



National
Semiconductor
Corporation

LH0004/LH0004C High Voltage Operational Amplifier

General Description

The LH0004/LH0004C is a general purpose operational amplifier designed to operate from supply voltages up to $\pm 40\text{V}$. The device dissipates extremely low quiescent power, typically 8 mW at 25°C and $V_S = \pm 40\text{V}$.

The LH0004's high gain and wide range of operating voltages make it ideal for applications requiring large output swing and low power dissipation.

The LH0004 is specified for operation over the -55°C to $+125^\circ\text{C}$ military temperature range. The LH0004C is specified for operation over the 0°C to $+85^\circ\text{C}$ temperature range.

Features

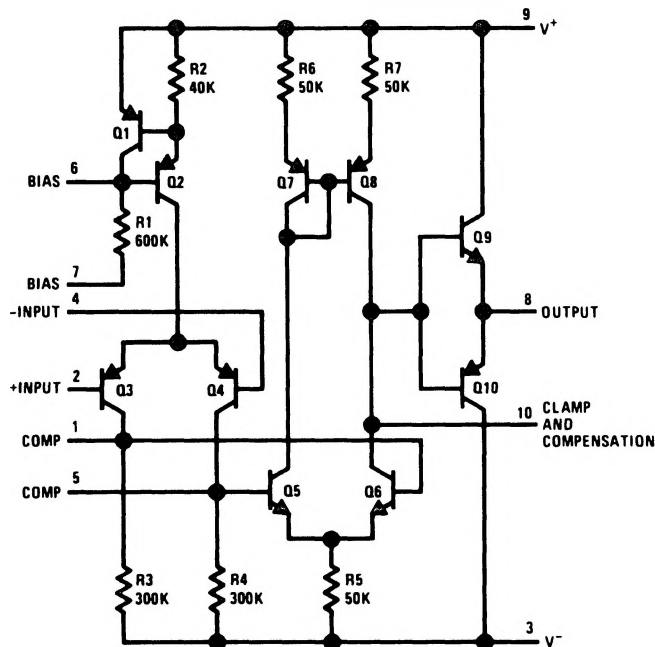
- Capable of operation over the range of $\pm 5\text{V}$ to $\pm 40\text{V}$
- Large output voltage typically $\pm 35\text{V}$ for the LH0004 and $\pm 33\text{V}$ for the LH0004C into a $2\text{ k}\Omega$ load with $\pm 40\text{V}$ supplies

- Low input offset current typically 20 nA for the LH0004 and 45 nA for the LH0004C
- Low input offset voltage typically 0.3 mV
- Frequency compensation with 2 small capacitors
- Low power consumption 8 mW at $\pm 40\text{V}$

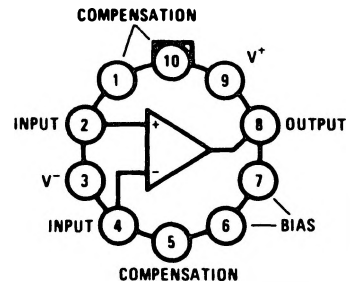
Applications

- Precision high voltage power supply
- Resolver excitation
- Wideband high voltage amplifier
- Transducer power supply

Schematic and Connection Diagrams



TL/H/5559-1



TL/H/5559-2

Note: Pin 7 must be grounded or connected to a voltage at least 5V more negative than the positive supply (Pin 9). Pin 7 may be connected to the negative supply; however, the standby current will be increased. A resistor may be inserted in series with Pin 7 to Pin 9. The value of the resistor should be a maximum of 100 k Ω per volt of potential between Pin 3 and Pin 9.

Order Number LH0004H or LH0004CH
See NS Package Number H10G

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, contact the National Semiconductor Sales Office/Distributors for availability and specifications.

(Note 2)

Supply Voltage, Continuous	±45V
Power Dissipation (see Curve)	400 mW
Differential Input Voltage	±7V
Input Voltage	Equal to Supply

Short Circuit Duration	3 sec
Operating Temperature Range	–55°C to +125°C
LH0004	0°C to +85°C
LH0004C	
Storage Temperature Range	–65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	260°C
ESD rating to be determined.	

