

FEATURES

- Low V_{OS} $25\mu V$ Max.
- Low V_{OS} Drift $0.3\mu V/^{\circ}C$ Max.
- High Gain 5,000,000 Min.
- Fits 725, 108A, 308A, AD510, OP-05, OP-07 & 741 Sockets
- Low Power Consumption 60mW Max.
- High PSRR 110dB Min.
- High CMRR $1\mu V/V$ Max.

APPLICATIONS

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

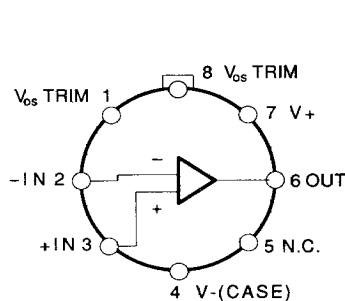
DESCRIPTION

The OP-77 represents a significant improvement in precision operational amplifiers. The low initial V_{OS} drift and 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. With only 50mW power consumption, 110dB PSRR and 120dB CMRR virtually eliminate errors caused by power supply drifts and common mode signals. These characteristics combined with an impressive open loop gain of $5V/\mu V$ minimum and a great linearity, makes the OP-77 ideally suited for precision instrumentation applications.

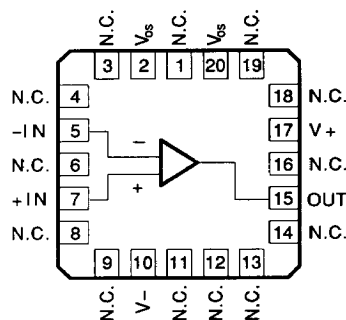
ORDERING INFORMATION

$T_A = 25^{\circ}C$ $V_{OS} MAX$ (μV)	PACKAGE					OPER. TEMP. RANGE
	TO-99 8-PIN	HERMETIC DIP 8-PIN	PLASTIC DIP 8-PIN	PLASTIC SOIC 8-PIN	LCC	
25	OP77AJ	OP77AZ	—	—	—	MIL
25	OP77EJ	OP77EZ	—	—	—	IND
25	—	—	OP77EP	OP77ES	—	COM
60	OP77BJ	OP77BZ	—	—	OP77BRC/883	MIL
60	OP77FJ	OP77FZ	—	—	—	IND
60	—	—	OP77FP	OP77FS	—	COM
100	—	—	OP77GP	OP77GS	—	COM

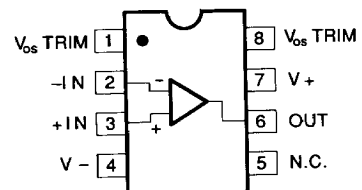
Pin Connections (Top View)



TO-99 (J-Suffix)



LCC
(RC-Suffix)



EPOXY MINI-DIP
(P-Suffix)
8-PIN HERMETIC DIP
(Z-Suffix)
8-PIN PLASTIC SOIC
(S-Suffix)

REPRESENTED BY

Technical Consultants

(415) 830-0829

ABSOLUTE MAXIMUM RATINGS (Note 2)

Supply Voltage	$\pm 22V$
Internal Power Dissipation (Note 1)	500mW
Differential Input Voltage	$\pm 30V$
Input Voltage (Note 3)	$\pm 22V$
Output Short-Circuit Duration	Indefinite
Storage Temperature Range	
J, RC and Z Packages	$-65^{\circ}C$ to $+150^{\circ}C$
P and SO Packages	$-65^{\circ}C$ to $+125^{\circ}C$
Operating Temperature Range	
OP-77A, OP-77B (J, Z, RC)	$-55^{\circ}C$ to $+125^{\circ}C$
OP-77E, OP-77F (J, Z)	$-25^{\circ}C$ to $+85^{\circ}C$
OP-77E, OP-77F, OP-77G (P or S)	$0^{\circ}C$ to $70^{\circ}C$
Lead Temperature (Soldering, 60 sec.)	$300^{\circ}C$
DICE Junction Temperature (T_j)	$-65^{\circ}C$ to $+150^{\circ}C$

