

### FEATURES

- **Fast Slew Rate** ..... 22V/ $\mu$ s Typ
- **Settling Time (0.01%)** ..... 1.2 $\mu$ s Max
- **Offset Voltage** ..... 300 $\mu$ V Max
- **High Open-Loop Gain** ..... 1000V/mV Min
- **Low Total Harmonic Distortion** ..... 0.002% Typ
- **Improved Replacement for AD712, LT1057, OP-215, TL072, and MC34082**
- **Available in Die Form**

### APPLICATIONS

- **Output Amplifier for Fast D/As**
- **Signal Processing**
- **Instrumentation Amplifiers**
- **Fast Sample/Holds**
- **Active Filters**
- **Low Distortion Audio Amplifiers**
- **Input Buffer for A/D Converters**
- **Servo Controllers**

### GENERAL DESCRIPTION

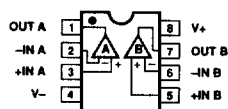
The OP-249 is a high-speed, precision dual JFET op amp, similar to the popular single op amp, the OP-42. The OP-249 outperforms available dual amplifiers by providing superior speed with excellent DC performance. Ultra-high open-loop gain (1kV/mV minimum), low offset voltage, and superb gain linearity, makes the OP-249 the industry's first true precision, dual high-speed amplifier.

With a slew rate of 22V/ $\mu$ s typical, and a fast settling time of less than 1.2 $\mu$ s maximum to 0.01%, the OP-249 is an ideal choice for high-speed bipolar D/A and A/D converter applications. The excellent DC performance of the OP-249 allows the full accuracy of high-resolution CMOS D/As to be realized.

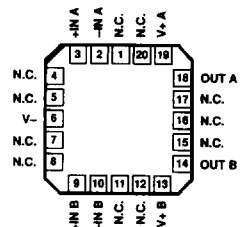
Symmetrical slew rate, even when driving large loads, such as 600 $\Omega$ , or 200pF of capacitance, and ultra-low distortion, make the OP-249 ideal for professional audio applications, active filters, high-speed integrators, servo systems, and buffer amplifiers.

The OP-249 provides significant performance upgrades to the TL072, AD712, OP-215, MC34082 and the LT1057.

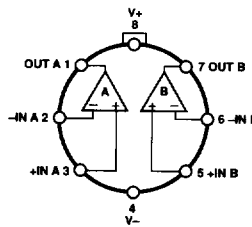
### PIN CONNECTIONS



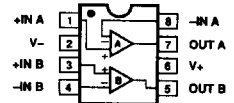
8-PIN EPOXY MINI-DIP (P-Suffix)



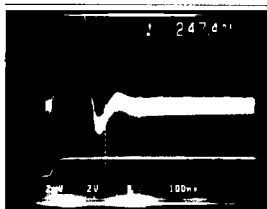
20-CONTACT LCC (RC-Suffix)



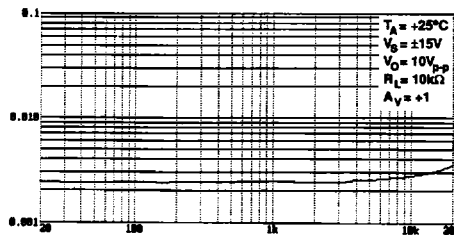
TO-99 (J-Suffix)



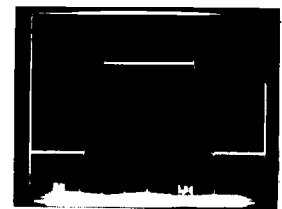
8-PIN SO (S-Suffix)



**FAST SETTLING**  
(0.01%)



**LOW DISTORTION**  
 $A_V = +1, R_L = 10\text{k}\Omega$



**EXCELLENT OUTPUT DRIVE**  
 $R_L = 600\Omega$

## ORDERING INFORMATION <sup>†</sup>

TO-99	PACKAGE			OPERATING TEMPERATURE RANGE
	CERDIP 8-PIN	PLASTIC 8-PIN	LCC 20-CONTACT	
OP249AJ*	OP249AZ*	-	OP249ARC/883	MIL
OP249EJ	-	-	-	XIND
OP249FJ	OP249FZ	-	-	XIND
-	-	OP249GP	-	XIND
-	-	OP249GS <sup>††</sup>	-	XIND

\* For devices processed in total compliance to MIL-STD-883, add /883 after part number. Consult factory for 883 data sheet.

