Low Cost, Low Noise, CMOS, RRO Operational Amplifiers

AD8691/AD8692/AD8694

FEATURES

Offset voltage: 400 µV typical
Low offset voltage drift: 6 µV/°C maximum (AD8692/AD8694)
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
Qualified for automotive applications

APPLICATIONS

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

GENERAL DESCRIPTION

The AD8691, AD8692, and AD8694 are low cost, single, dual, and quad rail-to-rail output, single-supply amplifiers featuring low offset and input voltages, low current noise, and wide signal bandwidth. The combination of low offset, low noise, very low input bias currents, and high speed make these amplifiers useful in a wide variety of applications. Filters, integrators, photodiode amplifiers, and high impedance sensors all benefit from this combination of performance features. Audio and other ac applications benefit from the wide bandwidth and low distortion of these devices.

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

The small SC70 and TSOT package options for the AD8691 allow it to be placed next to sensors, thereby reducing external noise pickup.

The AD8691, AD8692, and AD8694 are specified over the extended industrial temperature range of −40°C to +125°C. The AD8691 single is available in 5-lead SC70 and 5-lead TSOT packages. The AD8692 dual is available in 8-lead MSOP and narrow SOIC surface-mount packages. The AD8694 quad is available in 14-lead TSSOP and narrow 14-lead SOIC packages.

See the Ordering Guide section for automotive grades.

PIN CONFIGURATIONS

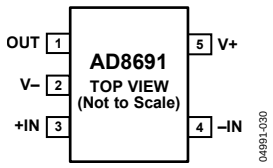


Figure 1. 5-Lead TSOT

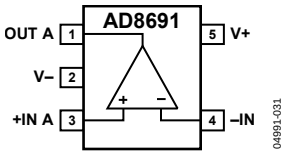


Figure 2. 5-Lead SC70

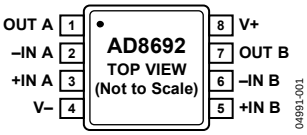


Figure 3. 8-Lead MSOP

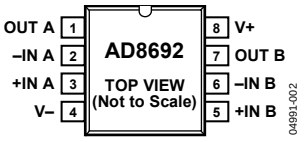


Figure 4. 8-Lead SOIC

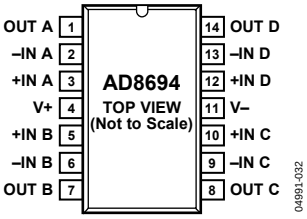


Figure 5. 14-Lead SOIC

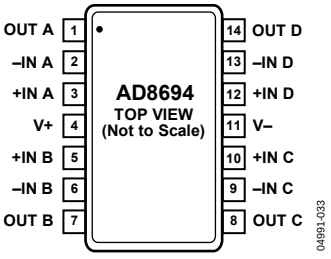


Figure 6. 14-Lead TSSOP

Rev. E
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.

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 781.329.4700 **www.analog.com**
Fax: 781.461.3113 **©2004–2011 Analog Devices, Inc. All rights reserved.**

TABLE OF CONTENTS

Features 1
Applications 1
General Description 1
Pin Configurations 1
Revision History 2
Specifications 3
Electrical Characteristics 3
Absolute Maximum Ratings 5
Thermal Characteristics 5
ESD Caution 5
Typical Performance Characteristics 6
Outline Dimensions 11
Ordering Guide 14
Automotive Products 14

REVISION HISTORY

8/11—Rev. D to Rev. E

Changes to Figure 20 8

11/10—Rev. C to Rev. D

Changes to Features Section and General Descriptions Section 1
Updated Outline Dimensions 11
Changes to Ordering Guide 14
Added Automotive Products Section 14

5/07—Rev. B to Rev. C

Change to Figure 1 1
Changes to Large Signal Voltage Gain Values in Table 1 3
Change to Phase Margin Symbol in Table 1 3
Change to T_A Value for Table 2 4
Changes to Large Signal Voltage Gain Values in Table 2 4
Change to Phase Margin Symbol in Table 2 4
Changes to Table 4 5
Changes to Outline Dimensions 11
Changes to Ordering Guide 12

3/05—Rev. A to Rev. B

Added AD8694 ..... Universal

1/05—Rev. 0 to Rev. A

Added AD8691 ..... Universal
Changes to Features 1
Added Figure 1 and Figure 2 1
Changes to Electrical Characteristics 3
Changes to Figure 6 caption 6
Changes to Figure 9 6
Updated Outline Dimensions 11
Changes to Ordering Guide 11

10/04—Revision 0: Initial Version

SPECIFICATIONS

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	68	90		dB
		V_{CM} = −0.1 V to +1.6 V; −40°C < T_A < +125°C	60	85		dB
Large Signal Voltage Gain	A_{VO}					
AD8691/AD8692		R_L = 2 kΩ, V_O = 0.5 V to 2.2 V	90	250		V/mV
AD8694		R_L = 2 kΩ, V_O = 0.5 V to 2.2 V	60			V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$					
AD8691				2	12	µV/°C
AD8692/AD8694				1.3	6	µV/°C
INPUT CAPACITANCE						
Common-Mode Input Capacitance	C_{CM}			5		pF
Differential Input Capacitance	C_{DM}			2.5		pF
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			60	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	$Ø_m$			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	$e_{n\ p-p}$	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 = 25°C, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	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	70	95		dB
		V_{CM} = −0.1 V to +3.9 V; −40°C < T_A < +125°C	67	95		dB
Large Signal Voltage Gain	A_{VO}					
AD8691/AD8692		V_O = 0.5 V to 4.5 V, R_L = 2 kΩ, V_{CM} = 0 V	250	2000		V/mV
AD8694		V_O = 0.5 V to 4.5 V, R_L = 2 kΩ, V_{CM} = 0 V	150			V/mV
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$					
AD8691				2	12	µV/°C
AD8692/AD8694				1.3	6	µV/°C
INPUT CAPACITANCE						
Common-Mode Input Capacitance	C_{CM}			5		pF
Differential Input Capacitance	C_{DM}			2.5		pF
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
Output Voltage Low	V_{OL}	I_L = 1 mA		20	40	mV
AD8691/AD8692		I_L = 10 mA		165	210	mV
AD8694		I_L = 10 mA		185	240	mV
AD8691/AD8692		−40°C to +125°C			290	mV
AD8694		−40°C to +125°C			370	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	$Ø_m$			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	$e_{n\,p-p}$	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.

