Operational Amplifiers

LM118/LM218 operational amplifier

general description

The LM118 and LM218 are precision high speed operational amplifiers designed for applications requiring wide bandwidth and high slew rate. They feature a factor of ten increase in speed over general purpose devices without sacrificing DC performance.

features

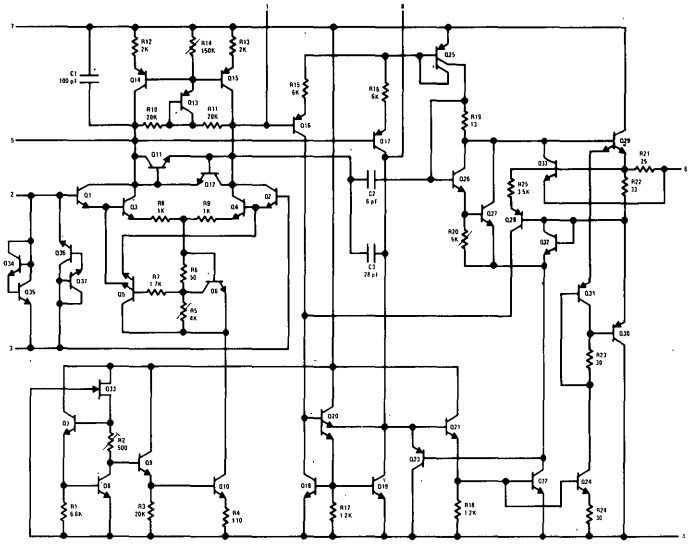
- 15 MHz small signal bandwidth
- Guaranteed 50V/μs slew rate
- Maximum bias current of 250 nA
- Operates from supplies of ±5V to ±20V
- Internal frequency compensation
- Input and output overload protected
- Pin compatible with general purpose op amps

The LM118 has internal unity gain frequency compensation. 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, feedforward compensation will boost the slew rate to over 150V/μs and almost double the bandwidth. 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.

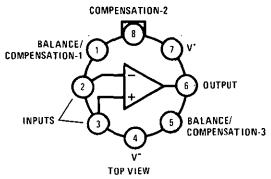
The high speed and fast settling time of these op amps make them useful in A/D converters, oscillators, active filters, sample and hold circuits, or general purpose amplifiers. These devices are easy to apply and offer an order of magnitude better AC performance than industry standards such as the LM709.

The LM218 is identical to the LM118 except that the LM218 has its performance specified over a −25°C to 85°C temperature range, instead of −55°C to 125°C.

schematic diagram and connection diagrams

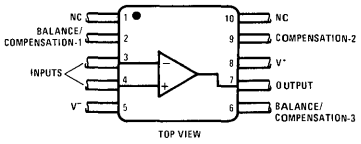


Metal Can Package*



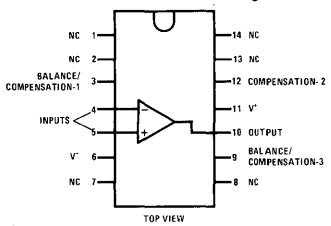
Order Number LM118H or LM218H
See Package 11

Flat Package



Order Number LM118F or LM218F
See Package 3

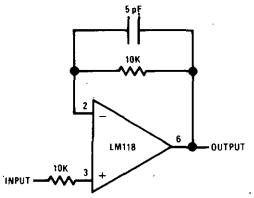
Dual-In-Line Package



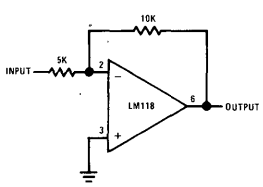
*Pin connections shown on schematic diagram and typical applications are for TO-5 package.

Order Number LM118D or LM218D
See Package 1

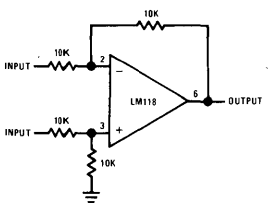
typical applications



Fast Voltage Follower



Fast Summing Amplifier



Differential Amplifier

absolute maximum ratings

Supply Voltage	±20V
Power Dissipation (Note 1)	500 mW
Differential Input Current (Note 2)	±10 mA
Input Voltage (Note 3)	±15V
Output Short-Circuit Duration	Indefinite
Operating Temperature Range LM118	−55°C to 125°C
LM218	−25°C to 85°C
Storage Temperature Range	−65°C to 150°C
Lead Temperature (Soldering, 60 sec)	300°C

electrical characteristics (Note 4)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$T_A = 25°C$		2	4	mV
Input Offset Current	$T_A = 25°C$		6	50	nA
Input Bias Current	$T_A = 25°C$		120	250	nA
Input Resistance	$T_A = 25°C$	1	3		MΩ
Supply Current	$T_A = 25°C$		5	8	mA
Large Signal Voltage Gain	$T_A = 25°C$, $V_S = ±15V$ $V_{OUT} = ±10V$, $R_L \geq 2\ k\Omega$	50	200		V/mV
Slew Rate	$T_A = 25°C$, $V_S = ±15V$, $A_V = 1$	50	70		V/μs
Small Signal Bandwidth	$T_A = 25°C$, $V_S = ±15V$		15		MHz
Input Offset Voltage				6	mV
Input Offset Current				100	nA
Input Bias Current				500	nA
Supply Current	$T_A = +125°C$		4.5	7	mA
Large Signal Voltage Gain	$V_S = ±15V$, $V_{OUT} = ±10V$ $R_L \geq 2\ k\Omega$	25			V/mV
Output Voltage Swing	$V_S = ±15V$, $R_L = 2\ k\Omega$	±12	±13		V
Input Voltage Range	$V_S = ±15V$	±11.5			V
Common Mode Rejection Ratio		80	100		dB
Supply Voltage Rejection Ratio		70	80		dB