† Burn-in is available on commercial and industrial temperature range parts in CerDIP, plastic DIP, and TO-can packages. For ordering information, see PMI's Data Book, Section 2.

†† For availability and burn-in information on SO and PLCC packages, contact your local sales office.

## ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage	±18V
Input Voltage (Note 2)	±18V
Differential Input Voltage (Note 2)	36V
Output Short-Circuit Duration	Indefinite
Storage Temperature Range	-65°C to +175°C

## Operating Temperature Range

OP-249A (J, Z, RC)	-55°C to +125°C
OP-249E,F (J, Z)	-40°C to +85°C
OP-249G (P, S)	-40°C to +85°C

## Junction Temperature

OP-249 (J, Z, RC)	-65°C to +175°C
OP-249 (P, S)	-65°C to +150°C

## Lead Temperature Range (Soldering, 60 sec)

	300°C
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PACKAGE TYPE	$\theta_{JA}$ (Note 3)	$\theta_{JC}$	UNITS
TO-99 (J)	145	16	°C/W
8-Pin Hermetic DIP (Z)	134	12	°C/W
8-Pin Plastic DIP (P)	96	37	°C/W
20-Contact LCC (RC)	88	33	°C/W
8-Pin SO (S)	150	41	°C/W

## NOTES:

- Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.
- For supply voltages less than ±18V, the absolute maximum input voltage is equal to the supply voltage.
- $\theta_{JA}$  is specified for worst case mounting conditions, i.e.,  $\theta_{JA}$  is specified for device in socket for TO, CerDIP, P-DIP, and LCC packages;  $\theta_{JA}$  is specified for device soldered to printed circuit board for SO package.

## ELECTRICAL CHARACTERISTICS at $V_S = \pm 15V$ , $T_A = +25^\circ C$ , unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-249A			OP-249E			OP-249F			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Offset Voltage	$V_{OS}$		-	0.2	0.5	-	0.1	0.3	-	0.2	0.7	mV
Long Term Offset Voltage	$V_{OS}$	(Note 1)	-	-	0.8	-	-	0.6	-	-	1.0	mV
Offset Stability			-	1.5	-	-	1.5	-	-	1.5	-	μV/Month
Input Bias Current	$I_B$	$V_{CM} = 0V, T_J = +25^\circ C$	-	30	75	-	20	50	-	30	75	pA
Input Offset Current	$I_{OS}$	$V_{CM} = 0V, T_J = +25^\circ C$	-	6	25	-	4	15	-	6	25	pA
Input Voltage Range	IVR	(Note 2)	±11	+12.5 -12.5	-	±11	+12.5 -12.5	-	±11	+12.5 -12.5	-	V
Common-Mode Rejection	CMR	$V_{CM} = \pm 11V$	80	90	-	86	95	-	80	90	-	dB
Power-Supply Rejection Ratio	PSRR	$V_S = \pm 4.5V$ to ±18V	-	12	31.6	-	9	31.6	-	12	50	μV/V
Large-Signal Voltage Gain	$A_{VO}$	$V_O = \pm 10V$ $R_L = 2k\Omega$	1000	1400	-	1000	1400	-	500	1200	-	V/mV
Output Voltage Swing	$V_O$	$R_L = 2k\Omega$	±12.0	+12.5 -12.5	-	±12.0	+12.5 -12.5	-	±12.0	+12.5 -12.5	-	V
Short-Circuit Current Limit	$I_{SC}$	Output Shorted to Ground	±20	+36 -33	±50	±20	+36 -33	±50	±20	+36 -33	±50	mA
Supply Current	$I_{SY}$	No Load $V_O = 0V$	-	5.6	7.0	-	5.6	7.0	-	5.6	7.0	mA
Slew Rate	SR	$R_L = 2k\Omega, C_L = 50pF$	18	22	-	18	22	-	18	22	-	V/μs
Gain-Bandwidth Product	GBW	(Note 4)	3.5	4.7	-	3.5	4.7	-	3.5	4.7	-	MHz
Settling Time	$t_s$	10V Step 0.01% (Note 3)	-	0.9	1.2	-	0.9	1.2	-	0.9	1.2	μs
Phase Margin	$\theta_0$	0dB Gain	-	55	-	-	55	-	-	55	-	Deg

