

AD707/AD708

FEATURES

Very High DC Precision

Low Offset Voltages

(15 μV max: AD707)

(30 μV max: AD708)

Low Offset Drift

(0.1 $\mu\text{V}/^\circ\text{C}$ max: AD707)

(0.3 $\mu\text{V}/^\circ\text{C}$ max: AD708)

Low Input Bias Current: 1 nA max

Low Noise: 0.35 μV p-p max (0.1 Hz to 10 Hz)

130 dB min CMRR

120 dB min PSRR

AC Performance

0.3 V/ μs Slew Rate

900 kHz Closed-Loop Bandwidth

Matching Characteristics

30 μV max Offset Voltage Match

0.3 $\mu\text{V}/^\circ\text{C}$ max Offset Drift Match

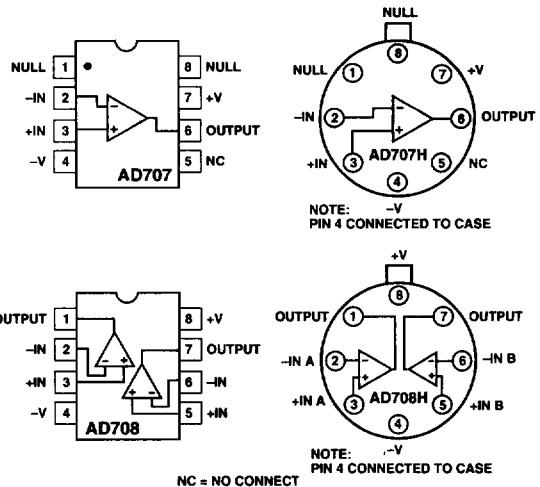
130 dB min CMRR Match

MIL-STD-883B Versions Available

Single: AD707

Dual: AD708

FUNCTIONAL BLOCK DIAGRAMS



PRODUCT DESCRIPTION

The AD707 (single) and AD708 (dual) are very high precision, monolithic operational amplifiers. Each device offers excellent dc precision with the best available max offset voltage and max offset voltage drift of any single/dual bipolar combination available.

The AD707 and AD708 set new standards for precision op amps by providing 5 V/ μV min open-loop gain and guaranteed max input voltage noise of 350 nV p-p (0.1 Hz to 10 Hz). All dc specifications show excellent stability over temperature, with offset voltage drift typically 0.1 $\mu\text{V}/^\circ\text{C}$ and input bias current drift of 25 pA/ $^\circ\text{C}$ max. Both CMRR (130 dB max) and PSRR (120 dB max) are an order of magnitude improved over any available monolithic op amp.

The AD707 and AD708 are available in seven performance grades. The "J" and "K" grades are rated over the commercial temperature range of 0 $^\circ\text{C}$ to +70 $^\circ\text{C}$. The "A," "B" and "C" grades are rated over the industrial temperature range of -40 $^\circ\text{C}$ to +85 $^\circ\text{C}$. The "S" and "T" grades are rated over the military temperature range of -55 $^\circ\text{C}$ to +125 $^\circ\text{C}$. Select versions are also available processed to MIL-STD-883B, Rev. C.

PRODUCT HIGHLIGHTS

1. The combination of outstanding matching and individual specifications make the AD707 and AD708 ideal for constructing high gain, precision instrumentation amplifiers.
2. The low offset voltage drift and low noise of the AD707 and AD708 allow the user to amplify very small signals without sacrificing overall system performance.
3. The AD707 and AD708 can be used where chopper amplifiers are required, but without the inherent noise and application problems.
4. The AD707 is an improved, pin-for-pin replacement for the LT1001, and the AD708 is an improved, pin-for-pin replacement for the LT1002.

This is an abridged data sheet. To obtain the most recent version or complete data sheet, call our fax retrieval system at 1-800-446-6212.