NOTES:

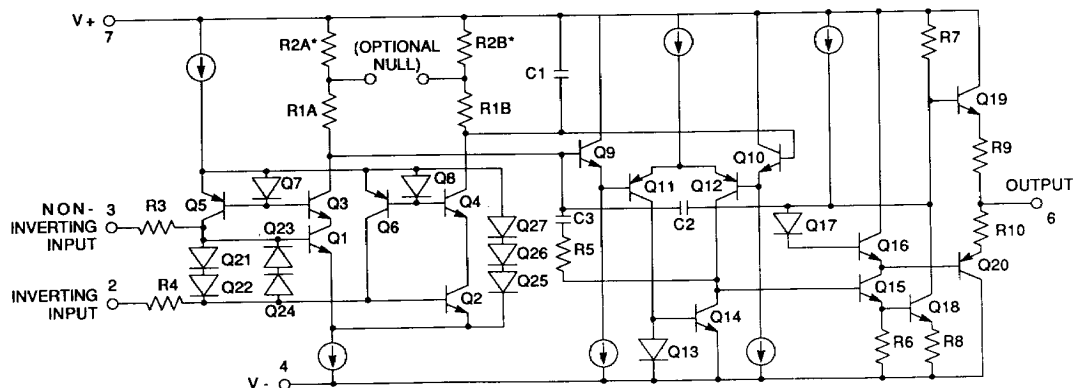
1. See table for maximum ambient temperature rating and derating factor.

PACKAGE TYPE	MAXIMUM AMBIENT TEMPERATURE FOR RATING	DERATE ABOVE MAXIMUM AMBIENT TEMPERATURE
TO-99 (J)	$80^{\circ}C$	$7.1mW/^{\circ}C$
8-Pin Hermetic DIP (Z)	$75^{\circ}C$	$6.7mW/^{\circ}C$
8-Pin Plastic DIP (P)	$36^{\circ}C$	$5.6mW/^{\circ}C$
LCC (RC)	$72^{\circ}C$	$7.8mW/^{\circ}C$

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

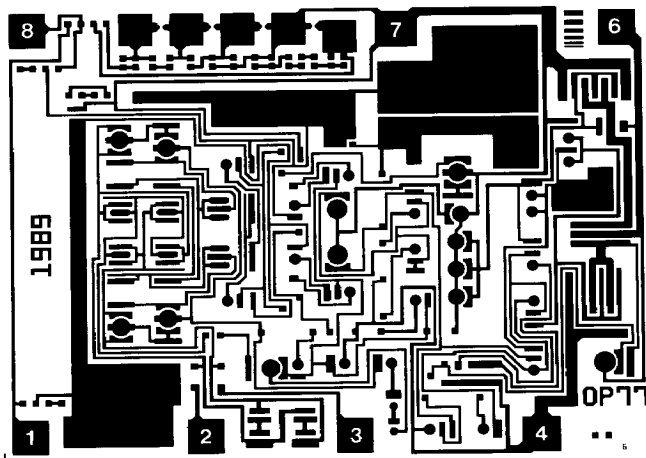
3. For supply voltages less than $\pm 22V$, the absolute maximum input voltage is equal to the supply voltage.

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 0.079x0.060 inch, 4740 sq. mils
(2.007x1.524mm, 3.058 sq. mm)