**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 15V$ ,  $T_A = +25^\circ C$ , unless otherwise noted. *Continued*

PARAMETER	SYMBOL	CONDITIONS	OP-249A			OP-249E			OP-249F			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Differential Input Impedance	$Z_{IN}$		-	$10^{12} \parallel 6$	-	-	$10^{12} \parallel 6$	-	-	$10^{12} \parallel 6$	-	$\Omega \parallel pF$
Open-Loop Output Resistance	$R_O$		-	35	-	-	35	-	-	35	-	$\Omega$
Voltage Noise	$e_{n,p-p}$	0.1Hz to 10Hz	-	2	-	-	2	-	-	2	-	$\mu V_{p-p}$
Voltage Noise Density	$e_n$	$f_O = 10Hz$	-	75	-	-	75	-	-	75	-	-
		$f_O = 100Hz$	-	26	-	-	26	-	-	26	-	-
		$f_O = 1kHz$	-	17	-	-	17	-	-	17	-	$nV/\sqrt{Hz}$
		$f_O = 10kHz$	-	16	-	-	16	-	-	16	-	-
Current Noise Density	$i_n$	$f_O = 1kHz$	-	0.003	-	-	0.003	-	-	0.003	-	$pA/\sqrt{Hz}$
Voltage Supply Range	$V_S$		$\pm 4.5$	$\pm 15$	$\pm 18$	$\pm 4.5$	$\pm 15$	$\pm 18$	$\pm 4.5$	$\pm 15$	$\pm 18$	V

**NOTES:**

1. Long term offset voltage is guaranteed by a 1000 HR life test performed on 3 independent wafer lots at +125°C with a LTPD of 3.
2. Guaranteed by CMR test.
3. Settling-time is sample tested.
4. Guaranteed by design.

**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 15V$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-249G			UNITS
			MIN	TYP	MAX	
Offset Voltage	$V_{OS}$		-	0.4	2.0	mV
Input Bias Current	$I_B$	$V_{CM} = 0V, T_J = +25^\circ C$	-	40	75	pA
Input Offset Current	$I_{OS}$	$V_{CM} = 0V, T_J = +25^\circ C$	-	10	25	pA
Input Voltage Range	IVR	(Note 1)	$\pm 11$	+12.5 -12.0	-	V
Common-Mode Rejection	CMR	$V_{CM} = \pm 11V$	76	90	-	dB
Power-Supply Rejection Ratio	PSRR	$V_S = \pm 4.5V$ to $\pm 18V$	-	12	50	$\mu V/V$
Large-Signal Voltage Gain	$A_{VO}$	$V_O = \pm 10V$ $R_L = 2k\Omega$	500	1100	-	V/mV
Output Voltage Swing	$V_O$	$R_L = 2k\Omega$	$\pm 12.0$	+12.5 -12.5	-	V
Short-Circuit Current Limit	$I_{SC}$	Output Shorted to Ground	$\pm 20$	+36 -33	$\pm 50$	mA
Supply Current	$I_{SY}$	No Load $V_O = 0V$	-	5.6	7.0	mA
Slew Rate	SR	$R_L = 2k\Omega, C_L = 50pF$	18	22	-	V/ $\mu s$
Gain-Bandwidth Product	GBW	(Note 2)	-	4.7	-	MHz
Settling Time	$t_s$	10V Step 0.01%	-	0.9	1.2	$\mu s$
Phase Margin	$\theta_0$	0dB Gain	-	55	-	Deg

**NOTES:**

1. Guaranteed by CMR test.
2. Guaranteed by design.

**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 15V$ ,  $T_A = +25^\circ C$ , unless otherwise noted. *Continued*

PARAMETER	SYMBOL	CONDITIONS	OP-249G			UNITS
			MIN	TYP	MAX	
Differential Input Impedance	$Z_{IN}$		–	$10^{12}    6$	–	$\Omega    pF$
Open-Loop Output Resistance	$R_O$		–	35	–	$\Omega$
Voltage Noise	$e_{n\ p-p}$	0.1Hz to 10Hz	–	2	–	$\mu V_{p-p}$
Voltage Noise Density	$e_n$	$f_O = 10Hz$	–	75	–	$nV/\sqrt{Hz}$
		$f_O = 100Hz$	–	26	–	
		$f_O = 1kHz$	–	17	–	
		$f_O = 10kHz$	–	16	–	
Current Noise Density	$i_n$	$f_O = 1kHz$	–	0.003	–	$pA/\sqrt{Hz}$
Voltage Supply Range	$V_S$		$\pm 4.5$	$\pm 15$	$\pm 18$	V

**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 15V$ ,  $-40^\circ C \leq T_A \leq +85^\circ C$  for E/F grades, and  $-55^\circ C \leq T_A \leq +125^\circ C$  for A grade, unless otherwise noted.

