Precision Low-Voltage Micropower Operational Amplifier

OP90

FEATURES

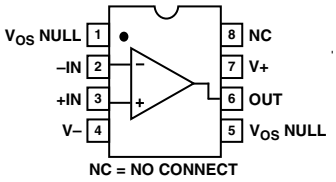
Single/Dual Supply Operation: 1.6 V to 36 V, ±0.8 V to ±18 V
True Single-Supply Operation; Input and Output Voltage Ranges Include Ground
Low Supply Current: 20 μA Max
High Output Drive: 5 mA Min
Low Input Offset Voltage: 150 μV Max
High Open-Loop Gain: 700 V/mV Min
Outstanding PSRR: 5.6 μV/V Max
Standard 741 Pinout with Nulling to V–

PIN CONNECTIONS

8-Lead Hermetic DIP (Z-Suffix)

8-Lead Epoxy Mini-DIP (P-Suffix)

8-Lead SO (S-Suffix)



GENERAL DESCRIPTION

The OP90 is a high performance, micropower op amp that operates from a single supply of 1.6 V to 36 V or from dual supplies of ±0.8 V to ±18 V. The input voltage range includes the negative rail allowing the OP90 to accommodate input signals down to ground in a single-supply operation. The OP90's output swing also includes a ground when operating from a single-supply, enabling "zero-in, zero-out" operation.

The OP90 draws less than 20 μA of quiescent supply current, while able to deliver over 5 mA of output current to a load. The input offset voltage is below 150 μV eliminating the need for external nulling. Gain exceeds 700,000 and common-mode rejection is better than 100 dB. The power supply rejection ratio of under 5.6 μV/V minimizes offset voltage changes experienced in battery-powered systems.

The low offset voltage and high gain offered by the OP90 bring precision performance to micropower applications. The minimal voltage and current requirements of the OP90 suit it for battery and solar powered applications, such as portable instruments, remote sensors, and satellites.

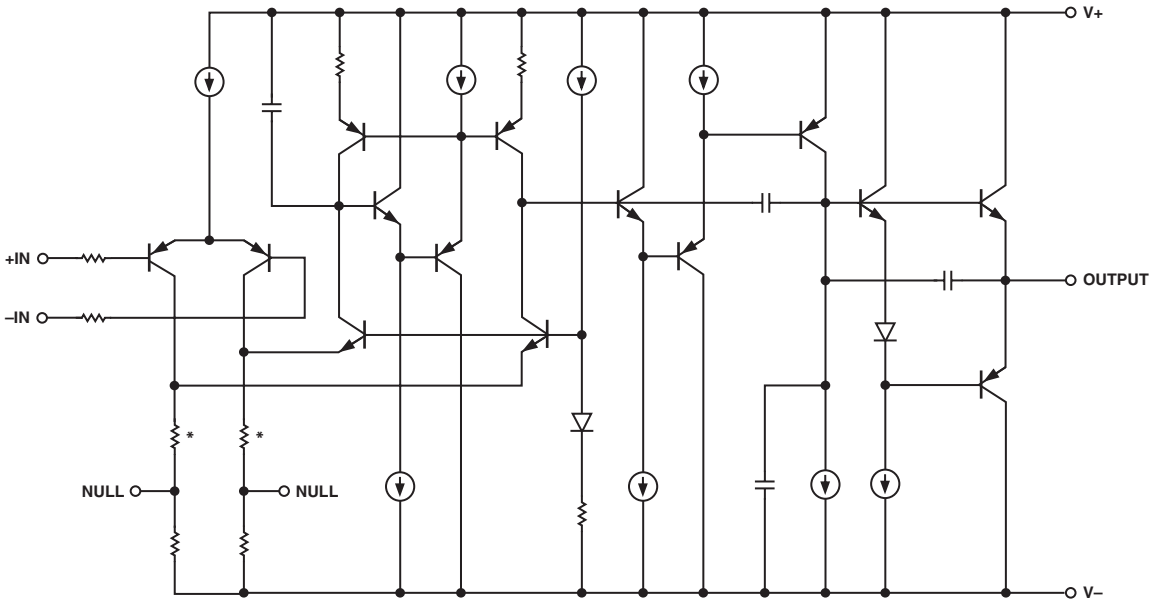


Figure 1. Simplied Schematic

OP90–SPECIFICATIONS

ELECTRICAL CHARACTERISTICS (V_S = ±1.5 V to ±15 V, T_A = 25°C, unless otherwise noted.)

