

HS OP-27/OP-37

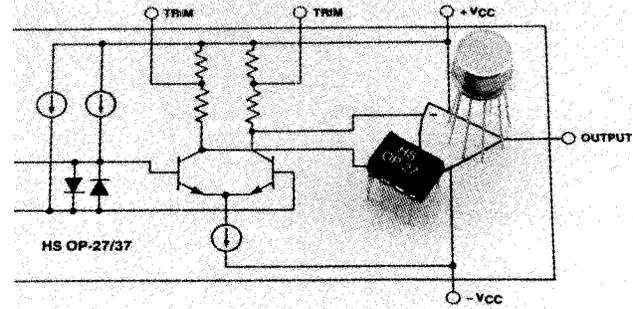
Ultra-Low Noise, High Speed, Precision Operational Amplifiers

DESCRIPTION

The HS OP-27 and OP-37 operational amplifiers combine low noise, precision DC performance, and wide bandwidth on a single monolithic integrated circuit.

Hybrid Systems combines a low noise transistor process with sophisticated circuit design to produce the lowest noise precision op amp available in the industry ($e_n = 3.5 \text{ nV}/\sqrt{\text{Hz}} @ 10 \text{ Hz}$).

These op amps also include high speed performance ($17\text{V}/\mu\text{s}$ SR and 63 MHz gain bandwidth product), low initial offset ($10 \mu\text{V}$), high gain ($1500\text{V}/\text{mV}$), low input bias current ($\pm 10 \text{ nA}$), and power supply requirements of only 3 mA .



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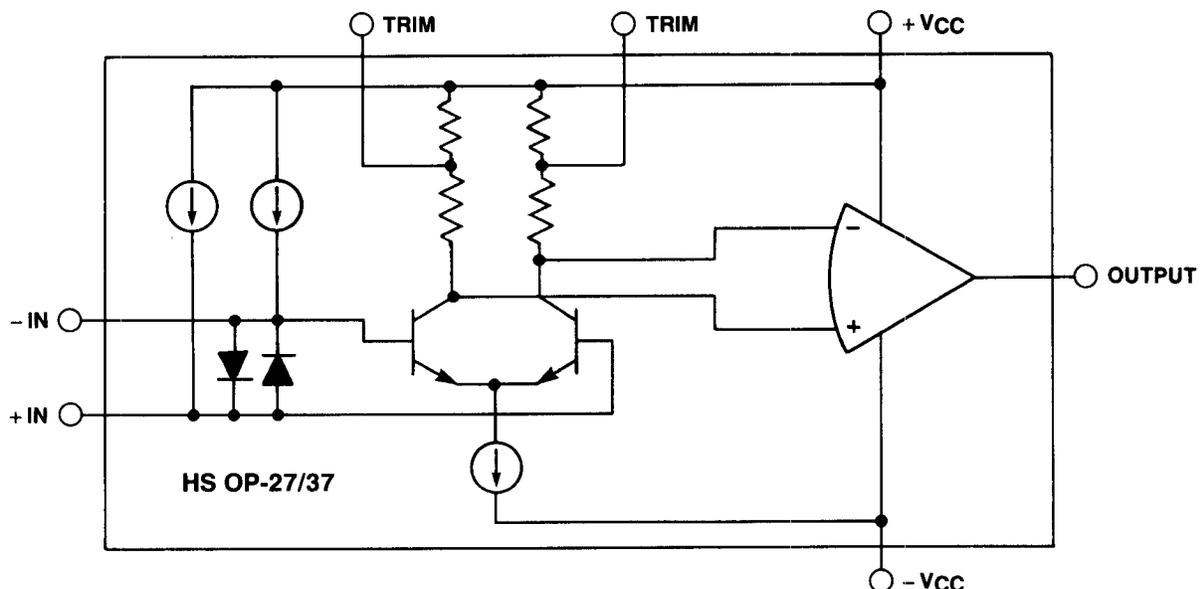
FEATURES