Parameter	Rating
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	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 (Soldering, 60 sec)	300°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 CHARACTERISTICS

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

Table 4. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
8-Lead MSOP (RM-8)	210	45	°C/W
8-Lead SOIC (R-8)	158	43	°C/W
5-Lead TSOT (UJ-5)	207	61	°C/W
5-Lead SC70 (KS-5)	376	126	°C/W
14-Lead TSSOP (RU-14)	180	35	°C/W
14-Lead SOIC (R-14)	120	36	°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

V_S = +5 V or ±2.5 V, unless otherwise noted.

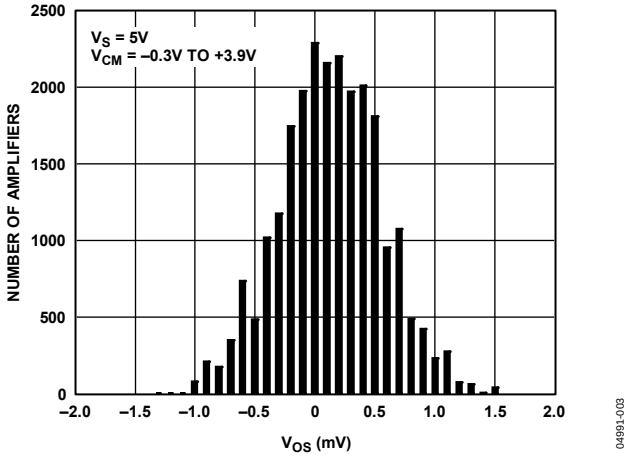


Figure 7. Input Offset Voltage Distribution

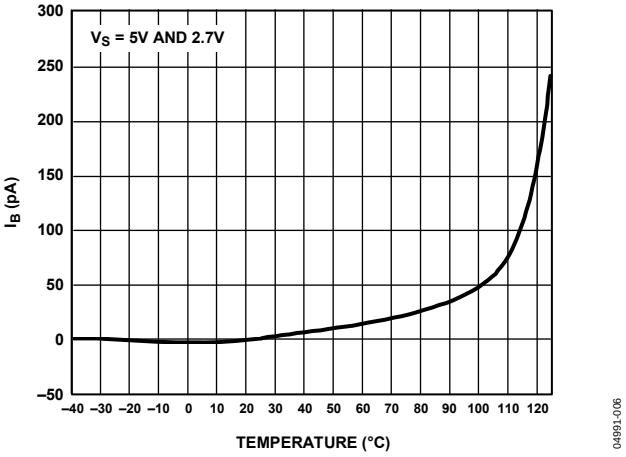