Parameter	Conditions	Model	I/A		K/B/S		C/T		Units
			Min	Typ Max	Min	Max	Min	Typ Max	
INPUT OFFSET VOLTAGE ¹ Initial Offset vs. Temperature Drift Adjustment Range Long-Term Stability	T_{MIN} to T_{MAX}	AD707	30	90	10	25	5	15	μV
		AD708	30	100	15	65/65/50			μV
		AD707	50	100	15	45	7/8	25	μV
		AD708	50	150	15	65			μV
		AD707	0.3	1.0	0.1	0.3	0.03	0.1	$\mu\text{V}/^\circ\text{C}$
		AD708	0.3	1.0	0.1	0.4/0.4/0.4			$\mu\text{V}/^\circ\text{C}$
INPUT BIAS CURRENT vs. Temperature Average Drift	T_{MIN} to T_{MAX}	AD707	1.0	2.5	0.5	1.5	0.5	1.0	nA
		AD708	1.0	2.5	0.5	1.0			nA
		AD707	2.0	4.0	1.5	3.0	1.0	2.0	nA
		AD708	2.0	4.0	1.0	2.0/2.0/4.0			nA
		AD707	15	40	15	25/25/35	1	25	$\text{pA}/^\circ\text{C}$
		AD708	15	40	10	25/25/30			$\text{pA}/^\circ\text{C}$
INPUT OFFSET CURRENT $V_{CM} = 0\text{ V}$ T_{MIN} to T_{MAX} Average Drift	T_{MIN} to T_{MAX}	AD707	0.5	2.0	0.3	1.5	0.1	1.0	nA
		AD708	0.5	2.0	0.1	1.0			nA
		AD707	2.0	4.0	1.5	3.0	0.2	1.5	nA
		AD708	2.0	4.0	0.2	1.5/1.5/1.5			nA
		AD707	2	40	1	25/25/35	1	25	$\text{pA}/^\circ\text{C}$
		AD708	2	60	1	25			$\text{pA}/^\circ\text{C}$
MATCHING CHARACTERISTICS ² Offset Voltage Offset Voltage Drift Input Bias Current Common-Mode Rejection Power Supply Rejection Channel Separation	T_{MIN} to T_{MAX}	AD708		80		50/50/50			μV
		AD708		150		75/75/75			μV
	T_{MIN} to T_{MAX}	AD708		1.0		0.4/0.4/0.4			$\mu\text{V}/^\circ\text{C}$
		AD708		4.0		1.0			nA
	T_{MIN} to T_{MAX}	AD708		5.0		2.0/2.0/2.0			nA
		AD708	120	300	130/130/120	140			dB
	T_{MIN} to T_{MAX}	AD708	110	600	130/130/115				dB
		AD708	110		120				dB
T_{MIN} to T_{MAX}	AD708	110	500	120				dB	
	AD708	135		140				dB	
INPUT VOLTAGE NOISE 0.1 Hz to 10 Hz f = 10 Hz f = 100 Hz f = 1 kHz	0.1 Hz to 10 Hz	AD707	0.23	0.6	0.23	0.6	0.23	0.35	$\mu\text{V p-p}$
		AD708	0.23	0.6	0.23	0.6/0.6/0.6			$\mu\text{V p-p}$
		AD707	10.3	15.0	10.3	14.0	10.3	13.0	$\text{nV}/\sqrt{\text{Hz}}$
		AD708	10.3	18.0	10.3	12.0			$\text{nV}/\sqrt{\text{Hz}}$
		AD707	10.0	13.0	10.0	12.0	10.0	11.0	$\text{nV}/\sqrt{\text{Hz}}$
		AD708	10.0	13.0	10.0	11.0			$\text{nV}/\sqrt{\text{Hz}}$
		AD707	9.6	11.0	9.6	11.0	9.6	11.0	$\text{nV}/\sqrt{\text{Hz}}$
		AD708	9.6	11.0	9.6	11.0			$\text{nV}/\sqrt{\text{Hz}}$
INPUT CURRENT NOISE 0.1 Hz to 10 Hz f = 10 Hz f = 100 Hz f = 1 kHz	0.1 Hz to 10 Hz	AD707	14	35	14	30	14	30	pA p-p
		AD708	14	35	14	35			pA p-p
		AD707	0.32	0.9	0.32	0.8	0.32	0.8	$\text{pA}/\sqrt{\text{Hz}}$
		AD708	0.32	0.9	0.32	0.8			$\text{pA}/\sqrt{\text{Hz}}$
		AD707	0.14	0.27	0.14	0.23	0.14	0.23	$\text{pA}/\sqrt{\text{Hz}}$
		AD708	0.14	0.27	0.14	0.23			$\text{pA}/\sqrt{\text{Hz}}$
		AD707	0.12	0.18	0.12	0.17	0.12	0.17	$\text{pA}/\sqrt{\text{Hz}}$
		AD708	0.12	0.18	0.12	0.17			$\text{pA}/\sqrt{\text{Hz}}$
COMMON-MODE REJECTION RATIO $V_{CM} = \pm 13\text{ V}$ T_{MIN} to T_{MAX}	T_{MIN} to T_{MAX}	Both	120	140	130	140	130	140	dB
		Both	120	140	130	140	130	140	dB
OPEN-LOOP GAIN $V_O = \pm 10\text{ V}$ $R_L \geq 2\text{ k}\Omega$ T_{MIN} to T_{MAX}	T_{MIN} to T_{MAX}	AD707	3	13	5	13	8	13	$\text{V}/\mu\text{V}$
		AD708	3	10	5/5/4	10			$\text{V}/\mu\text{V}$
		AD707	3	13	5	13	8	13	$\text{V}/\mu\text{V}$
		AD708	3	10	5/5/4	10/10/7			$\text{V}/\mu\text{V}$
POWER SUPPLY REJECTION RATIO $V_S = \pm 3\text{ V}$ to $\pm 18\text{ V}$ T_{MIN} to T_{MAX}	T_{MIN} to T_{MAX}	AD707	110	130	115	130	120	130	dB
		AD708	120	130	120	130			dB
		AD707	110	130	115	130	120	130	dB
		AD708	110	130	120	130			dB
FREQUENCY RESPONSE Closed Loop Bandwidth Slew Rate		Both	0.5	0.9	0.5	0.9	0.5	0.9	MHz
		Both	0.15	0.3	0.15	0.3	0.15	0.3	$\text{V}/\mu\text{s}$