1. Low Noise — $3 \text{ nV}/\sqrt{\text{Hz}} @ 1 \text{ kHz}$ 80 nVp-p from 0.1 Hz to 10 Hz
2. Ultra-Low $V_{OS} - 10 \mu\text{V}$
3. Slew Rate OP-27... $2.8\text{V}/\mu\text{sec}$
OP-37... $17\text{V}/\mu\text{sec}$
Gain Bandwidth OP-27... 8 MHz
OP-37... 63 MHz
4. Superior Stability $0.2 \mu\text{V}/\text{month}$; $0.2 \mu\text{V}/^\circ\text{C}$
5. Replaces OP-05, OP-07, OP-06, 725, AD510, AD517

BENEFITS

1. Suitable for Precision Instrumentation and Low level Signal Conditioning Applications
2. Eliminates the Need for External Offset-Null Circuitry
3. Suitable for High Speed Applications
4. Provides Stable Performance Over Both Time and Temperature
5. Superior Replacement

FUNCTIONAL DIAGRAM



SPECIFICATIONS

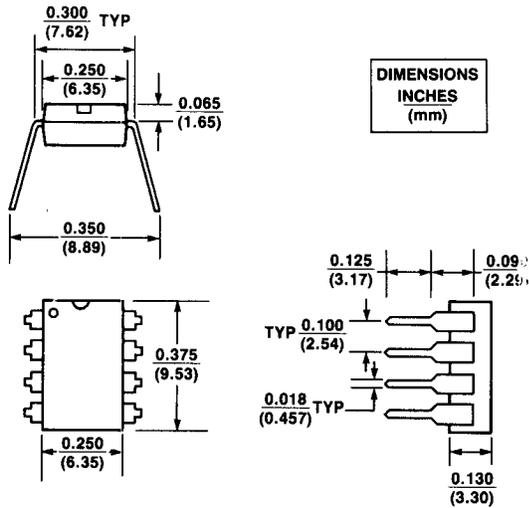
DC ELECTRICAL CHARACTERISTICS

$T_A = +25^\circ\text{C}$ and $\pm V_S = \pm 15\text{V}$ unless otherwise noted.

