Operational Amplifiers

LH0062/LH0062C high speed FET op amp

general description

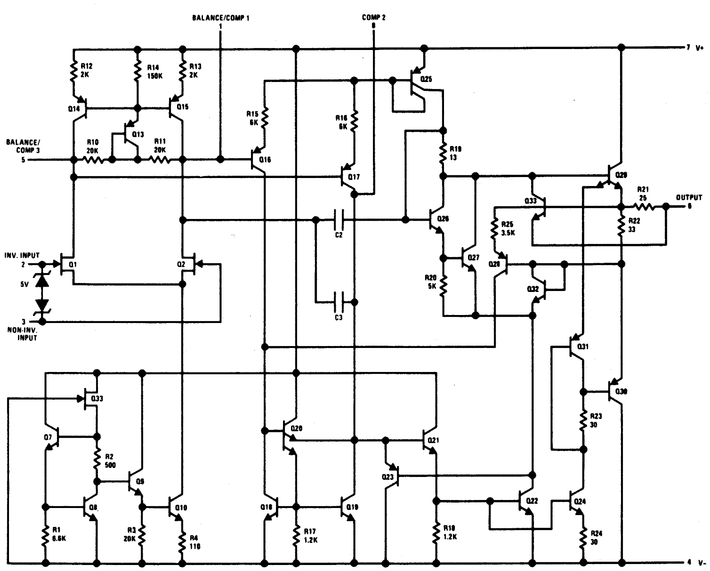
The LH0062/LH0062C is a precision, high speed FET input operational amplifier with more than an order of magnitude improvement in slew rate and bandwidth over conventional FET IC op amps. In addition it features very closely matched input characteristics, very high input impedance, and ultra low input currents with no compromise in noise, common mode rejection ratio or open loop gain. The device has internal unity gain frequency compensation, thus assuring stability in all normal applications. This considerably simplifies its application, since no external components are necessary for operation. However, unlike most internally compensated amplifiers, external frequency compensation may be added for optimum performance. For inverting applications, feed-forward compensation will boost the slew rate to over 120 V/µs and almost double the bandwidth. (See LB-2, LB-14, and LB-17 for discussions of the application of feed-forward techniques). Overcompensation can be used with the amplifier for greater stability when maximum bandwidth is not needed. Further, a single capacitor can be added to reduce the 0.1% settling time to under 1 µs. In addition it is free of latch-up and may be simply offset nulled with negligible effect on offset drift or CMRR.

The LH0062 is designed for applications requiring wide bandwidth, high slew rate and fast settling time while at the same time demanding the high input impedance and low input currents characteristic of FET inputs. Thus it is particularly suited for such applications as video amplifiers, sample/hold circuits, high speed integrators, and buffers for A/D conversion and multiplex system. The LH0062 is specified for the full military temperature range of −55° to +125°C while the LH0062C is specified to operate over a −25°C to +85°C temperature range.

features

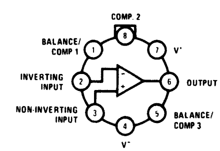
- High slew rate — 70 V/µs
- Wide bandwidth — 15 MHz
- Settling time (0.1%) — 1µs
- Low input offset voltage — 2 mV
- Low input offset current — 1 pA
- Wide supply range — ±5V to ±20V
- Internal 6 dB/octave frequency compensation
- Pin compatible with std IC op amps (TO-5 pkg)

schematic and connection diagrams*



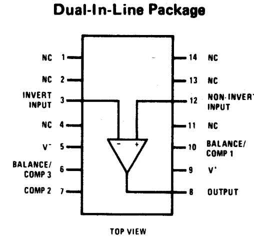
*Pin Numbers Shown for TO-5 Package

Metal Can Package



Order Number
LH0062H or LH0062CH
See Package 11

Dual-In-Line Package



Order Number
LH0062D or LH0062CD
See Package 1

absolute maximum ratings

Supply Voltage	±20V	Operating Temperature	
Power Dissipation (see graph)	500 mW	LH0062,	−55°C to +125°C
Input Voltage (Note 1)	±15V	LH0062C,	−25°C to +85°C
Differential Input Voltage (Note 2)	±30V	Storage Temperature Range	−65°C to +150°C
Short Circuit Duration	Continuous	Lead Temperature (Soldering, 10 sec)	300°C

dc electrical characteristics (Note 3)

