



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

AD8692

FEATURES

- Offset voltage: 400 μV typ
- Low offset voltage drift: 6 $\mu\text{V}/^\circ\text{C}$ maximum
- Very low input bias currents: 1 pA maximum
- Low noise: 8 nV/ $\sqrt{\text{Hz}}$
- 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

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.

PIN CONFIGURATIONS



Figure 1. 8-Lead MSOP Pin Configuration



Figure 2. 8-Lead SOIC Pin Configuration

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 $+125^\circ\text{C}$. The AD8692 is available in the micro-SOIC and 8-lead narrow SOIC surface-mount packages.



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REVISION HISTORY

10/04—Revision 0: Initial Version

ELECTRICAL CHARACTERISTICS

$V_S = 2.7\text{ V}$, $V_{CM} = V_S/2$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	$V_{CM} = -0.3\text{ V to }+1.6\text{ V}$ $V_{CM} = -0.1\text{ V to }+1.6\text{ V}; -40^\circ\text{C} < T_A < +125^\circ\text{C}$		0.4	2.0	mV
Input Bias Current	I_B	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$ $-40^\circ\text{C} < T_A < +125^\circ\text{C}$		0.2	1	pA
Input Offset Current	I_{OS}	$-40^\circ\text{C} < T_A < +85^\circ\text{C}$ $-40^\circ\text{C} < T_A < +125^\circ\text{C}$		0.1	0.5	pA
Input Voltage Range			-0.3		+1.6	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -0.3\text{ V to }+1.6\text{ V}$ $V_{CM} = -0.1\text{ V to }+1.6\text{ V}; -40^\circ\text{C} < T_A < +125^\circ\text{C}$	70	90		dB
Large Signal Voltage Gain	A_{VO}	$R_L = 2\text{ k}\Omega$, $V_O = 0.5\text{ V to }2.2\text{ V}$	65	85		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$			1.3	6.0	$\mu\text{V}/^\circ\text{C}$
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	$I_L = 1\text{ mA}$ $-40^\circ\text{C} < T_A < +125^\circ\text{C}$	2.64	2.66		V
Output Voltage Low	V_{OL}	$I_L = 1\text{ mA}$ $-40^\circ\text{C} < T_A < +125^\circ\text{C}$	2.6	25	40	mV
Short-Circuit Current	I_{SC}			± 20	50	mV
Closed-Loop Output Impedance	Z_{OUT}	$f = 1\text{ MHz}$, $A_V = 1$		12		Ω
POWER SUPPLY						
Power-Supply Rejection Ratio	PSRR	$V_S = 2.7\text{ V to }5.5\text{ V}$ $-40^\circ\text{C} < T_A < +125^\circ\text{C}$	80	95		dB
Supply Current/Amplifier	I_{SY}	$V_O = 0\text{ V}$ $-40^\circ\text{C} < T_A < +125^\circ\text{C}$	75	95	0.95	dB
				0.85	1.2	mA
DYNAMIC PERFORMANCE						
Slew Rate	SR	$R_L = 2\text{ k}\Omega$		5		$\text{V}/\mu\text{s}$
Settling Time	t_s	To 0.01%		1		μs
Gain Bandwidth Product	GBP			10		MHz
Phase Margin	ϕ_o			60		Degrees
Total Harmonic Distortion + Noise	THD+N	$G = 1$, $R_L = 600\ \Omega$, $f = 1\text{ kHz}$, $V_O = 250\text{ mV p-p}$		0.003		%
NOISE PERFORMANCE						
Voltage Noise	$e_{n\text{ p-p}}$	$f = 0.1\text{ Hz to }10\text{ Hz}$		1.6	3.0	$\mu\text{V p-p}$
Voltage Noise Density	e_n	$f = 1\text{ kHz}$		8	12	$\text{nV}/\sqrt{\text{Hz}}$
	e_n	$f = 10\text{ kHz}$		6.5		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	i_n	$f = 1\text{ kHz}$		0.05		$\text{pA}/\sqrt{\text{Hz}}$

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$V_S = 5.0\text{ V}$, $V_{CM} = V_S/2$, $T_A = 5^\circ\text{C}$, unless otherwise noted.