Figure 10. Input Bias Current vs. Temperature

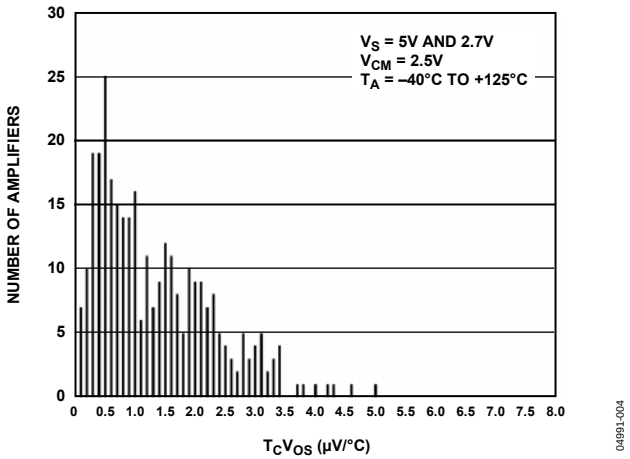


Figure 8. AD8692/AD8694 Input Offset Voltage Drift Distribution

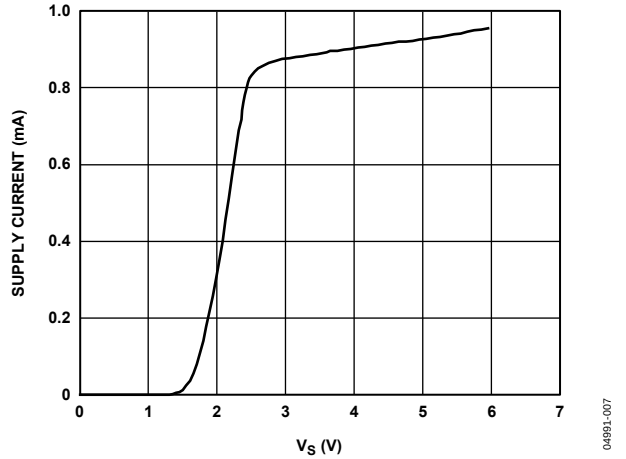


Figure 11. Supply Current vs. Supply Voltage

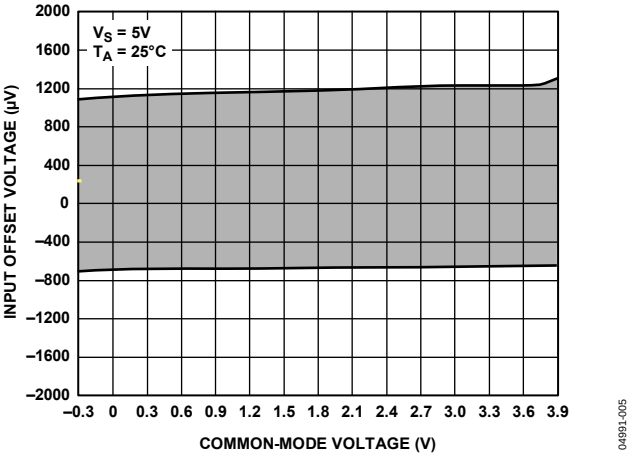


Figure 9. Input Offset Voltage vs. Common-Mode Voltage

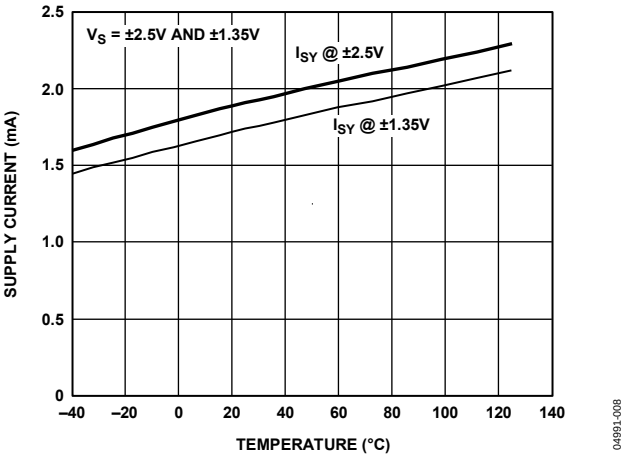


Figure 12. Supply Current vs. Temperature

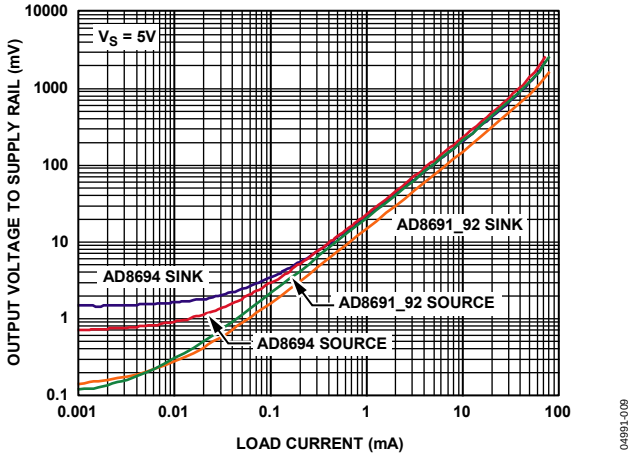


Figure 13. Output Voltage to Supply Rail vs. Load Current

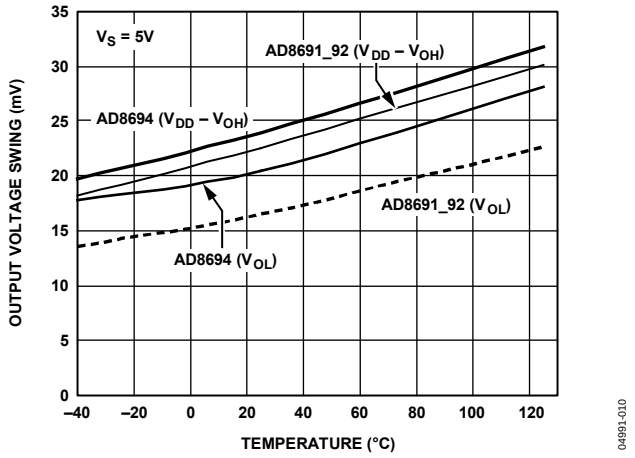


Figure 14. Output Voltage Swing vs. Temperature (I_L = 1 mA)

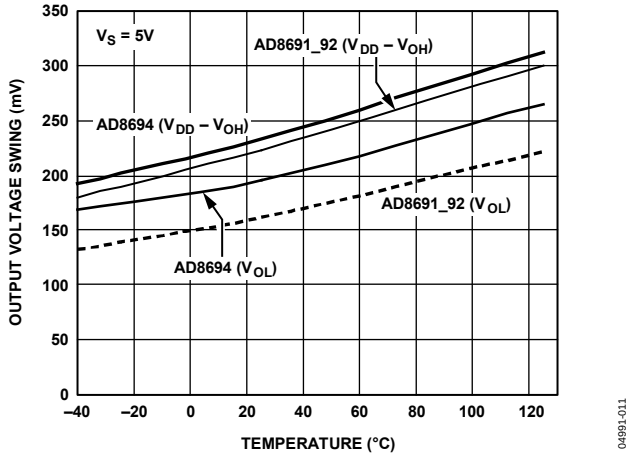


Figure 15. Output Voltage Swing vs. Temperature (I_L = 10 mA)