Note 1: The maximum junction temperature of the LM118 is 150°C, while that of the LM218 is 100°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. For the flat package, the derating is based on a thermal resistance of 185°C/W when mounted on a 1/16-inch-thick epoxy glass board with ten, 0.03-inch-wide, 2-ounce copper conductors. The thermal resistance of the dual-in-line package is 100°C/W, junction to ambient.

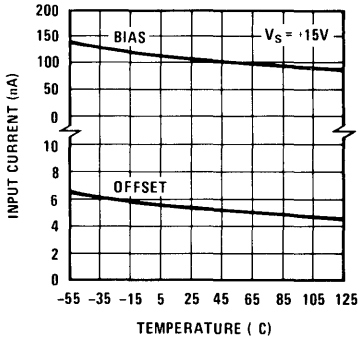
Note 2: The inputs are shunted with back-to-back diodes for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs unless some limiting resistance is used.

Note 3: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

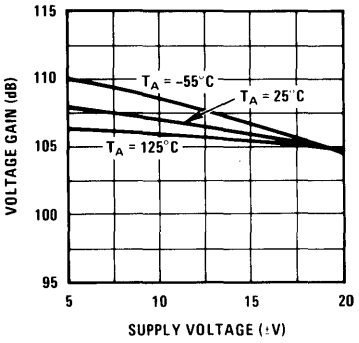
Note 4: These specifications apply for $±5V \leq V_S \leq ±20V$ and $-55°C \leq T_A \leq 125°C$, unless otherwise specified. With the LM218, however, all temperature specifications are limited to $-25°C \leq T_A \leq 85°C$. Also, power supplies must be bypassed with 0.1 μF disc capacitors.