PARAMETER	CONDITIONS	LIMITS LH0062 MIN	LH0062 TYP	LH0062 MAX	LH0062C MIN	LH0062C TYP	LH0062C MAX	UNITS
Input Offset Voltage	$R_S \leq 100\ k\Omega$; $T_A = 25°C$		2	5		10	15	mV
	$R_S \leq 100\ k\Omega$			7			20	mV
Temperature Coefficient of Input Offset Voltage	$R_S \leq 100\ k\Omega$		5	25		10	35	µV/°C
Offset Voltage Drift with Time			4			5		µV/week
Input Offset Current	$T_A = 25°C$		0.2	2		1	5	pA
				2			0.2	nA
Temperature Coefficient of Input Offset Current		Doubles every 10°C			Doubles every 10°C			
Offset Current Drift with Time			0.1			0.1		pA/week
Input Bias Current	$T_A = 25°C$		5	10		10	65	pA
				10			2	nA
Temperature Coefficient of Input Bias Current		Doubles every 10°C			Doubles every 10°C			
Differential Input Resistance			10^{12}			10^{12}		Ω
Common Mode Input Resistance			10^{12}			10^{12}		Ω
Input Capacitance			4			4		pF
Input Voltage Range	$V_S = \pm 15V$	±10	±12		±10	±12		V
Common Mode Rejection Ratio	$R_S \leq 10\ k\Omega$, $V_{IN} = \pm 10V$	80	90		70	90		dB
Supply Voltage Rejection Ratio	$R_S \leq 10\ k\Omega$, $\pm 5V \leq V_S \leq \pm 15V$	80	90		70	90		dB
Large Signal Voltage Gain	$R_L = 2\ k\Omega$, $V_{OUT} = \pm 10V$, $T_A = 25°C$, $V_S = \pm 15V$	50	200		25	160		V/mV
	$R_L = 2\ k\Omega$, $V_{OUT} = \pm 10V$, $V_S = \pm 15V$	25			25			V/mV
Output Voltage Swing	$R_L = 2\ k\Omega$, $T_A = 25°C$, $V_S = \pm 15V$	±12	±13		±12	±13		V
	$R_L = 2\ k\Omega$, $V_S = \pm 15V$	±10			±10			V
Output Current Swing	$V_{OUT} = \pm 10V$, $T_A = 25°C$	±10	±15		±10	±15		mA
Output Resistance			75			75		Ω
Output Short Circuit Current	$T_A = 25°C$		25			25		mA
Supply Current	$V_S = \pm 15V$		5	8		7	12	mA
Power Consumption	$V_S = \pm 15V$			240			360	mW

ac electrical characteristics ($T_A = 25°C$, $V_S = \pm 15V$)

PARAMETER	CONDITIONS	LIMITS LH0062 MIN	LH0062 TYP	LH0062 MAX	LH0062C MIN	LH0062C TYP	LH0062C MAX	UNITS
Slew Rate	Voltage Follower	50	70		50	70		V/µs
Large Signal Bandwidth	Voltage Follower		2			2		MHz
Small Signal Bandwidth			15			15		MHz
Rise Time			25			25		ns
Overshoot			10			15		%
Settling Time (0.1%)	$\Delta V_{IN} = 10V$		1			1		µs
Overload Recovery			0.9			0.9		µs
Input Noise Voltage	$R_S = 10\ k\Omega$, $f_o = 10\ Hz$		150			150		$nV/\sqrt{Hz}$
Input Noise Voltage	$R_S = 10\ k\Omega$, $f_o = 100\ Hz$		55			55		$nV/\sqrt{Hz}$
Input Noise Voltage	$R_S = 10\ k\Omega$, $f_o = 1\ kHz$		35			35		$nV/\sqrt{Hz}$
Input Noise Voltage	$R_S = 10\ k\Omega$, $f_o = 10\ kHz$		30			30		$nV/\sqrt{Hz}$
Input Noise Voltage	BW = 10 Hz to 10 kHz, $R_S = 10\ k\Omega$		12			12		µVrms
Input Noise Current	BW = 10 Hz to 10 kHz		<.1			<.1		pArms