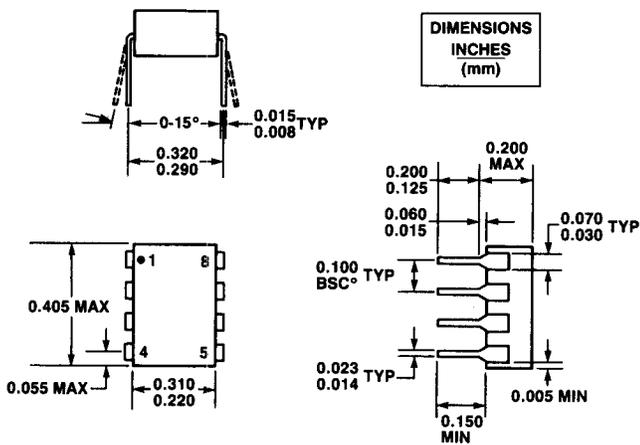
PARAMETER	TEST CONDITIONS	HS OP-27/37 A/E			HS OP-27/37 B/F			HS OP-27/37 C/G			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage ¹	$T_A = +25^\circ\text{C}$	—	10	25	—	20	60	—	30	100	μV
	$-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	—	20	50	—	40	140	—	55	220	
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	—	30	60	—	50	200	—	70	300	
Input Offset Current	$T_A = +25^\circ\text{C}$	—	7	35	—	9	50	—	12	75	nA
	$-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	—	10	50	—	14	85	—	20	135	
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	—	15	50	—	22	85	—	30	135	
Input Bias Current	$T_A = +25^\circ\text{C}$	—	± 10	± 40	—	± 12	± 55	—	± 15	± 80	nA
	$-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	—	± 14	± 60	—	± 18	± 95	—	± 25	± 150	
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	—	± 20	± 60	—	± 28	± 95	—	± 35	± 150	
Average Input Offset Drift ²	$-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	—	0.2	0.6	—	0.3	1.3	—	0.4	1.8	$\mu\text{V}/^\circ\text{C}$
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	—	0.2	0.6	—	0.3	1.3	—	0.4	1.8	
Long Term Offset Stability ²		—	0.2	1.0	—	0.3	1.5	—	0.4	2.0	$\mu\text{V}/\text{Mo}$
Offset Adjustment Range	$R_D = 10\text{K}\Omega$	—	± 4.0	—	—	± 4.0	—	—	± 4.0	—	mV
Input Voltage Range	$T_A = +25^\circ\text{C}$	± 11.0	± 12.3	—	± 11.0	± 12.0	—	± 11.0	± 12.3	—	V
	$-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	± 10.5	± 11.8	—	± 10.5	± 11.8	—	± 10.5	± 11.8	—	
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	± 10.3	± 11.5	—	± 10.3	± 11.5	—	± 10.2	± 11.5	—	
Input Resistance Diff. Mode		1.5	6	—	1.2	5	—	0.8	4	—	M Ω
Input Resistance Com. Mode		—	3	—	—	2.5	—	—	2	—	G Ω
Common Mode Rejection Ratio	$V_{CM} = \pm 11\text{V}$ $T_A = 25^\circ\text{C}$	114	126	—	106	123	—	100	120	—	dB
	$V_{CM} = \pm 10\text{V}$ $-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	110	124	—	102	121	—	96	118	—	
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	108	122	—	100	119	—	94	116	—	
Large Signal Voltage Gain	$T_A = +25^\circ\text{C}$ $R_L \geq 2\text{K}\Omega, V_O = \pm 10\text{V}$	1000	1800	—	1000	1800	—	700	1500	—	V/mV
	$R_L \geq 1\text{K}\Omega, V_O = \pm 10\text{V}$	800	1500	—	800	1500	—	—	1500	—	
	$R_L \geq 600\Omega, V_O = \pm 1\text{V}$ $V_S = \pm 4\text{V}$	250	700	—	250	700	—	200	500	—	
	$-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ $R_L \geq 2\text{K}\Omega, V_O = \pm 10\text{V}$	750	1500	—	700	1300	—	450	1000	—	
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ $R_L \geq 2\text{K}\Omega, V_O = \pm 10\text{V}$	600	1200	—	500	1000	—	300	800	—	
Output Voltage Swing	$T_A = +25^\circ\text{C}$ $R_L \geq 2\text{K}\Omega$	± 12.0	± 13.8	—	± 12.0	± 13.8	—	± 11.5	± 13.5	—	V
	$R_L \geq 600\Omega$	± 10.0	± 11.5	—	± 10.0	± 11.5	—	± 10.0	± 11.5	—	
	$-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ $R_L \geq 2\text{K}\Omega$	± 11.7	± 13.6	—	± 11.4	± 13.5	—	± 11.0	± 13.3	—	
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ $R_L \geq 2\text{K}\Omega$	± 11.5	± 13.5	—	± 11.0	± 13.2	—	± 10.5	± 13.0	—	
Output Resistance	Open Loop	—	70	—	—	70	—	—	70	—	Ω
Power Supply Rejection Ratio	$T_A = +25^\circ\text{C}$ $\pm V_S = \pm 4\text{V to } \pm 18\text{V}$	—	1	10	—	1	10	—	2	20	$\mu\text{V}/\text{V}$
	$-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ $\pm V_S = \pm 4.5\text{V to } \pm 18\text{V}$	—	2	16	—	2	20	—	4	51	
	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ $\pm V_S = \pm 4.5\text{V to } \pm 18\text{V}$	—	2	15	—	2	16	—	2	32	
		—	2	15	—	2	16	—	2	32	
Power Supply Rated Voltage Voltage Range Current, Quiescent Power Consumption	$V_O = 0$	—	± 15	—	—	± 15	—	—	± 15	—	V_{DC} V_{DC} mA mW
		± 4	—	± 22	± 4	—	± 22	± 4	—	± 22	
		—	± 3	± 4.7	—	± 3	± 4.7	—	± 3	± 4.7	
		—	90	140	—	90	140	—	100	170	
Temperature Range Specification	A, B, C	-55	—	+125	-55	—	+125	-55	—	+125	$^\circ\text{C}$
	E, F, G	-25	—	+85	-25	—	+85	-25	—	+85	
	Operating	-55	—	+125	-55	—	+125	-55	—	+125	
	E, F, G	-25	—	+85	-25	—	+85	-25	—	+85	
Storage		-65	—	+150	-65	—	+150	-65	—	+150	