Table 2.

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

ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 3.

Parameters	Ratings
Supply Voltage	6 V
Input Voltage	$V_{SS} - 0.3\text{ V}$ to $V_{DD} + 0.3\text{ V}$
Differential Input Voltage	$\pm 6\text{ V}$
Output Short-Circuit Duration to Gnd ¹	Observe derating curves
Storage Temperature Range	-65°C to $+150^\circ\text{C}$
Operating Temperature Range	-40°C to $+125^\circ\text{C}$
Junction Temperature Range	-65°C to $+150^\circ\text{C}$
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	$^\circ\text{C}/\text{W}$
8-Lead SOIC (R)	158	43	$^\circ\text{C}/\text{W}$

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

$V_S = +5\text{ V}$ or $\pm 2.5\text{ V}$.

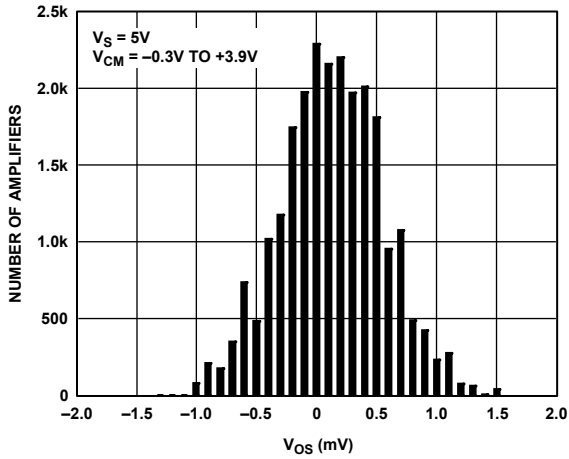


Figure 3. Input Offset Voltage Distribution

04991-003

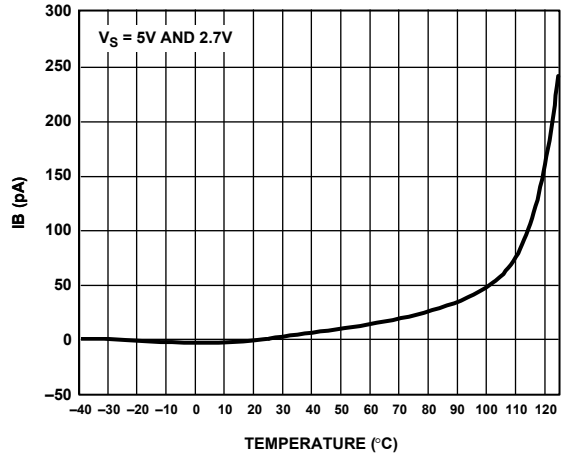


Figure 6. Input Bias Current vs. Temperature

04991-006

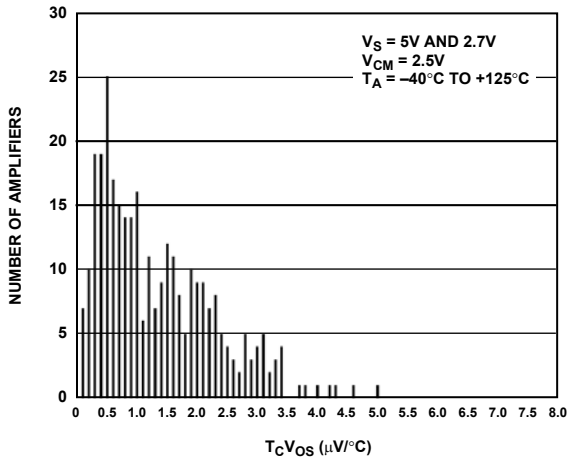


Figure 4. Input Offset Voltage Drift Distribution

04991-004

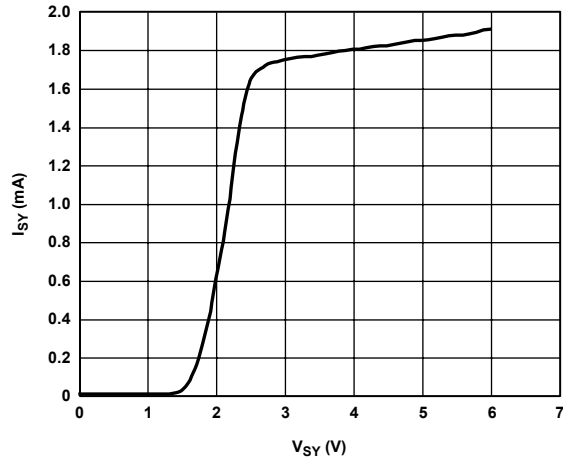


Figure 7. Supply Current vs. Supply Voltage

04991-007

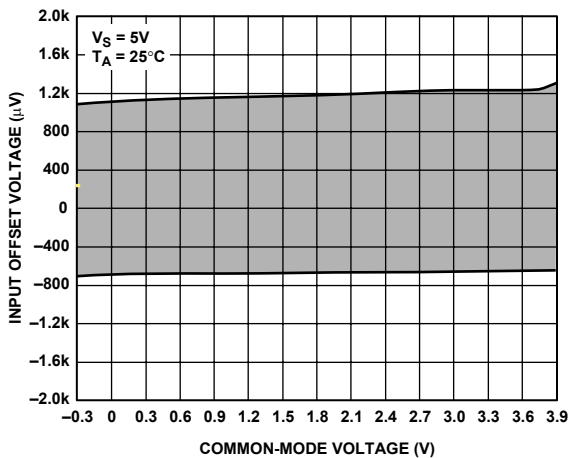


Figure 5. Input Offset Voltage vs. Common-Mode Voltage

04991-005