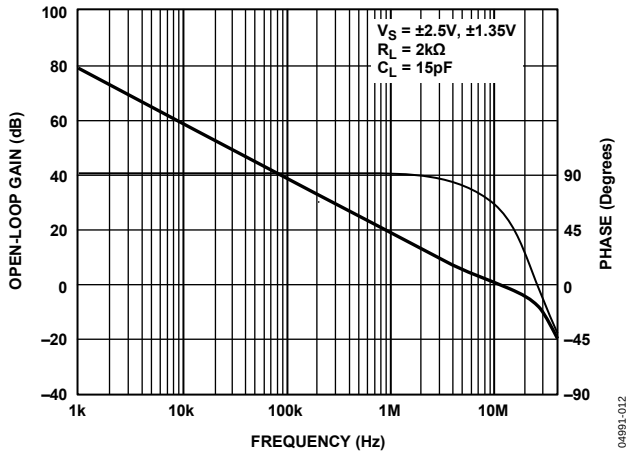


Figure 16. Open-Loop Gain and Phase vs. Frequency

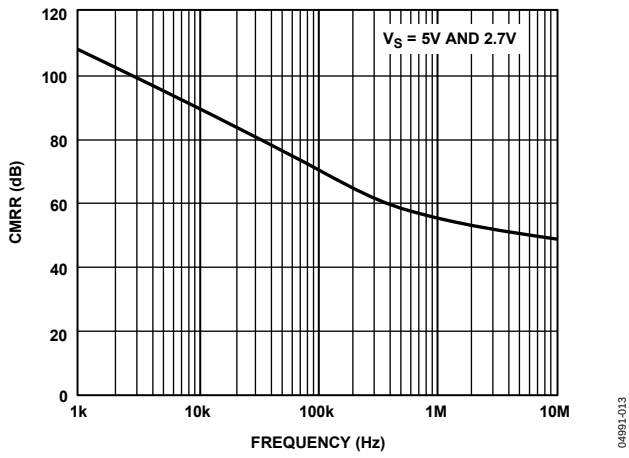


Figure 17. CMRR vs. Frequency

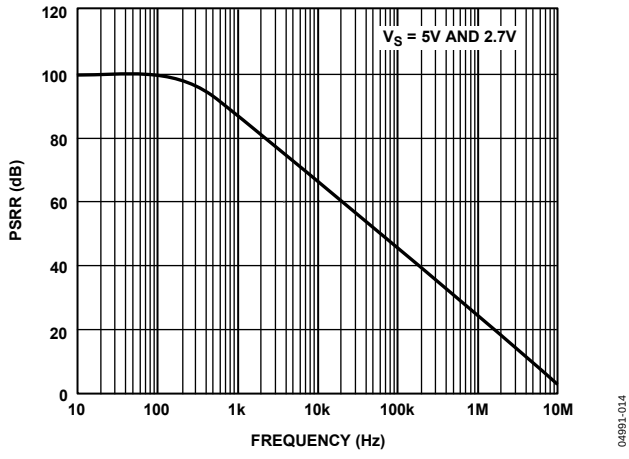


Figure 18. PSRR vs. Frequency

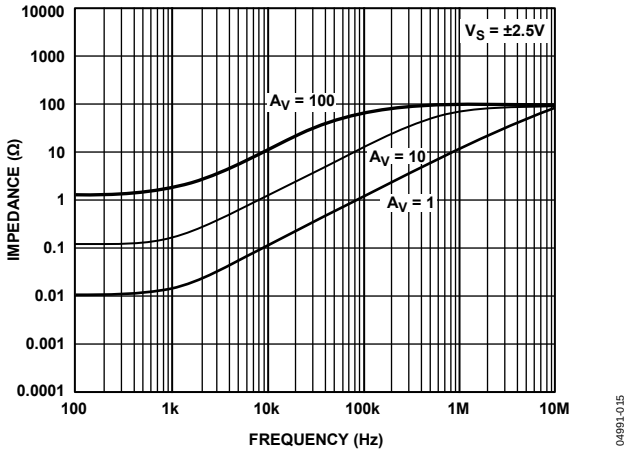


Figure 19. Closed-Loop Output Impedance vs. Frequency

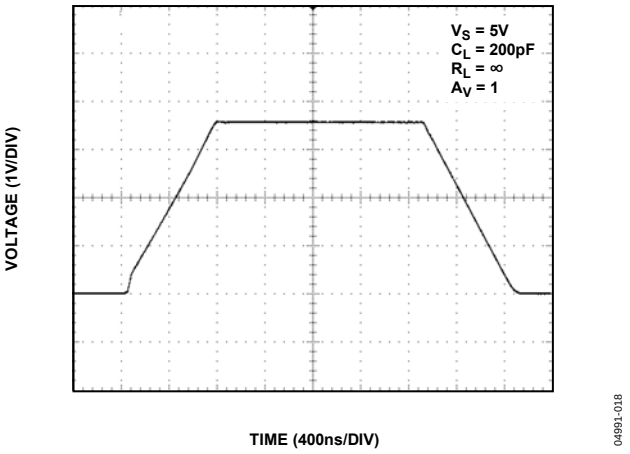


Figure 22. Large Signal Transient Response

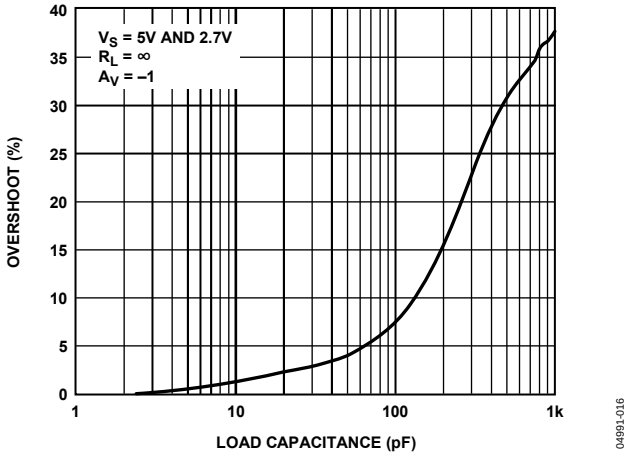


