

FEATURES

High DC Precision
100 μV Max Offset Voltage
1.5 $\mu\text{V}/^\circ\text{C}$ Max Offset Drift
200 pA Max Input Bias Current
0.5 μV p-p Voltage Noise, 0.1 Hz to 10 Hz
750 μA Supply Current
Available in 8-Lead Plastic Mini-DIP and Surface-Mount (SOIC) Packages
Available in Tape and Reel in Accordance with EIA-481A Standard
Quad Version: AD704

APPLICATIONS

Low Frequency Active Filters
Precision Instrumentation
Precision Integrators

GENERAL DESCRIPTION

The AD706 is a dual, low power, bipolar op amp that has the low input bias current of a JFET amplifier, but which offers a significantly lower I_B drift over temperature. It utilizes superbeta bipolar input transistors to achieve picoampere input bias current levels (similar to FET input amplifiers at room temperature), while its I_B typically only increases by $5\times$ at 125°C (unlike a JFET amp, for which I_B doubles every 10°C for a $1000\times$ increase at 125°C). The AD706 also achieves the microvolt offset voltage and low noise characteristics of a precision bipolar input amplifier.

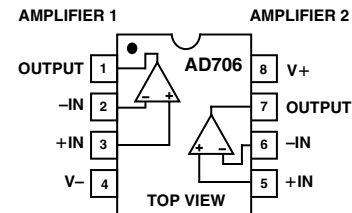
Since it has < 200 pA of bias current, the AD706 does not require the commonly used "balancing" resistor. Furthermore, the current noise is only $50 \text{ fA}/\sqrt{\text{Hz}}$, which makes this amplifier usable with very high source impedances. At $600 \mu\text{A}$ max supply current (per amplifier), the AD706 is well suited for today's high density boards.

The AD706 is an excellent choice for use in low frequency active filters in 12-bit and 14-bit data acquisition systems, in precision instrumentation, and as a high quality integrator. The AD706 is internally compensated for unity gain and is available in five performance grades. The AD706J is rated over the commercial temperature range of 0°C to $+70^\circ\text{C}$. The AD706A is rated for the extended industrial temperature range of -40°C to $+85^\circ\text{C}$.

The AD706 is offered in two varieties of an 8-lead package: plastic mini-DIP and surface-mount (SOIC).

CONNECTION DIAGRAM

Plastic Mini-DIP (N) and Plastic SOIC (R) Packages



PRODUCT HIGHLIGHTS

1. The AD706 is a dual low drift op amp that offers JFET level input bias currents, yet has the low I_B drift of a bipolar amplifier. It may be used in circuits using dual op amps such as the LT1024.
2. The AD706 provides both low drift and high dc precision.
3. The AD706 can be used in applications where a chopper amplifier would normally be required but without the chopper's inherent noise.

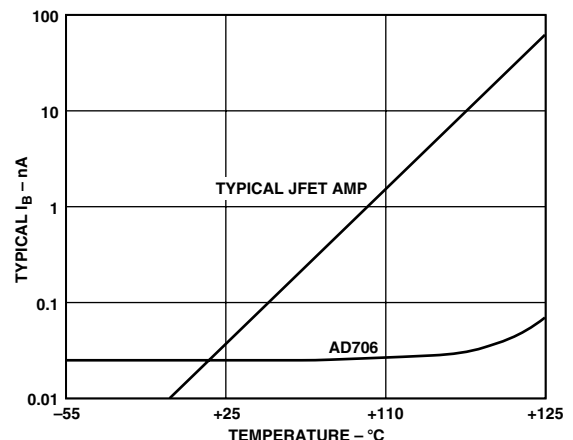


Figure 1. Input Bias Current vs. Temperature

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AD706—SPECIFICATIONS (@ T_A = +25°C, V_{CM} = 0 V and ±15 V dc, unless otherwise noted.)

