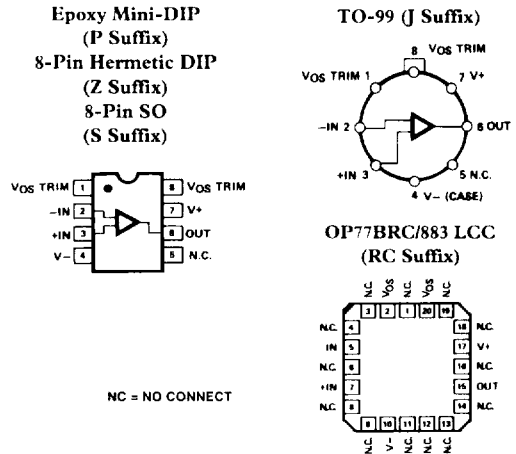


### FEATURES

- Outstanding Gain Linearity
- Ultrahigh Gain: 5000 V/mV min
- Low  $V_{OS}$  Over Temperature: 60  $\mu$ V max
- Excellent  $TCV_{OS}$ : 0.3  $\mu$ V/ $^{\circ}$ C max
- High PSRR: 3  $\mu$ V/V max
- Low Power Consumption: 60 mW max
- Fits OP07, 725, 108A/308A, 741 Sockets
- Available in Die Form

### PIN CONFIGURATIONS



### GENERAL DESCRIPTION

The OP77 significantly advances the state-of-the-art in precision op amps. The OP77's outstanding gain of 10,000,000 or more is maintained over the full  $\pm 10$  V output range. This exceptional gain-linearity eliminates incorrectable system nonlinearities common in previous monolithic op amps, and provides superior performance in high closed-loop-gain applications. Low initial  $V_{OS}$  drift and rapid stabilization time, combined with only 50 mW power consumption, are significant improvements over previous designs. These characteristics, plus the exceptional  $TCV_{OS}$  of 0.3  $\mu$ V/ $^{\circ}$ C maximum and the low  $V_{OS}$  of 25  $\mu$ V maximum, eliminates the need for  $V_{OS}$  adjustment and increases system accuracy over temperature.

PSRR of 3  $\mu$ V/V (110 dB) and CMRR of 1.0  $\mu$ V/V maximum virtually eliminate errors caused by power supply drifts and common-mode signals. This combination of outstanding characteristics makes the OP77 ideally suited for high-resolution instrumentation and other tight error budget systems.

This product is available in six standard grades and five standard packages: the TO-99 can, the 8-pin mini-DIP in ceramic, SO or epoxy, and the 20-contact LCC.

The OP77 is a direct or upgrade replacement for the OP07, 05, 725, or 108A op amps. 741-types can be replaced by eliminating the  $V_{OS}$  adjust pot. For higher precision performance refer to OP177.