PACKAGE OUTLINE

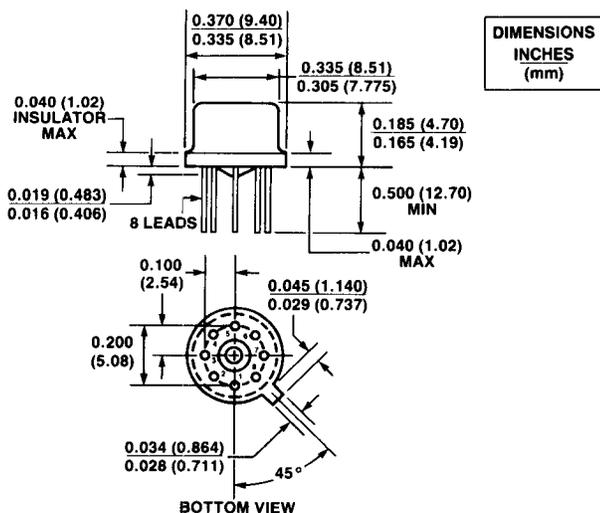
8-PIN PLASTIC MINI DIP (Suffix P)



8-PIN CERDIP (Suffix Z)



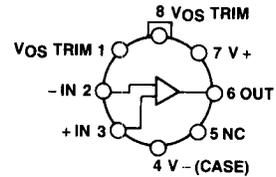
TO-99 (Suffix J)



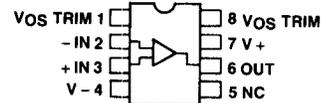
ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±22V
Internal Power Dissipation ¹	500 mW
Input Voltage ³	±22V
Output Short Circuit Duration	Indefinite
Differential Input Voltage ²	±0.7V
Differential Input Current ²	±25 mA
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	
A, B, C	-55°C to +125°C
E, F, G	-25°C to +85°C
Lead Temperature Range (Soldering, 60 sec)	300°C

PIN CONFIGURATION (Top View)



TO-99 (Suffix J)



8-PIN PLASTIC MINI DIP (Suffix P)

8-PIN CERDIP (Suffix Z)

NOTES:

1. Maximum Package Power Dissipation vs. Ambient Temperature:

PACKAGE TYPE	MAXIMUM AMBIENT TEMPERATURE FOR RATING	DERATE ABOVE MAXIMUM AMBIENT TEMPERATURE
TO-99 (J)	80°C	7.1 mW/°C
Hermetic 8-Pin Cerdip (Z)	75°C	6.7 mW/°C
Plastic 8-Pin Mini-Dip (P)	36°C	5.6 mW/°C

2. The inputs are protected by back-to-back diodes. Current limiting resistors are not used in order to achieve low noise. If differential input voltage exceeds ±0.7V, the input current should be limited to 25 mA.

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

AC ELECTRICAL CHARACTERISTICS

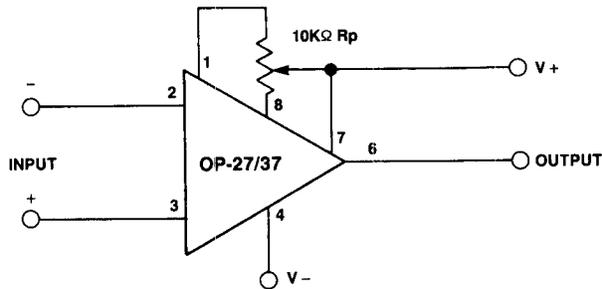
T_A = +25°C and V_S = ±15V unless otherwise noted.

