

FEATURES

Very high dc precision

- 30 μV maximum offset voltage**
- 0.3 $\mu\text{V}/^\circ\text{C}$ maximum offset voltage drift**
- 0.35 μV p-p maximum voltage noise (0.1 Hz to 10 Hz)**
- 5 million V/V minimum open-loop gain**
- 130 dB minimum CMRR**
- 120 dB minimum PSRR**

Matching characteristics

- 30 μV maximum offset voltage match**
- 0.3 $\mu\text{V}/^\circ\text{C}$ maximum offset voltage drift match**
- 130 dB minimum CMRR match**

Available in 8-lead narrow body, PDIP, and

hermetic CERDIP and CERDIP/883B packages

GENERAL DESCRIPTION

The AD708 is a high precision, dual monolithic operational amplifier. Each amplifier individually offers excellent dc precision with maximum offset voltage and offset voltage drift of any dual bipolar op amp.

The matching specifications are among the best available in any dual op amp. In addition, the AD708 provides 5 V/ μV minimum open-loop gain and guaranteed maximum 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/ $^\circ\text{C}$ maximum.

The AD708 is available in four performance grades. The AD708J is rated over the commercial temperature range of 0 $^\circ\text{C}$ to 70 $^\circ\text{C}$ and is available in a narrow body, PDIP. The AD708A and AD708B are rated over the industrial temperature range of -40 $^\circ\text{C}$ to +85 $^\circ\text{C}$ and are available in a CERDIP.

PIN CONFIGURATION

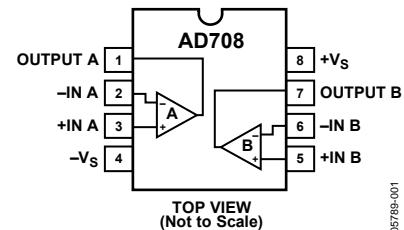


Figure 1. PDIP (N) and CERDIP (Q) Packages

The AD708S is rated over the military temperature range of -55 $^\circ\text{C}$ to +125 $^\circ\text{C}$ and is available in a CERDIP military version processed to MIL-STD-883B.

PRODUCT HIGHLIGHTS

1. The combination of outstanding matching and individual specifications make the AD708 ideal for constructing high gain, precision instrumentation amplifiers.
2. The low offset voltage drift and low noise of the AD708 allow the designer to amplify very small signals without sacrificing overall system performance.
3. The AD708 10 V/ μV typical open-loop gain and 140 dB common-mode rejection make it ideal for precision applications.

SPECIFICATIONS

@ 25°C and ±15 V dc, unless otherwise noted.

Table 1.