typical performance characteristics

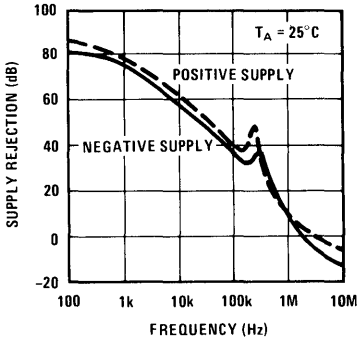
Input Current



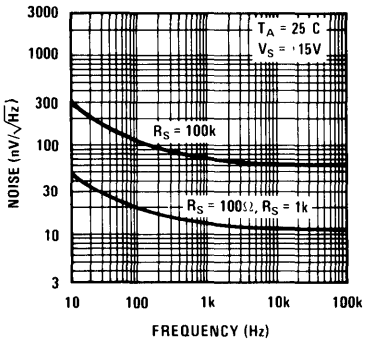
Voltage Gain



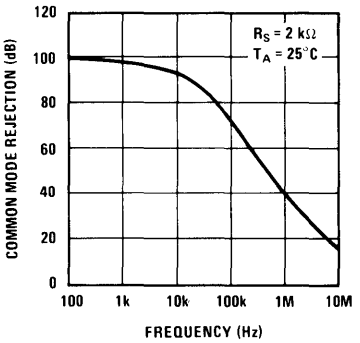
Power Supply Rejection



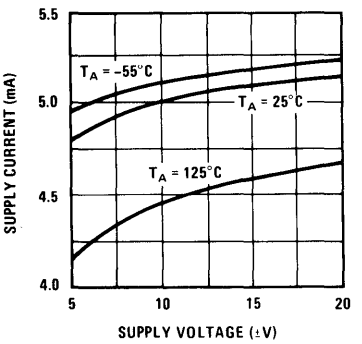
Input Noise Voltage



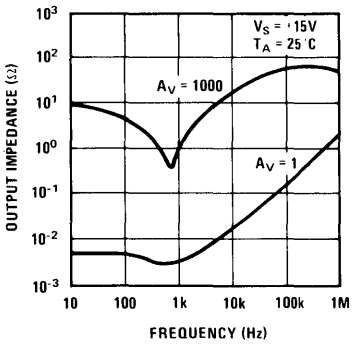
Common Mode Rejection



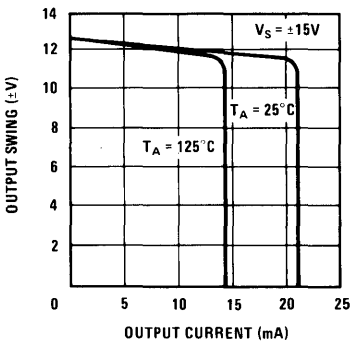
Supply Current



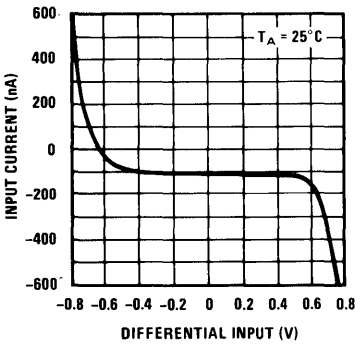
Closed Loop Output Impedance



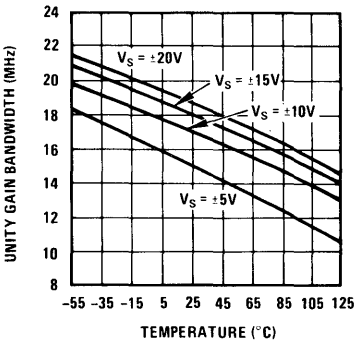
Current Limiting



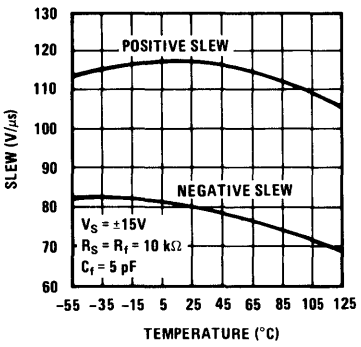
Input Current



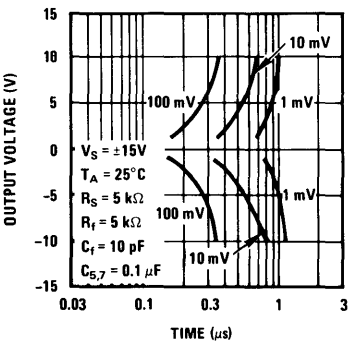
Unity Gain Bandwidth



Voltage Follower Slew Rate

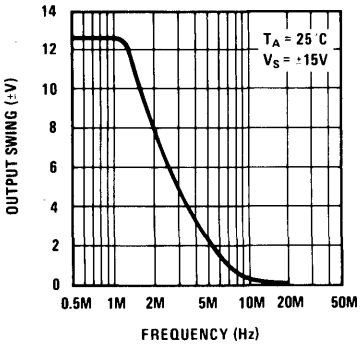


Inverter Settling Time

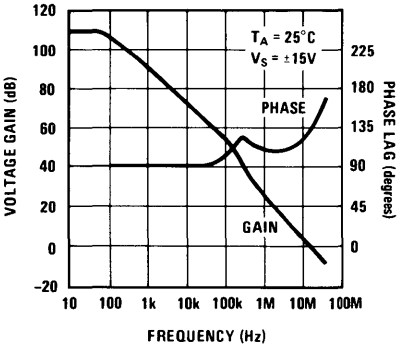


typical performance characteristics (con't)