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

PARAMETER	SYMBOL	CONDITIONS	OP-77A			OP-77B			UNITS
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage	V_{OS}		—	10	25	—	20	60	μV
Long-Term Input Offset Voltage Stability	$\Delta V_{OS}/\text{Time}$	(Note 1)	—	0.2	—	—	0.2	—	mV
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}	0.1Hz to 10Hz (Note 2)	—	0.35	0.6	—	0.35	0.6	μV_{p-p}
Input Noise Voltage Density	e_n	$f_O = 10\text{Hz}$ (Note 2)	—	10.3	18.0	—	10.3	18.0	$nV/\sqrt{Hz}$
		$f_O = 100\text{Hz}$ (Note 2)	—	10.0	13.0	—	10.0	13.0	
		$f_O = 1000\text{Hz}$ (Note 2)	—	9.6	11.0	—	9.6	11.0	
Input Noise Current	i_{n-p}	0.1Hz to 10Hz (Note 2)	—	14	30	—	14	30	pA_{p-p}
Input Noise Current Density	i_n	$f_O = 10\text{Hz}$ (Note 2)	—	0.32	0.80	—	0.32	0.80	$pA/\sqrt{Hz}$
		$f_O = 100\text{Hz}$ (Note 2)	—	0.14	0.23	—	0.14	0.23	
		$f_O = 1000\text{Hz}$ (Note 2)	—	0.12	0.17	—	0.12	0.17	
Input Resistance—Differential-Mode	R_{IN}	(Note 3)	26	45	—	18.5	45	—	M Ω
Input Resistance—Common-Mode	R_{INCM}		—	200	—	—	200	—	G Ω
Input Voltage Range	IVR		± 13	± 14	—	± 13	± 14	—	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 13V$	—	0.1	1.0	—	0.1	1.6	$\mu V/V$
Power Supply Rejection Ratio	PSRR	$V_S = \pm 3V$ to $\pm 18V$	—	0.7	3	—	0.7	3	$\mu V/V$
Large-Signal Voltage Gain	A_{VO}	$R_L \geq 2k\Omega$, $V_O = \pm 10V$	5000	12000	—	2000	8000	—	V/mV
Output Voltage Swing	V_O	$R_L \geq 10k\Omega$	± 13.5	± 14.0	—	± 13.5	± 14.0	—	V
		$R_L \geq 2k\Omega$	± 12.5	± 13.0	—	± 12.5	± 13.0	—	
		$R_L \geq 1k\Omega$	± 12.0	± 12.5	—	± 12.0	± 12.5	—	
Slew Rate	SR	$R_L \geq 2k\Omega$ (Note 2)	0.1	0.3	—	0.1	0.3	—	V/ μs
Closed-Loop Bandwidth	BW	$A_{VCL} = +1$ (Note 2)	0.4	0.6	—	0.4	0.6	—	MHz
Open-Loop Output Resistance	R_O		—	60	—	—	60	—	Ω
Power Consumption	P_d	$V_S = \pm 15V$, No Load	—	50	60	—	50	60	mW
		$V_S = \pm 3V$, No load	—	3.5	4.5	—	3.5	4.5	
Offset Adjustment Range		$R_p = 20k\Omega$	—	± 3	—	—	± 3	—	mV

NOTES:

1. 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 $2.5\mu V$.
2. Sample tested.
3. Guaranteed by design.

ELECTRICAL CHARACTERISTICS at $V_S = \pm 15V$, $-55^\circ C \leq T_A \leq +125^\circ C$, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-77A			OP-77B			UNITS
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage	V_{OS}		—	25	60	—	45	120	μV
Average Input Offset Voltage Drift	TCV_{OS}	(Note 1)	—	0.1	0.3	—	0.2	0.6	$\mu V/^\circ C$
Input Offset Current	I_{OS}		—	0.5	2.2	—	0.5	4.5	nA
Average Input Offset Current Drift	TCI_{OS}	(Note 2)	—	1.5	25	—	1.5	50	$pA/^\circ C$
Input Bias Current	I_B		– 0.2	2.4	4	– 0.2	2.4	6	nA
Average Input Bias Current Drift	TCI_B	(Note 2)	—	8	25	—	0.1	3	$pA/^\circ C$
Input Voltage Range	IVR		± 13	± 13.5	—	± 13	± 13.5	—	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 13V$	—	0.1	1.0	—	15	35	$\mu V/V$
Power Supply Rejection Ratio	PSRR	$V_S = \pm 3V$ to $\pm 18V$	—	1	3	—	1	5	$\mu V/V$
Large-Signal Voltage Gain	A_{VO}	$R_L \geq 2k\Omega$, $V_O = \pm 10V$	2000	6000	—	1000	4000	—	V/mV
Output Voltage Swing	V_O	$R_L \geq 2k\Omega$	± 12	± 13.0	—	± 12	± 13.0	—	V
Power Consumption	P_d	$V_S = \pm 15V$, No Load	—	60	75	—	60	75	mW