Electrical Characteristics (Note 1)

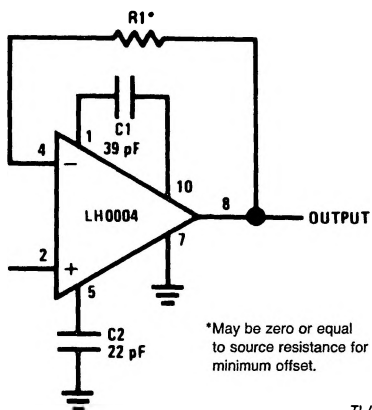
Parameter	Conditions	LH0004			LH0004C			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$R_S \leq 100\Omega$, $T_A = 25^\circ\text{C}$ $R_S \leq 100\Omega$		0.3	1.0 2.0		0.3	1.5 3.0	mV
Input Bias Current	$T_A = 25^\circ\text{C}$		20	100 300		30	120 300	nA
Input Offset Current	$T_A = 25^\circ\text{C}$		3	20 100		10	45 150	nA
Positive Supply Current	$V_S = \pm 40\text{V}$, $T_A = 25^\circ\text{C}$ $V_S = \pm 40\text{V}$		110	150 175		110	150 175	μA
Negative Supply Current	$V_S = \pm 40\text{V}$, $T_A = 25^\circ\text{C}$ $V_S = \pm 40\text{V}$		80	100 135		80	100 135	μA
Voltage Gain	$V_S = \pm 40\text{V}$, $R_L = 100\text{k}$, $T_A = 25^\circ\text{C}$ $V_{\text{OUT}} = \pm 30\text{V}$	30	60		30	60		V/mV
	$V_S = \pm 40\text{V}$, $R_L = 100\text{k}$ $V_{\text{OUT}} = \pm 30\text{V}$	10			10			V/mV
Output Voltage	$V_S = \pm 40\text{V}$, $R_L = 10\text{k}$	±30	±35		±30	±33		V
CMRR	$V_S = \pm 40\text{V}$, $R_S \leq 5\text{k}$ $V_{\text{IN}} = \pm 33\text{V}$	70	90		70	90		dB
PSRR	$V_S = \pm 40\text{V}$, $R_S \leq 5\text{k}$ $\Delta V = 20\text{V to } 40\text{V}$	70	90		70	90		dB
Average Temperature Coefficient Offset Voltage	$R_S \leq 100\Omega$		4.0			4.0		$\mu\text{V}/^\circ\text{C}$
Average Temperature Coefficient of Offset Current			0.4			0.4		nA/ $^\circ\text{C}$
Equivalent Input Noise Voltage	$R_S = 100\Omega$, $V_S = \pm 40\text{V}$ $f = 500\text{ Hz to } 5\text{ kHz}$, $T_A = 25^\circ\text{C}$		3.0			3.0		μVrms

Note 1: These specifications apply for $\pm 5\text{V} \leq V_S \leq \pm 40\text{V}$, Pin 7 grounded, with capacitors $C_1 = 39\text{ pF}$ between Pin 1 and Pin 10, $C_2 = 22\text{ pF}$ between Pin 5 and ground, -55°C to $+125^\circ\text{C}$ for the LH0004, and 0°C to $+85^\circ\text{C}$ for the LH0004C unless otherwise specified.

Note 2: Refer to RETS0004X for LH0004H military specifications.

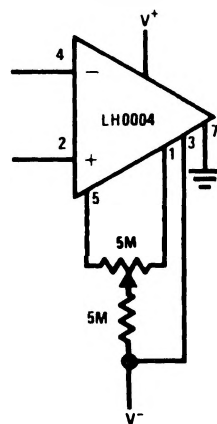
Typical Applications

Voltage Follower



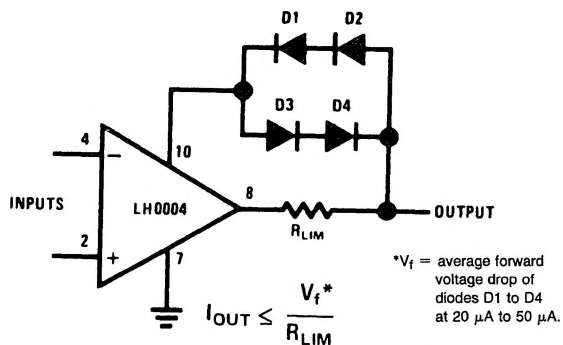
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Input Offset Voltage Adjust