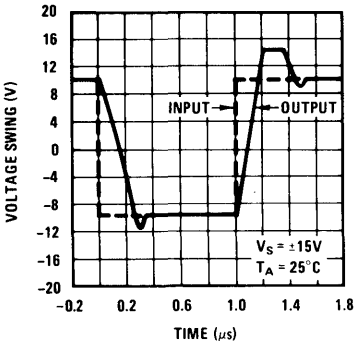
Large Signal Frequency Response



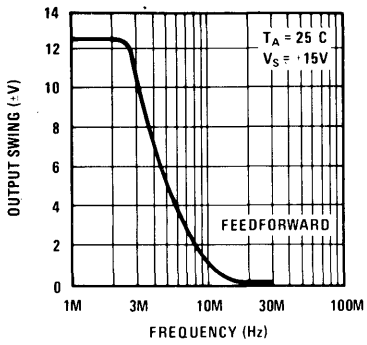
Open Loop Frequency Response



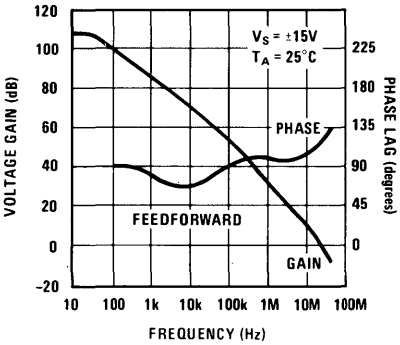
Voltage Follower Pulse Response



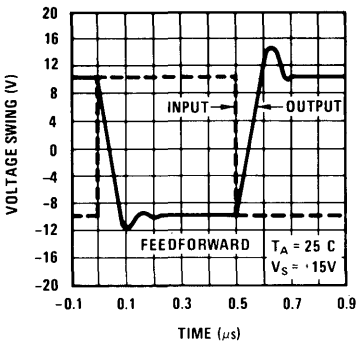
Large Signal Frequency Response



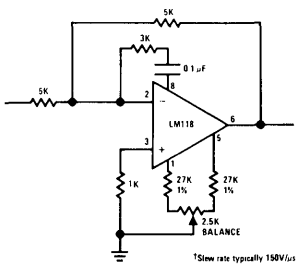
Open Loop Frequency Response



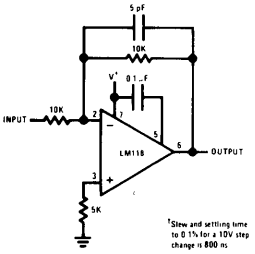
Inverter Pulse Response



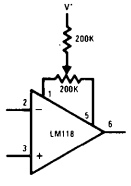
auxiliary circuits



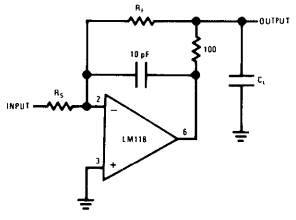
Feedforward Compensation for Greater Inverting Slew Rate†



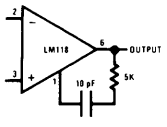
Compensation for Minimum Settling† Time



Offset Balancing

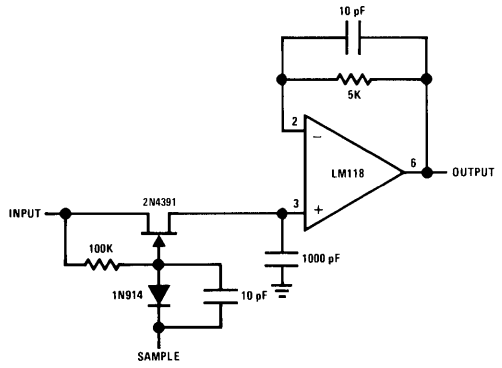


Isolating Large Capacitive Loads

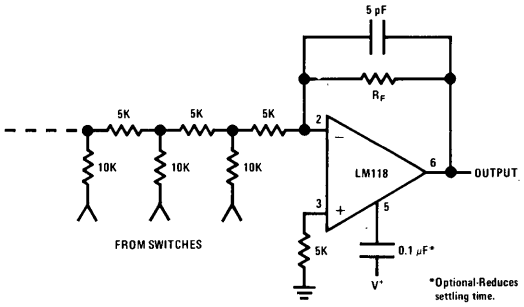


Overcompensation

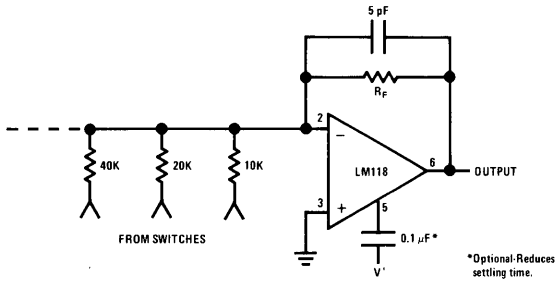
typical applications (con't)



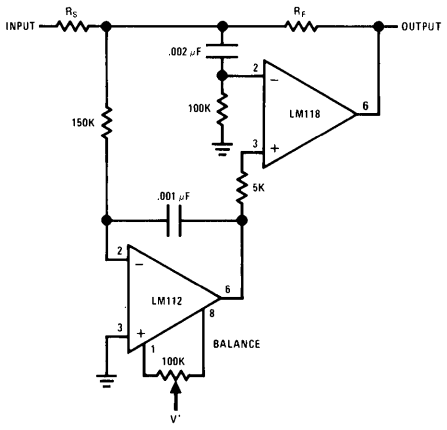
Fast Sample and Hold



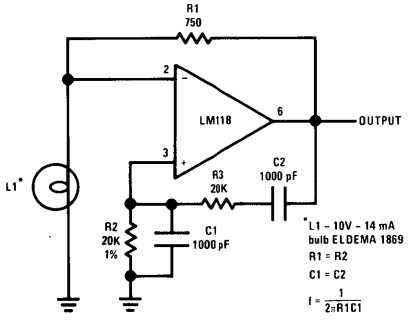
D/A Converter Using Ladder Network



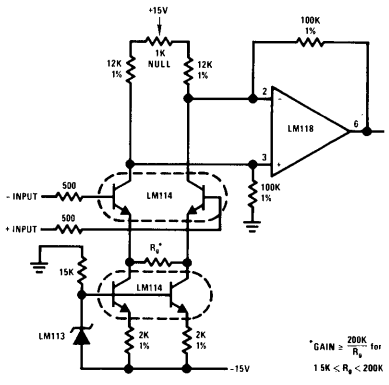
D/A Converter Using Binary Weighted Network



Fast Summing Amplifier with Low Input Current



Wein Bridge Sine Wave Oscillator



Instrumentation Amplifier

Operational Amplifiers

LM318 operational amplifier

general description

The LM318 is a precision high speed operational amplifier designed for applications requiring wide bandwidth and high slew rate. It features a factor of ten increase in speed over general purpose devices without sacrificing DC performance.