Parameter	Conditions	AD708J/AD708A			AD708B			AD708S			Unit	
		Min ¹	Typ	Max ¹	Min ¹	Typ	Max ¹	Min ¹	Typ	Max ¹		
INPUT OFFSET VOLTAGE ²	T_{MIN} to T_{MAX}		30	100		5	50		5	30	μV	
		Drift		50	150		15	65		15	50	μV
		Long Term Stability		0.3	1.0		0.1	0.4		0.1	0.3	μV/°C
				0.3			0.3			0.3		μV/month
INPUT BIAS CURRENT	T_{MIN} to T_{MAX}		1.0	2.5		0.5	1.0		0.5	1	nA	
		Average Drift		2.0	4.0		1.0	2.0		1.0	4	nA
				15	40		10	25		10	30	pA/°C
OFFSET CURRENT	$V_{CM} = 0V$ T_{MIN} to T_{MAX}		0.5	2.0		0.1	1.0		0.1	1	nA	
		Average Drift		2.0	4.0		0.2	1.5		0.2	1.5	nA
				2	60		1	25		1	25	pA/°C
MATCHING CHARACTERISTICS ³	T_{MIN} to T_{MAX}	Offset Voltage		80			50			30	μV	
		Offset Voltage Drift			150			75			50	μV
		Input Bias Current			1.0			0.4			0.3	μV/°C
	T_{MIN} to T_{MAX}	Common-Mode Rejection			4.0			1.0			1.0	nA
					5.0			2.0			2.0	nA
	T_{MIN} to T_{MAX}	Power Supply Rejection	120	140		130	140		130	140		dB
	T_{MIN} to T_{MAX}	Channel Separation	110			130			130			dB
INPUT VOLTAGE NOISE	0.1 Hz to 10 Hz		0.23	0.6		0.23	0.6		0.23	0.35	μV p-p	
		$f = 10$ Hz		10.3	18		10.3	12		10.3	12	nV/√Hz
		$f = 100$ Hz		10.0	13.0		10.0	11.0		10.0	11	nV/√Hz
		$f = 1$ kHz		9.6	11.0		9.6	11.0		9.6	11	nV/√Hz
INPUT CURRENT NOISE	0.1 Hz to 10 Hz		14	35		14	35		14	35	pA p-p	
		$f = 10$ Hz		0.32	0.9		0.32	0.8		0.32	0.8	pA/√Hz
		$f = 100$ Hz		0.14	0.27		0.14	0.23		0.14	0.23	pA/√Hz
		$f = 1$ kHz		0.12	0.18		0.12	0.17		0.12	0.17	pA/√Hz
COMMON-MODE REJECTION RATIO	$V_{CM} = \pm 13V$ T_{MIN} to T_{MAX}		120	140		130	140		130	140	dB	
			120	140		130	140		130	140	dB	
OPEN-LOOP GAIN	$V_O = \pm 10V$ $R_{LOAD} \geq 2k\Omega$ T_{MIN} to T_{MAX}		3	10		5	10		4	10	V/μV	
			3	10		5	10		4	7	V/μV	
POWER SUPPLY REJECTION RATIO	$V_S = \pm 3V$ to $\pm 18V$ T_{MIN} to T_{MAX}		110	130		120	130		120	130	dB	
			110	130		120	130		120	130	dB	
FREQUENCY RESPONSE		Closed-Loop Bandwidth	0.5	0.9		0.5	0.9		0.5	0.9	MHz	
		Slew Rate	0.15	0.3		0.15	0.3		0.15	0.3	V/μs	
INPUT RESISTANCE		Differential		60			200			200	MΩ	
		Common Mode			200			400			400	GΩ

AD708

Parameter	Conditions	AD708J/AD708A			AD708B			AD708S			Unit
		Min ¹	Typ	Max ¹	Min ¹	Typ	Max ¹	Min ¹	Typ	Max ¹	
OUTPUT VOLTAGE	$R_{LOAD} \geq 10 \text{ k}\Omega$	13.5	14		13.5	14.0		13.5	14		$\pm V$
	$R_{LOAD} \geq 2 \text{ k}\Omega$	12.5	13.0		12.5	13.0		12.5	13		$\pm V$
	$R_{LOAD} \geq 1 \text{ k}\Omega$	12.0	12.5		12.0	12.5		12.0	12.5		$\pm V$
	T_{MIN} to T_{MAX}	12.0	13.0		12.0	13.0		12.0	13		$\pm V$
OPEN-LOOP OUTPUT RESISTANCE			60		60			60			Ω
POWER SUPPLY											
Quiescent Current			4.5	5.5		4.5	5.5		4.5	5.5	mA
Power Consumption	$V_S = \pm 15 \text{ V}$		135	165		135	165		135	165	mW
	$V_S = \pm 3 \text{ V}$		12	18		12	18		12	18	mW
Operating Range		± 3		± 18	± 3		± 18	± 3		± 18	V

¹ 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.

² Input offset voltage specifications are guaranteed after five minutes of operation at $T_A = 25^\circ\text{C}$.

