

#### FEATURES

- Low  $V_{OS}$  .....  $25\mu\text{V}$  Max.
- Low  $V_{OS}$  Drift .....  $0.6\text{V}/\mu\text{C}$  Max.
- Very Stable .....  $1.0\mu\text{V}/\text{Month}$  Max.
- Replaces 725, 108A/308A, AD510
- Wide Input Voltage Range .....  $\pm 14\text{V}$

#### APPLICATIONS

- High-Stability Instrumentation Amplifiers
- Precision Absolute Value Circuits
- Adjustment-Free Precision Summing Amplifiers

#### DESCRIPTION

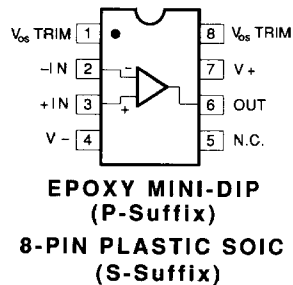
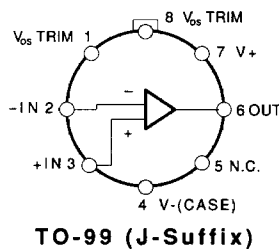
The OP-07 is a very low offset ( $25\mu\text{V}$  max. for OP-07A), very low drift operational amplifier. Because of this low offset voltage, in many applications the OP-07 does not require external nulling. OP-07 also exhibits a very low input bias current ( $\pm 2\text{nA}$  for OP-07A) and high gain (300,000). The OP-07 can be used as a direct replacement for 725 and 108A/308A (in TO-99 package) amplifiers, as well as for unnullled 741 amplifiers. Commercial temperature range devices, OP-07C, OP-07D and OP-07E are available in 8-pin plastic DIP packages, TO-99 metal cans and 8-pin plastic SOIC packages.

#### ORDERING INFORMATION†

$T_A = 25^\circ\text{C}$ $\Delta V_{OS} \text{ MAX}$ ( $\mu\text{V}$ )	PACKAGE			OPER. TEMP. RANGE
	TO-99 8-PIN	PLASTIC DIP 8-PIN	PLASTIC SOIC 8-PIN	
75	OP07EJ	OP07EP	OP07ES	COM
150	OP07CJ	OP07CP	OP07CS	COM
150	OP07DJ	OP07DP	OP07DS	COM

†All commercial and industrial temperature range parts are available with burn-in.

#### Pin Connections (Top View)



### ABSOLUTE MAXIMUM RATINGS (Note 2)

Supply Voltage	±22V
Internal Power Dissipation (Note 1)	500mW
Differential Input Voltage	±30V
Input Voltage (Note 3)	±22V
Output Short-Circuit Duration	Indefinite
Storage Temperature Range	
J	-65°C to +150°C
P Package	-65°C to +125°C
Operating Temperature Range	
OP-07E, OP-07C, OP-07D	0°C to +70°C
Lead Temperature (Soldering, 60 sec.)	300°C
DICE Junction Temperature (T <sub>j</sub> )	-65°C to +150°C

### NOTES:

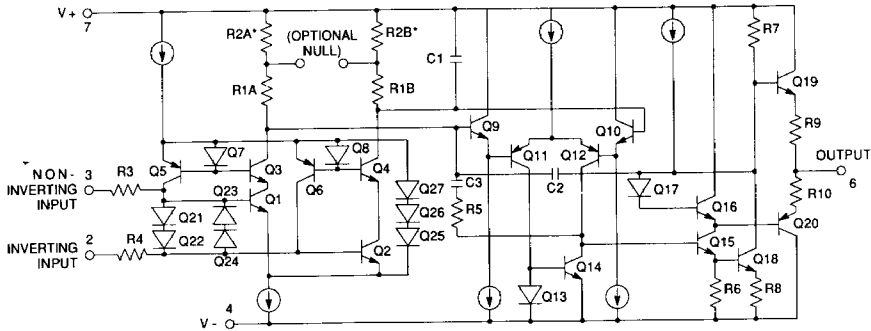
1. See table for maximum ambient temperature rating and derating factor.