NOTES:

1. OP-77A: TCV_{OS} is 100% tested.
2. Guaranteed by end-point limits.

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

PARAMETER	SYMBOL	CONDITIONS	OP-77E			OP-77F			OP-77G			UNITS
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage	V_{OS}		—	10	25	—	20	60	—	50	100	μV
Long-Term V_{OS} Stability	V_{OS}/Time	(Note 1)	—	0.3	—	—	0.4	—	—	0.4	—	$\mu V/\text{Mo}$
Input Offset Current	I_{OS}		—	0.3	1.5	—	0.3	2.8	—	0.3	2.8	nA
Input Bias Current	I_B		−0.2	1.2	2.0	−0.2	1.2	2.8	−0.2	1.2	2.8	nA
Input Noise Voltage	e_{n-p}	0.1Hz to 10Hz (Note 2)	—	0.35	0.6	—	0.38	0.65	—	0.38	0.65	μV_{p-p}
Input Noise Voltage Density	e_n	$f_O = 10\text{Hz}$	—	10.3	18.0	—	10.5	20.0	—	10.5	20.0	$nV/\sqrt{\text{Hz}}$
		$f_O = 100\text{Hz}$ (Note 2)	—	10.0	13.0	—	10.2	13.5	—	10.3	13.5	
		$f_O = 1000\text{Hz}$	—	9.6	11.0	—	9.8	11.5	—	9.8	11.5	
Input Noise Current	i_{n-p-p}	0.1Hz to 10Hz (Note 2)	—	14	30	—	15	35	—	15	35	pA_{p-p}
Input Noise Current Density	i_n	$f_O = 10\text{Hz}$	—	0.32	0.80	—	0.35	0.90	—	0.35	0.90	$pA/\sqrt{\text{Hz}}$
		$f_O = 100\text{Hz}$ (Note 2)	—	0.14	0.23	—	0.15	0.27	—	0.15	0.27	
		$f_O = 1000\text{Hz}$	—	0.12	0.17	—	0.13	0.18	—	0.13	0.18	
Input Resistance—Differential-Mode	R_{IN}	(Note 3)	26	45	—	18.5	45	—	18.5	45	—	$M\Omega$
Input Resistance—Common-Mode	R_{INCM}		—	200	—	—	200	—	—	200	—	$G\Omega$
Input Voltage Range	IVR		± 13	± 14	—	± 13	± 14	—	± 13	± 14	—	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 13V$	—	0.1	1.0	—	0.1	1.6	—	0.1	1.6	$\mu V/V$
Power Supply Rejection Ratio	PSRR	$V_S = \pm 3V$ to $\pm 18V$	—	0.7	3.0	—	0.7	3.0	—	0.7	3.0	$\mu V/V$
Large-Signal Voltage Gain	A_{VO}	$R_L \geq 2k\Omega$, $V_O = \pm 10V$	5000	12000	—	2000	6000	—	2000	6000	—	V/mV
Output Voltage Swing	V_O	$R_L \geq 10k\Omega$	± 13.5	± 14.0	—	± 13.5	± 14.0	—	± 13.5	± 14.0	—	V
		$R_L \geq 2k\Omega$	± 12.5	± 13.0	—	± 12.5	± 13.0	—	± 12.5	± 13.0	—	
		$R_L \geq 1k\Omega$	± 12.0	± 12.5	—	± 12.0	± 12.5	—	± 12.0	± 12.5	—	
Slew Rate	SR	$R_L \geq 2k\Omega$ (Note 2)	0.1	0.3	—	0.1	0.3	—	0.1	0.3	—	$V/\mu s$
Closed-Loop Bandwidth	BW	$A_{VCL} = +1.0$ (Note 2)	0.4	0.6	—	0.4	0.6	—	0.4	0.6	—	MHz
Open-Loop Output Resistance	R_O		—	60	—	—	60	—	—	60	—	Ω
Power Consumption	P_d	$V_S = \pm 15V$, No Load	—	50	60	—	50	60	—	50	60	mW
		$V_S = \pm 3V$, No load	—	3.5	4.5	—	3.5	4.5	—	3.5	4.5	
Offset Adjustment Range		$R_p = 20k\Omega$	—	± 3	—	—	± 3	—	—	± 3	—	mV