Parameter	Conditions	AD706J/A			Unit
		Min	Typ	Max	
INPUT OFFSET VOLTAGE					
Initial Offset			30	100	μV
Offset	T _{MIN} to T _{MAX}		40	150	μV
vs. Temperature, Average TC			0.2	1.5	μV/°C
vs. Supply (PSRR)	V _S = ±2 V to ±18 V	110	132		dB
T _{MIN} to T _{MAX}	V _S = ±2.5 V to ±18 V	106	126		dB
Long Term Stability			0.3		μV/Month
INPUT BIAS CURRENT¹					
	V _{CM} = 0 V		50	200	pA
	V _{CM} = ±13.5 V			250	pA
vs. Temperature, Average TC			0.3		pA/°C
T _{MIN} to T _{MAX}	V _{CM} = 0 V			300	pA
T _{MIN} to T _{MAX}	V _{CM} = ±13.5 V			400	pA
INPUT OFFSET CURRENT					
	V _{CM} = 0 V		30	150	pA
	V _{CM} = ±13.5 V			250	pA
vs. Temperature, Average TC			0.6		pA/°C
T _{MIN} to T _{MAX}	V _{CM} = 0 V		80	250	pA
T _{MIN} to T _{MAX}	V _{CM} = ±13.5 V		80	350	pA
MATCHING CHARACTERISTICS					
Offset Voltage				150	μV
	T _{MIN} to T _{MAX}			250	μV
Input Bias Current ²				300	pA
	T _{MIN} to T _{MAX}			500	pA
Common-Mode Rejection		106			dB
	T _{MIN} to T _{MAX}	106			dB
Power Supply Rejection		106			dB
	T _{MIN} to T _{MAX}	104			dB
Crosstalk (Figure 2a)	T _{MIN} to T _{MAX} @ f = 10 Hz R _L = 2 kΩ		150		dB
FREQUENCY RESPONSE					
Unity Gain Crossover Frequency			0.8		MHz
Slew Rate	G = -1		0.15		V/μs
	T _{MIN} to T _{MAX}		0.15		V/μs
INPUT IMPEDANCE					
Differential			40 2		MΩ pF
Common Mode			300 2		GΩ pF
INPUT VOLTAGE RANGE					
Common-Mode Voltage		±13.5	±14		V
Common-Mode Rejection Ratio	V _{CM} = ±13.5 V	110	132		dB
	T _{MIN} to T _{MAX}	108	128		dB
INPUT CURRENT NOISE					
	0.1 Hz to 10 Hz		3		pA p-p
	f = 10 Hz		50		fA/√Hz
INPUT VOLTAGE NOISE					
	0.1 Hz to 10 Hz		0.5		μV p-p
	f = 10 Hz		17		nV/√Hz
	f = 1 kHz		15	22	nV/√Hz
OPEN-LOOP GAIN					
	V _O = ±12 V				V/mV
	R _{LOAD} = 10 kΩ	200	2000		V/mV
	T _{MIN} to T _{MAX}	150	1500		V/mV
	V _O = ±10 V				V/mV
	R _{LOAD} = 2 kΩ	200	1000		V/mV
	T _{MIN} to T _{MAX}	150	1000		V/mV
OUTPUT CHARACTERISTICS					
Voltage Swing	R _{LOAD} = 10 kΩ	±13	±14		V
	T _{MIN} to T _{MAX}	±13	±14		V
Current	Short Circuit		±15		mA
Capacitive Load Drive Capability	Gain = +1		10,000		pF

SPECIFICATIONS (continued)

Parameter	Conditions	AD706J/A			Unit
		Min	Typ	Max	
POWER SUPPLY					
Rated Performance			±15		V
Operating Range		±2.0		±18	V
Quiescent Current, Total			0.75	1.2	mA
	T _{MIN} to T _{MAX}		0.8	1.4	mA
TRANSISTOR COUNT	Number of Transistors		90		

NOTES

¹Bias current specifications are guaranteed maximum at either input.

²Input bias current match is the difference between corresponding inputs (I_B of -IN of Amplifier 1 minus I_B of -IN of Amplifier 2).

CMRR match is the difference between $\frac{\Delta V_{OS1}}{\Delta V_{CM}}$ for Amplifier 1 and $\frac{\Delta V_{OS2}}{\Delta V_{CM}}$ for Amplifier 2, expressed in dB.

PSRR match is the difference between $\frac{\Delta V_{OS1}}{\Delta V_{SUPPLY}}$ for Amplifier 1 and $\frac{\Delta V_{OS2}}{\Delta V_{SUPPLY}}$ for Amplifier 2, expressed in dB.

All min and max specifications are guaranteed.
Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS¹

Supply Voltage	±18 V
Internal Power Dissipation (Total: Both Amplifiers) ²	650 mW
Input Voltage	±V _S
Differential Input Voltage ³	+0.7 V
Output Short Circuit Duration	Indefinite
Storage Temperature Range (N, R)	-65°C to +125°C
Operating Temperature Range	
AD706J	0°C to +70°C
AD706A	-40°C to +85°C
Lead Temperature (Soldering 10 secs)	300°C

NOTES

¹Stresses 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.