Figure 20. Small Signal Overshoot vs. Load Capacitance

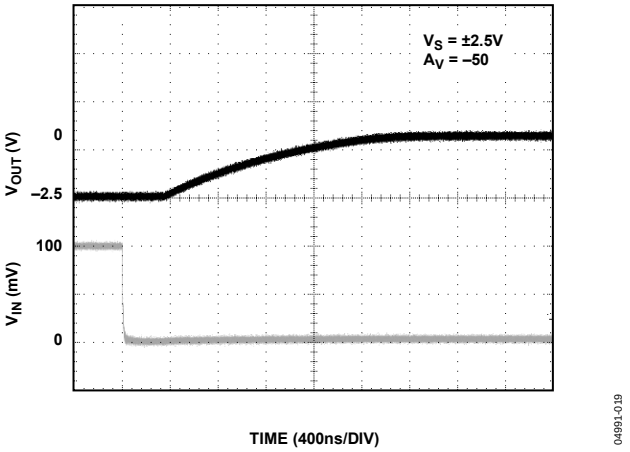


Figure 23. Positive Overload Recovery

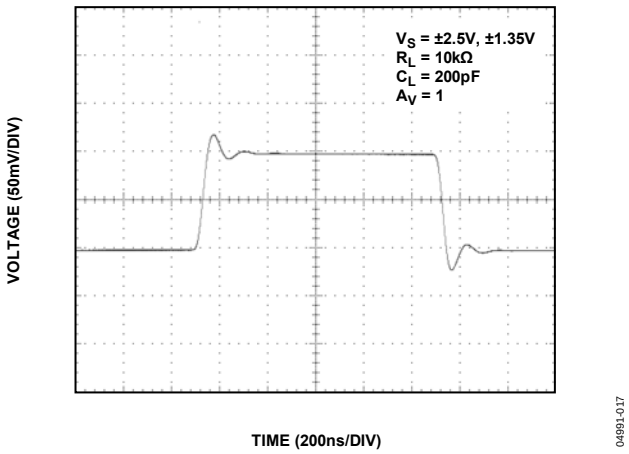


Figure 21. Small Signal Transient Response

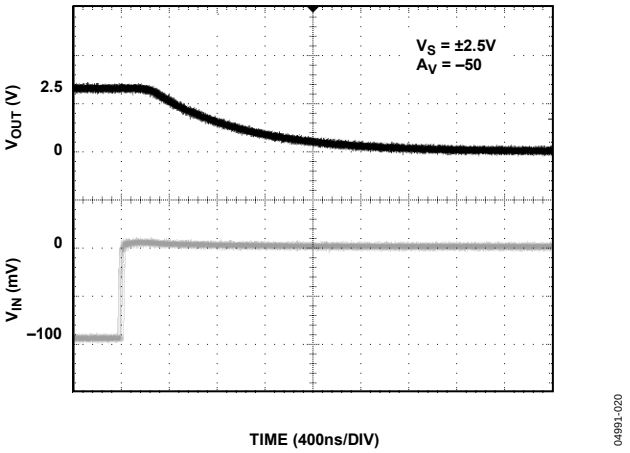


Figure 24. Negative Overload Recovery

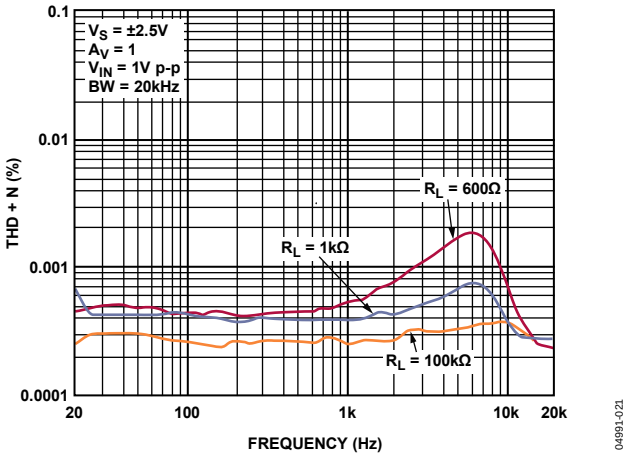


Figure 25. THD + N vs. Frequency

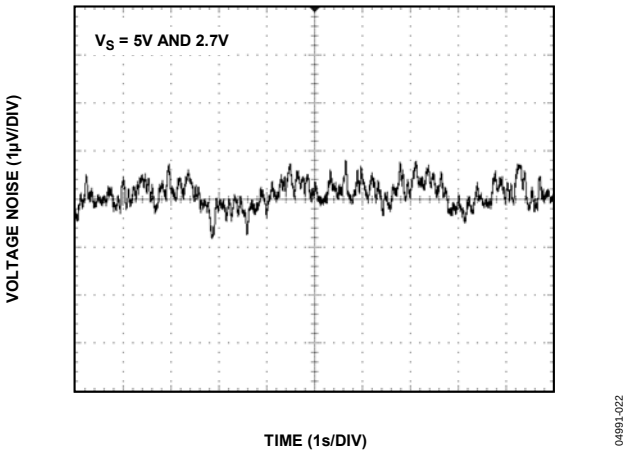