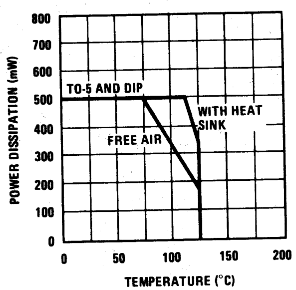
Note 1: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 2: Rating applies for minimum source resistance of 10 kΩ, for source resistances less than 10 kΩ, maximum differential input voltage is ±5V.

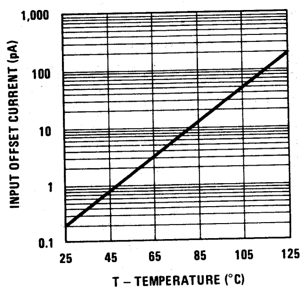
Note 3: Unless otherwise specified, these specifications apply for $\pm 5V \leq V_S \leq \pm 20V$ and $-55°C \leq T_A \leq +125°C$ for the LH0062 and $-25°C \leq T_A \leq +85°C$ for LH0062C. Typical values are given for $T_A = 25°C$. Power supplies should be bypassed with 0.1 µF ceramic capacitors.

typical performance characteristics

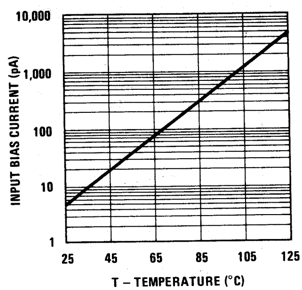
Maximum Power Dissipation



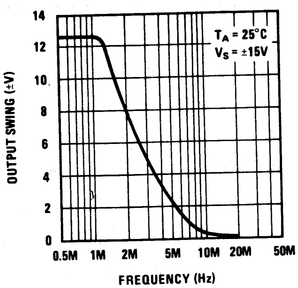
Input Offset Current vs Temperature



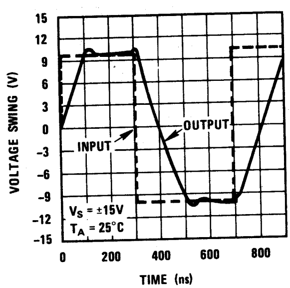
Input Bias Current vs Temperature



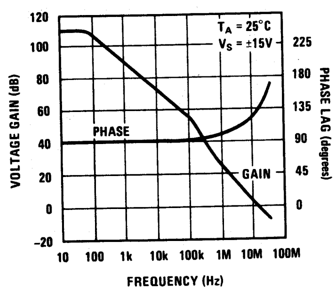
Large Signal Frequency Response



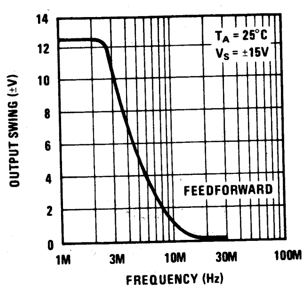
Voltage Follower Pulse Response



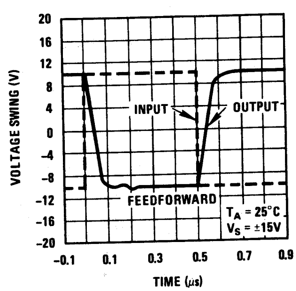
Open Loop Frequency Response



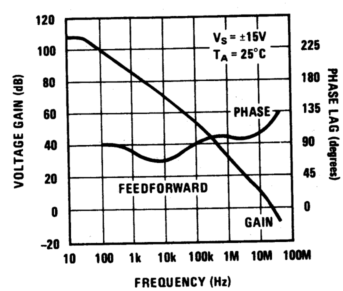
Large Signal Frequency Response



