Dual, Precision JFET High Speed Operational Amplifier

OP249

FEATURES

- **Fast Slew Rate ..... 22V/μs Typ**
- **Settling Time (0.01%) ..... 1.2μs Max**
- **Offset Voltage ..... 300μV 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

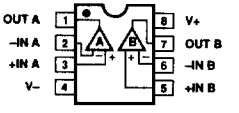
The OP-249 is a high-speed, precision dual JFET op amp, similar to the popular single op amp, the OP-42. The OP-249 outperforms available dual amplifiers by providing superior speed with excellent DC performance. Ultra-high open-loop gain (1kV/mV minimum), low offset voltage, and superb gain linearity,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

With a slew rate of 22V/μs typical, and a fast settling time of less than 1.2μs 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 600Ω, 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.

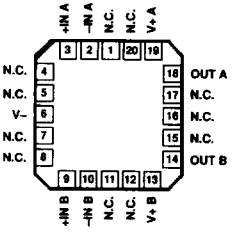
The OP-249 provides significant performance upgrades to the TL072, AD712, OP-215, MC34082 and the LT1057.

PIN CONNECTIONS

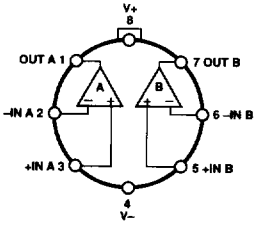


8-PIN CERDIP
(Z-Suffix)

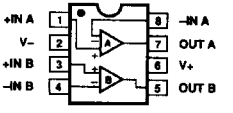
8-PIN EPOXY MINI-DIP
(P-Suffix)



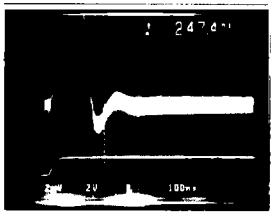
20-CONTACT LCC
(RC-Suffix)



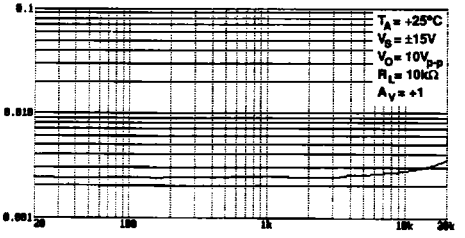
TO-99
(J-Suffix)



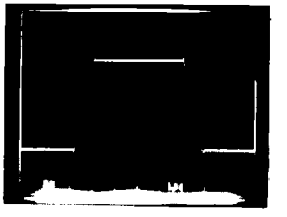
8-PIN SO
(S-Suffix)



FAST SETTLING
(0.01%)



LOW DISTORTION
A_V = +1, R_L = 10kΩ



EXCELLENT OUTPUT DRIVE
R_L = 600Ω

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.

ORDERING INFORMATION †

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

PACKAGE TYPE	Θ_{JA} (Note 3)	Θ_{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:
1. Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.
2. For supply voltages less than ±18V, the absolute maximum input voltage is equal to the supply voltage.
3. Θ_{JA} is specified for worst case mounting conditions, i.e., Θ_{JA} is specified for device in socket for TO, CerDIP, P-DIP, and LCC packages; Θ_{JA} is specified for device soldered to printed circuit board for SO package.

9

ELECTRICAL CHARACTERISTICS at V_S = ±15V, T_A = +25°C, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-249A MIN	OP-249A TYP	OP-249A MAX	OP-249E MIN	OP-249E TYP	OP-249E MAX	OP-249F MIN	OP-249F TYP	OP-249F MAX	UNITS
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°C	–	30	75	–	20	50	–	30	75	pA
Input Offset Current	I_{OS}	V_{CM} = 0V, T_j = +25°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} = ±11V	80	90	–	86	95	–	80	90	–	dB
Power-Supply Rejection Ratio	PSRR	V_S = ±4.5V to ±18V	–	12	31.6	–	9	31.6	–	12	50	µV/V
Large-Signal Voltage Gain	A_{VO}	V_O = ±10V R_L = 2kΩ	1000	1400	–	1000	1400	–	500	1200	–	V/mV
Output Voltage Swing	V_O	R_L = 2kΩ	±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 = 2kΩ, 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	Θ_0	0dB Gain	–	55	–	–	55	–	–	55	–	Deg

ELECTRICAL CHARACTERISTICS at V_S = ±15V, T_A = +25°C, unless otherwise noted. *Continued*