Figure 26. 0.1 Hz to 10 Hz Input Voltage Noise

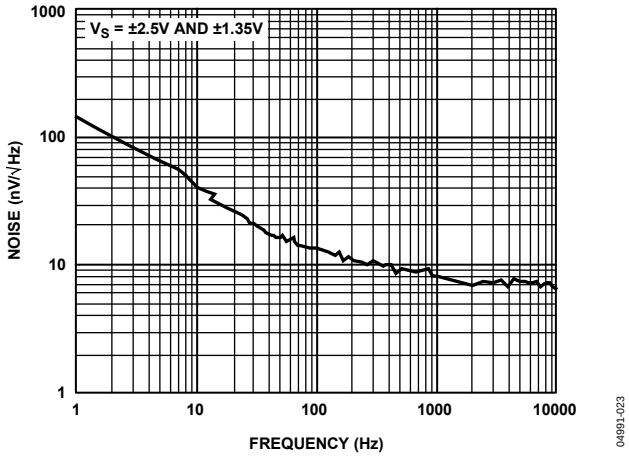


Figure 27. Voltage Noise Density

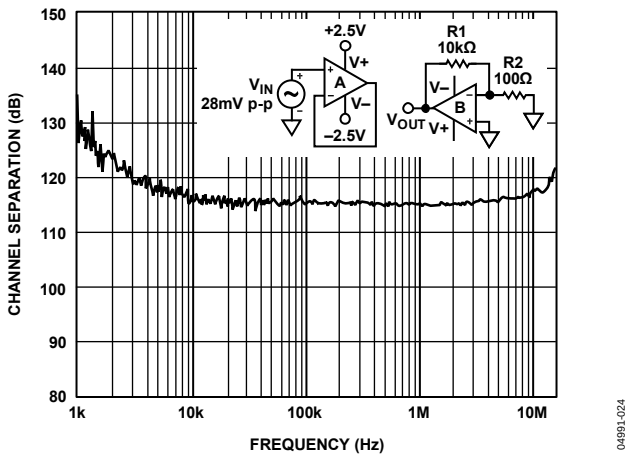


Figure 28. AD8692/AD8694 Channel Separation

V_S = +2.7 V or ±1.35 V, unless otherwise noted.

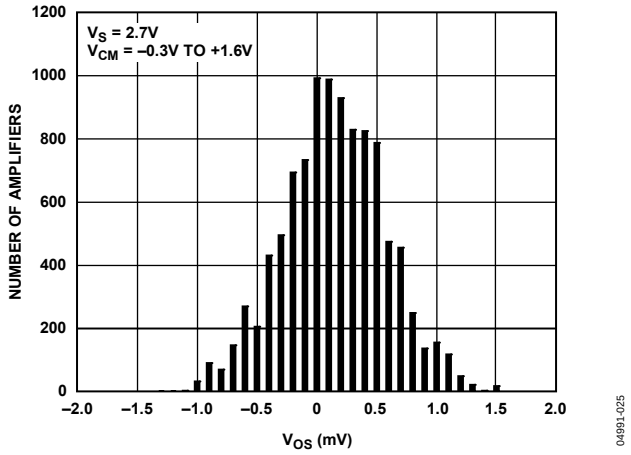


Figure 29. Input Offset Voltage Distribution

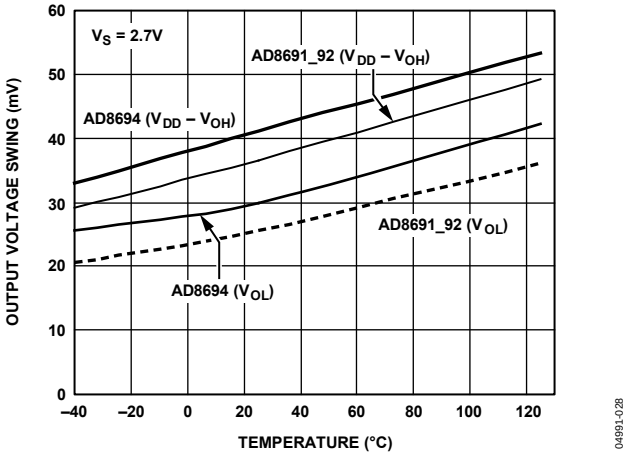


Figure 32. Output Voltage Swing vs. Temperature (I_L = 1 mA)