²Specification is for device in free air:

8-Lead Plastic Package: $\theta_{JA} = 100^\circ\text{C}/\text{W}$

8-Lead Small Outline Package: $\theta_{JA} = 155^\circ\text{C}/\text{W}$

³The input pins of this amplifier are protected by back-to-back diodes. If the differential voltage exceeds ±0.7 V, external series protection resistors should be added to limit the input current to less than 25 mA.

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 AD706 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.

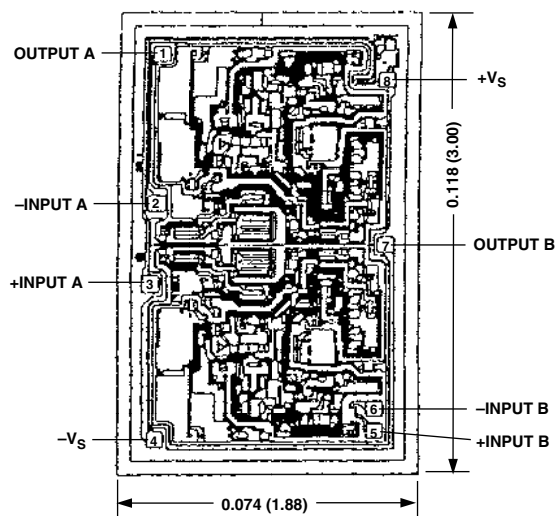
ORDERING GUIDE

Model	Temperature Range	Description	Package Option
AD706JN	0°C to 70°C	Plastic DIP	N-8
AD706JR	0°C to 70°C	SOIC	R-8
AD706JR-REEL	0°C to 70°C	Tape and Reel	R-8
AD706JR-REEL7	0°C to 70°C	Tape and Reel	R-8
AD706AR	-40°C to +85°C	SOIC	R-8
AD706AR-REEL	-40°C to +85°C	Tape and Reel	R-8
AD706AR-REEL7	-40°C to +85°C	Tape and Reel	R-8
AD706ARZ-REEL*	-40°C to +85°C	Tape and Reel	R-8

*Lead-free part.

METALIZATION PHOTOGRAPH

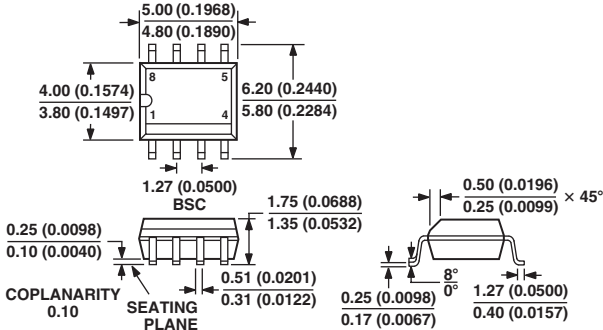
Dimensions shown in inches and (mm).
Contact factory for latest dimensions.



OUTLINE DIMENSIONS

8-Lead Standard Small Outline Package [SOIC]
(R-8)

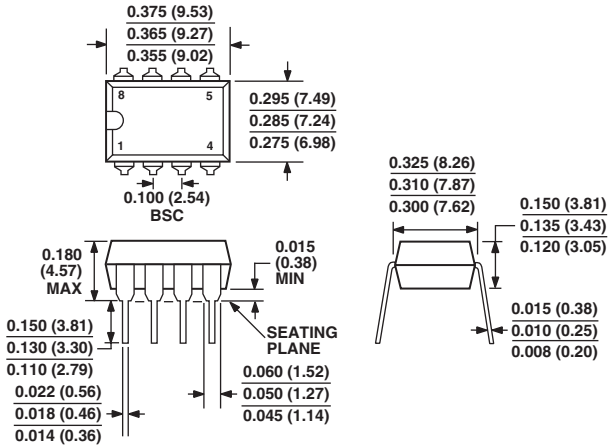
Dimensions shown in millimeters and (inches)



COMPLIANT TO JEDEC STANDARDS MS-012AA
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

8-Lead Plastic Dual-in-Line Package [PDIP]
(N-8)

Dimensions shown in inches and (millimeters)



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