features

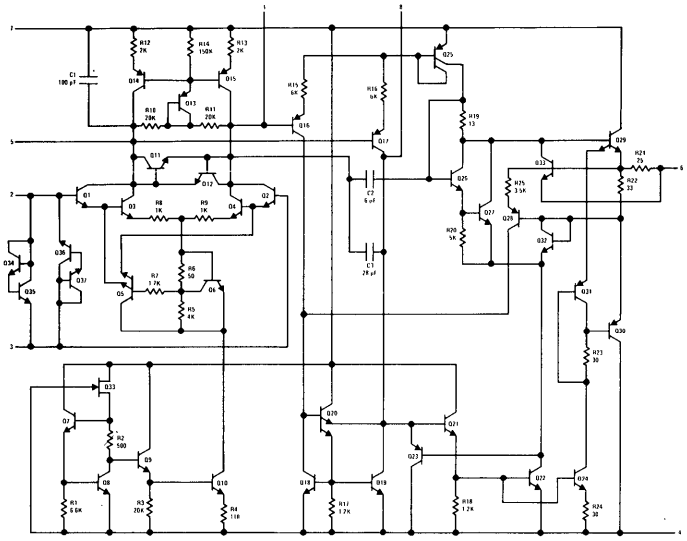
- 15 MHz small signal bandwidth
- Guaranteed 50V/μs slew rate
- Maximum bias current of 500 nA
- Operates from supplies of ±5V to ±20V
- Internal frequency compensation
- Input and output overload protected
- Pin compatible with general purpose op amps

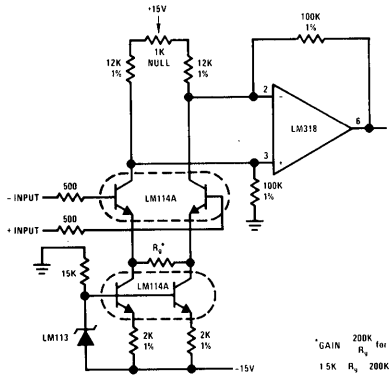
The LM318 has internal unity gain frequency compensation. This considerably simplifies its application since no external components are necessary for operation. However, unlike most internally compensated amplifiers, external frequency compensation may be added for optimum performance. For inverting applications, feedforward compensation will boost the slew rate to over 150V/μs and almost double the bandwidth. 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.

The high speed and fast settling time of these op amps make them useful in A/D converters, oscillators, active filters, sample and hold circuits, or general purpose amplifiers. These devices are easy to apply and offer an order of magnitude better AC performance than industry standards such as the LM709.

The LM318 is specified for operation over 0°C to 70°C.

schematic diagram and typical applications

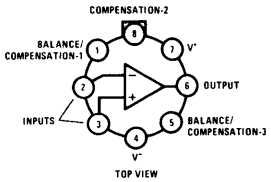




Instrumentation Amplifier

connection diagrams

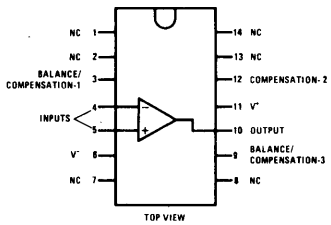
Metal Can Package*



***Pin connections shown on schematic diagram and typical applications are for TO-5 package.**

Order Number LM318H
See Package 11

Dual-In-Line Package



Order Number LM318D
See Package 1

absolute maximum ratings

Supply Voltage	±20V
Power Dissipation (Note 1)	500 mW
Differential Input Current (Note 2)	±10 mA
Input Voltage (Note 3)	±15V
Output Short-Circuit Duration	Indefinite
Operating Temperature Range	0°C to 70°C
Storage Temperature Range	−65°C to 150°C
Lead Temperature (Soldering, 60 sec)	300°C

electrical characteristics (Note 4)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	$T_A = 25°C$		4	10	mV
Input Offset Current	$T_A = 25°C$		30	200	nA
Input Bias Current	$T_A = 25°C$		150	500	nA
Input Resistance	$T_A = 25°C$	0.5	3		MΩ
Supply Current	$T_A = 25°C$		5	10	mA
Large Signal Voltage Gain	$T_A = 25°C$, $V_S = ±15V$ $V_{OUT} = ±10V$, $R_L \geq 2\ k\Omega$	25	200		V/mV
Slew Rate	$T_A = 25°C$, $V_S = ±15V$, $A_V = 1$	50	70		V/μs
Small Signal Bandwidth	$T_A = 25°C$, $V_S = ±15V$		15		MHz
Input Offset Voltage				15	mV
Input Offset Current				300	nA
Input Bias Current				750	nA
Large Signal Voltage Gain	$V_S = ±15V$, $V_{OUT} = ±10V$ $R_L \geq 2\ k\Omega$	20			V/mV
Output Voltage Swing	$V_S = ±15V$, $R_L = 2\ k\Omega$	±12	±13		V
Input Voltage Range	$V_S = ±15V$	±11.5			V
Common Mode Rejection Ratio		70	100		dB
Supply Voltage Rejection Ratio		65	80		dB

Note 1: The maximum junction temperature of the LM318 is 85°C. For operating at elevated temperatures, devices in the TO-5 package must be derated based on a thermal resistance of 150°C/W, junction to ambient, or 45°C/W, junction to case. The thermal resistance of the dual-in-line package is 100°C/W, junction to ambient.