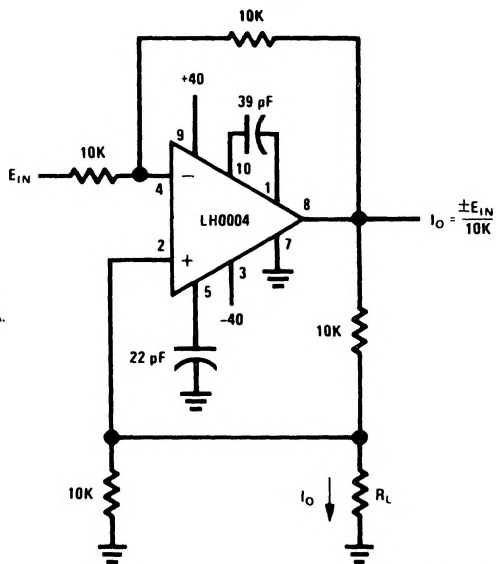
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External Current Limiting Method



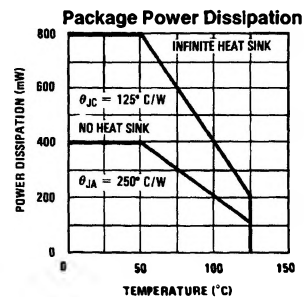
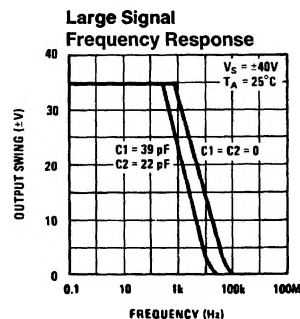
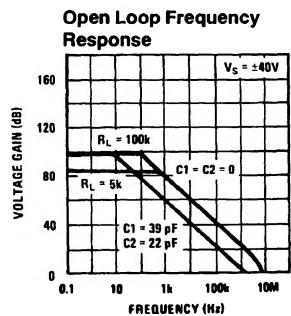
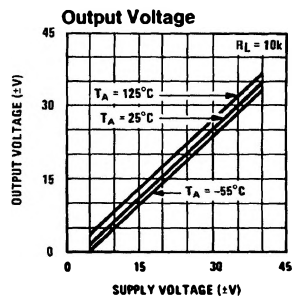
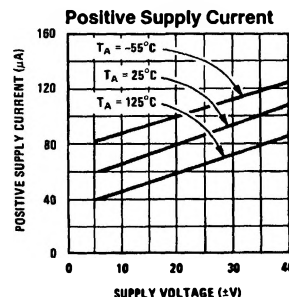
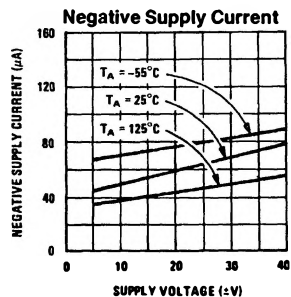
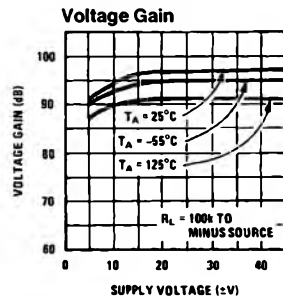
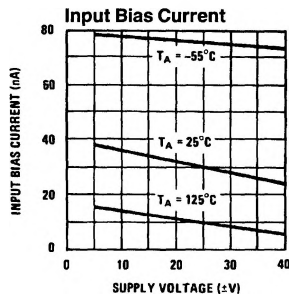
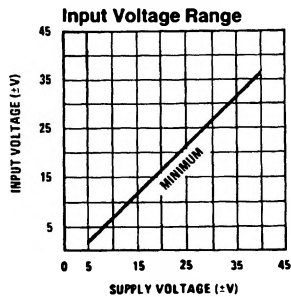
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High Compliance Current Source



TL/H/5559-6

Typical Performance Characteristics



TL/H/5559-7