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PARAMETER	SYMBOL	CONDITIONS	OP-249A			OP-249E			OP-249F			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Offset Voltage	$V_{OS}$		–	0.12	1.0	–	0.1	0.5	–	0.5	1.1	mV
Offset Voltage Temperature Coefficient	$TCV_{OS}$		–	1	5	–	1	3	–	1.2	6	$\mu V/^\circ C$
Input Bias Current	$I_B$	(Note 1)	–	4	20	–	0.25	3.0	–	0.3	4.0	nA
Input Offset Current	$I_{OS}$	(Note 1)	–	0.04	4	–	0.01	0.7	–	0.02	1.2	nA
Input Voltage Range	IVR	(Note 2)	$\pm 11$	$+12.5$ $-12.5$	–	$\pm 11$	$+12.5$ $-12.5$	–	$\pm 11$	$+12.5$ $-12.5$	–	V
Common-Mode Rejection	CMR	$V_{CM} = \pm 11V$	76	110	–	86	100	–	76	95	–	dB
Power-Supply Rejection Ratio	PSRR	$V_S = \pm 4.5V$ to $\pm 18V$	–	5	50	–	5	50	–	7	100	$\mu V/V$
Large-Signal Voltage Gain	$A_{VO}$	$R_L = 2k\Omega$ $V_O = \pm 10V$	500	1400	–	750	1400	–	250	1200	–	V/mV
Output Voltage Swing	$V_O$	$R_L = 2k\Omega$	$\pm 12.0$	$+12.5$ $-12.5$	–	$\pm 12.0$	$+12.5$ $-12.5$	–	$\pm 12.0$	$+12.5$ $-12.5$	–	V
Short-Circuit Current Limit	$I_{SC}$	Output Shorted to Ground	$\pm 10$	–	$\pm 60$	$\pm 18$	–	$\pm 60$	$\pm 18$	–	$\pm 60$	mA
Supply Current	$I_{SY}$	No Load $V_O = 0V$	–	5.6	7.0	–	5.6	7.0	–	5.6	7.0	mA

**NOTES:**

- $T_j = 85^\circ C$  for E/F Grades;  $T_j = 125^\circ C$  for A Grade.
- Guaranteed by CMR test.

# OP249

## ELECTRICAL CHARACTERISTICS at $V_S = \pm 15V$ , $-40^\circ C \leq T_A \leq +85^\circ C$ , unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-249G			UNITS
			MIN	TYP	MAX	
Offset Voltage	$V_{OS}$		–	1.0	3.6	mV
Offset Voltage Temperature Coefficient	$TCV_{OS}$		–	6	25	$\mu V/^\circ C$
Input Bias Current	$I_B$	(Note 1)	–	0.5	4.5	nA
Input Offset Current	$I_{OS}$	(Note 1)	–	0.04	1.5	nA
Input Voltage Range	IVR	(Note 2)	$\pm 11.0$	+12.5 –12.5	–	V
Common-Mode Rejection	CMR	$V_{CM} = \pm 11V$	76	95	–	dB
Power-Supply Rejection Ratio	PSRR	$V_S = \pm 4.5V$ to $\pm 18V$	–	10.0	100	$\mu V/V$
Large-Signal Voltage Gain	$A_{VO}$	$R_L = 2k\Omega$ $V_O = \pm 10V$	250	1200	–	V/mV
Output Voltage Swing	$V_O$	$R_L = 2k\Omega$	$\pm 12.0$	+12.5 –12.5	–	V
Short-Circuit Current Limit	$I_{SC}$	Output Shorted to Ground	$\pm 18$	–	$\pm 60$	mA
Supply Current	$I_{SY}$	No Load $V_O = 0V$	–	5.6	7.0	mA

### NOTES:

- $T_J = 85^\circ C$ .
- Guaranteed by CMR test.