PACKAGE TYPE	MAXIMUM AMBIENT TEMPERATURE FOR RATING	DERATE ABOVE MAXIMUM AMBIENT TEMPERATURE
TO-99 (J)	80°C	7.1mW/°C
8-Pin Plastic DIP (P)	36°C	5.6mW/°C

2. Absolute maximum ratings apply to both packaged parts and DICE, unless otherwise noted.

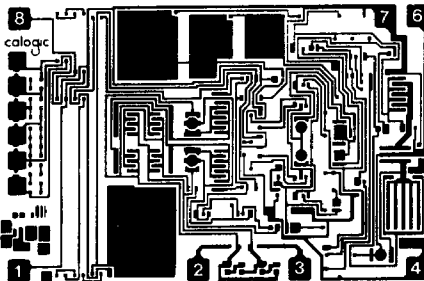
3. For supply voltages less than ±22V, the absolute maximum input voltage is equal to the supply voltage.

### Simplified Schematic



\*NOTE: R2A AND R2B ARE ELECTRONICALLY ADJUSTED ON CHIP AT FACTORY FOR MINIMUM INPUT OFFSET VOLTAGE.

### Die Characteristics



1. TRIM
2. (-) INPUT
3. (+) INPUT
4. V-
6. OUTPUT
7. V+
8. TRIM

DIE SIZE 0.099×0.066 inch, 6534 sq. mils  
(2.515×1.676mm, 4.215 sq. mm)

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

PARAMETER	SYMBOL	CONDITIONS	OP-07A			OP-07			UNITS
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage	$V_{OS}$	(Note 1)	—	10	25	—	30	75	$\mu V$
Long-Term Input Offset Voltage Stability	$\Delta V_{OS}/\text{Time}$	(Note 2)	—	0.2	1.0	—	0.2	1.0	mV
Input Offset Current	$I_{OS}$		—	0.3	2.0	—	0.4	2.8	nA
Input Bias Current	$I_B$		—	$\pm 0.7$	$\pm 2.0$	—	$\pm 1.0$	$\pm 3.0$	nA
Input Noise Voltage	$e_{np-p}$	0.1Hz to 10Hz (Note 3)	—	0.35	0.6	—	0.35	0.6	$\mu V_{p-p}$
Input Noise Voltage Density	$e_n$	$f_O = 10\text{Hz}$ (Note 3)	—	10.3	18.0	—	10.3	18.0	$nV/\sqrt{Hz}$
		$f_O = 100\text{Hz}$ (Note 3)	—	10.0	13.0	—	10.0	13.0	
		$f_O = 1000\text{Hz}$ (Note 3)	—	9.6	11.0	—	9.6	11.0	
Input Noise Current	$i_{np-p}$	0.1Hz to 10Hz (Note 3)	—	14	30	—	14	30	$\mu A_{p-p}$
Input Noise Current Density	$i_n$	$f_O = 10\text{Hz}$ (Note 3)	—	0.32	0.80	—	0.32	0.80	$pA/\sqrt{Hz}$
		$f_O = 100\text{Hz}$ (Note 3)	—	0.14	0.23	—	0.14	0.23	
		$f_O = 1000\text{Hz}$ (Note 3)	—	0.12	0.17	—	0.12	0.17	
Input Resistance—Differential-Mode	$R_{IN}$	(Note 4)	30	80	—	20	60	—	M $\Omega$
Input Resistance—Common-Mode	$R_{INCM}$		—	200	—	—	200	—	G $\Omega$
Input Voltage Range	IVR		$\pm 13$	$\pm 14$	—	$\pm 13$	$\pm 14$	—	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 13V$	110	126	—	110	126	—	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 3V$ to $\pm 18V$	—	4	10	—	4	10	$\mu V/V$
Large-Signal Voltage Gain	$A_{VO}$	$R_L \geq 2k\Omega$ , $V_O = \pm 10V$ $R_L \geq 500\Omega$ , $V_O = \pm 0.5V$ , $V_S = \pm 3V$ (Note 4)	300	500	—	200	500	—	V/mV
			150	400	—	150	400	—	
Output Voltage Swing	$V_O$	$R_L \geq 10k\Omega$	$\pm 12.5$	$\pm 13.0$	—	$\pm 12.5$	$\pm 13.0$	—	V
		$R_L \geq 2k\Omega$	$\pm 12.0$	$\pm 12.8$	—	$\pm 12.0$	$\pm 12.8$	—	
		$R_L \geq 1k\Omega$	$\pm 10.5$	$\pm 12.0$	—	$\pm 10.5$	$\pm 12.0$	—	
Slew Rate	SR	$R_L \geq 2k\Omega$ (Note 3)	0.1	0.3	—	0.1	0.3	—	V/ $\mu s$
Closed-Loop Bandwidth	BW	$A_{VCL} = +1$ (Note 3)	0.4	0.6	—	0.4	0.6	—	MHz
Open-Loop Output Resistance	$R_O$	$V_O = 0$ , $I_O = 0$	—	60	—	—	60	—	$\Omega$
Power Consumption	$P_d$	$V_S = \pm 15V$ , No Load	—	75	120	—	75	120	mW
		$V_S = \pm 3V$ , No load	—	4	6	—	4	6	
Offset Adjustment Range		$R_p = 20k\Omega$	—	$\pm 4$	—	—	$\pm 4$	—	mV