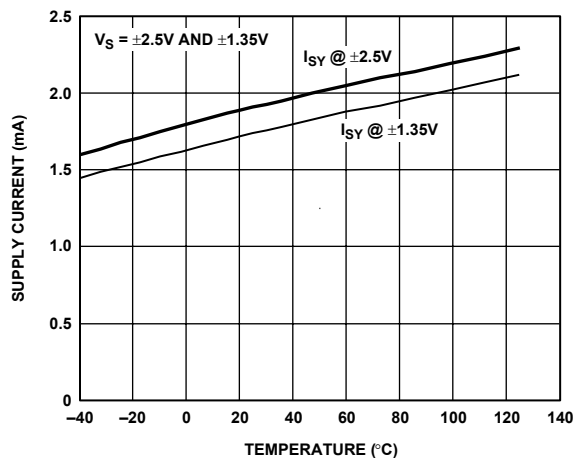


Figure 8. Supply Current vs. Temperature

04991-008

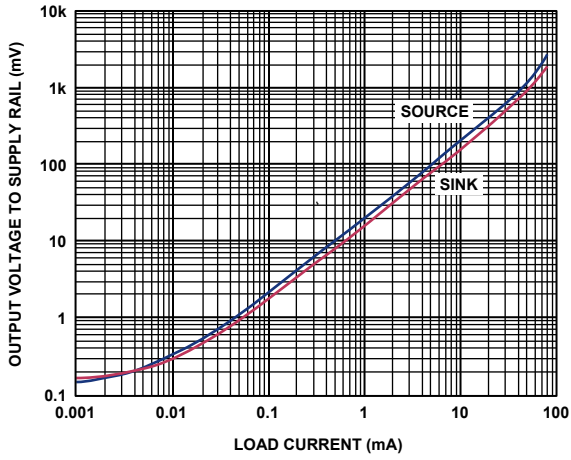


Figure 9. Output Voltage to Supply Rail vs. Load Current

04991-009

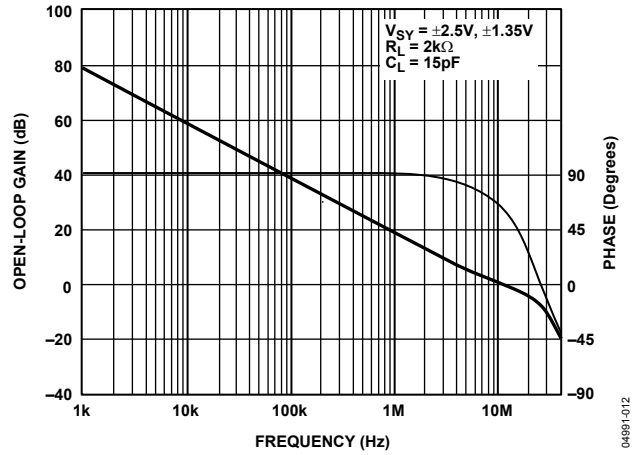


Figure 12. Open-Loop Gain and Phase vs. Frequency

04991-012

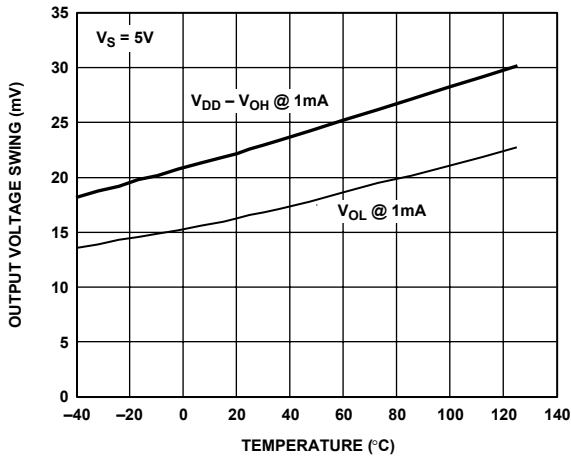


Figure 10. Output Voltage Swing vs. Temperature ($I_L = 1 \text{ mA}$)

04991-010

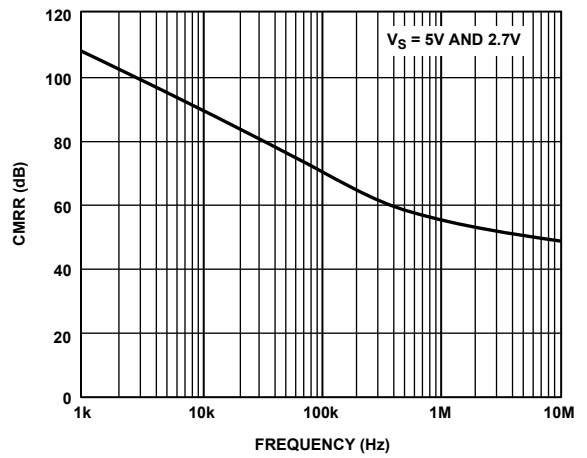


Figure 13. CMRR vs. Frequency

04991-013

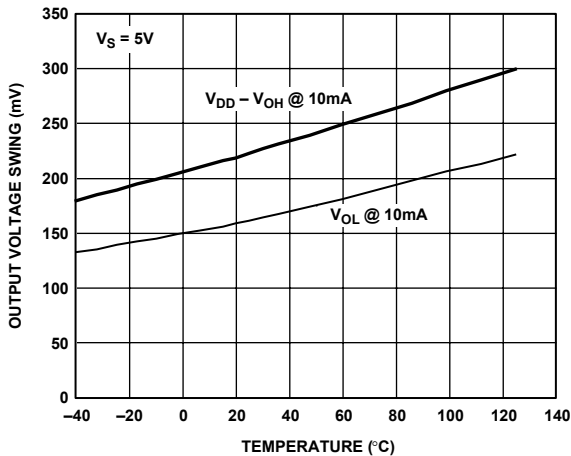


Figure 11. Output Voltage Swing vs. Temperature ($I_L = 10 \text{ mA}$)