Parameter	Symbol	Conditions	OP90A/E Min	OP90A/E Typ	OP90A/E Max	OP90G Min	OP90G Typ	OP90G Max	Unit
INPUT OFFSET VOLTAGE	V_{OS}			50	150		125	450	µV
INPUT OFFSET CURRENT	I_{OS}	V_{CM} = 0 V		0.4	3		0.4	5	nA
INPUT BIAS CURRENT	I_B	V_{CM} = 0 V		4.0	15		4.0	25	nA
LARGE-SIGNAL VOLTAGE GAIN		V_S = ±15 V, V_O = ±10 V							
	A_{VO}	R_L = 100 kΩ	700	1200		400	800		V/mV
	A_{VO}	R_L= 10 kΩ	350	600		200	400		V/mV
	A_{VO}	R_L = 2 kΩ	125	250		100	200		V/mV
		V+ = 5 V, V– = 0 V, 1 V < V_O < 4 V							
	A_{VO}	R_L = 100 kΩ	200	400		100	250		V/mV
	A_{VO}	R_L = 10 kΩ	100	180		70	140		V/mV
INPUT VOLTAGE RANGE[1]	IVR	V+ = 5 V, V– = 0 V	0/4			0/4			V
		V_S = ±15 V	–15/13.5			–15/13.5			V
OUTPUT VOLTAGE SWING	V_O	V_S = ±15 V							
		R_L = 10 kΩ	±14	±14.2		±14	±14.2		V
		R_L = 2 kΩ	±11	±12		±11	±12		V
	V_{OH}	V+ = 5 V, V– = 0 V							
		R_L = 2 kΩ	4.0	4.2		4.0	4.2		V
	V_{OL}	V+ = 5 V, V– = 0 V							
		R_L = 10 kΩ		100	500		100	500	µV
COMMON-MODE REJECTION	CMR	V+ = 5 V, V– = 0 V, 0 V < V_{CM} < 4 V	90	110		80	100		dB
	CMR	V_S = ±15 V, –15 V < V_{CM} < 13.5 V	100	130		90	120		dB
POWER SUPPLY REJECTION RATIO	PSRR			1.0	5.6		3.2	10	µV/V
SLEW RATE	SR	V_S = ±15 V	5	12		5	12		V/ms
SUPPLY CURRENT	I_{SY}	V_S = ±1.5 V		9	15		9	15	µA
	I_{SY}	V_S = ±15 V		14	20		14	20	µA
CAPACITIVE LOAD STABILITY[2]		A_V = 1 No Oscillations	250	650		250	650		pF
INPUT NOISE VOLTAGE	$e_{n\ p\text{-}p}$	f_O = 0.1 Hz to 10 Hz							
		V_S = ±15 V		3			3		µV p-p
INPUT RESISTANCE DIFFERENTIAL MODE	R_{IN}	V_S = ±15 V		30			30		MΩ
INPUT RESISTANCE COMMON-MODE	R_{INCM}	V_S = ±15 V		20			20		GΩ

NOTES
[1]Guaranteed by CMR test.
[2]Guaranteed but not 100% tested.

Specifications subject to change without notice.