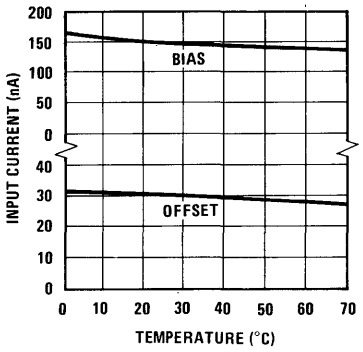
Note 2: The inputs are shunted with back-to-back diodes for overvoltage protection. Therefore, excessive current will flow if a differential input voltage in excess of 1V is applied between the inputs unless some limiting resistance is used.

Note 3: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

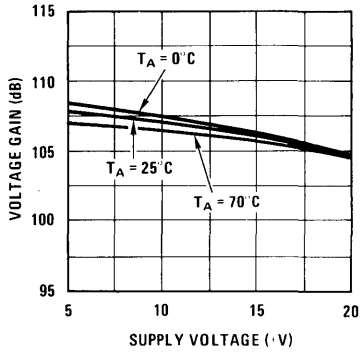
Note 4: These specifications apply for $±5V \leq V_S \leq ±20V$ and $0°C \leq T_A \leq 70°C$, unless otherwise specified. For proper operation, the power supplies must be bypassed with 0.1 μF disc capacitors.