³ Matching is defined as the difference between parameters of the two amplifiers.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage	± 22 V
Internal Power Dissipation ¹	
Input Voltage ²	$\pm V_S$
Output Short-Circuit Duration	Indefinite
Differential Input Voltage	$+V_S$ and $-V_S$
Storage Temperature Range (Q)	-65°C to $+150^\circ\text{C}$
Storage Temperature Range (N)	-65°C to $+125^\circ\text{C}$
Lead Temperature (Soldering 60 sec)	300°C

¹ Thermal Characteristics

8-lead PDIP: $\theta_{JC} = 33^\circ\text{C}/\text{W}$, $\theta_{JA} = 100^\circ\text{C}/\text{W}$

8-lead CERDIP: $\theta_{JC} = 30^\circ\text{C}/\text{W}$, $\theta_{JA} = 110^\circ\text{C}/\text{W}$

² For supply voltages less than ± 22 V, the absolute maximum input voltage is equal to the supply voltage.

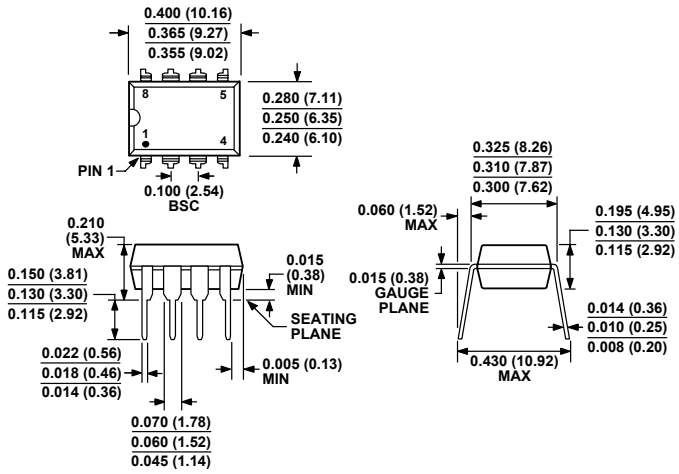
Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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.

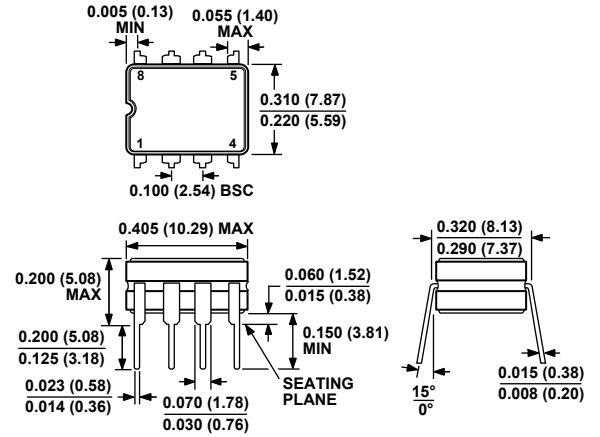


OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-001-BA
 CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN. CORNER LEADS MAY BE CONFIGURED AS WHOLE OR HALF LEADS.

Figure 33. 8-Lead Plastic Dual In-Line Package [PDIP]
 Narrow Body
 (N-8)
 Dimensions shown in inches and (millimeters)



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

Figure 34. 8-Lead Ceramic Dual In-Line Package [CERDIP]
 (Q-8)
 Dimensions shown in inches and (millimeters)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD708JN	0°C to +70°C	8-Lead Plastic Dual In-Line Package [PDIP]	N-8
AD708JNZ ¹	0°C to +70°C	8-Lead Plastic Dual In-Line Package [PDIP]	N-8
AD708AQ	-40°C to +85°C	8-Lead Ceramic Dual In-Line Package [CERDIP]	Q-8
AD708BQ	-40°C to +85°C	8-Lead Ceramic Dual In-Line Package [CERDIP]	Q-8
AD708SQ/883B	-55°C to +125°C	8-Lead Ceramic Dual In-Line Package [CERDIP]	Q-8

¹ Z = Pb-free part.