04991-011

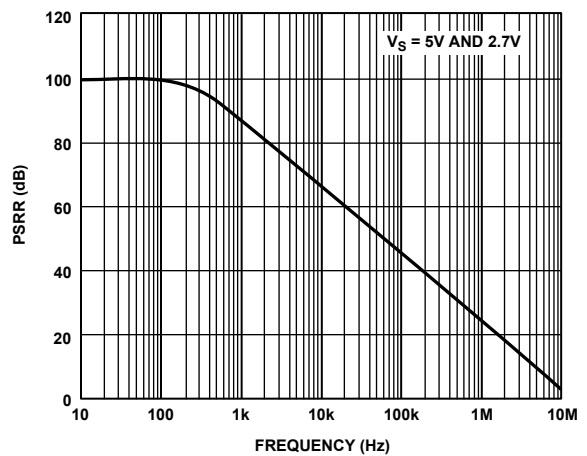


Figure 14. PSRR vs. Frequency

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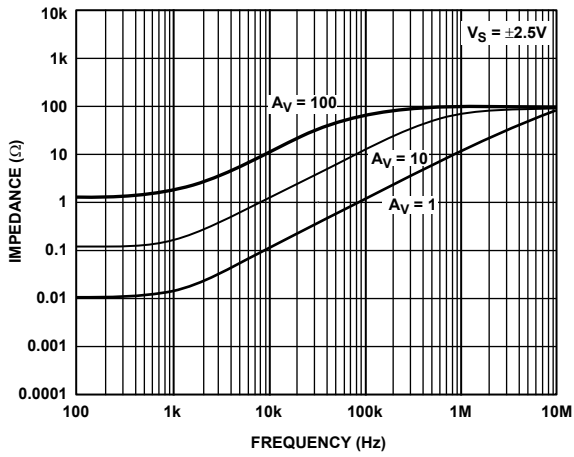