PARAMETER	SYMBOL	CONDITIONS	OP-249A MIN	OP-249A TYP	OP-249A MAX	OP-249E MIN	OP-249E TYP	OP-249E MAX	OP-249F MIN	OP-249F TYP	OP-249F MAX	UNITS
Differential Input Impedance	Z_{IN}		–	10^{12}||6	–	–	10^{12}||6	–	–	10^{12}||6	–	Ω||pF
Open-Loop Output Resistance	R_O		–	35	–	–	35	–	–	35	–	Ω
Voltage Noise	$e_{n\ p\text{-}p}$	0.1Hz to 10Hz	–	2	–	–	2	–	–	2	–	$\mu V_{p\text{-}p}$
Voltage Noise Density	e_n	f_O = 10Hz	–	75	–	–	75	–	–	75	–	nV/√Hz
		f_O = 100Hz	–	26	–	–	26	–	–	26	–	
		f_O = 1kHz	–	17	–	–	17	–	–	17	–	
		f_O = 10kHz	–	16	–	–	16	–	–	16	–	
Current Noise Density	i_n	f_O = 1kHz	–	0.003	–	–	0.003	–	–	0.003	–	pA/√Hz
Voltage Supply Range	V_S		±4.5	±15	±18	±4.5	±15	±18	±4.5	±15	±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 = ±15V, T_A = +25°C, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-249G MIN	OP-249G TYP	OP-249G MAX	UNITS
Offset Voltage	V_{OS}		–	0.4	2.0	mV
Input Bias Current	I_B	V_{CM} = 0V, T_J = +25°C	–	40	75	pA
Input Offset Current	I_{OS}	V_{CM} = 0V, T_j = +25°C	–	10	25	pA
Input Voltage Range	IVR	(Note 1)	±11	+12.5 −12.0	–	V
Common-Mode Rejection	CMR	V_{CM} = ±11V	76	90	–	dB
Power-Supply Rejection Ratio	PSRR	V_S = ±4.5V to ±18V	–	12	50	µV/V
Large-Signal Voltage Gain	A_{VO}	V_O = ±10V R_L = 2kΩ	500	1100	–	V/mV
Output Voltage Swing	V_O	R_L = 2kΩ	±12.0	+12.5 −12.5	–	V
Short-Circuit Current Limit	I_{SC}	Output Shorted to Ground	±20	+36 −33	±50	mA
Supply Current	I_{SY}	No Load V_O = 0V	–	5.6	7.0	mA
Slew Rate	SR	R_L = 2kΩ, C_L = 50pF	18	22	–	V/µs
Gain-Bandwidth Product	GBW	(Note 2)	–	4.7	–	MHz
Settling Time	t_s	10V Step 0.01%	–	0.9	1.2	µs
Phase Margin	Θ_0	0dB Gain	–	55	–	Deg

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

ELECTRICAL CHARACTERISTICS at V_S = ±15V, T_A = +25°C, unless otherwise noted. *Continued*

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

ELECTRICAL CHARACTERISTICS at V_S = ±15V, –40°C ≤ T_A ≤ +85°C for E/F grades, and –55°C ≤ T_A ≤ +125°C for A grade, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-249A MIN	OP-249A TYP	OP-249A MAX	OP-249E MIN	OP-249E TYP	OP-249E MAX	OP-249F MIN	OP-249F TYP	OP-249F MAX	UNITS
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	µV/°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)	±11	+12.5 –12.5	–	±11	+12.5 –12.5	–	±11	+12.5 –12.5	–	V
Common-Mode Rejection	CMR	V_{CM} = ±11V	76	110	–	86	100	–	76	95	–	dB
Power-Supply Rejection Ratio	PSRR	V_S = ±4.5V to ±18V	–	5	50	–	5	50	–	7	100	µV/V
Large-Signal Voltage Gain	A_{VO}	R_L = 2kΩ V_O = ±10V	500	1400	–	750	1400	–	250	1200	–	V/mV
Output Voltage Swing	V_O	R_L = 2kΩ	±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	±10	–	±60	±18	–	±60	±18	–	±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:
1. T_j = 85°C for E/F Grades; T_j = 125°C for A Grade.
2. Guaranteed by CMR test.

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

PARAMETER	SYMBOL	CONDITIONS	OP-249G MIN	TYP	MAX	UNITS
Offset Voltage	V_{OS}		–	1.0	3.6	mV
Offset Voltage Temperature Coefficient	TCV_{OS}		–	6	25	µV/°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)	±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	µV/V
Large-Signal Voltage Gain	A_{VO}	$R_L = 2k\Omega$ $V_O = \pm 10V$	250	1200	–	V/mV
Output Voltage Swing	V_O	$R_L = 2k\Omega$	±12.0	+12.5 –12.5	–	V
Short-Circuit Current Limit	I_{SC}	Output Shorted to Ground	±18	–	±60	mA
Supply Current	I_{SY}	No Load $V_O = 0V$	–	5.6	7.0	mA

NOTES:
1. $T_J = 85°C$.
2. Guaranteed by CMR test.