typical performance characteristics

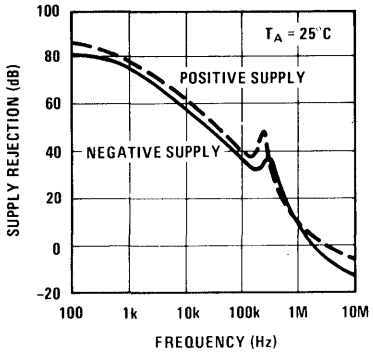
Input Current



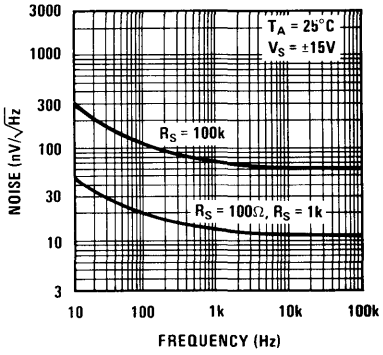
Voltage Gain



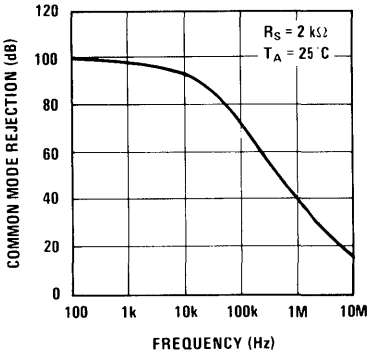
Power Supply Rejection



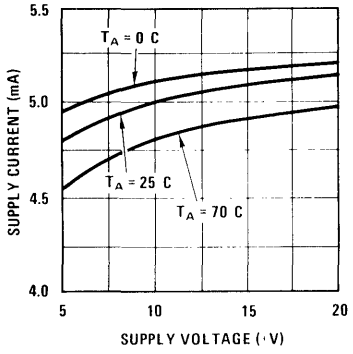
Input Noise Voltage



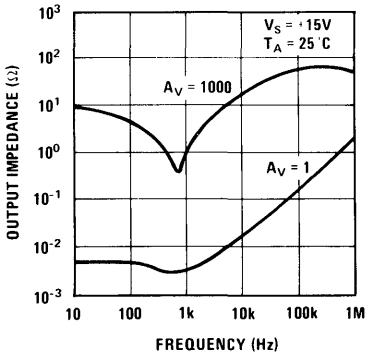
Common Mode Rejection



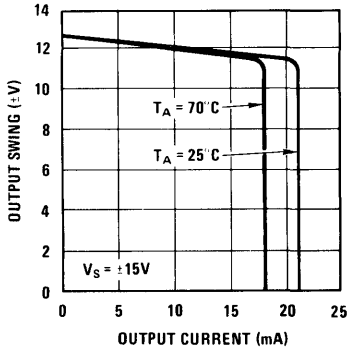
Supply Current



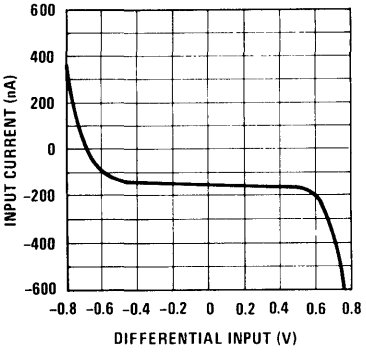
Closed Loop Output Impedance



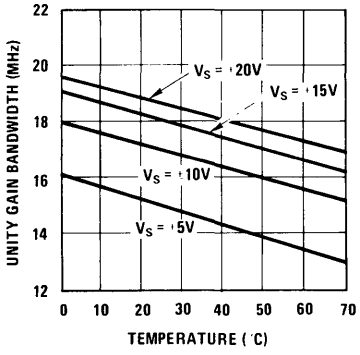
Current Limiting



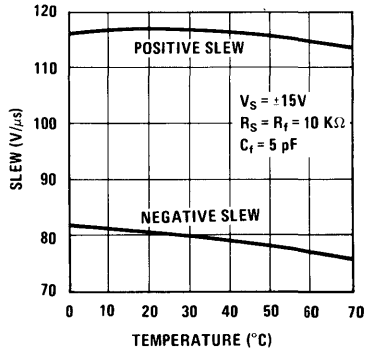
Input Current



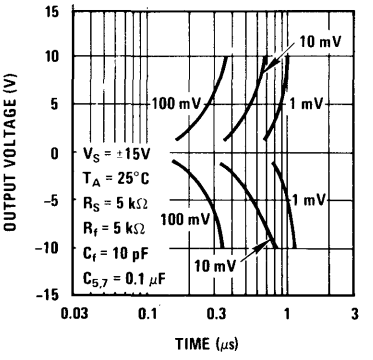
Unit Gain Bandwidth



Voltage Follower Slew Rate

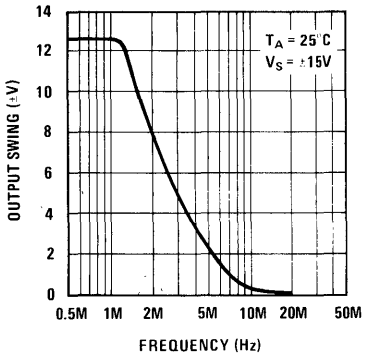


Inverter Settling Time

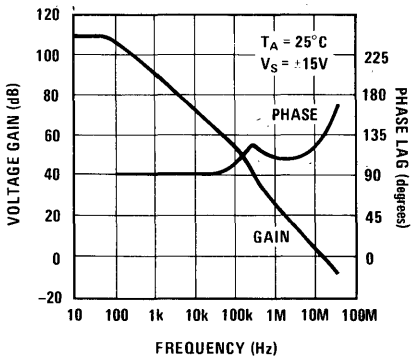


typical performance characteristics (con't)

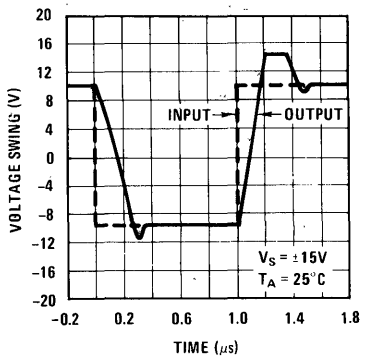
Large Signal Frequency Response



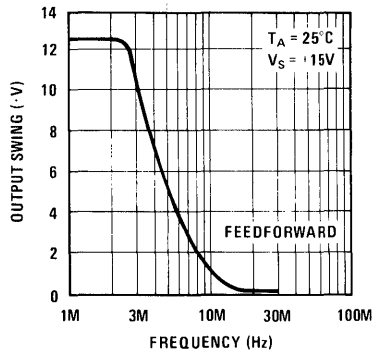
Open Loop Frequency Response



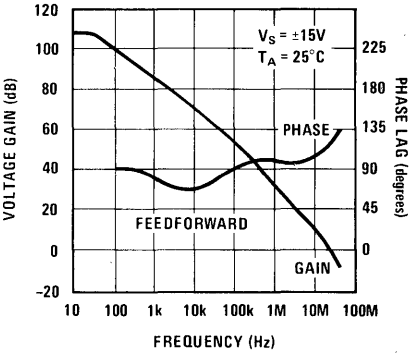
Voltage Follower Pulse Response



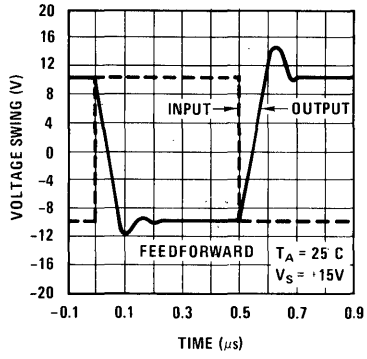
Large Signal Frequency Response



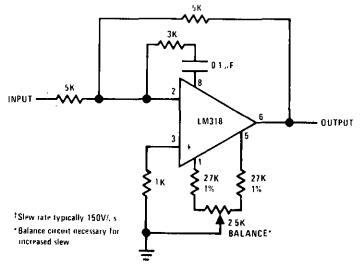
Open Loop Frequency Response



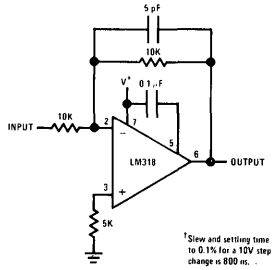
Inverter Pulse Response



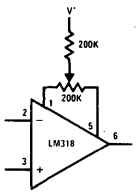
auxiliary circuits



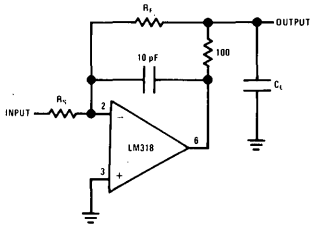
Feedforward Compensation for Greater Inverting Slew Rate†