Figure 15. Closed-Loop Output Impedance vs. Frequency

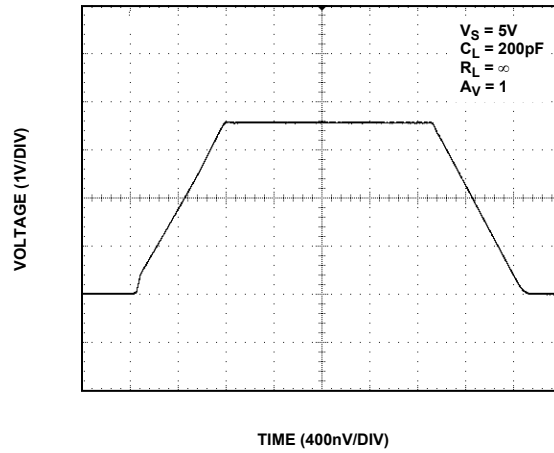


Figure 18. Large Signal Transient Response

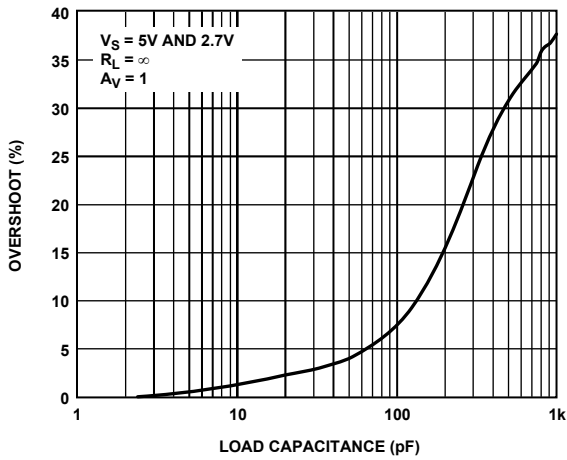


Figure 16. Small Signal Overshoot vs. Load Capacitance

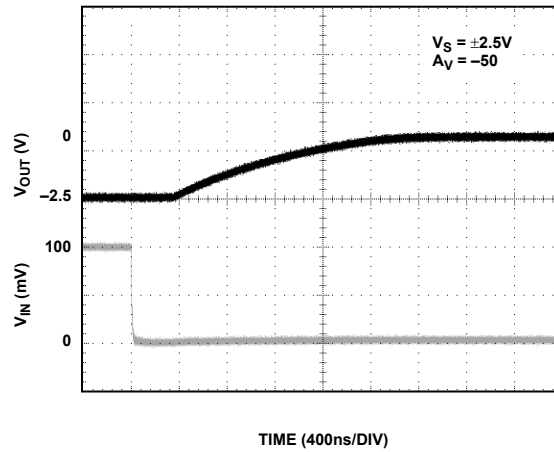


Figure 19. Positive Overload Recovery

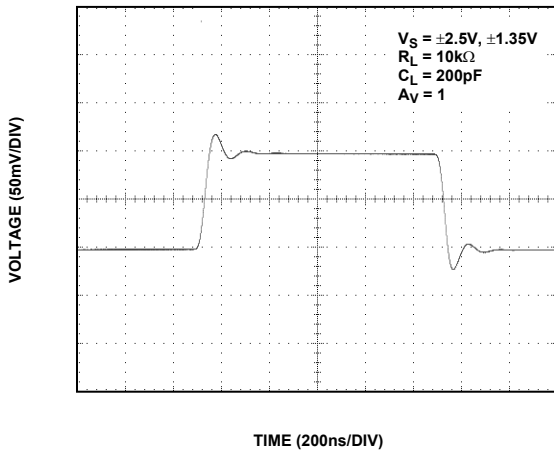


Figure 17. Small Signal Transient Response

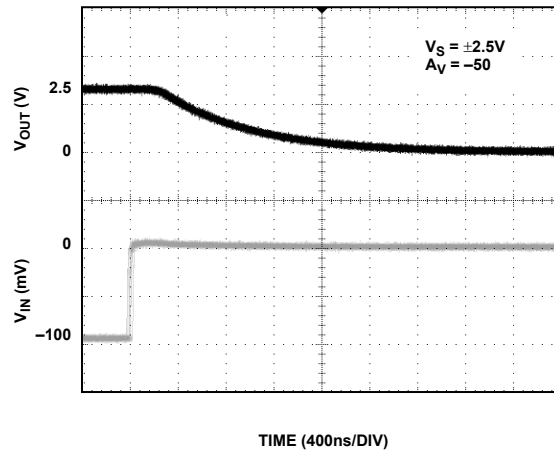


Figure 20. Negative Overload Recovery

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04891-018