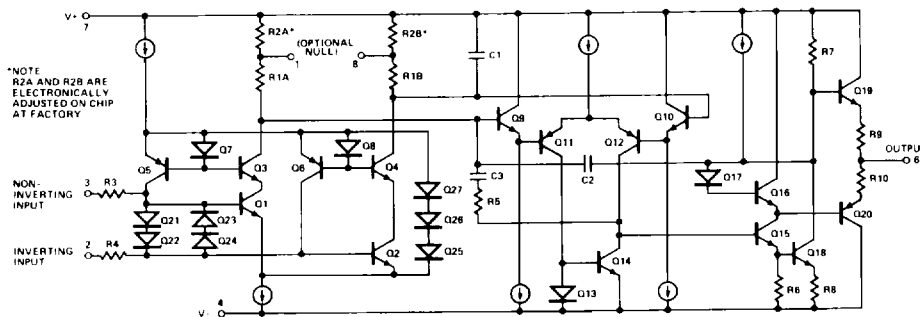


Figure 1. Simplified Schematic

# OP77—SPECIFICATIONS

## ELECTRICAL CHARACTERISTICS (@ $V_S = \pm 15$ V, $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

Parameter	Symbol	Conditions	OP77A			OP77B			Units
			Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$V_{OS}$			10	25		20	60	$\mu\text{V}$
Long-Term Input Offset Voltage Stability	$\Delta V_{OS}/\text{Time}$	(Note 1)		0.2			0.2		$\mu\text{V}/\text{Mo}$
Input Offset Current	$I_{OS}$			0.3	1.5		0.3	2.8	nA
Input Bias Current	$I_B$		0.2	1.2	2.0	0.2	1.2	2.8	nA
Input Noise Voltage	$e_n$ p-p	0.1 Hz to 10 Hz <sup>2</sup> $f_n = 10$ Hz <sup>2</sup>		0.35	0.6		0.35	0.6	$\mu\text{V}$ p-p
		$f_n = 100$ Hz <sup>2</sup>		10.3	18.0		10.3	18.0	$\mu\text{V}$ p-p
Input Noise Voltage Density	$e_n$	$f_n = 100$ Hz <sup>2</sup> $f_n = 1000$ Hz <sup>2</sup>		10.0	13.0		10.0	13.0	$\text{V}/\sqrt{\text{Hz}}$
		$f_n = 1000$ Hz <sup>2</sup>		9.6	11.0		9.6	11.0	$\text{V}/\sqrt{\text{Hz}}$
Input Noise Current	$i_n$ p-p	0.1 Hz to 10 Hz <sup>2</sup> $f_n = 10$ Hz <sup>2</sup>		14	30		14	30	pA p-p
		$f_n = 100$ Hz <sup>2</sup>		0.32	0.80		0.32	0.80	pA p-p
Input Noise Current Density	$i_n$	$f_n = 100$ Hz <sup>2</sup> $f_n = 1000$ Hz <sup>2</sup>		0.14	0.23		0.14	0.23	$\text{pA}/\sqrt{\text{Hz}}$
		$f_n = 1000$ Hz <sup>2</sup>		0.12	0.17		0.12	0.17	$\text{pA}/\sqrt{\text{Hz}}$
Input Resistance—Differential-Mode	$R_{ID}$	(Note 3)	26	15		18.5	15		M $\Omega$
Input Resistance—Common-Mode	$R_{ICM}$			200			200		G $\Omega$
Input Voltage Range	IVR		$\pm 13$	$\pm 14$		$\pm 13$	$\pm 14$		V
Common Mode Rejection Ratio	CMRR	$V_{CM} = \pm 13$ V		0.1	1.0		0.1	1.0	$\mu\text{V}/\text{V}$
Power Supply Rejection Ratio	PSRR	$V_S = +3$ V to $-18$ V		0.7	3		0.7	3	$\mu\text{V}/\text{V}$
Large-Signal Voltage Gain	$A_{VOL}$	$R_L = 2$ k $\Omega$ , $V_O = +10$ V	5000	12000		2000	8000		V/mV
Output Voltage Swing	$V_{OH}$	$R_L = 10$ k $\Omega$ $R_L = 2$ k $\Omega$ $R_L = 1$ k $\Omega$	$\pm 13.5$ $\pm 12.5$ $\pm 12.0$	$\pm 14.0$ $\pm 13.0$ $\pm 12.5$		$\pm 13.5$ $\pm 12.5$ $\pm 12.0$	$\pm 14.0$ $\pm 13.0$ $\pm 12.5$		V
Slew Rate	SR	$R_L = 2$ k $\Omega$ <sup>2</sup>	0.1	0.3		0.1	0.3		V/ $\mu\text{s}$
Closed-Loop Bandwidth	BW	$A_{VOL} = +1$ <sup>2</sup>	0.4	0.6		0.4	0.6		MHz
Open-Loop Output Resistance	$R_{OL}$			60			60		$\Omega$
Power Consumption	$P_T$	$V_S = \pm 15$ V, No Load		50	60		50	60	mW
Offset Adjustment Range		$V_S = +3$ V, No Load $R_p = 20$ k $\Omega$		3.5	4.5		3.5	4.5	mW
				$\pm 3$			$\pm 3$		mV

### NOTES

<sup>1</sup>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  $\pm 2.5$   $\mu\text{V}$ .

<sup>2</sup>Sample tested.

<sup>3</sup>Guaranteed by design.

Specifications subject to change without notice.

### ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

Supply Voltage	$\pm 22$ V
Differential Input Voltage	$\pm 30$ V
Input Voltage <sup>2</sup>	$\pm 22$ V
Output Short-Circuit Duration	Indefinite
Storage Temperature Range	
J, Z, and RC Packages	$65^\circ\text{C}$ to $+150^\circ\text{C}$
P Package	$65^\circ\text{C}$ to $+125^\circ\text{C}$
Operating Temperature Range	
OP77A, OP77B (J, Z, RC)	$55^\circ\text{C}$ to $+125^\circ\text{C}$
OP77E, OP77F (J, Z)	$25^\circ\text{C}$ to $+85^\circ\text{C}$
OP77E, OP77F, OP77G (P, S)	$0^\circ\text{C}$ to $+70^\circ\text{C}$
OP77H (P, S)	$-40^\circ\text{C}$ to $+85^\circ\text{C}$
Junction Temperature ( $T_J$ )	$65^\circ\text{C}$ to $+150^\circ\text{C}$
Lead Temperature (Soldering, 60 sec)	$+300^\circ\text{C}$

Package Type	$\theta_{JA}$ <sup>3</sup>	$\theta_{JC}$	Units
TO-99 (J)	150	18	$^\circ\text{C}/\text{W}$
8-Pin Hermetic DIP (Z)	148	16	$^\circ\text{C}/\text{W}$
8-Pin Plastic DIP (P)	103	43	$^\circ\text{C}/\text{W}$
20-Contact I.C.C. (RC, TC)	98	38	$^\circ\text{C}/\text{W}$
8-Pin SO (S)	158	43	$^\circ\text{C}/\text{W}$

### NOTES

<sup>1</sup>Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.

<sup>2</sup>For supply voltages less than  $\pm 22$  V, the absolute maximum input voltage is equal to the supply voltage.

<sup>3</sup> $\theta_{JA}$  is specified for worst case mounting conditions, i.e.,  $\theta_{JA}$  is specified for device in socket for TO, Cerdip, P-DIP, and I.C.C. packages;  $\theta_{JC}$  is specified for device soldered to printed circuit board for SO package.

### ORDERING GUIDE<sup>1</sup>

Model	Temperature Range	Package Option <sup>2</sup>
OP77AJ <sup>3</sup>	$55^\circ\text{C}$ to $+125^\circ\text{C}$	TO-99
OP77AZ <sup>3</sup>	$-55^\circ\text{C}$ to $+125^\circ\text{C}$	8-Pin Cerdip
OP77EJ	$25^\circ\text{C}$ to $+85^\circ\text{C}$	TO-99
OP77EZ	$25^\circ\text{C}$ to $+85^\circ\text{C}$	8-Pin Cerdip
OP77EP	$0^\circ\text{C}$ to $+70^\circ\text{C}$	8-Pin Plastic DIP
OP77BJ	$-55^\circ\text{C}$ to $+125^\circ\text{C}$	TO-99
OP77BRC/883C	$-55^\circ\text{C}$ to $+125^\circ\text{C}$	20-Contact I.C.C.
OP77FJ	$-25^\circ\text{C}$ to $+85^\circ\text{C}$	TO-99
OP77FZ	$-25^\circ\text{C}$ to $+85^\circ\text{C}$	8-Pin Cerdip
OP77FP	$0^\circ\text{C}$ to $+70^\circ\text{C}$	8-Pin Plastic DIP
OP77GP	$0^\circ\text{C}$ to $+70^\circ\text{C}$	8-Pin Plastic DIP
OP77GS <sup>4</sup>	$0^\circ\text{C}$ to $+70^\circ\text{C}$	8-Pin SO
OP77GS-REEL	$0^\circ\text{C}$ to $+70^\circ\text{C}$	8-Pin SO
OP77GS-REEL7 <sup>4</sup>	$0^\circ\text{C}$ to $+70^\circ\text{C}$	8-Pin SO
OP77HS <sup>4</sup>	$40^\circ\text{C}$ to $+85^\circ\text{C}$	8-Pin SO
OP77HS-REEL	$-40^\circ\text{C}$ to $+85^\circ\text{C}$	8-Pin SO
OP77HS-REEL7 <sup>4</sup>	$-40^\circ\text{C}$ to $+85^\circ\text{C}$	8-Pin SO

### NOTES

<sup>1</sup>Burn-in is available on commercial and industrial temperature range parts in Cerdip, Plastic DIP, and TO-can packages.

<sup>2</sup>For outline information see Package Information section.

<sup>3</sup>For devices processed in total compliance to MIL-STD 883, add 883 after part number. Consult factory for 883 data sheet.

<sup>4</sup>For availability and burn-in information on SO and PLCC packages, contact your local sales office.