**NOTES:**

- OP-07A grade  $V_{OS}$  is measured approximately one minute after application of power. For all other grades  $V_{OS}$  is measured approximately 0.5 seconds after application of power.
- Long-Term Input Offset Voltage Stability refers to the averaged trend line of  $V_{OS}$  vs. Time over extended periods after the first 30 days of operation.

Excluding the initial hour of operation, changes in  $V_{OS}$  during the first 30 operating days are typically  $2.5\mu V$ —refer to typical performance curves.

- Sample tested.
- Guaranteed by design.

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

PARAMETER	SYMBOL	CONDITIONS	OP-07E			OP-07C			OP-07D			UNITS
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage	$V_{OS}$	(Note 1)	—	30	75	—	60	150	—	60	150	$\mu V$
Long-Term $V_{OS}$ Stability	$V_{OS}/Time$	(Note 2)	—	0.3	1.5	—	0.4	2.0	—	0.5	3.0	$\mu V/Mo$
Input Offset Current	$I_{OS}$		—	0.5	3.8	—	0.8	6.0	—	0.8	6.0	nA
Input Bias Current	$I_B$		—	$\pm 1.2$	$\pm 4.0$	—	$\pm 1.8$	$\pm 7.0$	—	$\pm 2.0$	$\pm 12$	nA
Input Noise Voltage	$e_{np-p}$	0.1Hz to 10Hz (Note 3)	—	0.35	0.6	—	0.38	0.65	—	0.38	0.65	$\mu V_{p-p}$
Input Noise Voltage Density	$e_n$	$f_O = 10Hz$	—	10.3	18.0	—	10.5	20.0	—	10.5	20.0	$nV/\sqrt{Hz}$
		$f_O = 100Hz$ (Note 3)	—	10.0	13.0	—	10.2	13.5	—	10.3	13.5	
		$f_O = 1000Hz$	—	9.6	11.0	—	9.8	11.5	—	9.8	11.5	
Input Noise Current	$i_{np-p}$	0.1Hz to 10Hz (Note 3)	—	14	30	—	15	35	—	15	35	$pA_{p-p}$
Input Noise Current Density	$i_n$	$f_O = 10Hz$	—	0.32	0.80	—	0.35	0.90	—	0.35	0.90	$pA/\sqrt{Hz}$
		$f_O = 100Hz$ (Note 3)	—	0.14	0.23	—	0.15	0.27	—	0.15	0.27	
		$f_O = 1000Hz$	—	0.12	0.17	—	0.13	0.18	—	0.13	0.18	
Input Resistance—Differential-Mode	$R_{IN}$	(Note 4)	15	50	—	8	33	—	7	31	—	$M\Omega$
Input Resistance—Common-Mode	$R_{INCM}$		—	160	—	—	120	—	—	120	—	$G\Omega$
Input Voltage Range	IVR		$\pm 13$	$\pm 14$	—	$\pm 13$	$\pm 14$	—	$\pm 13$	$\pm 14$	—	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 13V$	106	123	—	100	120	—	94	110	—	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 3V$ to $\pm 18V$	—	5	20	—	7	32	—	7	32	$\mu V/V$
Large-Signal Voltage Gain	$A_{VO}$	$R_L \geq 2k\Omega$ , $V_O = \pm 10V$	200	500	—	120	400	—	120	400	—	V/mV
		$R_L \geq 500\Omega$ , $V_O = \pm 0.5V$	150	400	—	100	400	—	—	400	—	
		$V_S = \pm 3V$ (Note 3)										
Output Voltage Swing	$V_O$	$R_L \geq 10k\Omega$	$\pm 12.5$	$\pm 13.0$	—	$\pm 12.0$	$\pm 13.0$	—	$\pm 12.0$	$\pm 13.0$	—	V
		$R_L \geq 2k\Omega$	$\pm 12.0$	$\pm 12.8$	—	$\pm 11.5$	$\pm 12.8$	—	$\pm 11.5$	$\pm 12.8$	—	
		$R_L \geq 1k\Omega$	$\pm 10.5$	$\pm 12.0$	—	—	$\pm 12.0$	—	—	$\pm 12.0$	—	
Slew Rate	SR	$R_L \geq 2k\Omega$ (Note 3)	0.1	0.3	—	0.1	0.3	—	0.1	0.3	—	$V/\mu s$
Closed-Loop Bandwidth	BW	$A_{VCL} = +1.0$ (Note 5)	0.4	0.6	—	0.4	0.6	—	0.4	0.6	—	MHz
Open-Loop Output Resistance	$R_O$	$V_O = 0$ , $I_O = 0$	—	60	—	—	60	—	—	60	—	$\Omega$
Power Consumption	$P_d$	$V_S = \pm 15V$ , No Load	—	75	120	—	80	150	—	80	150	mW
		$V_S = \pm 3V$ , No load	—	4	6	—	4	8	—	4	8	
Offset Adjustment Range		$R_p = 20k\Omega$	—	$\pm 4$	—	—	$\pm 4$	—	—	$\pm 4$	—	mV