PARAMETER	TEST CONDITIONS	HS OP-27/37 A/E			HS OP-27/37 B/F			HS OP-27/37 C/G			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Slew Rate	R _L ≥ 2KΩ (OP-27)	1.7	2.8	—	1.7	2.8	—	1.7	2.8	—	V/μS
	R _L ≥ 2KΩ (OP-37)	11.0	17.0	—	11.0	17.0	—	11.0	17.0	—	
Gain Bandwidth Product	OP-27	5.0	8.0	—	5.0	8.0	—	5.0	8.0	—	MHz
	OP-37 f _o = 10 kHz	45	63	—	45	63	—	45	63	—	
	f _o = 1 MHz	—	40	—	—	40	—	—	40	—	
Input Noise Voltage	0.1 Hz to 10 Hz	—	0.08	0.18	—	0.08	0.18	—	0.09	0.25	μVp-p
Input Noise Voltage Density	f _o = 10 Hz	—	3.5	5.5	—	3.5	5.5	—	3.8	8.0	nV/√Hz
	f _o = 30 Hz	—	3.1	4.5	—	3.1	4.5	—	3.3	5.6	
	f _o = 1000 Hz	—	3.0	3.8	—	3.0	3.8	—	3.2	4.5	
Input Noise Current Density	f _o = 10 Hz	—	1.7	4.0	—	1.7	4.0	—	1.7	—	pA/√Hz
	f _o = 30 Hz	—	1.0	2.3	—	1.0	2.3	—	1.0	—	
	f _o = 1000 Hz	—	0.4	0.6	—	0.4	0.6	—	0.4	0.6	

NOTES:

- Input offset voltage measurements are performed by automated test equipment approximately 0.5 seconds after application of power. A/E grades guaranteed fully warmed up.
- Long term input offset voltage stability refers to the average 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 days are typically 2.5 μV.

OFFSET NULLING CIRCUIT



ORDERING INFORMATION

HS OP-27 ORDERING GUIDE

MODEL	PACKAGE	MAXIMUM INITIAL OFFSET (μV)	MAXIMUM OFFSET DRIFT (μV/°C)
HS OP-27AJ*	TO-99	25	0.6
HS OP-27AZ*	CERDIP	25	0.6
HS OP-27BJ*	TO-99	60	1.3
HS OP-27BZ*	CERDIP	60	1.3
HS OP-27CJ*	TO-99	100	1.8
HS OP-27CZ*	CERDIP	100	1.8
HS OP-27EJ	TO-99	25	0.6
HS OP-27EP	MINI DIP	25	0.6
HS OP-27EZ	CERDIP	25	0.6
HS OP-27FJ	TO-99	60	1.3
HS OP-27FP	MINI DIP	60	1.3
HS OP-27FZ	CERDIP	60	1.3
HS OP-27GJ	TO-99	100	1.8
HS OP-27GP	MINI DIP	100	1.8
HS OP-27GZ	CERDIP	100	1.8

*/883 for MIL-STD-883 screening.

HS OP-37 ORDERING GUIDE

MODEL	PACKAGE	MAXIMUM INITIAL OFFSET (μV)	MAXIMUM OFFSET DRIFT (μV/°C)
HS OP-37AJ*	TO-99	25	0.6
HS OP-37AZ*	CERDIP	25	0.6
HS OP-37BJ*	TO-99	60	1.3
HS OP-37BZ*	CERDIP	60	1.3
HS OP-37CJ*	TO-99	100	1.8
HS OP-37CZ*	CERDIP	100	1.8
HS OP-37EJ	TO-99	25	0.6
HS OP-37EP	MINI DIP	25	0.6
HS OP-37EZ	CERDIP	25	0.6
HS OP-37FJ	TO-99	60	1.3
HS OP-37FP	MINI DIP	60	1.3
HS OP-37FZ	CERDIP	60	1.3
HS OP-37GJ	TO-99	100	1.8
HS OP-37GP	MINI DIP	100	1.8
HS OP-37GZ	CERDIP	100	1.8

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