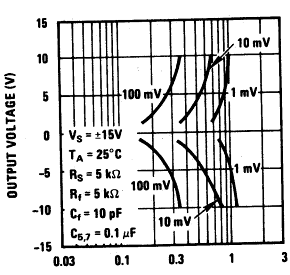
Inverter Pulse Response



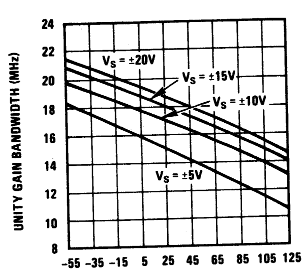
Open Loop Frequency Response



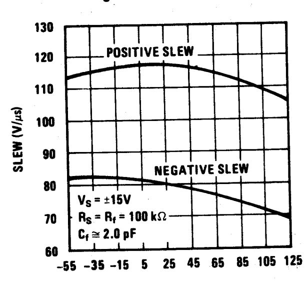
Inverter Settling Time



Unity Gain Bandwidth

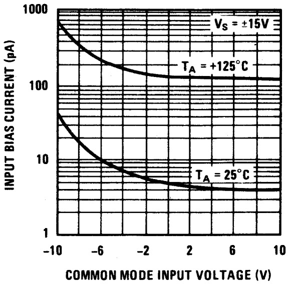


Voltage Follower Slew Rate

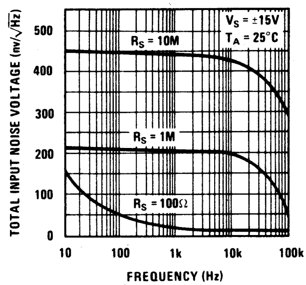


typical performance characteristics (con't)

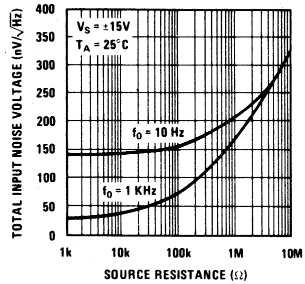
Input Bias Current vs Input Voltage



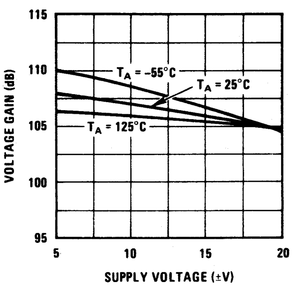
Total Input Noise Voltage* vs Frequency



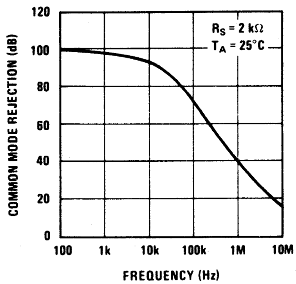
Total Input Noise Voltage* vs Source Resistance



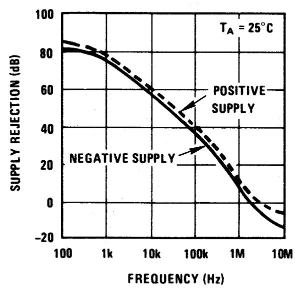
Voltage Gain



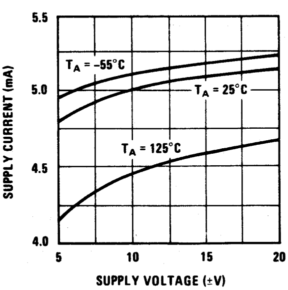
Common Mode Rejection



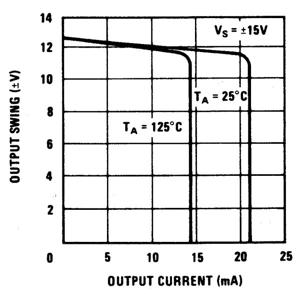
Power Supply Rejection



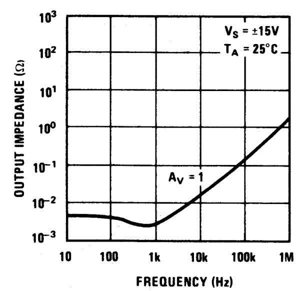
Supply Current



Current Limiting



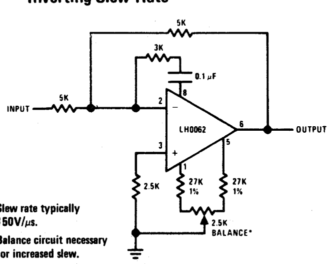
Closed Loop Output Impedance



*Noise Voltage Includes Contribution from Source Resistance

auxiliary circuits

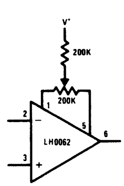
Feedforward Compensation for Greater Inverting Slew Rate†