**NOTES:**

1. Input Offset Voltage measurements are performed by automated test equipment approximately 0.5 seconds after application of power.
2. Long-Term Input Offset Voltage Stability refers to the averaged trend line of  $V_{OS}$  vs. Time over extended periods after the first 30 days of operation.

- Excluding the initial hour of operation, changes in  $V_{OS}$  during the first 30 operating days are typically  $2.5\mu V$ —refer to typical performance curves.
3. Sample tested.
  4. Guaranteed by design.

**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 15V$ ,  $0^\circ C \leq T_A \leq +70^\circ C$ , unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-07E			OP-07C			OP-07D			UNITS
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage	$V_{OS}$	(Note 1)	—	45	130	—	85	250	—	85	250	$\mu V$
Average Input Offset Voltage Drift Without External Trim	$TCV_{OS}$	(Note 3)	—	0.3	1.3	—	0.5	1.8	—	0.7	2.5	$\mu V/^\circ C$
Average Input Offset Voltage Drift With External Trim	$TCV_{OSn}$	$R_p = 20k\Omega$ (Note 3)	—	0.3	1.3	—	0.4	1.6	—	0.7	2.5	$\mu V/^\circ C$
Input Offset Current	$I_{OS}$		—	0.9	5.3	—	1.6	8.0	—	1.6	8.0	nA
Average Input Offset Current Drift	$TCI_{OS}$	(Note 2)	—	8	35	—	12	50	—	12	50	$\mu A/^\circ C$
Input Bias Current	$I_B$		—	$\pm 1.5$	$\pm 5.5$	—	$\pm 2.2$	$\pm 9.0$	—	$\pm 3.0$	$\pm 14$	nA
Average Input Bias Current Drift	$TCI_B$	(Note 2)	—	13	35	—	18	50	—	18	50	$\mu A/^\circ C$
Input Voltage Range	IVR		$\pm 13.0$	$\pm 13.5$	—	$\pm 13.0$	$\pm 13.5$	—	$\pm 13.0$	$\pm 13.5$	—	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 13V$	103	123	—	97	120	—	94	106	—	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 3V$ to $\pm 18V$	—	7	32	—	10	51	—	10	51	$\mu V/V$
Large-Signal Voltage Gain	$A_{VO}$	$R_L \geq 2k\Omega$ , $V_O = \pm 10V$	180	450	—	100	400	—	100	400	—	V/mV
Output Voltage Swing	$V_O$	$R_L \geq 2k\Omega$	$\pm 12$	$\pm 12.6$	—	$\pm 11$	$\pm 12.6$	—	$\pm 11$	$\pm 12.6$	—	V

**NOTES:**

1. Input offset voltage measurements are performed by automated test equipment approximately 0.5 seconds after application of power.
2. Sample tested.
3. Guaranteed by design.