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04891-017

04891-020

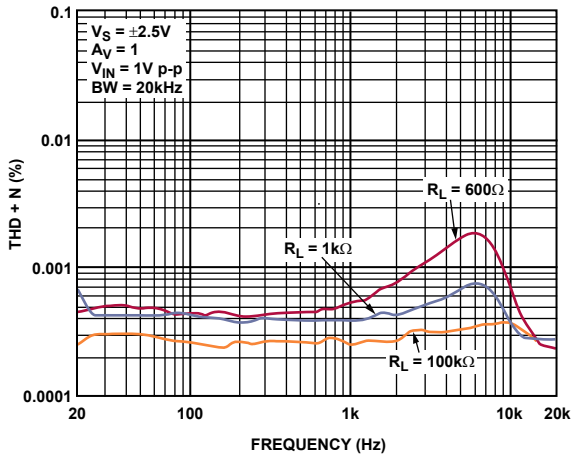


Figure 21. THD + N vs. Frequency

04991-021

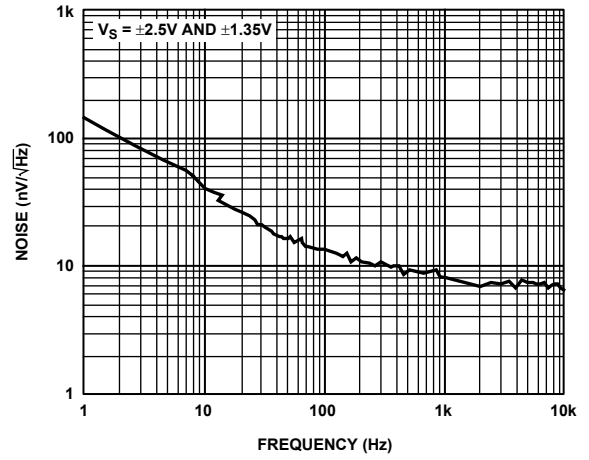


Figure 23. Voltage Noise Density

04991-023

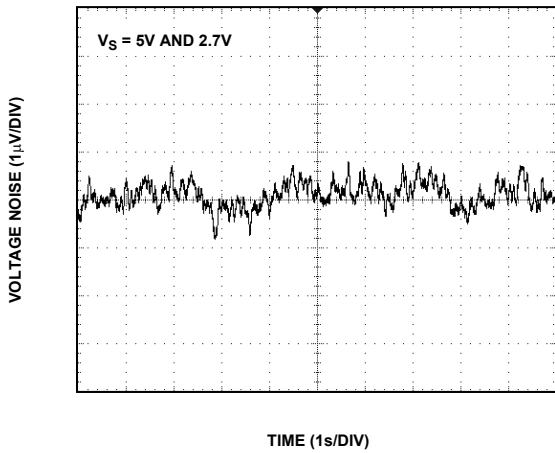


Figure 22. 0.1 Hz to 10 Hz Input Voltage Noise

04991-022

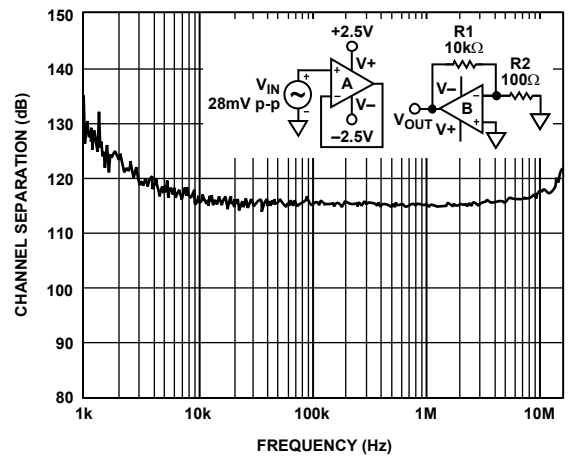


Figure 24. Channel Separation

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$V_S = +2.7\text{ V}$ or $\pm 1.35\text{ V}$.