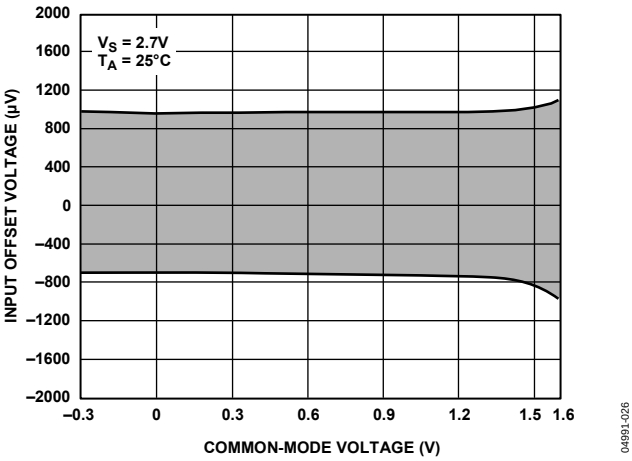


Figure 30. Input Offset Voltage vs. Common-Mode Voltage

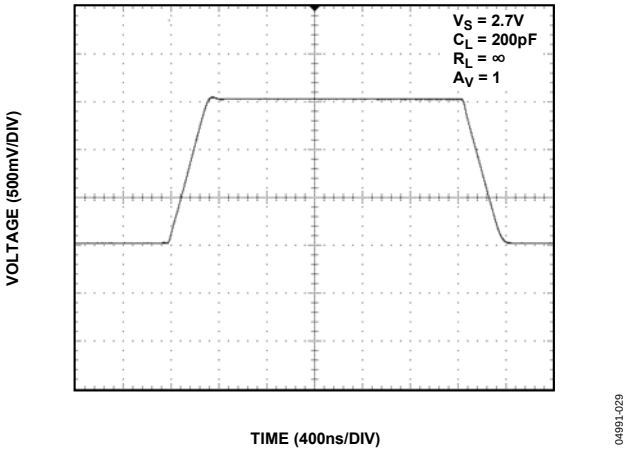


Figure 33. Large Signal Transient Response

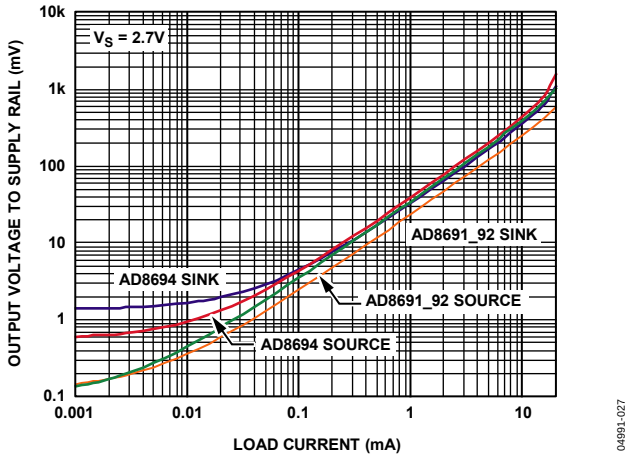
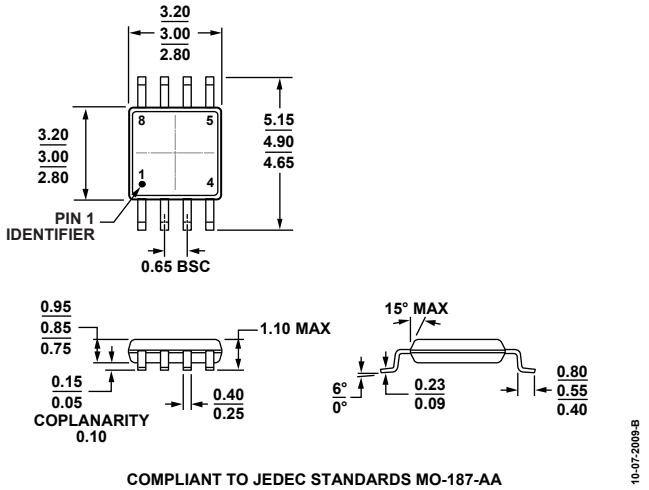


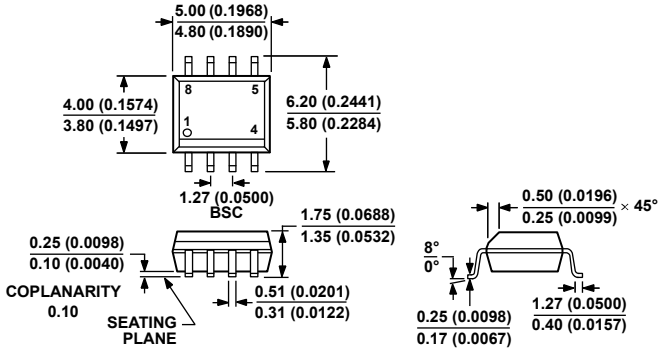
Figure 31. Output Voltage to Supply Rail vs. Load Current

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-187-AA

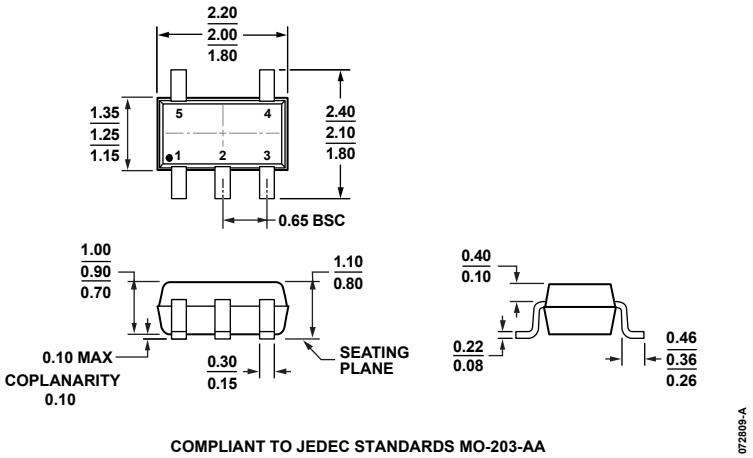
Figure 34. 8-Lead Mini Small Outline Package [MSOP]
(RM-8)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MS-012-AA

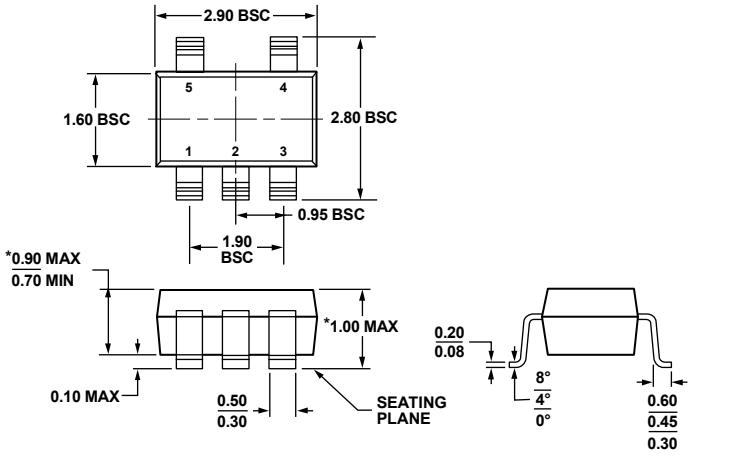
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 35. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body (R-8)
Dimensions shown in millimeters and (inches)