NOTES:

1. Long-Term 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 $2.5\mu V$.

2. Sample tested.
3. Guaranteed by design.

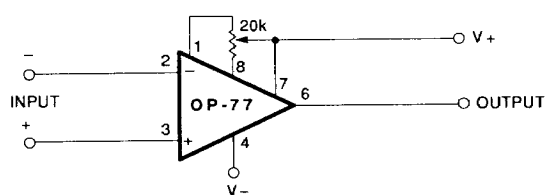
ELECTRICAL CHARACTERISTICS at $V_S = \pm 15V$, $-25^\circ C \leq T_A \leq +85^\circ C$ for OP-77E/FJ and OP-77E/FZ, $0^\circ C \leq T_A \leq +70^\circ C$ for OP-77E/FGP and OP-77E/FGS, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-77E			OP-77F			OP-77G			UNITS
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage	V_{OS}	J, Z Packages P Package	—	10	45	—	20	100	—	—	—	μV
			—	10	55	—	20	100	—	80	150	
Average Input Offset Voltage Drift	TCV_{OS}	J, Z Package (Note 1) P Package	—	0.1	0.3	—	0.2	0.6	—	—	—	$\mu V/^\circ C$
			—	0.3	0.6	—	0.4	1.0	—	0.7	1.2	
Input Offset Current	I_{OS}		—	0.5	2.2	—	0.5	4.5	—	0.5	4.5	nA
Average Input Offset Current Drift	TCI_{OS}	(Note 2)	—	1.5	40	—	1.5	85	—	1.5	85	pA/°C
Input Bias Current	I_B		-0.2	2.4	4.0	-0.2	2.4	6.0	-0.2	2.4	6.0	nA
Average Input Bias Current Drift	TCI_B	(Note 2)	—	8	40	—	15	60	—	15	60	pA/°C
Input Voltage Range	IVR		± 13.0	± 13.5	—	± 13.0	± 13.5	—	± 13.0	± 13.5	—	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 13V$	—	0.1	1.0	—	0.1	3.0	—	0.1	3.0	$\mu V/V$
Power Supply Rejection Ratio	PSRR	$V_S = \pm 3V$ to $\pm 18V$	—	1.0	3.0	—	1.0	5.0	—	1.0	5.0	$\mu V/V$
Large-Signal Voltage Gain	A_{VO}	$R_L \geq 2k\Omega$, $V_O = \pm 10V$	2000	6000	—	1000	4000	—	1000	4000	—	V/mV
Output Voltage Swing	V_O	$R_L \geq 2k\Omega$	± 12	± 13.0	—	± 12	± 13.0	—	± 12	± 13.0	—	V
Power Consumption	P_D	$V_S = \pm 15V$, No Load	—	60	75	—	60	75	—	60	75	mW

NOTES:

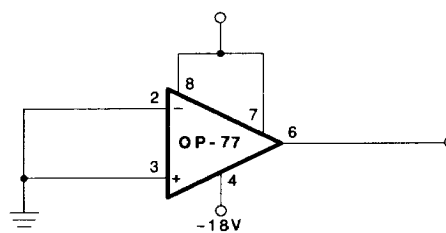
1. OP-77E: TCV_{OS} is 100% tested on J and Z packages.
2. Guaranteed by end-point limits.

Optional Offset Nulling Circuit



PINOUTS SHOWN FOR J, P, AND Z PACKAGES

Burn-In Circuit



PINOUTS SHOWN FOR J, P, AND Z PACKAGES

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