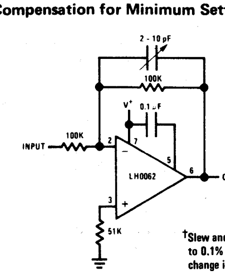
†Slew rate typically 150V/µs.

*Balance circuit necessary for increased slew.

Offset Balancing



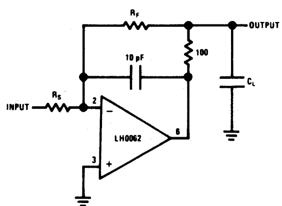
Compensation for Minimum Settling† Time



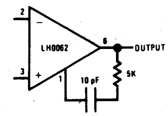
†Slew and settling time to 0.1% for a 10V step change is 800 ns.

auxiliary circuits (con't)

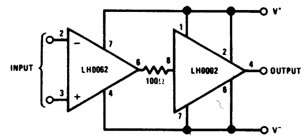
Isolating Large Capacitive Loads



Overcompensation

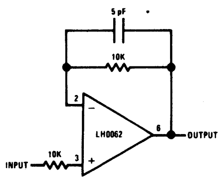


Boosting Output Drive to ±100 mA

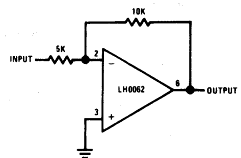


typical applications*

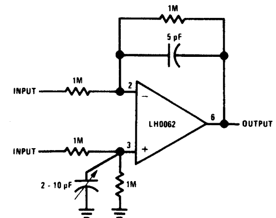
Fast Voltage Follower



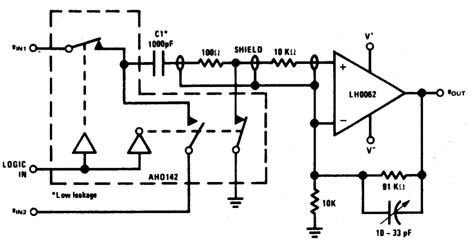
Fast Summing Amplifier



Differential Amplifier

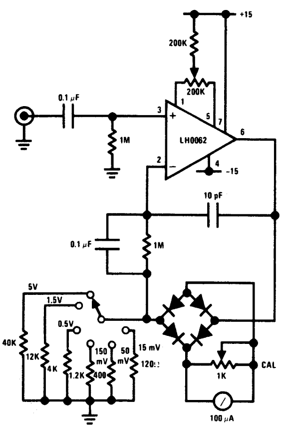


High Speed Subtractor

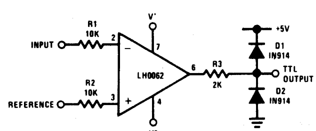


$e_{OUT} = 10 \times (e_{IN1} - e_{IN2})$

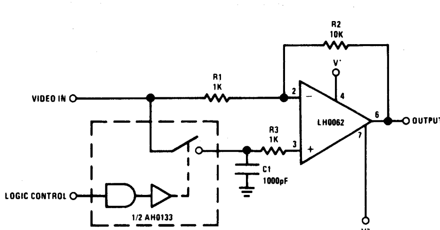
Wide Range AC Voltmeter



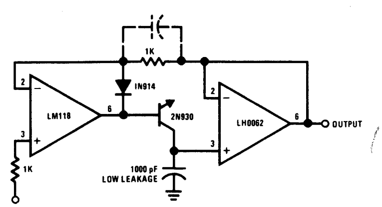
Fast Precision Voltage Comparator



Video DC Restoring Amplifier



High Speed Positive Peak Detector



*Pin numbers shown for TO-5 package