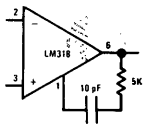
Compensation for Minimum Settling† Time



Offset Balancing

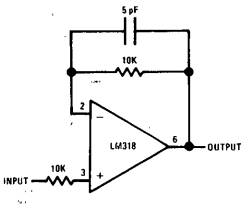


Isolating Large Capacitive Loads

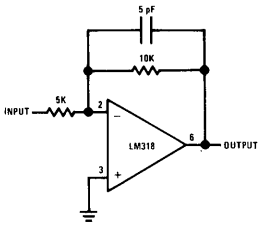


Overcompensation

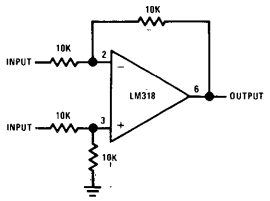
typical applications (con't)



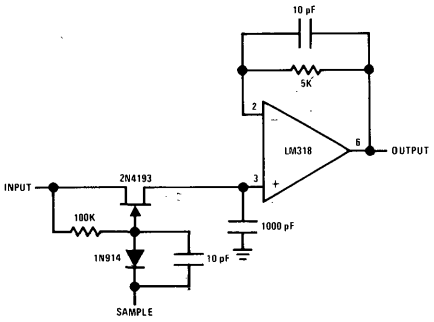
Fast Voltage Follower



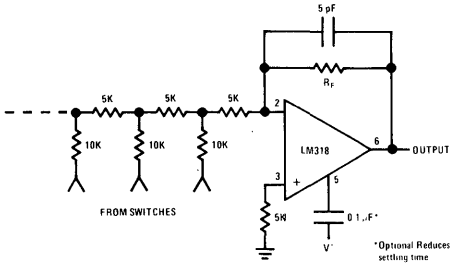
Fast Summing Amplifier



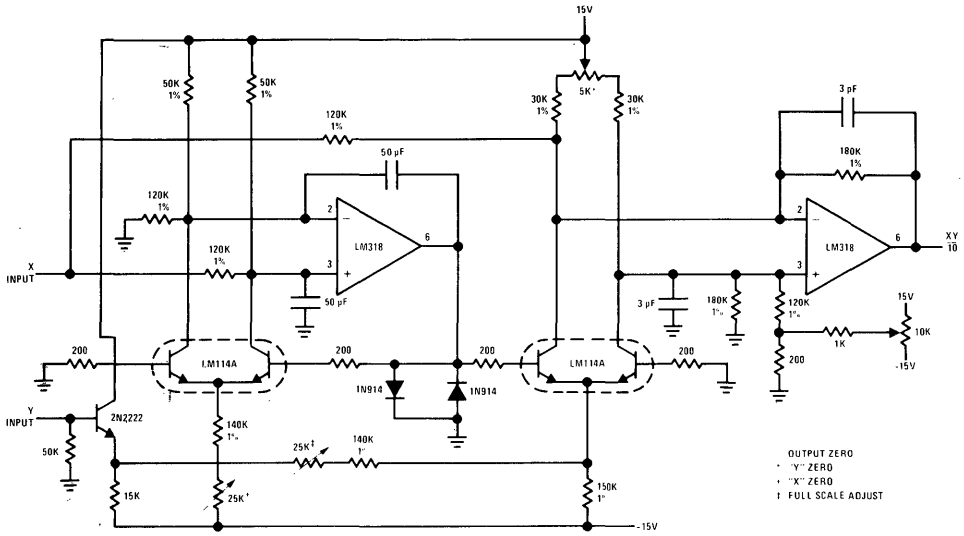
Differential Amplifier



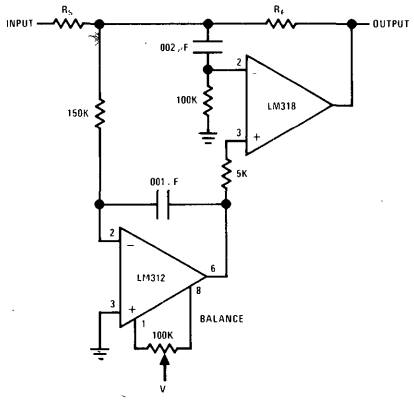
Fast Sample and Hold



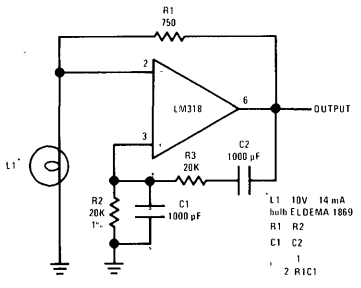
D/A Converter Using Ladder Network



Four Quadrant Multiplier



Fast Summing Amplifer with Low Input Current



Wein Bridge Sine Wave Oscillator