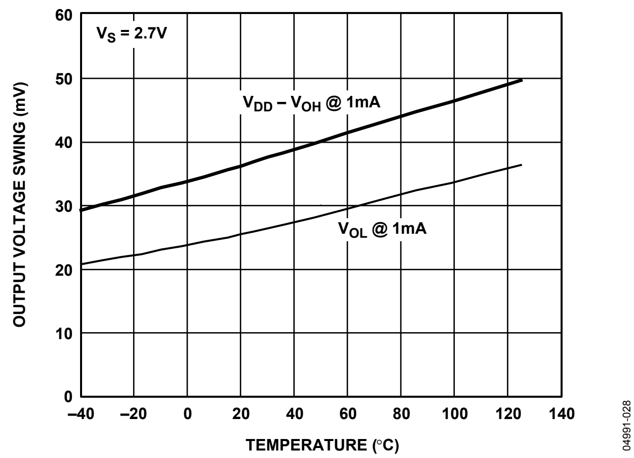

Figure 28. Output Voltage Swing vs. Temperature

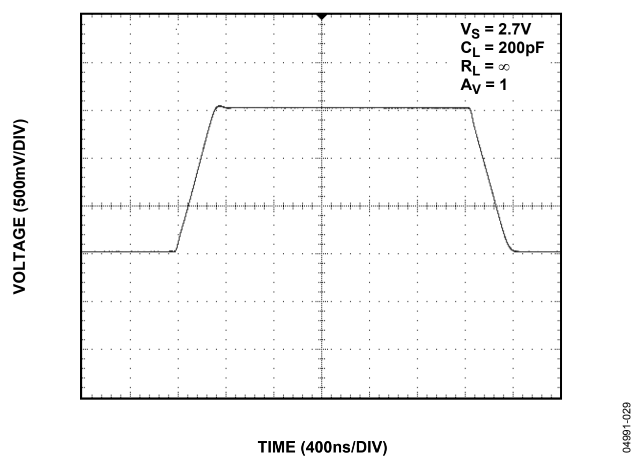

Figure 29. Large Signal Transient Response

OUTLINE DIMENSIONS

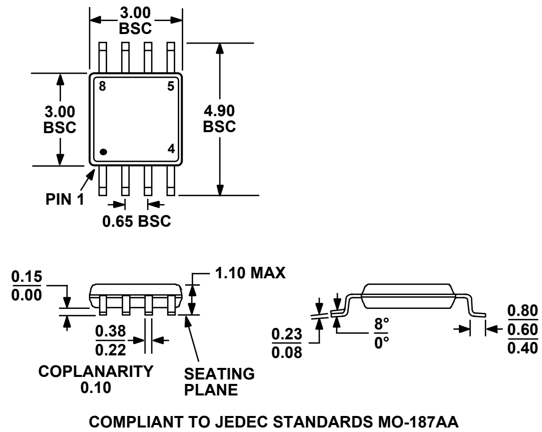

Figure 30. 8-Lead Mini Small Outline Package [MSOP]
(RM-8)
Dimensions shown in millimeters

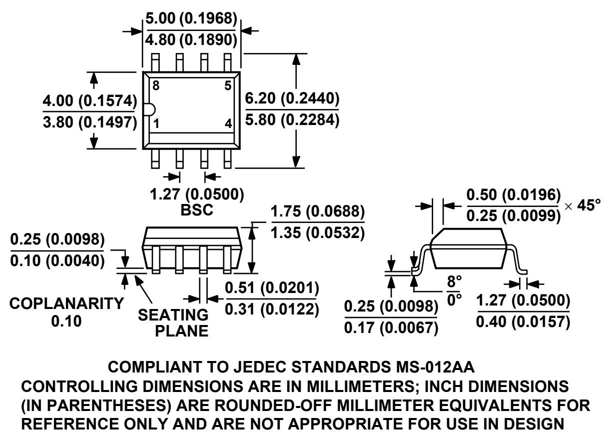

Figure 31. 8-Lead Standard Small Outline Package [SOIC]
(R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option	Branding
AD8692ARMZ-R2[1]	−40°C to +125°C	8-Lead MSOP	RM-8	APA
AD8692ARMZ-REEL[1]	−40°C to +125°C	8-Lead MSOP	RM-8	APA
AD8692ARZ[1]	−40°C to +125°C	8-Lead SOIC	R-8	
AD8692ARZ-REEL[1]	−40°C to +125°C	8-Lead SOIC	R-8	
AD8692ARZ-REEL7[1]	−40°C to +125°C	8-Lead SOIC	R-8	

[1] Z = Pb-free part.

NOTES

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