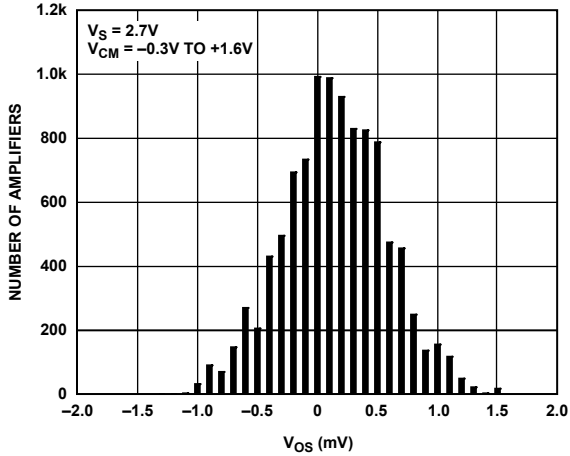


Figure 25. Input Offset Voltage Distribution

04991-025

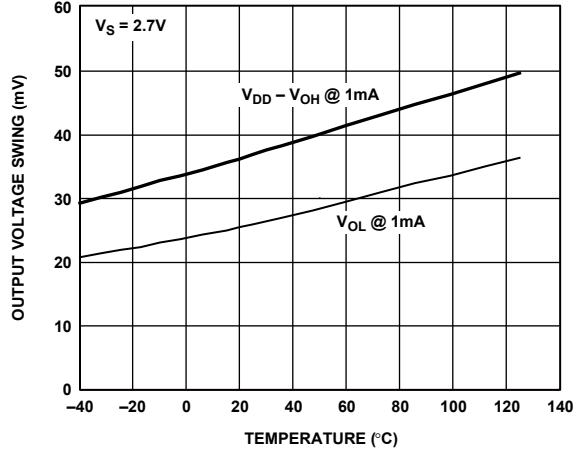


Figure 28. Output Voltage Swing vs. Temperature

04991-028

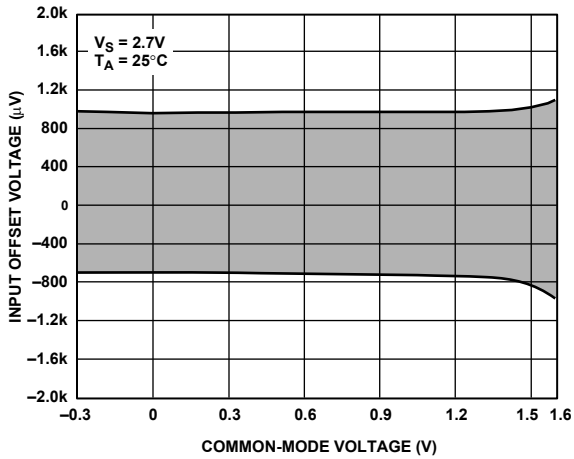


Figure 26. Input Offset Voltage vs. Common-Mode Voltage

04991-026

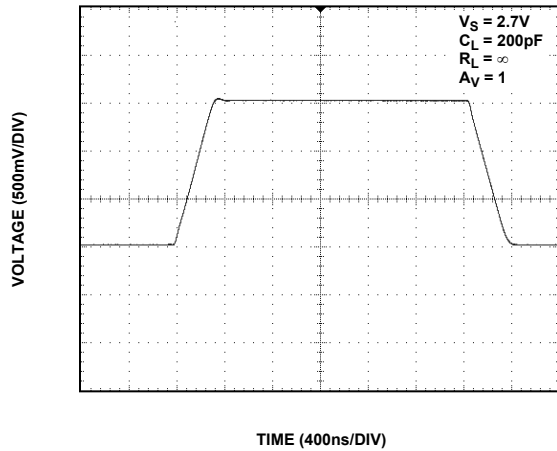


Figure 29. Large Signal Transient Response

04991-029

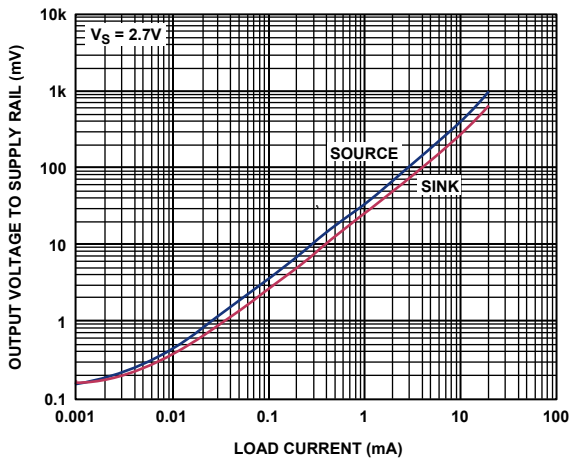


Figure 27. Output Voltage to Supply Rail vs. Load Current

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OUTLINE DIMENSIONS

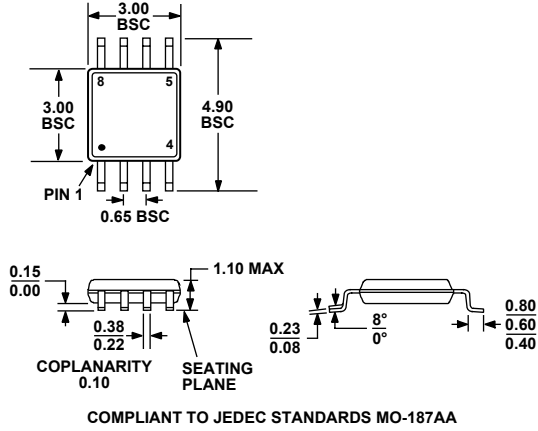


Figure 30. 8-Lead Mini Small Outline Package [MSOP] (RM-8)
Dimensions shown in millimeters

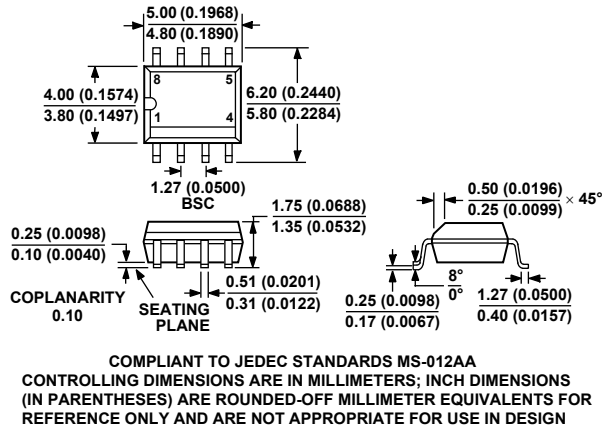


Figure 31. 8-Lead Standard Small Outline Package [SOIC] (R-8)
Dimensions shown in millimeters and (inches)

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.

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NOTES