AD707/AD708

Parameter	Conditions	Model	J/A			K/B/S			C/T		Units
			Min	Typ	Max	Min	Typ	Max	Min	Typ	
INPUT RESISTANCE		AD707 AD708	24	100	45	200	60	200	400		MΩ
				60		200		MΩ			
				200		300		GΩ			
Common Mode		AD708	200		400		400			GΩ	
OUTPUT CHARACTERISTICS											
Voltage	$R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$ $R_L \geq 1\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$ T_{MIN} to T_{MAX}	Both	13.5	14.0	13.5	14.0	13.5	14.0	$\pm V$		
			12.5	13.0	12.5	13.0	$\pm V$				
			12.0	12.5	12.0	12.5	$\pm V$				
			12.0	13.0	12.0	13.0	$\pm V$				
OPEN-LOOP OUTPUT RESISTANCE		Both	60			60			Ω		
POWER SUPPLY											
Quiescent Current		AD707 AD708	2.5 4.5	3.0 5.5	2.5 4.5	3.0 5.5	2.5 3.0	3.0	mA mA		
Power Consumption, No Load	$V_S = \pm 15\text{ V}$	AD707	75	90	75	90	75	90	mW mW		
		AD708	135	165	135	165					
	$V_S = \pm 3\text{ V}$	AD707	7.5	9.0	7.5	9.0	7.5	9.0	mW mW		
		AD708	12	18	12	18					
		Both	± 3	± 18	± 3	± 18	± 3	± 18	V		

NOTES

¹Input offset voltage specifications are guaranteed after 5 minutes of operation at $T_A = +25^\circ\text{C}$.

²Matching is defined as the difference between parameters of the two amplifiers.

