Dual Low Bias Current Precision Operational Amplifier

OP297

FEATURES

Low offset voltage: 50 µV maximum
Low offset voltage drift: 0.6 µV/°C maximum
Very low bias current: 100 pA maximum
Very high open-loop gain: 2000 V/mV minimum
Low supply current (per amplifier): 625 µA maximum
Operates from ±2 V to ±20 V supplies
High common-mode rejection: 120 dB minimum

APPLICATIONS

Strain gage and bridge amplifiers
High stability thermocouple amplifiers
Instrumentation amplifiers
Photocurrent monitors
High gain linearity amplifiers
Long-term integrators/filters
Sample-and-hold amplifiers
Peak detectors
Logarithmic amplifiers
Battery-powered systems

GENERAL DESCRIPTION

The OP297 is the first dual op amp to pack precision performance into the space saving, industry-standard 8-lead SOIC package. The combination of precision with low power and extremely low input bias current makes the dual OP297 useful in a wide variety of applications.

Precision performance of the OP297 includes very low offset (less than 50 µV) and low drift (less than 0.6 µV/°C). Open-loop gain exceeds 2000 V/mV, ensuring high linearity in every application.

Errors due to common-mode signals are eliminated by the common-mode rejection of over 120 dB, which minimizes offset voltage changes experienced in battery-powered systems. The supply current of the OP297 is under 625 µA.

The OP297 uses a super-beta input stage with bias current cancellation to maintain picoamp bias currents at all temperatures. This is in contrast to FET input op amps whose bias currents start in the picoamp range at 25°C, but double for every 10°C rise in temperature, to reach the nanoamp range above 85°C. Input bias current of the OP297 is under 100 pA at 25°C and is under 450 pA over the military temperature range per amplifier. This part can operate with supply voltages as low as ±2 V.

PIN CONFIGURATION

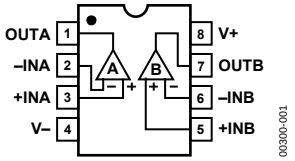


Figure 1.

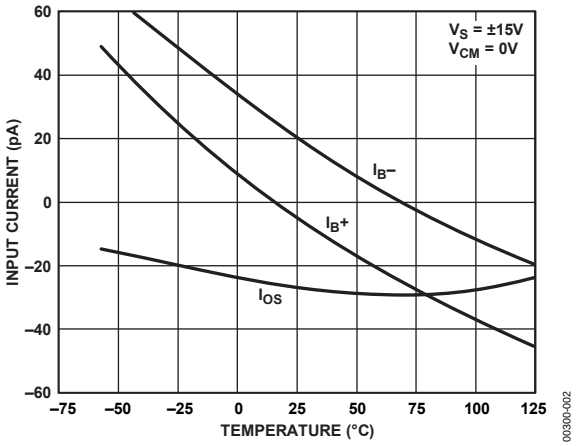


Figure 2. Low Bias Current over Temperature

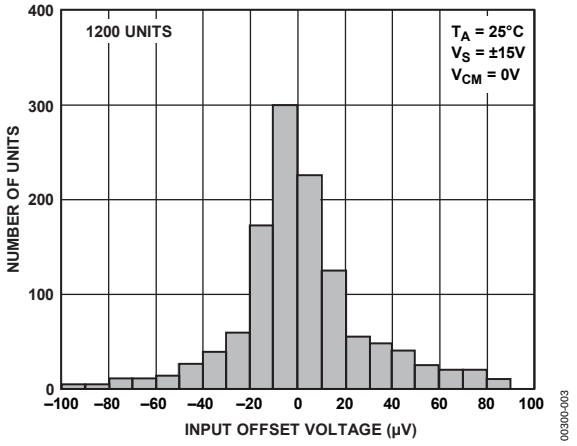


Figure 3. Very Low Offset

Combining precision, low power, and low bias current, the OP297 is ideal for a number of applications, including instrumentation amplifiers, log amplifiers, photodiode preamplifiers, and long term integrators. For a single device, see the OP97; for a quad device, see the OP497.

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

@ V_S = ±15 V, T_A = 25°C, unless otherwise noted.

Table 1.