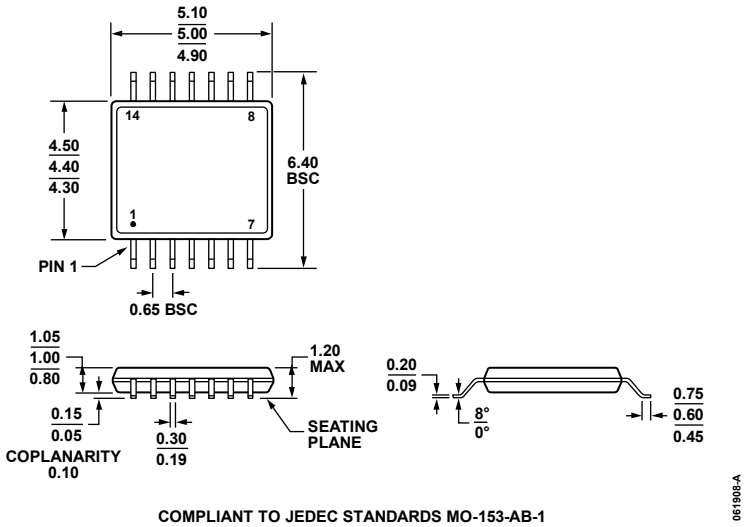
COMPLIANT TO JEDEC STANDARDS MO-203-AA

Figure 36. 5-Lead Thin Shrink Small Outline Package [SC70]
(KS-5)
Dimensions shown in millimeters



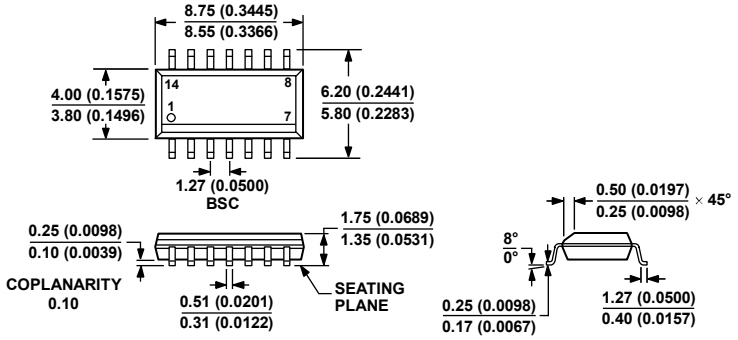
*COMPLIANT TO JEDEC STANDARDS MO-193-AB WITH THE EXCEPTION OF PACKAGE HEIGHT AND THICKNESS.

Figure 37. 5-Lead Thin Small Outline Transistor Package [TSOT]
(UJ-5)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-153-AB-1

Figure 38. 14-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-14)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MS-012-AB
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

Figure 39. 14-Lead Standard Small Outline Package [SOIC_N]
Narrow Body (R-14)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model[1, 2]	Temperature Range	Package Description	Package Option	Branding
AD8691AUJZ-R2	−40°C to +125°C	5-Lead TSOT	UJ-5	ACA
AD8691AUJZ-REEL	−40°C to +125°C	5-Lead TSOT	UJ-5	ACA
AD8691AUJZ-REEL7	−40°C to +125°C	5-Lead TSOT	UJ-5	ACA
AD8691AKSZ-R2	−40°C to +125°C	5-Lead SC70	KS-5	ACA
AD8691AKSZ-REEL	−40°C to +125°C	5-Lead SC70	KS-5	ACA
AD8691AKSZ-REEL7	−40°C to +125°C	5-Lead SC70	KS-5	ACA
AD8691WAUJZ-R7	−40°C to +125°C	5-Lead TSOT	UJ-5	ACA
AD8691WAUJZ-RL	−40°C to +125°C	5-Lead TSOT	UJ-5	ACA
AD8692ARMZ-R7	−40°C to +125°C	8-Lead MSOP	RM-8	APA
AD8692ARMZ-REEL	−40°C to +125°C	8-Lead MSOP	RM-8	APA
AD8692ARZ	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8692ARZ-REEL	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8692ARZ-REEL7	−40°C to +125°C	8-Lead SOIC_N	R-8	
AD8692WARMZ-REEL	−40°C to +125°C	8-Lead MSOP	RM-8	APA
AD8694ARUZ	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8694ARUZ-REEL	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8694WARUZ	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8694WARUZ-REEL	−40°C to +125°C	14-Lead TSSOP	RU-14	
AD8694ARZ	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8694ARZ-REEL	−40°C to +125°C	14-Lead SOIC_N	R-14	
AD8694ARZ-REEL7	−40°C to +125°C	14-Lead SOIC_N	R-14	

[1] Z = RoHS Compliant Part.
[2] W = Qualified for Automotive Applications.

AUTOMOTIVE PRODUCTS

The AD8691W/AD8692W/AD8694W models are available with controlled manufacturing to support the quality and reliability requirements of automotive applications. Note that these automotive models may have specifications that differ from the commercial models; therefore, designers should review the Specifications section of this data sheet carefully. Only the automotive grade products shown are available for use in automotive applications. Contact your local Analog Devices account representative for specific product ordering information and to obtain the specific Automotive Reliability reports for these models.

NOTES

NOTES

©2004–2011 Analog Devices, Inc. All rights reserved. Trademarks and registered trademarks are the property of their respective owners.
D04991-0-8/11(E)

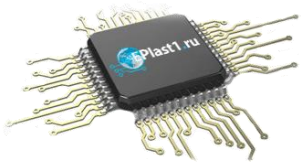
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.