ELECTRICAL CHARACTERISTICS (V_S = ±1.5 V to ±15 V, –55°C ≤ T_A ≤ +125°C, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT OFFSET VOLTAGE	V_{OS}			80	400	µV
AVERAGE INPUT OFFSET VOLTAGE DRIFT	TCV_{OS}			0.3	2.5	µV/°C
INPUT OFFSET CURRENT	I_{OS}	V_{CM} = 0 V		1.5	5	nA
INPUT BIAS CURRENT	I_B	V_{CM} = 0 V		4.0	20	nA
LARGE-SIGNAL VOLTAGE GAIN	A_{VO}	V_S = ±15 V, V_O = ±10 V				
		R_L = 100 kΩ	225	400		V/mV
		R_L = 10 kΩ	125	240		V/mV
		R_L = 2 kΩ	50	110		V/mV
	A_{VO}	V+ = 5 V, V– = 0 V, 1 V < V_O < 4 V				
		R_L = 100 kΩ	100	200		V/mV
		R_L = 10 kΩ	50	110		V/mV
INPUT VOLTAGE RANGE*	IVR	V+ = 5 V, V– = 0 V	0/3.5			V
		V_S = ±15 V	–15/13 5			V
OUTPUT VOLTAGE SWING	V_O	V_S = ±15 V				
		R_L = 10 kΩ	±13.5	±13.7		V
		R_L = 2 kΩ	±10.5	±11.5		V
	V_{OH}	V+ = 5 V, V– = 0 V				
		R_L = 2 kΩ	3.9	4.1		V
	V_{OL}	V+ = 5 V, V– = 0 V				
		R_L = 10 kΩ		100	500	µV
COMMON-MODE REJECTION	CMR	V+ = 5 V, V– = 0 V, 0 V < V_{CM} < 3.5 V	85	105		dB
		V_S = ±15 V, 15 V < V_{CM} < 13.5 V	95	115		dB
POWER SUPPLY REJECTION RATIO	PSRR			3.2	10	µV/V
SUPPLY CURRENT	I_{SY}	V_S = ±1.5 V		15	25	µA
		V_S = ±15 V		19	30	µA

NOTE
*Guaranteed by CMR test.

OP90

ELECTRICAL CHARACTERISTICS

(V_S = ±1.5 V to ±15 V, –25°C ≤ T_A ≤ +85°C for OP90E/F, –40°C ≤ T_A ≤ +85°C for OP90G, unless otherwise noted.)

Parameter	Symbol	Conditions	OP90E Min	OP90E Typ	OP90E Max	OP90G Min	OP90G Typ	OP90G Max	Unit
INPUT OFFSET VOLTAGE	V_{OS}			70	270		180	675	µV
AVERAGE INPUT OFFSET VOLTAGE DRIFT	TCV_{OS}			0.3	2		1.2	5	µV/°C
INPUT OFFSET CURRENT	I_{OS}	VCM = 0 V		0.8	3		1.3	7	nA
INPUT BIAS CURRENT	I_B	VCM = 0 V		4.0	15		4.0	25	nA
LARGE-SIGNAL VOLTAGE GAIN	A_{VO}	V_S = ±15 V, V_O = ±10 V							
		R_L = 100 kΩ	500	800		300	600		V/mV
		R_L = 10 kΩ	250	400		150	250		V/mV
		R_L = 2 kΩ	100	200		75	125		V/mV
	A_{VO}	V+ = 5 V, V– = 0 V, 1 V < V_O < 4 V							
		R_L = 100 kΩ	150	280		80	160		V/mV
		R_L = 10 kΩ	75	140		40	90		V/mV
INPUT VOLTAGE RANGE*	IVR	V+ = 5 V, V– = 0 V	0/3.5			0/3.5			V
		V_S = ±15 V	–15/13.5			–15/13.5			V
OUTPUT VOLTAGE SWING	V_O	V_S = ±15 V							
		R_L = 10 kΩ	±13.5	±14		±13.5		±14	V
		R_L = 2 kΩ	±10.5	±11.8		±10.5		±11.8	V
	V_{OH}	V+ = 5 V, V– = 0 V							
		R_L = 2 kΩ	3.9	4.1		3.9	4.1		V
	V_{OL}	V+ = 5 V, V– = 0 V							
		R_L = 10 kΩ		100	500		100	500	µV
COMMON-MODE REJECTION	CMR	V+ = 5 V, V– = 0 V, 0 V < V_{CM} < 3.5 V	80	100		80	100		dB
		V_S = ±15 V, –15 V < V_{CM} < 13.5 V	100	120		90	110		dB
POWER SUPPLY REJECTION RATIO	PSRR			10	5.6		5.6	17.8	µV/V
SUPPLY CURRENT	I_{SY}	V_S = ±1.5 V		13	25		12	25	µA
		V_S = ±15 V		17	30		16	30	µA