			OP297E			OP297F			OP297G			
Parameter	**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**
Input Offset Voltage	V_{OS}			25	50		50	100		80	200	µV
Long-Term Input Voltage Stability				0.1			0.1			0.1		µV/month
Input Offset Current	I_{OS}	V_{CM} = 0 V		20	100		35	150		50	200	pA
Input Bias Current	I_B	V_{CM} = 0 V		+20	±100		+35	±150		+50	±200	pA
Input Noise Voltage	$e_{n\ p\text{-}p}$	0.1 Hz to 10 Hz		0.5			0.5			0.5		µV p-p
Input Noise Voltage Density	e_n	f_{OUT} = 10 Hz		20			20			20		nV/√Hz
		f_{OUT} = 1000 Hz		17			17			17		nV/√Hz
Input Noise Current Density	i_n	f_{OUT} = 10 Hz		20			20			20		fA/√Hz
Input Resistance												
Differential Mode	R_{IN}			30			30			30		MΩ
Common-Mode	R_{INCM}			500			500			500		GΩ
Large Signal Voltage Gain	A_{VO}	V_{OUT} = ±10 V, R_L = 2 kΩ	2000	4000		1500	3200		1200	3200		V/mV
Input Voltage Range[1]	V_{CM}		±13	±14		±13	±14		±13	±14		V
Common-Mode Rejection	CMRR	V_{CM} = ±13 V	120	140		114	135		114	135		dB
Power Supply Rejection	PSRR	V_S = ±2 V to ±20 V	120	130		114	125		114	125		dB
Output Voltage Swing	V_{OUT}	R_L = 10 kΩ	±13	±14		±13	±14		±13	±14		V
		R_L = 2 kΩ	±13	±13.7		±13	±13.7		±13	±13.7		V
Supply Current per Amplifier	I_{SY}	No load		525	625		525	625		525	625	µA
Supply Voltage	V_S	Operating range	±2		±20	±2		±20	±2		±20	V
Slew Rate	SR		0.05	0.15		0.05	0.15		0.05	0.15		V/µs
Gain Bandwidth Product	GBWP	A_V = +1		500			500			500		kHz
Channel Separation	CS	V_{OUT} = 20 V p-p, f_{OUT} = 10 Hz		150			150			150		dB
Input Capacitance	C_{IN}			3			3			3		pF

[1] Guaranteed by CMR test.

@ V_S = ±15 V, −40°C ≤ T_A ≤ +85°C, unless otherwise noted.

Table 2.

			OP297E			OP297F			OP297G			
Parameter	**Symbol**	**Conditions**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**
Input Offset Voltage	V_{OS}			35	100		80	300		110	400	µV
Average Input Offset Voltage Drift	TCV_{OS}			0.2	0.6		0.5	2.0		0.6	2.0	µV/°C
Input Offset Current	I_{OS}	V_{CM} = 0 V		50	450		80	750		80	750	pA
Input Bias Current	I_B	V_{CM} = 0 V		+50	±450		+80	±750		+80	±750	pA
Large Signal Voltage Gain	A_{VO}	V_{OUT} = ±10 V, R_L = 2 kΩ	1200	3200		1000	2500		800	2500		V/mV
Input Voltage Range[1]	V_{CM}		±13	±13.5		±13	±13.5		±13	±13.5		V
Common-Mode Rejection	CMRR	V_{CM} = ±13	114	130		108	130		108	130		dB
Power Supply Rejection	PSRR	V_S = ±2.5 V to ±20 V	114			108			108			dB
Output Voltage Swing	V_{OUT}	R_L = 10 kΩ	±13	±13.4		±13	±13.4		±13	±13.4		V
Supply Current per Amplifier	I_{SY}	No load		550	750		550	750		550	750	µA
Supply Voltage	V_S	Operating range	±2.5		±20	±2.5		±20	±2.5		±20	V

[1] Guaranteed by CMR test.

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	±20 V
Input Voltage[1]	±20 V
Differential Input Voltage[1]	40 V
Output Short-Circuit Duration	Indefinite
Storage Temperature Range	
Z-Suffix	−65°C to +175°C
P-Suffix, S-Suffix	−65°C to +150°C
Operating Temperature Range	
OP297E (Z-Suffix)	−40°C to +85°C
OP297F, OP297G (P-Suffix, S-Suffix)	−40°C to +85°C
Junction Temperature	
Z-Suffix	−65°C to +175°C
P-Suffix, S-Suffix	−65°C to +150°C
Lead Temperature (Soldering, 60 sec)	300°C

[1] For supply voltages less than ±20 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.

THERMAL RESISTANCE

θ_{JA} is specified for worst-case mounting conditions, that is, θ_{JA} is specified for device in socket for CERDIP and PDIP packages; θ_{JA} is specified for device soldered to printed circuit board for the SOIC package.

Table 4. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
8-Lead CERDIP (Z-Suffix)	134	12	°C/W
8-Lead PDIP (P-Suffix)	96	37	°C/W
8-Lead SOIC (S-Suffix)	150	41	°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.