All min and max specifications are guaranteed. Specifications in **boldface** are tested on all production units at final electrical test. Results from those tests are used to calculate outgoing quality levels.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS¹

Supply Voltage	$\pm 22\text{ V}$
Internal Power Dissipation ²	500 mW
Input Voltage	$\pm V_S$
Differential Input Voltage	$+V_S$ and $-V_S$
Output Short Circuit Duration	Indefinite
Storage Temperature Range (N, R)	-65°C to $+125^\circ\text{C}$
Storage Temperature Range (Q, H)	-65°C to $+150^\circ\text{C}$
Operating Temperature Range	
AD70xJ/K	0°C to $+70^\circ\text{C}$
AD70xA/B	-40°C to $+85^\circ\text{C}$
AD70xS/T	-55°C to $+125^\circ\text{C}$
Lead Temperature Range (Soldering 60 sec)	$+300^\circ\text{C}$

NOTES

¹Stresses 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.

²Specification is for device in free air: 8-pin plastic package, $\theta_{JA} = 165^\circ\text{C}/\text{Watt}$; 8-pin cerdip package, $\theta_{JA} = 110^\circ\text{C}/\text{Watt}$; 8-pin small outline package, $\theta_{JA} = 155^\circ\text{C}/\text{Watt}$; 8-pin header package, $\theta_{JA} = 200^\circ\text{C}/\text{Watt}$.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option*
AD707AH	-40°C to $+85^\circ\text{C}$	8-Pin Metal Can	H-08A
AD707AQ	-40°C to $+85^\circ\text{C}$	8-Pin Ceramic DIP	Q-8
AD707AR	-40°C to $+85^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707AR-REEL	-40°C to $+85^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707AR-REEL7	-40°C to $+85^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707BH	-40°C to $+85^\circ\text{C}$	8-Pin Metal Can	H-08A
AD707BQ	-40°C to $+85^\circ\text{C}$	8-Pin Ceramic DIP	Q-8
AD707CH	-40°C to $+85^\circ\text{C}$	8-Pin Metal Can	H-08A
AD707CQ	-40°C to $+85^\circ\text{C}$	8-Pin Ceramic DIP	Q-8
AD707JN	0°C to $+70^\circ\text{C}$	8-Pin Plastic DIP	N-8
AD707JR	0°C to $+70^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707JR-REEL	0°C to $+70^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707JR-REEL7	0°C to $+70^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707KN	0°C to $+70^\circ\text{C}$	8-Pin Plastic DIP	N-8
AD707KR	0°C to $+70^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707KR-REEL	0°C to $+70^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707KR-REEL7	0°C to $+70^\circ\text{C}$	8-Pin Plastic SOIC	R-8
AD707SH/883B	-55°C to $+125^\circ\text{C}$	8-Pin Metal Can	H-08A
AD707SQ/883B	-55°C to $+125^\circ\text{C}$	8-Pin Ceramic DIP	Q-8
AD707TH/883B	-55°C to $+125^\circ\text{C}$	8-Pin Metal Can	H-08A
AD707TQ/883B	-55°C to $+125^\circ\text{C}$	8-Pin Ceramic DIP	Q-8
AD708AH	-40°C to $+85^\circ\text{C}$	8-Pin Metal Can	H-08A
AD708AQ	-40°C to $+85^\circ\text{C}$	8-Pin Ceramic DIP	Q-8
AD708BH	-40°C to $+85^\circ\text{C}$	8-Pin Metal Can	H-08A
AD708BQ	-40°C to $+85^\circ\text{C}$	8-Pin Ceramic DIP	Q-8
AD708JCHIPS	0°C to $+70^\circ\text{C}$	Bare Die	
AD708JN	0°C to $+70^\circ\text{C}$	8-Pin Plastic DIP	N-8
AD708SQ	-55°C to $+125^\circ\text{C}$	8-Pin Ceramic DIP	Q-8
AD708SQ/883B	-55°C to $+125^\circ\text{C}$	8-Pin Ceramic DIP	Q-8

*For outline information see Package Information section.

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 the AD707 and AD708 feature 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.