NOTE
*Guaranteed by CMR test.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage . . . . . ±18 V
Differential Input Voltage . . . . [(V–) – 20 V] to [(V+) + 20 V]
Common-Mode Input Voltage . . . . . .
. . . . . [(V–) – 20 V] to [(V+) + 20 V]

Output Short-Circuit Duration . . . . . Indefinite
Storage Temperature Range
Z Package . . . . . –65°C to +150°C
P Package . . . . . –65°C to +150°C
Operating Temperature Range
OP90A . . . . . –55°C to +125°C
OP90E . . . . . –25°C to +85°C
OP90G . . . . . –40°C to +85°C
Junction Temperature (T_J) . . . . . –65°C to +150°C
Lead Temperature (Soldering 60 sec) . . . . . 300°C

Package Type	θ_{JA}[2]	θ_{JC}	Unit
8-Lead Hermetic DIP (Z)	148	16	°C/W
8-Lead Plastic DIP (P)	103	43	°C/W
8-Lead SO (S)	158	43	°C/W

NOTES
[1]Absolute Maximum Ratings apply to packaged parts, unless otherwise noted.
[2]θ_{JA} is specified for worst-case mounting conditions; i.e., θ_{JA} is specified for device in socket for CerDIP, and P-DIP; θ_{JA} is specified for devices soldered to printed circuit board for SO package.

ORDERING GUIDE

T_A = 25°C V_{OS} Max (mV)	Package Options: CERDIP 8-Lead	Package Options: Plastic 8-Lead	Operating Temperature Range
150	OP90AZ/883*		MIL
150	OP90EZ*		IND
450		OP90GP	XIND
450		OP90GS	XIND

*Not for new design, obsolete April 2002.

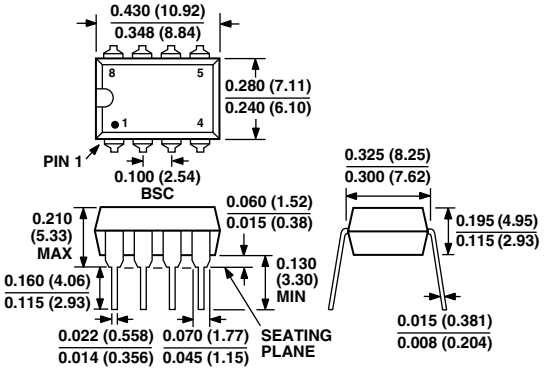
CAUTION

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 OP90 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.

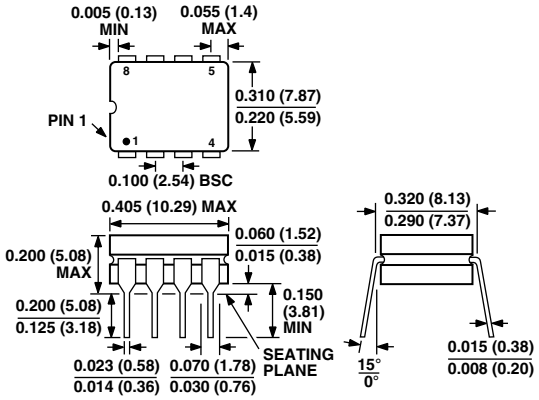
OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

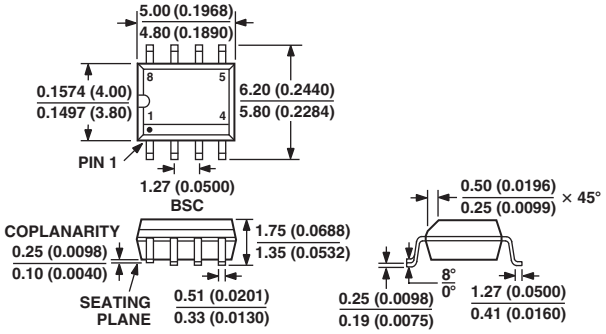
8-Lead PDIP Package
(N-8)



8-Lead Hermetic Package
(Q-8)



8-Lead Soic Package
(R-8)



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

COMPLIANT TO JEDEC STANDARDS MS-012 AA

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