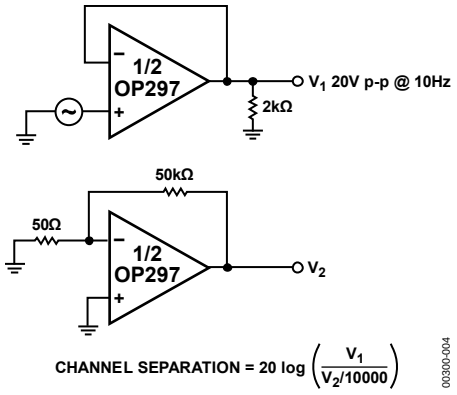
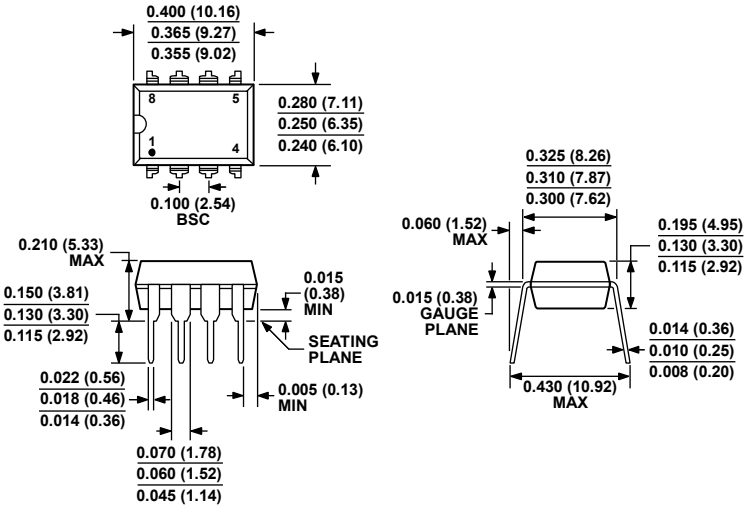


Figure 4. Channel Separation Test Circuit

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-001

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.

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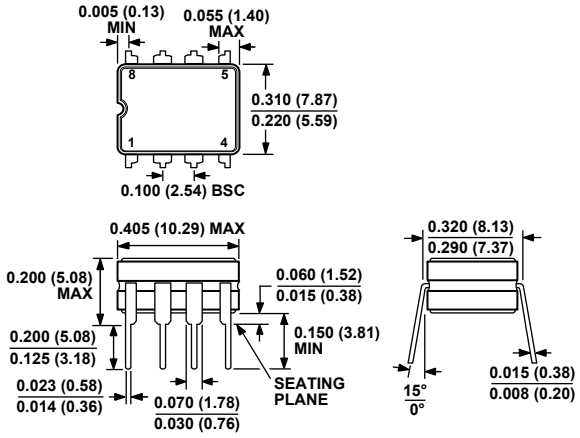
Figure 37. 8-Lead Plastic Dual In-Line Package [PDIP]
P-Suffix (N-8)
Dimensions shown in inches and (millimeters)



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 38. 8-Lead Ceramic Dual In-Line Package [CERDIP]
Z-Suffix (Q-8)
Dimensions shown in inches and (millimeters)

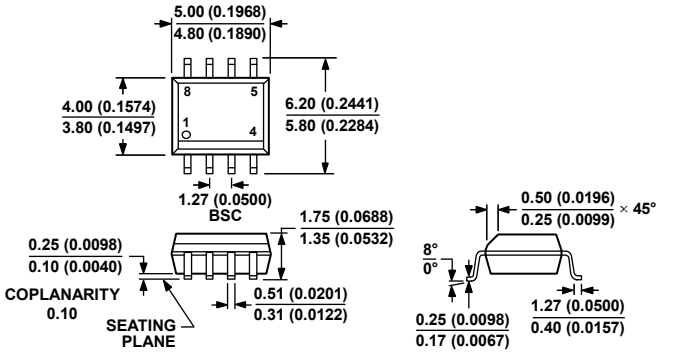


Figure 39. 8-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
S-Suffix (R-8)
Dimensions shown in millimeters and (inches)

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Options
OP297EZ	−40°C to +85°C	8-Lead CERDIP	Q-8 (Z-Suffix)
OP297FP	−40°C to +85°C	8-Lead PDIP	N-8 (P-Suffix)
OP297FPZ[1]	−40°C to +85°C	8-Lead PDIP	N-8 (P-Suffix)
OP297FS	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297FS-REEL	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297FS-REEL7	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297FSZ[1]	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297FSZ-REEL[1]	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297FSZ-REEL7[1]	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297GP	−40°C to +85°C	8-Lead PDIP	N-8 (P-Suffix)
OP297GPZ[1]	−40°C to +85°C	8-Lead PDIP	N-8 (P-Suffix)
OP297GS	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297GS-REEL	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297GS-REEL7	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297GSZ[1]	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297GSZ-REEL[1]	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)
OP297GSZ-REEL7[1]	−40°C to +85°C	8-Lead SOIC_N	R-8 (S-Suffix)

[1] Z = RoHS Compliant Part.